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The Divergent Characteristics and Spatial Organisation of Living Spaces in Greater Metropolitan Shanghai

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Abstract

With the trend of cross-domain, high-frequency and quality of residents' living behaviours, the living space gradually breaks through the single city boundary and forms a multi-scale and multi-level regional network. In this paper, we clarify the connotation of regional living space, identify the evolutionary trends of spatial expansion, pattern reconfiguration and value leap of regional living behaviours, and then integrate spatio-temporal behaviours and Maslow's hierarchy of needs theory to construct a three-dimensional model of regional living space with the three dimensions of 'time frequency-activity area-need hierarchy'. Taking the Great Shanghai Metropolitan as an example, we analyse the spatial scale differences driven by individual needs and the spatial organisation characteristics of the 'hierarchy-flow' combination, with a view to shedding light on the characteristics of living space and planning responses in the metropolitan area.

Keywords: *Regional living space; Spatio-temporal behaviour; Spatial organisation; Greater Shanghai Metropolitan Area*

1. Introduction

As China's socioeconomic development has shifted from the stage of high-speed development to that of high-quality development (HQD), the pursuit of a better life among urban and rural residents has undergone a profound transformation, leading to higher demands for the quality, functionality, and diversity of living spaces (Li, Sun, Li, & Linlin, 2021; Pan, Wang, Lu, Liu, & Li, 2021). With population agglomeration accelerating in metropolitan regions such as the Yangtze River Delta and Pearl River Delta, cross-regional commuting, spatial expansion along high-speed transport corridors, and industrial chain extensions into hinterland areas have intensified significantly. The provision of high-quality public services, employment opportunities, and innovation resources is increasingly transcending administrative boundaries, making regional spatial units represented by urban agglomerations and metropolitan areas the core carriers for the interactive evolution of production, living, and ecological functions.

Under this context, the spatial scope of residents' daily lives is no longer confined to a single city. Instead, through high-frequency cross-city commuting, periodic leisure and recreation, and cross-regional access to public services, a living space network at the metropolitan scale has gradually taken shape. For example, within the Greater Shanghai Metropolitan Area, individuals may reside in Suzhou, work in Shanghai, seek medical care in Hangzhou, and vacation in Huzhou. Such cross-city living behaviours link multiple urban functional nodes, driving the transformation of living spaces from an independent single-city model towards a regionally coordinated model. At the same time, economic growth and the evolution of life values are propelling the connotation of living space to evolve from material spaces meeting basic survival needs towards composite spaces accommodating diverse needs such as social interaction, cultural experience, and self-actualisation, with their scale correspondingly expanding to the metropolitan area, city cluster, and even city-region levels.

Similar to concepts like living territory and life circle, living space possesses rich spatio-temporal scale attributes. Consequently, its research and practice are primarily based on spatio-temporal behaviourism theory. For instance, in terms of the behavioural space scale, based on the multi-scale behavioural space research framework, Chai et al.

(Chai, Liu, & Ta, 2013) divided living space into urban behavioural space, metropolitan behavioural space, and urban agglomeration behavioural space according to urban development stages and patterns. Among these, the expanded living circle corresponds to the urban agglomeration behavioral space, which refers to the formation under the context of economic connections and functional coordination between cities—through the sharing of high-level urban functions (such as regional industry, medical care, tourism, and culture) and social needs by residents of different cities, as well as through population migration, leisure tourism, and partial inter-city shopping.

Previous studies on living spaces in metropolitan areas primarily focus on the fields of "regional living space" and "life circle" (Gao, Yang, Liu, Xin, & Chen, 2024; Zhang, Zhang, Yu, Jiang, & Zhang, 2024). Scholars generally share a consistent understanding of the "life circle" as "the spatial scope constituted by numerous activities occurring to maintain daily life" (T. Liu & Chai, 2015). Building on this, and based on differences in scale and focus, domestic scholars have proposed concepts such as the commuting life circle, the expanded life circle, the synergistic life circle, the opportunity life circle, and the high-quality life circle. Overall, current research on living spaces within metropolitan areas is still in its early stages. Existing studies exhibit issues such as inconsistent hierarchical frameworks, behavioural biases in focus, and unclear or non-standardised evaluation criteria.

2. Theoretical Discussion

2.1 The Connotation and Characteristics of Regional Living Space

From a theoretical perspective, the concept of living space originates from studies examining both residents' living behaviours and the spatial-functional structure of urban systems (Yang, Xu, & Wang, 2025; Yuhui, An, A, & Baohui, 2024; Zhu, Shang, Long, & Lu, 2023). It describes the dynamic system of flows and spatial organisation formed through residents' daily activities and interactions within urban areas. Expanding this concept from the individual to the regional scale, this study defines regional living space as the spatial domain encompassing the range of activities and movements conducted by individuals to satisfy their own living needs within regional spatial systems such as metropolitan areas or city clusters. The term "living space" thus includes both the relatively stable "residential space" generated by long-term relocation and the dynamic "activity space" constituted by daily behaviours such as working, shopping, leisure, and entertainment.

From the perspective of behavioural geography, regional living space exhibits distinctive spatio-temporal characteristics and reveals the diversity of cross-city living behaviours. Spatially, regional living space transcends the boundaries of traditional cities and demonstrates clear intercity linkages. Residents' activities are no longer confined to a single city but instead fluctuate between multiple cities within the metropolitan area. Such cross-city mobility includes not only commuting but also consumption, leisure, and education-related behaviours. For example, some residents live in one city while working in another, or travel to nearby cities for weekend tourism and shopping. Temporally, regional living space encompasses both short-term and long-term dimensions. It includes high-frequency daily behaviours such as commuting and shopping, as well as long-term, low-frequency activities such as purchasing housing or planning children's education. The temporal distribution and frequency of these behaviours reveal the rhythms and patterns of residents' metropolitan lives. In terms of purpose, the diversity of intercity living behaviours reflects differences across population groups in age, occupation, and income. Younger individuals tend to favour core metropolitan cities for fashionable consumption and cultural activities, whereas older residents prioritise comfort and medical convenience, preferring to live in cities with a pleasant environment and advanced healthcare infrastructure. This behavioural heterogeneity and diversity of lifestyles together make the regional living space highly complex and dynamic.

2.2 The Definition and Role of Regional Living Space

Regional production space typically departs from global city-region theory, focusing on production behaviours, emphasising the connectivity of functional synergies like industrial chains and innovation chains (Guo & He, 2017), and treating flows of people, goods, and capital as key elements measuring factor linkages and division of labour between different circles of the metropolitan area. Drawing on research methods for the spatial organisation of production space in city clusters from the global city-region perspective, regional living space is the carrier of frequent behavioural activities of urban residents. Its core is a higher-level, cross-regional living service space starting from the human perspective, representing the carrier and manifestation space of the life circle. Similar to economic linkages like industrial and supply chains, this type of population linkage is an important element in measuring regional vitality and internal functional organisation.

This study takes behavioural trajectories between residential locations and destinations as the entry point to identify, analyse, and summarise the structure and characteristics of living space within the metropolitan area. Through the mapping of living behaviours and

classification based on behavioural destinations, the metropolitan living space is defined as a composite space of "our functions, one support, one foundation". Here, the "four functions" refer to the mapping spaces of four typical behaviours: public service space, cultural experience space, commercial service space, and leisure recreation space; the "one support" refers to transportation facility space; and the "one foundation" refers to residential space.

Public service space is a service space, led by the government, that guarantees residents' living needs, including facilities for education, healthcare, scientific research, etc. Cultural experience space primarily provides spiritual and cultural activities and experiences, such as museums, theatres, stadiums, etc. Commercial service space primarily serves residents' shopping and consumption needs, covering various formats like shopping malls, supermarkets, and commercial streets. Leisure recreation space, based on blue-green spaces, provides places for residents to relax, such as parks, green spaces, and scenic areas. The transportation support system is the link connecting various functional spaces; its level of completeness directly impacts residents' cross-regional living behaviours, as a convenient transport network can shorten travel times between different functional spaces and increase travel frequency. Residential base space is the anchor point of residents' living space, encompassing both long-term stable residences and periodic second homes.

3. Differentiation Trends of Regional Living Space Oriented Toward a Better Life

3.1 Evolutionary Trends of Regional Living Behaviours

3.1.1 Spatial Expansion: Extension of Travel Distance from "Suburban Travel" to "Cross-Domain Flow"

With the continuous upgrading of regional transportation infrastructure and the acceleration of regional integration, the travel radius of residents' cross-city activities has shown a significant expansion trend. In the past, due to the constraints of transportation and time costs, residents' cross-city travel was mostly concentrated in the suburban areas of cities, with relatively short activity distances. In the post-pandemic era, travel demand has been fully released. According to the analysis of mobile phone signalling data in the Yangtze River Delta, the average distance of residents' leisure travel has exceeded 400 km, nearly doubling compared with 2022, and the proportion of long-distance travel has increased by 35%. At the same time, changes have also occurred in travel modes. Self-driving has become an important way for long-distance travel, and tourism products such as self-driving tours and RV camping have become new favourites in the tourism market. The popularity of self-driving tours increased by 39% year-on-year in 2023.

3.1.2 Pattern Reconfiguration: Growth in Travel Frequency from "Occasional Behaviour" to "Daily Necessity"

In recent years, the frequency of residents' cross-city activities has shown an explosive growth, forming a new "high-frequency + low-intensity" living rhythm. People are no longer limited to local public facilities and resources but are more willing to cross city boundaries to seek higher-quality and more diverse spatial services. Taking leisure travel as an example, according to mobile phone signalling data, the number of cross-city leisure trips in 11 rest days in October 2023 in the Yangtze River Delta reached 1.33 billion, an increase of 33% compared with 2019. Meanwhile, driven by the continuously improved policy of cross-regional medical insurance settlement, the cross-city flow of medical needs has also increased significantly. The number of direct cross-regional medical settlement trips nationwide increased from 147 million in 2019 to 243 million in 2023, and exceeded 238 million in 2024, among which the cross-provincial settlement of outpatient chronic and special diseases increased by 174.81%. In the field of shopping travel, Shenzhen-Hong Kong is a typical case of cross-city consumption. With the continuous facilitation of customs clearance, "inter-city consumption" has become the norm. In 2024, the number of Hong Kong residents entering the mainland through Shenzhen ports exceeded 77 million, an increase of 24 million compared with 2023, with an average of 10.2 trips per Hong Kong resident to the mainland.

3.1.3 Value Leap: Upgrade of Travel Demand from "Function Satisfaction" to "Quality Experience"

The demand level of residents' cross-city behaviours has been significantly upgraded, showing the composite characteristics of "material + spirit + service". In recent years, the demand for experiential consumption has increased significantly. In 2024, the proportion of cross-city attendance at large-scale concerts nationwide reached 64%. Cities such as Chengdu and Xi'an have adopted the "concert + tourism" model, driving 26.8% of the audience to extend their travel itinerary locally after the performance. Cultural experience has become an important driving force for residents' cross-city travel. The consumption scenarios in the Shenzhen-Hong Kong region have also been continuously upgraded, expanding from traditional shopping to "experience-oriented" consumption, such as Costco membership-based consumption and massage SPA. Among the consumption of Hong Kong residents in the mainland, service-based consumption, such as beauty treatments, manicures, teeth cleaning, and orthodontics, accounts for 40%. The new consumption scenarios in Shenzhen and the international brands and art exhibitions

in Hong Kong have formed a differentiated supply. At the same time, the cross-city upgrade of elderly care needs is also particularly prominent. The "working in Shanghai-elderly care in surrounding areas" model has been formed in the Yangtze River Delta. Shuikou Village in Changxing County, Zhejiang Province, through the "Shuikou Cloud Manager" platform, provides high-quality elderly care services for retired technical talents in Shanghai, with a daily passenger flow of 60,000 - 70,000 people, 60% - 70% of whom are the elderly, realising multi-directional empowerment of "elderly care + cultural tourism + innovation".

3.2 Construction of the Differentiation Model of Regional Living Spaces

The traditional theory of spatio-temporal behaviour starts from the dimension of time frequency, analyses the path of residents' daily lives, and expands from the daily life path to the weekly, monthly, and even occasional life paths, thereby revealing the usage mode and frequency of living spaces in the metropolitan area. In this dimension, different types of behaviours show different frequencies and spatial scales. For example, tourism and education behaviours usually have low frequencies but broader spatial scales, because they often involve longer distances and more specific destinations. On the contrary, commuting and shopping behaviours have high frequencies and relatively shorter spatial scales, as these behaviours are part of residents' daily lives and require frequent travel between home, workplace, and commercial areas.

However, for the pursuit of a better life, regional living behaviours demonstrate the characteristics of spatial expansion, pattern reconstruction, and value leap. Residents are no longer satisfied with basic living needs but pursue happiness, integration with nature, and self-actualisation, resulting in more and more individual differences in living patterns and behaviours. Against this background, according to Maslow's hierarchy of needs theory in sociology, regional living behaviours can be correspondingly divided into physiological needs-based activities, safety needs-based activities, belongingness needs-based activities, esteem needs-based activities, and self-actualisation needs-based activities, and there is a corresponding iterative logic in their spatial functions.

Therefore, from the perspective of the development trend of regional living behaviours, the evolution of regional living behaviours is essentially a three-dimensional reconstruction of spatial scale, time frequency, and demand level. Based on the traditional time - space classification method of living behaviors, the differentiation model of living spaces in the metropolitan area can integrate the upgrade of demand levels, introduce individual demand levels such as basic needs, safety needs, belongingness needs, esteem needs, and self-actualization, to reflect residents' cross-regional living behaviors in the pursuit of happiness and improved quality of life. Thus, a three-dimensional differentiation model of "time frequency-activity area-demand level" is constructed (see Fig. 1), and the combined evolution of metropolitan living behaviours in these three dimensions forms a complex living space in the metropolitan area oriented towards a better life.

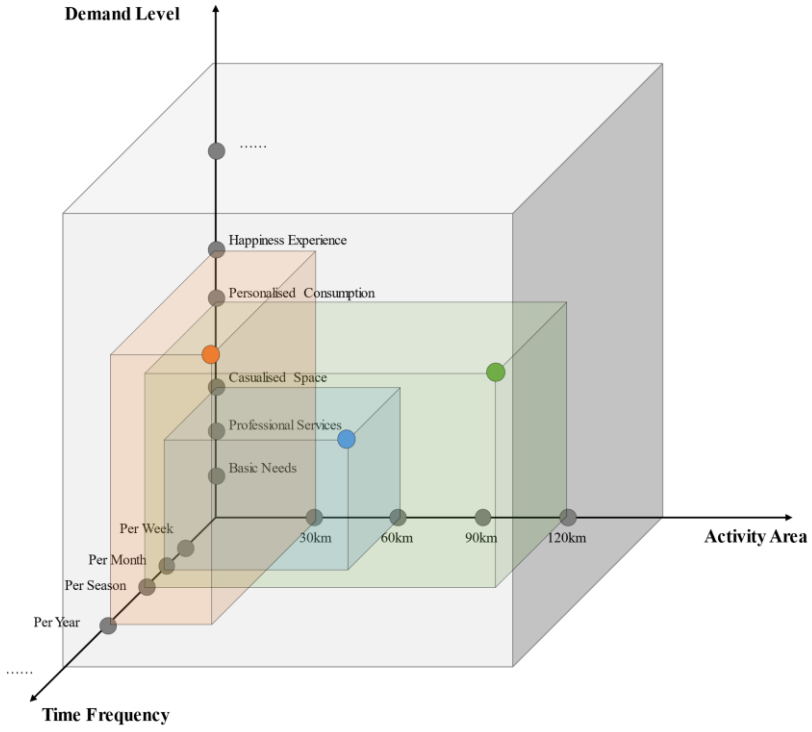

Fig. 1 Three-dimensional differentiation model of "time frequency-activity area-demand level".

4. Characteristics of Regional Living Spaces in the Greater Shanghai Metropolitan Area

4.1 Identification of Living Spaces in the Greater Shanghai Metropolitan Area

Taking the Greater Shanghai Metropolitan Area as an example, this study analyses the spatial characteristics of different regional living behaviours, such as shopping consumption, leisure and recreation, and medical and educational services, in combination with the characteristics of living behaviours, aiming to reveal the spatial scale laws of different living behaviours and provide a reference for metropolitan planning and resource allocation.

Based on the economic continuity and population agglomeration in the Yangtze River Delta, and with reference to the relevant formulation in the Territorial Spatial Master Plan of the Greater Shanghai Metropolitan Area, the core research object is defined as an ultra-large-scale metropolitan area centered on Shanghai, with a radius of 90-minute transportation distance, covering Suzhou, Wuxi, Changzhou, Nantong, Yancheng, Taizhou, Hangzhou, Ningbo, Jiaxing, Huzhou, Shaoxing, Zhoushan, and Xuancheng. The research background of relevant behaviours is extended to the scope of three provinces and one municipality directly under the Central Government in the Yangtze River Delta. Based on the theory of flow space, big data such as mobile phone signalling or Internet location service data are used as the basic research data, with the data period being October 2023, to identify and analyse the spatial characteristics of living behaviours in the metropolitan area.

This study defines the basic concepts of major regional living behaviours in the metropolitan area, and clarifies that cross-city living behaviours with cities in the metropolitan area as permanent workplaces and places of residence and cities in the Yangtze River Delta as destinations are within the scope of this study. Travel that leaves the permanent workplace and place of residence for a fixed period or more on holidays and excludes spaces such as commercial buildings and industrial parks is defined as leisure and recreation travel; travel that leaves the permanent place of residence and stays in spaces such as public services like Class-A tertiary hospitals for a fixed period or more is defined as public service behavior; travel that leaves the permanent place of residence and stays in consumption spaces such as business districts for a fixed period or more is defined as shopping consumption behavior (see Tab. 1) (L. Liu, Chen, & Liu, 2020). Focusing on the laws and characteristics of people's different travel purposes on workdays and holidays, based on the "commuting circle" algorithm model, local travel behaviors are deducted, and the measurement methods and models of regional living spaces such as "leisure and recreation circle", "public service circle", and "shopping consumption circle" are constructed by calculating indicators such as travel distance and time frequency of residents' different living behaviors. The specific calculation formula is as follows:

$$R_l = \sum \left(R_{l1}+R_{l2}+R_{l3}+R_{lq}\right) - \sum R_l' \qquad (1)$$

Where, R represents the activity range, l denotes the category of living behaviour, R_{l1} represents the travel range of the first subcategory, R_{l2} represents the travel range of the second subcategory, R_{l3} represents the travel range of the third subcategory, R_{lq} represents the travel range of other subcategories, and R_l' represents all travel ranges of that category within the city. By applying maximum standardisation to the living connection values of districts and counties, one may derive the standardised values for the intensity of living connections within a specific category for each district and county.

Tab 1 Definition and Classification of Metropolitan Area Living Behaviours Based on Points of Interest (POI)

Behavior classification	Scene classification	Destination POI facility
Commuting & Business	Residential	Residential estates, dormitories, flats, urban villages, etc.
	Office	Industrial parks, business parks, companies, office buildings, government agencies, etc.
Public Services	Medical	Class-A tertiary hospitals, specialist hospitals
	Cultural & Education	Schools, libraries
Shopping & Consumption	Retail	Shopping centres, luxury goods, large markets, boutiques, retail outlets, duty-free shops, supermarkets, convenience stores, etc.
	Beauty & Wellness	Hairdressing & Haircare, Nail & Eyelash Services, Makeup & Styling, Beauty & Spa, Wedding Photography, etc.

	Food & Dining	Restaurants, Snack Bars & Fast Food, Speciality Cuisine, Beverage Outlets, etc.
	Education & Culture	Training & Educational Institutions
Leisure & Recreation	Entertainment & Recreation	Recreational Activities, Leisure Sports, Ball Sports, Family Entertainment, etc.
	Tourist Attractions	Cultural Landmarks, Natural Scenery, Public Leisure Spaces, etc.
	Education & Culture	Exhibition Halls & Galleries
	Hotels	Hotels, guesthouses, inns, bed and breakfasts, youth hostels, etc.

4.2 Spatial Scale Driven by Individual Needs

4.2.1 Correlation between Behavioural Purposes and Spatial Scales

Through the identification and data analysis of various lifestyle behaviours among residents within the Greater Shanghai Metropolitan Area, it is evident that travel radii for different regional activities exhibit certain disparities. Leisure and recreational activities exhibit the longest travel radius, with an average of 86.6 km. These trips predominantly cover medium to long distances, featuring a high proportion of long-distance journeys. Over 10% of trips extend beyond 150 km, representing the highest proportion among the three activity types. Shopping and consumption activities fall midway, with an average radius of approximately 78.6 km, slightly exceeding that of public service-related travel. Their travel characteristics resemble those of leisure and recreation, but the cumulative curve for short distances rises more rapidly, exhibiting a pronounced short-distance distribution pattern. Fifty per cent of these activities occur within a 70-kilometre radius, significantly higher than other categories. Public service activities such as healthcare and education generally involve shorter travel radii, with an average exceeding 74.9 km. The cumulative curve for medium distances rises most steeply, particularly within the 40-100-kilometre range, while long-distance travel is relatively infrequent (see Fig. 2).

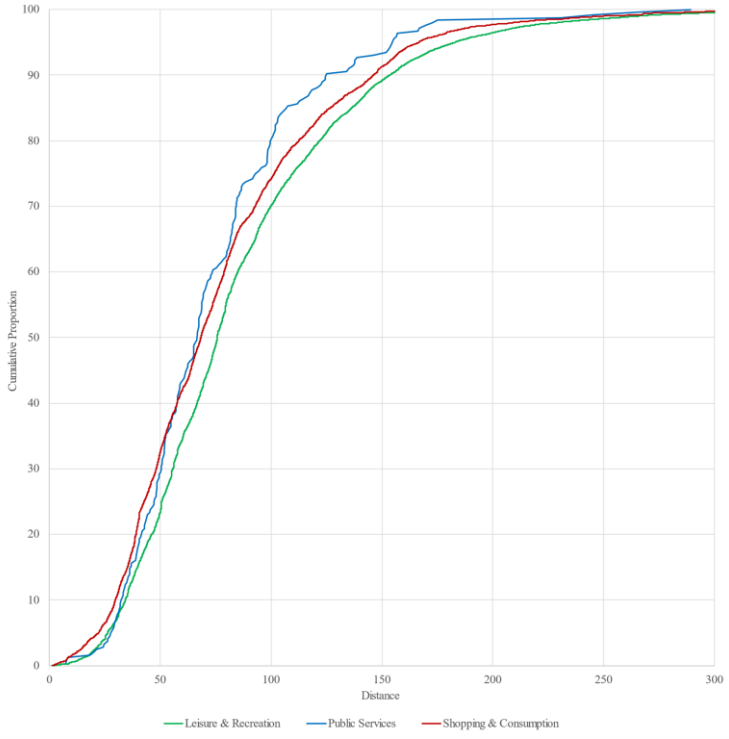

Fig. 2 Analysis of the travel radius of regional life behaviour within 300 km of the Greater Shanghai Metropolitan Area

As travel activities to meet residents' basic public service needs, medical and educational behaviours show a preference for high-level destinations at the regional cross-city travel level, with a relatively short travel radius. For example, cross-city medical and educational behaviours in the Greater Shanghai Metropolitan Area are concentrated within 100 km; in terms of the distribution of destinations, some residents choose to go to large cities to obtain higher-quality medical and educational services, and the travel distance often depends on the distance between their place of residence and the core city.

Based on meeting residents' daily material living needs, the spatial distribution of regional shopping consumption behaviours is comprehensively affected by factors such as the layout of urban commercial facilities, consumption habits, and transportation convenience, with a relatively limited travel radius. Generally, consumption mainly occurs in adjacent cities, concentrated in a radius of 40–80 km.

Leisure and recreation behaviours show a wide and scattered spatial pattern, with the longest travel radius among various living behaviours in the Greater Shanghai Metropolitan Area and relatively low sensitivity to spatial distance. In the Greater Shanghai Metropolitan Area, most travel activities are concentrated in a radius of 50–100 km, such as the tourist flow between cities in southern Jiangsu and between Hangzhou and Jiaxing, which reflects the preference and utilisation of surrounding leisure resources by urban residents. Areas with special endowments outside the metropolitan area have strong attractiveness for long-distance leisure and recreation behaviours, forming typical secondary relations such as Shanghai–Quzhou and Shanghai–Huangshan.

4.2.2 Correlation between Need Hierarchy and Spatial Scale

Research analysis based on big data of typical OD behaviours also reveals a certain correspondence between different living need hierarchies and their travel spatial scales. Specifically, the higher the need hierarchy, the larger the spatial scale residents are willing to traverse to fulfil that need.

High-level needs, such as leisure and recreation and high-end shopping, which belong to self-actualisation needs, have relatively long travel distances and large spatial scales, often manifested as travel circles of more than 50 km. For example, the spatial scope of leisure and recreation travel during holidays is relatively broad. Well-known tourist cities in the Greater Shanghai Metropolitan Area, such as Suzhou, Zhoushan, and Shaoxing, as well as those outside the metropolitan area, such as Quzhou, Taizhou, and Huangshan, attract a large number of long-distance cross-city tourists due to their unique tourism resource endowments. The radius of these long-distance trips is approximately 100–200 km, forming a regional long-distance recreation behaviour network. For residents in the metropolitan area who have consumption needs for special commodities, such as high-end luxury goods and characteristic handicrafts, they may travel a long distance for cross-city shopping, with the proportion of travel distances exceeding 80 km reaching nearly 30%.

Medium-level cross-city shopping consumption and general public services usually correspond to medium-level needs, which are matched with medium spatial scales. Taking shopping consumption as an example, the core business districts of adjacent cities, relying on a rich variety of commodities and high-quality service environments, attract and radiate residents from surrounding cities for consumption, thus forming a shopping consumption circle with a radius of more than 50 km. For instance, Haining Leather City has attracted many consumers from surrounding cities; at the same time, large shopping malls and characteristic commercial streets in Hangzhou also have a strong appeal to residents of surrounding cities, which reflects the preferences and needs of consumers for shopping experiences in different cities.

Low-level physiological needs and safety needs, such as daily shopping and basic medical services, are concentrated within a small spatial scale, usually dominated by intra-city travel. Only in the continuous urban boundary areas, where adjacent cities realise interconnection through transportation and share commercial and public services, will regional living behaviours occur. In the Greater Shanghai Metropolitan Area, such as between Haining and Hangzhou urban area, Shaoxing urban area and Hangzhou urban area, Kunshan and Shanghai Jiading/Qingpu, and Jiangyin and Zhangjiagang, cross-city shopping behaviours of consumers are frequent and close, forming a regional living space characterised by high travel frequency and community activity orientation.

4.3 Spatial Organisation Combining "Hierarchy-Flow"

On the basis of spatial scale differentiation, two typical modes of spatial organisation of living spaces in the Greater Shanghai Metropolitan Area can be further observed: one is the circle and hierarchical network mode, and the other is the corridor and flow space mode.

4.3.1 Circle-Layer and Hierarchical Network

The circle-layer and hierarchical network mode is based on the differentiation of activity areas, presenting a hierarchical network structure due to the varying levels of destination capacity (Ma, Xu, & Song, 2023). This spatial organisation is often constituted by point-to-point regional travel behaviours such as commuting, medical visits, and

schooling, where destinations have high-capacity levels, typically being regional central cities. Typical cross-city public service activities like medical care and education, due to the apparent gradient differences in the supply of public service resources like healthcare and education, and the concentration of high-quality resources in core cities, exhibit distinct hierarchical network characteristics in their spatial organisation under the drive of high-level medical and educational needs. Furthermore, constrained by administrative systems, they also possess distinct intra-provincial travel characteristics. Shanghai forms the first-level public service network within the metropolitan area, while Hangzhou, within the circle and provincial core cities like Nanjing and Hefei outside the circle, become main destinations for cross-city medical and education behaviours, aggregating from various locations within the province towards the provincial capital core cities, forming a second-level travel network.

4.3.2 Corridor and Flow Space

Different from single-point regional travel behaviours, behaviours such as leisure and recreation, consumption and entertainment present multi-point or divergent network characteristics, with diverse and heterogeneous destinations. With reference to the theory of flow space, which is different from the "place-oriented" field space and focuses on the unbalanced spatial connections and evolution between nodes, the spatial organisation of these living spaces mostly presents the characteristics of flow space, emphasising non-local "central flow connections". The destinations represented by shopping consumption and leisure and recreation in the Greater Shanghai Metropolitan Area have distinct spatial characteristics of the metropolitan flow network. On the one hand, the difference in the allocation of relevant resources between cities in the Greater Shanghai Metropolitan Area is relatively small, and the hierarchical behavior network is gradually weakened; on the other hand, non-core cities such as Huzhou, Xuancheng, and Shaoxing have become major destinations due to their beautiful natural landscapes, profound historical and cultural heritage, and high matching of service supply and demand. However, the emergence of regional living spaces in such non-core cities also requires the support of transportation networks, so their corridor characteristics are also relatively significant. For example, the high-speed railway and expressway composite corridors, such as the Shanghai-Nanjing and Shanghai-Hangzhou corridors in the Greater Shanghai Metropolitan Area, have become key corridors for regional living spaces.

5. Conclusion

The living space is fundamentally composed of the activity behaviours formed by the interaction between individual residents and spatial facilities in time and space. As urban agglomerations and metropolitan areas have become the core spatial units for urban development, residents' regional living behaviours have been increasingly dense, forming a living space network at the metropolitan area and urban agglomeration scale, and promoting the transformation of living spaces from an independent single-city model to a regional collaborative model.

By clarifying the concept of regional living spaces and starting from the evolutionary trend of regional living behaviours, this study attempts to introduce the dimension of demand level differentiation, providing a new perspective for the research on regional living spaces. For the pursuit of a better life, the connotation of living spaces has evolved from a material space that meets basic survival needs to a composite space that bears diverse needs such as social interaction, cultural experience, and self-actualisation. Regional living behaviours present evolutionary trends such as spatial expansion, pattern reconstruction, and value leap, behind which are multi-dimensional differentiation factors ranging from the time dimension to the spatial scale and then to the demand level.

Building on this, taking the Greater Shanghai Metropolitan Area as an example, through big data analysis, this paper summarises that the cross-city employment, medical treatment, leisure, and other behaviours of residents in the Greater Shanghai Metropolitan Area, starting from the underlying driving difference of demand levels, present differences in different time dimensions, different spatial scales, and spatial organisation. The upgrading of residents' needs from basic survival to self-actualisation is directly reflected in the expansion of the scale of living spaces. The demand for public services such as medical treatment and education is concentrated within a short-distance radius, focusing on local areas and core cities; living behaviours with richer self-actualisation needs drive longer-distance cross-city flows (100–200 km). For example, shopping consumption shows a bimodal distribution of short and long distances (66 km and 104 km), and leisure and recreation extend to a radius of 119 km. Public services rely on the circular hierarchical network of core cities, while consumption and leisure form a multi-centre flow space based on corridors. Together, they constitute the "circle-corridor" interactive spatial structure of the metropolitan area, and transportation infrastructure (such as high-speed railways and expressways) has become a key link supporting the organisation of flow space.

Considering the diversity of regional development stages and the complexity of the formation process of regional living spaces, their differentiation trends need to be subject to more extensive verification and further optimisation. However, from the perspective of long-term spatial

governance, the three-dimensional differentiation model of regional living spaces integrating demand levels has guiding significance for planning. Currently, the mode of planning resource allocation is gradually transforming from the previous "supply-oriented" model to a more precise "demand-driven" model. Through the analysis of residents' behaviours and needs, we can understand the functional needs and development potential of different regions in the metropolitan area, thereby realising the rational allocation of resources and the effective utilisation of space through the superposition of local and regional needs and the planning coordination between cities in the metropolitan area.

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