Spatial Perception and Humanistic Innovation in Smart Cities: A Systematic Review

Tongwen Wang[✉] and Wuzhong Zhou[✉]

Design Institute, Shanghai Jiao Tong University, Shanghai, China
{wangtongwen,wzzhou}@sjtu.edu.cn

Abstract. The literature on spatial perception from the context of China and abroad generally presents situation in which the research perspective is rich, and the research methods are diverse. From the research content of the literature, almost all of them cover the objective existence of space and the subjective perception of people. This paper uses the literature review method to analyze and summarize 50 documents in the world which it draws conclusions related to spatial perception. This paper explores the relevant elements of spatial perception in the traditional sense from the microscopic and macroscopic perspectives. At the level of reflection, under the scope of smart city construction, we will explore more on the interactive spatial perception for the future because of the additional technology. This paper is based on the existing literature on how to integrate spatial perception with humanistic innovation in smart cities.

Keywords: Spatial perception · Systematic review · Chinese and foreign · Smart city · Culture

1 Introduction

"Space" are being understood differently in different academic areas: early scientists represented by Newton in physics considered space to be substantial, while in Einstein's theory of relativity, the connection between space and phenomena was emphasized. Roger Jones believes that the concept of modern space is a compound metaphor. Heidegger believes that space needs to be considered relative to people is neither a simple external object nor a pure internal experience. And all the concepts cover the relative relationship between "space" and "people": people walk through space and experience it, which is often associated with time elements. And this relationship stimulates people's multi-level perception of space, including visual, phenomenological and spiritual aspects. Christian Norberg-Schulz calls it "space perception." The concept of "space perception" in this article is also based on this.

The literature on spatial perception in China and abroad generally covers both the objective existence of space and the subjective perception of people. This paper uses the literature review method to analyze, compare and summarize Chinese and foreign literatures. It attempts to draw microscopic and macroscopic conclusions and provide insight for future research on spatial perception as an introspective and reflective work, especially in the context of the rise of smart city planning, where understanding the characteristics of human spatial perception is crucial. At present, the wisdom of urban

discourse is fixated with technical ability and development. From the relevant research results, part of the problem that exists in the construction of smart cities can be summarized to be: the lack of humanistic care in smart city planning; the lack of humanistic considerations in smart applications and the lack of culture in urban public spaces. Taking the current situation in China as an example, technology-based and management-oriented smart cities have been highly valued. A digital government, digital transportation and government platforms have been launched based on digital technology, but due to the construction of smart and managed smart cities, the indispensable coordination and symbiosis between "technology", "society" and "culture" has been neglected to some extent. Technology has not been actively used to establish the unique cultural identity of cities, such as "smart cities" just focusing on the objective existence of development. But subjective perception of the city to the citizens is the key to urban sustainability.

The traditional urban space is dominated by static objective existence, while the smart urban space is an environment with more dynamic changes due to technology and may actively respond to human behavior. Therefore, smart urban spatial planning needs to consider the subjective perception of spatial users. This article reviews previous research on spatial perception based on such a starting point. The literature on spatial perception in China and abroad generally presents a situation in which the research perspective is rich and the research methods are diversified. From the research content of the literature, almost all of them cover the objective existence of space itself and the subjective perception of the people in it. Based on objective existence, the subjective perception of spatial users will be influenced by aesthetics, values, knowledge base, personal interests and living conditions, allowing space to produce another dimension related to time outside the physical existence dimension. In this sense, in addition to objectively defined physical facts, there are also the historical events and memories. The subjective perception of literature research in China and abroad can be roughly divided into the architectural narrative perception, perception of cultural symbols, local memory or collective memory. This article uses systematic literature research methods such as text analysis and comparative analysis to study the domestic and foreign literatures and summarizes the current conclusions from micro to macro in the direction of spatial perception. This work also summarizes the characteristics of human spatial perception at the level of reflection, thus provides insights for future research on spatial perception.

2   Rich Research Perspective

With the development of humanities and social sciences, spatial design has become an interdisciplinary multi-dimensional comprehensive discipline. As emphasized at the National Environmental Protection Act (NEPA) conference, culture and natural resources will generate new land uses and landscapes, and knowledge needs of different disciplines will be incorporated into larger planning areas [1].

From the results of foreign search engines, many foreign related articles related to the "landscape" and "space" topics cover psychology, human geography, sociology, communication, landscape semiotics, etc. Rouhvand started with immigration stories

and found geography landscape symbols in the text [2]. Simpson et al. used historical evidence behind the human landscape to infer the social norms of early local fuel use from the perspective of historical archaeology [3]. Peter's article emphasizes the operational concepts and inferences of anthropology and archaeology in space. He believes that space is a social bond that is generated through dynamics in the historical process [4]. From the perspective of sociology and communication, Javier investigates the narratives of local feelings, studies the emotional impact of local spatial changes on tourists, and provides relevant insights into the driving forces of spatial change in tourism [5]. Thomas studies the influence of landscape space on people in space from the perspective of psychology. He feels that the environment has a potential effect on the restoration of human internal state, and it can bring more psychological benefits to humans through landscape space [6].

3   Diverse Research Methods

The research methods used by Chinese scholars are often combined with field surveys, questionnaires, etc. based on qualitative descriptions. Most of the foreign literatures on the space use empirical methods, combined with field trips in geography, while also integrate other humanities and social science research methods: such as historical documentary methods in history, image and photographic methods in art history and quantitative analysis in archaeology, etc. In terms of research methods, more advanced science and technology have been gradually used globally [7]. For example, using GIS techniques is to explore the cultural significance attached to the space from the perspective of cultural geography [8]. These research methods are improving the study of paradigms, theoretical methods, etc. to promote future theory and practice [9].

4   Objective Existence in Research Content

"Spatial perception" can be divided into "space" and "perception". Predecessors' research is based on the existence of objective space, and then to study the subjective perception that objective existence inspires [10].

Gabriel Zuolun believes that the discussion of space issues should be based on the fictional world of texts. He creatively proposes three levels of narrative space reproduction: geography space, time space and text space. These three levels interact and complement each other on the basis of objective existence [11]. Peter Eisenman emphasized that "the objective existence should be seen through the form" [12].

Alison Blunt has proposed two basic characteristics of a historical city: one is the environmental capital it represents (including architecture and urban infrastructure), and the other is the social and cultural values it expresses. In his theory, physical attributes and social attributes are inseparable, that is, the existence of objective space is inseparable from subjective perception [13].

Li-Shin Chang uses the example of the Wiltshire Landscape Park in the United Kingdom: the objective design of the Temple of Florence, the Grotto, the Pantheon, the Rock Arch, the Temple of Apollo, etc., is to reveal the journey of Aeneas and the story

of Rome [14]. Tanga begins with the public art of modern urban spaces, taking Boston's bronze food memorial sculpture as an example. The designer redefines the "monument" in the urban environment using an objective existence like "monument" but not "monument". It evokes the public's subjective memory of people and events [15]. Ebru studied the objective existence of a specific type of urban space such as a commemorative public space. It is believed that a single or closed memorial site is not as good as a commemorative venue integrated into the urban public space, which can arouse the public's subjective memory and recognition of urban history [16].

In Hamzah Muzaini's article, attention is paid to the general problem in the existence of commemorative spaces, the neglect of gender issues. In the subject of the study, the Singapore's Changi Church Museum, the objective space for women's commemoration has somehow re-emphasized the gender issues in the commemorative landscape. Such design not only affects the individual subjectivity of the viewer but also affects the collective-subjective view at the national level [17]. Maria surveyed the cities of Lviv and Wroclaw, and the "place attachments" (i.e. apartments, streets, houses, urban areas, cities) in this article are an objective existence, and the "place memory" (including local identity, local attachment, and even racial prejudice in collective memory) is part of subjective perception [18]. Mahbub Rashid believes that "space" is an objective entity defined by coordinates and scales, while "place" is more like an emotional entity and has undergone subjective definitions emotionally [19].

5   Subjective Perception in Research Content

Centered on the objective existence, as an actor in space, every move affects the change of "subjective space", that is, another dimension related to time outside the physical existence dimension. In this dimension, in addition to objectively defined physical facts, more are historically related events and memories.

When people evaluate landscapes, their subjective perceptions are influenced by aesthetics, values, knowledge base, personal interests, and living conditions [20].

In Desiree Geib's book, "place" is defined by emotional experiences and subjective feelings. The "space" media is very different in terms of narrative potential and nature [21, 22]. With the change of human material concept, when the basic material needs to be satisfied, it is more important to have more stories than to have more items [23], that is, having better subjective perception is more important than objective existence itself.

In the predecessors' literature, subjective perception can be roughly divided into architectural narrative perception, cultural symbol perception, local or collective memory, and other memory perceptions.

5.1   Architectural Narrative Perception

Most of China's papers on spatial perception focus on architectural narrative. Ma Jie's article is based on architectural narrative to study commercial space design. The article is based on the subjective perspective of the "recipient" (space user). It analyzes the subjective intention that the "sender" (space designer) wants to express using information conveyed by "media" such as architectural forms [24]. Chen Tianyu studied

urban furniture in urban space. He believes that urban furniture is involved in urban "story" for people in the city [11].

Foreign scholars mostly use empirical research methods for architectural narrative research to explore the relationship between form and perception of famous architectural spaces.

After studying the interaction between the intrinsic and external meanings of buildings, Mahbub's article found that the geometry and configuration of buildings impose varying degrees of visual constraints on visitors in space. The article argues that subjective perceptions brought about by objective existence make buildings understood as different visual and spatial complexes. For example, when the Chiswick villa moves along the main pedestrian flow line, there is a lack of change in vision, so subjectively feel a strong sense of symmetry [19].

As Penz believes, from the architectural narrative, all movements of people in the building play a key role in constituting a storyline [25].

5.2   Cultural Symbol Perception

In the field of architectural design, in addition to architectural narrative perception, there is also cultural symbol perception.

In Spain, modern architecture such as the Bank of Bilbao has become a cultural symbol to some extent, representing the political change and modernization movement in Spain at the time. As Catherine Schonfeld said, when people see the role of architecture and its role in urbanization, it begins to consider the city's technology [26].

Architecture as a public object in the process of urban culture, like urban cultural symbols can arouse people's perception of the city's capital flow and modern identity.

In addition to modern cultural symbols such as architectural space, natural landscapes can also serve as cultural symbols. The Mongolian prairie and its nomadic people, horses, herds and small figures form a cultural landscape, which is the landmark of the region and the core image of Mongolian marketing. In other Mongolian and adjacent grasslands, natural and cultural heritage is considered an independent attraction. The concept of cultural landscape is widely used in the context of world heritage. The elements of the cultural landscape have become cultural symbols that can attract tourists. Visitors choose to travel to the local area because of the perception of these cultural symbols. Therefore, cultural symbolic perception plays an important role in tourism [27].

5.3   Memory Perception

Memory is an important concept in the current Western humanities and social sciences. The study of memory has increasingly becoming an area of concern for Western human geographers [28]. While "memory" is associated with "spirituality" and "spirit" in the West, western scholars believe that the physical environment can improve the level of individual sense of consciousness [29]. Urban memories use urban space as a backdrop, and they stimulate the local spirit of historical cities [29]. Mariam et al. also pointed out that collective memory is a "database" that encompasses the tangible and intangible social and cultural values of cities, thus plays an important role in promoting

the sustainable protection of historical cities [30]. Joaquim Sabaté Bel's article describes Barcelona's old industrial area, Poblenou, which was transformed into a creative district due to large-scale urban intervention. Urban memory based on elements such as community organization and collective life has been strengthened by the transformation of urban space [31].

In the commemorative landscape, collective memory is spatialized through objective material and symbolic commemorative landscapes [32, 33], and related memories include not only collective, political memory or memory of a generation, but also viewers' own experiences and pains.

In addition to cultural memories such as local memory, collective memory, and urban memory, western scholars have also studied the concept of practical memory in space. Lofland pointed out in the book: "Citizens' perceptions of the community are called 'community identity' and are reflected in the interaction between individual residents and the community" [34].

When studying the "spiritual" dimension of tourism, Gregory explores how people seek subjective meaning after experiencing various objective things on the way to viewing the landscape [35].

The "embedded activism" in Susan Haedicke's article is an appeal to the practice of embedding public affairs in space. It is believed that the practical story connects the narrative with the space and achieves a "reflexive narrative" [36].

Daugstad also believes that the experience space is beginning to turn to deeper perceptions, such as through personal experience to perceive local lifestyles [37].

In the memory landscape, practical perception is more compatible with cultural symbolic perception. Wasserman believes that "a truly good memorial will allow visitors to experience space, watch and touch artifacts, participate in ceremonies or community events, and the audience becomes a participant in the memory experience" [38].

6   Conclusion

6.1   Micro Level

From the related literatures such as "landscape", "space" and "perception", we can summarize the relevant enlightenment on the micro level, macro level and even reflection level of landscape space perception.

The landscape space is not only the story background, but also the narrative process that produces the story [39].

From the micro level, the various elements of landscape space affect the perception of landscape space. As Potteiger said, "landscape narrative" refers to the interaction and relationship between landscape elements and narratives. In the garden of Shinagawa, the narratives brought by landscape elements such as water, wood and stone give memory and respect to the history and customs of this area, express their attachment to natural things, dependence and rational thinking on human living environment [40].

In the landscape space, the relevant architectural form is also part of the narrative. It is interwoven with local and social practice and is the social capital of the narrative structure [41].

Franken believes that contemporary architecture not only satisfies the function of space. In the design of the Frankfurt Motor Show, he uses material integration narratives to view architecture as part of the BMW belief system [42].

However, spatial elements do not exist in isolation. In practice, there are often situations of contradiction, and reasonable choices should be made according to actual conditions [43].

6.2   Macro Level

From the macro level, thinking about "landscape space perception", more scholars have already fostered it to the research category of urban planning development. It is known in previous studies that it is important for cities to achieve future sustainability, recognizing and protecting all tangible and intangible socio-cultural values, since the nature of sustainability includes socio-cultural and economic aspects. This shows a strong interdependence between the environment and people [30]. ESRA Yaldız examined the relationship between Konya's urban architecture and urban ownership, emphasizing the role of buildings in forming unique urban brands [44].

When urban culture is homogenized, a space with nostalgic emotions like the market can stimulate tourists to be more emotionally concerned [45]. In the study of tourism narrative, there is also an inspirational article on the development of urban space: when urban culture is homogenized, spaces with nostalgic emotions, such as the market, can stimulate tourists to be more emotional.

In the design of museums that play a key role in urban cultural communication, local narratives also form part of the national narrative to a certain extent, which can shape local and local identity, realize local and national interactions and regulate community members [46].

There is great potential with external society and other aspects [47]. Urban memories evoked by space have been shown to influence urban competition rankings in urban renewal [31].

6.3   Reflection Level

At present, the contemporary landscape space lacks cultural connotation, and some landscapes are one-sided pursuit of visual impact [48]. Narrative has almost become a marketing tool. Most designers are indifferent to whether the story is clearly stated and whether the information is effectively conveyed [49].

It can be seen from the research literature that the research on spatial perception in China is significantly less than that in foreign countries, where most of the articles are examples of famous foreign architecture.

It can also be seen that for the domestic space design field, there are not many excellent cases that can truly apply the spatial perception to the design and correctly produce the perceived effect. From the perspective of academic research, most of China's articles on spatial perception design stay in the case of empirical analysis and

qualitative description, while foreign journal papers are combined with data model analysis methods commonly used in humanities and social sciences.

Therefore, it can be concluded that the lack of scientific exploration with data analysis in Chinese spatial perception research makes it difficult to draw more specific and objective conclusions. However in today's big data context, the study of objective and subjective relationships in the topic of "space perception" can be analyzed using software such as SPSS [50].

Urban landscape space already covers modern landscape spaces such as public art, while the existing literature rarely focuses on the study of modern landscape space perceptions such as public art. In the wave of building a "smart city" around the world, spatial perception is more related to human innovation. Urban space has gradually transitioned from the traditional static, passive experience space to a dynamic, interactive space. In this process, taking the situation in China as an example, many places have launched digital cities, digital government, digital transportation and other platforms based on digital technology. However, these are only functionally satisfying the requirements of efficiency and convenience, while ignoring the spiritual needs of most users in the city.

Furthermore, spatial perception, if combined with the concept of a smart city, can make the experience break the limits of time and space. As an example, we can combine the new generation of information technology with modern garden space and community space by designing smart gardens and smart communities. This makes people connect with space in a smart way, and based on previous spatial perception, it can increase interaction. In the space of cultural communication education, the development of smart apps such as digital museums can make local identity more interesting using microscopic elements such as symbols.

Inheritance of cultural heritage, intangible cultural heritage can be digitally stored in the cloud or online. Is it better if the material heritage also able to build a platform through smart cities, allowing citizens to participate in future related designs while being aware of space entities. Such an intelligent technology system will help to develop better contexts and strengthen building consensus and local sense.

For the humanistic innovation of smart cities, designers can combine the characteristics of human spatial perception and think from the macroscopic and microscopic perspectives, such as considering the aesthetic differences, cognitive differences, personal interests of different users and other factors related to subjective perception. In-depth integration of culture and technology. It is also possible to use the platform system of the smart city to collect, organize and analyze relevant data for analysis. Based on the characteristics of urban space, the cultural symbols of the city can be extracted and internalized into various media of the smart city, and the identity of the culture as one of the core factors together with the scientific and technological factors can promote the sustainable development of the city.

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