Analysing the perceptions of the elderly on space vitality and related environmental factors based on residential community

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Abstract

Environmental perception of the residential community has a non-negligible impact on a healthy lifestyle for the elderly. The perceived level- and actual satisfaction- of the elderly offered by the “space vitality” of the residential community is closely related to the physical and mental health for the elderly which also largely determines their quality of life. From the perspective of urban planning, it is a crucial measure to identify and effectively regulate the critical environmental impact factors of the residential community that affect the perception and experience of the elderly, to promote the construction of the age-friendly community. This paper took Dalian, China as the research range, and took the elderly as the object of research in relation to the perception of space vitality within the residential community and its associated environment-related factors. Correlation analysis was used to identify the potential environmental factors related to the perception of space vitality by the elderly. It found that the general level of the elderly's perception of space vitality has a positive correlation with many elements of the built environment e.g., the perception of the diversity, or the landscape of leisure places, which are both related to overall spatial quality. However, it does not show a significant correlation with the social environment. Therefore, useful suggestions are made on how to improve the elderly's perception of space vitality within the residential community, particularly in prior planning and design practice. The optimization of the spatial quality of the built environment should be the core point of concern. By optimizing the arrangement of the relevant elements of the site, the elderly's level of perception and satisfaction with the space vitality of the residential community should improve; furthermore, the physical and mental health of the elderly will be promoted in line with their quality of life.

Keywords

Healthy aging, Residential environment, Space vitality, Age-friendly community

1. Introduction

For the elderly, the perceived level- and actual satisfaction- offered by the “space vitality” of the residential environment has a non-negligible impact on subjective well-being and a

healthy lifestyle. In psychology, the concept of well-being is based on a combination of factors to do with personal quality of life and mental health (Wang et al., 2013). Subjective well-being often stems from an individual's subjective feelings about their daily life and their physical surroundings (Zhang, 2014). Research has shown that cultivating positive environmental perceptions is crucial for the promotion of healthy aging among the elderly. The person who actively participates in physical activities could be more likely to experience the well-being from the feelings of physical and psychological than those who access medical services passively (WHO, 2012). Moreover, a positive environmental perception not only contributes to mobilizing active participation in physical activities but also improving levels of physical health. It could offer significant mental health benefits generally, thus creating an interplay between participants and the environment. (Smith et al., 2002). Therefore, special attention on public spaces of residential community is necessary. It serves as the leading site for the daily activities of the elderly, and as a facilitator of social activities for communication and exchange among neighbours. The space vitality from the residential community often reflects the material and spiritual needs of the elderly.

Research by Chinese scholars on space vitality and its related factors mainly focuses on two aspects – the characteristics of urban space morphology and intensity of use for certain activities. Jiang developed a quantitative system for evaluating street vitality based on the vitality composition index including things like functional diversity and traffic accessibility. This system integrated the vitality characteristic factors such as the number of activists and their stopping time for the space area. (Jiang, 2013). Additionally, Long and Zhou discussed the impact of the population density on street vitality. Through a quantitative analysis of six indexes, including location, transportation accessibility, and mixed functions, Long and Zhou proposed the vitality factors from the different street types have the differentiated features. Its content has deepened the quantitative exploration of street vitality (Long et al., 2016). With increasing insights into urban space vitality in a cognitive context in recent years, attention has shifted to individual perception. Based on reviewing relevant international research, Ye highlighted the influence of street accessibility and the fitting degree of morphological elements on the role of urban vitality (Ye et al., 2017). He also conducted an empirical test of residents' activities, drawing connections between the strength of selected events and levels of space vitality (Ye et al., 2016). Similarly, Huang and Xu measured space vitality by looking at the intensity of quality street activities (Huang et al., 2017). In summary, the focus of existing research on urban space vitality has gradually shifted from focusing on the functional and social dimensions to the cognitive – the relevant research with individual behaviour and perception, attracting increased attention.

While the existing research has achieved fruitful results, deficiencies exist in the following aspects: The first is related to sample limitations. Previous research mainly aimed at ordinary urban residents, and despite the serious implications of an aging population, there has been a lack of discussion of the elderly as a specific research subject. The second deficiency is the fact that the definition of “space vitality” has failed to accurately interpret the essential characteristics of the concept of “vitality.” Can indicators such as the number of people, their stopping time, and population density adequately reflect space activity? Can “functional diversity” effectively express space vitality? The answer is no. Thirdly, although existing research has dealt with the idea of “perception,” it has not regarded individual behaviour as an area for focus. The essence of the current study still lies in measuring the

relevant elements of the built environment from the perspective of objective observation, making it impossible to examine the subjective experiences of individuals intuitively.

This paper takes the city of Dalian as its research range. Setting the individual perception, perceptions of space vitality for the elderly residents in their respective residential community was measured through the use of questionnaires. Utilizing methods of statistical analysis and considering the relevant elements of the built and social environment, this paper aimed to explore the complicated relationship between environmental factors and space vitality. The primary finding has been that the perceptions of space vitality among the elderly have a positive correlation with many elements of the built environment. However, a significant association with the social environment has not been shown to exist.

2. Concepts, Methods and Data

2.1. Concepts

The space vitality of the residential community is essentially the embodiment of the diversity of daily activity opportunities in the public space within and outside these communities. To a certain extent, space vitality depends on the environmental quality of the residential community and its surrounding area. Jane Jacobs brilliantly pointed out that the interweaving process between human activities and living places has created the concept of space vitality (Jacobs, 1961). Kevin Lynch further proposed that vitality, as an essential indicator of urban morphology, can provide a pleasant living environment for the continuation of living organisms. Therefore, "space vitality" is generally recognized as a measure of the quality of a space related to daily activities, and as the primary criterion for measuring the quality of urban morphology. Its external representation is closely related to the daily activities that people can pursue in a specific space (Tong, 2014), and its intrinsic motivation mainly stems from the combined effects of built environment characteristics and the underlying social environment factors (Ye et al., 2016). In existing studies of street vitality, the diversity of functions or activities inside and outside of the street interface often regarded as the main source of street vitality (Jacobs, 1961). Similarly, the diversity of functions and activities inside and outside of the residential community can be considered to be a representation of its space vitality. Diversity, as a concept closely related to space vitality, can be regarded as the scope of activity opportunities in a specific space. It reflected in people's daily lives, specifically in whether public spaces inside and outside of the residential community can provide residents with sufficient enriching activities.

The approach to developing residential community should consider both the built and social environment. When talking about the environment of the residential community, it is traditionally understood that we are referring to the "built environment." Space vitality has not been regarded as "an isomorphism by spatial characteristics and social activities behind it." (Ye, 2014) until the concept "duality" of urban space vitality has been put forward in recent years (Lees, 2010; Marcus, 2010). It is believed that the generation of urban space vitality originates from the joint action of the relevant factors of the residential environment, namely, the built and social environments. In this sense, the two factors above should be considered comprehensively in the analysis of the relationship between the residential community and space vitality.

2.2. Methods

➤ Data measurement

Subjective evaluation methods are used to obtain the variables for space vitality and environmental factors. Firstly, the elderly's perception of space vitality divided into three categories: physical-training activity, leisure activity, and shopping activity. Combined with relevant literature and field investigation, it determined that 18 physical activity indicators are selected for measurement and become into the overall indicators and classification indicators on elderly perception for the activity opportunities (Figure 1). Among, the household activity excluded because it almost unconstrained by the objective condition. Secondly, this research the perception of environmental factors divided into two levels as the built environment and social environment, in order to identify the relationship between space vitality perception and residential environmental factors further. Thereinto, the built environmental perception includes places diversity, places accessibility, pedestrian facilities, and landscape environment, and the social environment perception include neighborhood livability, neighborhood security, and neighborhood-trip safety.

Figure 1 Physical Activities Classification (Source: drawn by the author, 2019)

➤ Data analysis

This paper used the SPSS software is used to analyse the correlation between the environmental factors and activity opportunities by aggregated indicators and classification indicators, for exploring the relationship between various related factors and space vitality of the environment. Combining the value of Sig and the correlation coefficient of Kendall, the results of correlation analysis divided into four levels (strongest significant and high correlated, stronger significant and high correlated, strongest significant and medium correlated (no present in the result), stronger significant and medium correlated) with statistical significance. At the same time, through the on-site observation, big data, Google Earth, GIS, and other tools, the distribution characteristics of the variables mentioned above are visualized at the spatial level.

2.3. Data base

This paper took the main urban area of Dalian as the research range, the questionnaire interview conducted among the elderly residents. A total of 365 interview questionnaires were taken, and one invalid survey (exceeding the scope of the study) was excluded. Finally, the questionnaire information of 364 respondents was constructed to become the primary sample database of the study. The sample extraction during the interview comprehensively considered the equilibrium distribution of the proportions of the number of people, age, gender (Figure 2) and other factors in the spatial range, and is quite representative. The

results (Figure 3) show that the perceived level of activity opportunities of the elderly at the intermediate level (70%) in general. At the same time, the number of people at low level accounts for a certain proportion (26%) of the total sample size, while the ratio of high level is relatively very few (4%). Therefore, for identified effectively for the environmental impact factors of the spatial vitality, this paper divided the perception of environmental factors by the elderly into two parts: built environment perception and social environment perception (Figure 4).

Figure 2 Age and Gender Proportion of Respondents (Source: drawn by the author, 2019)

Figure 3 Distribution and Proportion of Activity Opportunity Perceived Level (Source: drawn by the author, 2019)

Figure 4 Classification of the Relevant Environment Factors (Source: drawn by the author, 2019)

3. Results

Given the complicated relationship between spatial vitality perception and related environmental factors, it divided the research process into two stages: firstly, the paper explored the statistical correlation between the space vitality perception on the overall level and environmental factors. Secondly, it separately observed the statistical correlation between activity opportunities on three dimensions of space vitality (physical-training activities, leisure activities, and shopping activities) and environmental factors (built environment and social environment). Among them, the places diversity, places accessibility, pedestrian facilities and landscape environment in related environmental factors regarded as the essential elements of built environment perception. The liveability, security and trip-safety of neighbourhoods are considered to be the essential elements of social environment perception. Through correlation analysis, it obtained the following main findings.

3.1. Space vitality and related environmental factors

There is a certain degree of the positive correlation between the built environment perception and overall-level of space vitality perception. Specifically, the Diversity of leisure places, landscape situation of leisure places, the landscape satisfaction of leisure places shown strongest significant and high correlated with the overall-level indicators of activity opportunities. There is a stronger significant and medium correlation between the accessibility of leisure places and the overall-level indicators of activity opportunities. However, there is no significant correlation between the perception elements of the social environment and space vitality.

From the results of correlation analysis (Table 1), three of the ten indicators for built environmental perception passed the double-tailed test with confidence of 0.01, and one passed the double-tailed test with confidence of 0.05. Combined with Kendall correlation coefficient R , according to its correlation significance and correlation degree, the order is diversity of leisure places ($p=0.000$, $r=0.160$), landscape situation of leisure places ($p=0.003$, $r=0.126$), landscape satisfaction of leisure places ($p=0.004$, $r=0.120$), and accessibility of leisure places ($p=0.019$, $r=0.099$). The above show that there is a relatively strong correlation

between the perception of the built environment and space vitality. The higher the satisfaction of the elderly to the built environment, the more activity opportunities they perceive, and the stronger the space vitality of the residential areas. The correlation analysis results mean that although there is an association among the indicators between the factors of social environment perception and space vitality, it is not statistically significant.

Table 1 Correlation Analysis between the Space Vitality Perception and Related Environment Factors (Source: drawn by the author, 2019)

			SPACE VITALITY PERCEPTION	
			Overall Level	
			A.S.	S.S.
Built Environment	Places Diversity	Leisure Places Diversity	●	●
		Shopping Places Diversity	—	--
	Places Accessibility	Leisure Places Accessibility	○	○
		Shopping Places Accessibility	○	--
	Pedestrian Facilities	Pedestrian Facilities Perception	—	--
		Pedestrian Facilities Satisfaction	—	--
	Landscape Environment	Communities Landscape Situation	—	--
		Communities Landscape Satisfaction	—	--
		Leisure Places Landscape Situation	●	●
		Leisure Places Landscape Satisfaction	●	●
Social Environment	Neighbourhood Liveability	Neighbourhood liveability satisfaction	—	--
	Neighbourhood Security	Neighbourhood Security Situation	—	--
		Neighbourhood Security Satisfaction	—	--
	Neighbourhood-Trip Safety	Neighbourhood-Trip Situation	—	--
		Neighbourhood-Trip Satisfaction	○	--

Actual Significance (A.S.): ● : High ($R \geq 0.15$); ○ : Medium ($0.05 \leq R < 0.15$); — : Low ($R < 0.05$)

Statistical Significance (S.S.): ● : Strongest ($p < 0.01$); ○ : Stronger ($0.01 \leq p < 0.05$); -- : General ($p \geq 0.05$)

* In this study, the range of R determined according to the actual sample size and statistical analysis results.

This result shows the built environment factors are essential to the space vitality. High-level space vitality perception often with the high-intensity built environment perception. It also shows that although social environment perception can promote the perceived level of space vitality, it is not the leading factor. The phenomena may be due to the improvement of life quality, which changes the activity needs of the elderly. The requirements of individuals are gradually evolving from distance-oriented to function-oriented and quality-oriented. Therefore, in a certain of the range (depending on the health status of the elderly), the diversity of the choice of place functions and the superiority of landscape quality have a strong attraction to elderly, so that they break through the “proximity principle” shackles.

Another phenomenon that the correlation between the diversity of leisure places and the activity opportunities is higher compared with other indicators, which coincides with the view of Jane Jacobs. She said that the diversity and identity of urban spaces could enhance the cohesion of communities and the attraction of individual behaviour activities, thus stimulating the vitality of the area.

Table 2 Correlation Analysis between the Activity Opportunities Perception and Related Environment Factors (Source: drawn by the author)

			Activity Opportunities Perception					
			Classification Level					
			Physical-training Activities		Leisure Activities		Shopping Activities	
			A.S.	S.S.	A.S.	S.S.	A.S.	S.S.
Built Environment	Places Diversity	Leisure Places Diversity	●	●	○	○	●	○
		Shopping Places Diversity	–	–	–	–	–	–
	Places Accessibility	Leisure Places Accessibility	○	○	–	–	–	–
		Shopping Places Accessibility	○	–	–	–	○	–
	Pedestrian Facilities	Pedestrian Facilities Situation	–	–	○	–	–	–
		Pedestrian Facilities Satisfaction	–	–	–	–	●	●
	Landscape Environment	Communities Landscape Situation	–	–	–	–	–	–
		Communities Landscape Satisfaction	–	–	–	–	●	●
		Leisure Places Landscape Situation	○	○	○	–	●	●
		Leisure Places Landscape Satisfaction	○	○	○	–	●	●
Social Environment	Neighbourhood Liveability	Neighbourhood Liveability Satisfaction	○	–	–	–	○	–
	Neighbourhood Security	Neighbourhood Security Situation	–	–	–	–	–	–
		Neighbourhood Security Satisfaction	–	–	–	–	–	–
	Neighbourhood-Trip Safety	Neighbourhood-Trip Situation	–	–	–	–	○	–
		Neighbourhood-Trip Satisfaction	○	○	–	–	–	–

Actual Significance (A.S.): ● : High ($R \geq 0.15$); ○ : Medium ($0.05 \leq R < 0.15$); – : Low ($R < 0.05$)

Statistical Significance (S.S.): ● : Strongest ($p < 0.01$); ○ : Stronger ($0.01 \leq p < 0.05$); – : General ($p \geq 0.05$)

* In this study, the range of R determined according to the actual sample size and statistical analysis results.

3.2. Physical-training activity opportunities and related environmental factors

There is a positive correlation between the perception of built environment factors and the perception of the physical-training activity opportunities. Specifically, there is the strongest significant and high correlated relationship between the diversity of leisure places and physical-training activity opportunities. The accessibility of leisure places, landscape situation of leisure places, the landscape satisfaction of leisure places was stronger significant and medium correlated with the physical-training activity opportunities. The neighbourhood-trip satisfaction, as a factor of the social environment, also shows a stronger significant and medium correlation with this kind of activity opportunities.

From the results of correlation analysis (Table 2), one of the ten indicators for built environmental perception passed the double-tailed test with confidence of 0.01, and three passed the double-tailed test with confidence of 0.05. Combined with Kendall correlation coefficient R , according to its correlation significance and correlation degree, the order is diversity of leisure places ($p=0.000$, $r=0.155$), accessibility of leisure places ($p=0.022$, $r=0.100$), landscape situation of leisure places ($p=0.024$, $r=0.097$), and landscape satisfaction of leisure places ($p=0.032$, $r=0.092$). Specifically, the positive correlation between the diversity of leisure places and physical-training activity opportunities shown that the variety of leisure places could provide participants with more choices for physical-training activities. The places diversity could improve the perceived level effectively of physical-training activity opportunities for the elderly. The correlation analysis results also show that the higher the landscape quality of leisure places and the stronger the satisfaction of the elderly on the inner needs provided, the more obvious the perception of the physical-training activity opportunities in the areas. In terms of the result, the neighbourhood-trip situation is the only social environment factor which passed the double-tail test with a confidence level of 0.05. It means that the built environment perception is more likely to have an impact on the perceived level of physical-training activity opportunities of the elderly than the social environment perception.

In conclusion, there is a positive correlation between the diversity of leisure places and the perception of physical-training activity opportunities. And then, the relationship between the accessibility of leisure places and the perception of physical-training of opportunities is slightly higher than the impact of landscape situation of leisure places and the landscape satisfaction of leisure places to the later. The reason could be that compared with other types of activities, the physical-training has more definite purpose and location. The elderly could a more easily perceive the area which has a higher degree of functional support and the more selectivity of the route. Furthermore, because walking, jogging, and other types of physical activities mostly occur in the residential area and the surrounding sidewalks, so the traffic conditions and parking of vehicles have an impact on them. It could explain why the satisfaction of neighbourhood-trip affects the perception of such opportunities.

3.3. Leisure activity opportunities and related environmental factors

There is almost no statistical correlation between the perception of leisure physical activity opportunities and the perception of the built environment and social environment. Only the diversity of leisure places shown stronger significant and medium correlated with the perception of leisure activity opportunities.

As shown in Table 2, only one index ($p=0.022$, $r=0.102$) of leisure place diversity in built environment related factors passed the confidence level test of 0.05, and the results of Kendall correlation coefficient R shown a low correlation between them. Besides, other related environmental factors did not pass the significance test of the correlation. The study finds that the association between the diversity of leisure places and perception of leisure activity opportunities is significantly lower than that between the diversity of leisure places and the opportunity perception of physical-training activities and shopping activities.

In summary, there is almost no statistical correlation between built environment perception, social environment perception, and leisure activity indicators. The reason is easy to explain that the most obvious difference among physical-training, shopping and leisure activities is that the occurrence of physical-training and shopping activities is more dependent on the

built environment, and many activities could be carried out without accompany. Compared with the first two items which care about the built environment, leisure activities pay more attention to the activity companion (e.g., family members, friends, pets).

3.4. Shopping activity opportunities and related environmental factors

There is a positive correlation between the perception of the built environmental factors and the perception of shopping activity opportunities. Among them, the landscape satisfaction of leisure places, landscape satisfaction of the communities, the pedestrian facilities satisfaction, the landscape situation of leisure places all shown the strongest significant and high correlated with the perception of shopping activity opportunities. And the diversity of leisure places and communities were the stronger significant and medium correlated with the perception of shopping activity opportunities. But with the analysis result, there is no statistically significant correlation on perception between social environment factors and the indicators of shopping activity opportunities of the elderly.

Table 2 shows that five of the ten indicators of the built environment have passed the significance test of the correlation, four of them passed the confidence level test of 0.01 and one passed the confidence level test of 0.05. Combined with Kendall correlation coefficient R, according to its correlation significance and correlation degree, the order is landscape satisfaction of leisure places ($p=0.004$, $r=0.134$), landscape satisfaction of communities ($p=0.005$, $r=0.133$), the satisfaction of pedestrian facilities ($p=0.005$, $r=0.133$), landscape situation of leisure places ($p=0.008$, $r=0.126$), and the diversity of leisure places ($p=0.018$, $r=0.111$). Among them, the correlation coefficient between landscape satisfaction of leisure places and the perception of shopping activity opportunities is the highest. The landscape satisfaction of leisure places is the most critical factor to the latter meant that the perception of shopping activity opportunities could be improved when the identity of the landscape quality strengthens.

In conclusion, the positive correlation between the landscape satisfaction of leisure environment and the perception of shopping opportunities is the most obvious, and other indicators followed by it. The above results could attribute to the fact that shopping activities of the elderly often accompanied by physical-training and leisure activities — most elderly accustomed to daily-shopping as a way of physical exercise. On the way back to home from shopping places, they commonly used to have a rest at the roadside, the square around the residential area, and the courtyard and achieves the purpose of participating in more than one activity at the same time. The landscape satisfaction of leisure places and the satisfaction of pedestrian facilities on the way also have a major impact on the perception of such activity opportunities. It should be the reason for the spatial quality indicators (landscape environment, pedestrian facilities, etc.) are positively correlated with the perception of shopping activity opportunities.

4. Conclusion and Revelation

Nowadays, awareness of healthy aging is the deepening of people. The importance of spatial vitality perception at the community level in the process of improving the quality of life and health level of elderly residents has gradually become prominent. Based on the analysis of the complicated relationship between environmental factors and spatial vitality perception, this paper draws the following three conclusions. Firstly, the overall level of elderly space

vitality perception positively correlated with many factors of the built environment (such as diversity of leisure places, landscape situation of leisure places, and landscape satisfaction of leisure places). But the correlation between the former and social environment was not significant. Secondly, the perception of the elderly on physical-training activity opportunities is closely related to the diversity of leisure places. The perception of the senior citizens on shopping activity opportunities is highly correlated with landscape satisfaction of leisure places and the residential community, the satisfaction of pedestrian facilities and landscape situation of leisure places. Thirdly, there is no statistical correlation between the perception of leisure activities opportunities and the built environment and social environment. In brief, there is a close relationship between the quality-related factors of the built environment and the perceived level of space vitality.

In order to improve the perceived level of space vitality, this paper puts forward suggestions from the following two aspects. On the one hand, the key point is to optimize the spatial quality of the built environment on the community level. Ensure the richness of the space in residential areas for outside activities. So as to enhance the type selectivity for activities of the elderly. At the same time, taking the "people-oriented" concept of ecological liveability to organize and optimize the landscape facilities to enhance the sensory experience of the elderly on neighbourhood activities (especially for the physical activities, shopping activities). On the other hand, the timely repair and maintenance of pedestrian facilities should be ensured, and the roaming interest and suitability of road space need to enhance. For example, the planner can base on maintaining the integrity and tidiness of road pavement, the feasibility of walking in streets to improve by optimizing the green vision rate of streets and other ways to promote the interest of walking activities. With planning strategies, the willingness to participate in outdoor activities should be mobilized to meet the health needs of the elderly.

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