Research Paper

Perception of street environment: a bibliometric study through CiteSpace

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Abstract

As an urban space closely related to people's daily lives, street influences people's psychological experience. This paper performs a literature review on human perception of street environment. Using CiteSpace, a literature analysis tool, the overall research evolution path and research hotspots were extracted. Three main research areas were summarized: health issues, place attachment and social issues related studies. This review advances our understanding of street perceived environment from different angles.

Keywords

Street Perception, environment, CiteSpace, bibliometric study

1. Background

With the improvement of urbanization worldwide, the study of built environment in urban planning has become much more detailed, and its focus has gradually shifted from large-scale expansion to the micro scale construction of urban public space (Ye Yu et al.,2021). Meanwhile, the pursuit of high-quality and healthy public space has become the mainstream thought. The importance of humanism in urban design has been raised to a new level.

Street plays an important role in the urban living environment. As an urban space closely related to people's daily lives, street provides a place for people's physical activity and influences their mental experience. High-quality streets bring a high-quality visual experience and create positive emotions such as comfort and safety for neighbourhoods. In addition, it has been revealed that high-quality streets and the network improve public physical health by promoting walking and cycling. This is the reason why many studies have focused on the street quality, making the perception of street environment a critical theme in this field.

2. Data sources and methods

An effective way to sort out all literatures about street perception is to use literature analysis software as an aid. Knowledge mapping is a graph that shows the development process and structural relationship of scientific knowledge. It can help researchers find the complex domain of modern scientific and technological ideas through data mining, information processing, knowledge measurement and graph drawing to extract the specific research field, correlation relationship and new hotspots.

To more accurately frame the literature needed for analysis, the search scope is limited to Science Citation Index Expanded (SCI-Expanded), Social Sciences Citation Index (SSCI), and Arts & Humanities

Citation Index (AHCI). The study takes “street”, “perception” and “environment” as the subject keywords and “articles” as the source to qualify the journal type. The data retrieval time is August 29, 2022, the period is 2002-2022 and a total of 882 articles are retrieved. From the perspective of the affiliation distribution of authors, the top five countries are United States, China, Australia, England, and Canada.

This paper uses CiteSpace to perform a literature review on the perception of street, exploring its overall evolution path as well as subject areas, publishing trends, hotspots and keyword cluster analysis through all related literatures in 20 years from the “web of science” database. Based on analysis and visualization, we will also make a summary of research areas.

3. Analysis

3.1. Subject areas and publishing trends

According to the analysis from the Web of Science, the literature research can be categorized into various subject areas. Table 1 shows the top ten areas and the records. After viewing the records, it is found that, with the overall goal of promoting public health, the street environment has been studied from environmental sciences, urban planning, transportation, geography and sustainable sciences.

Table 1. Top 10 subject areas. Source: Web of Science.

Subject area	Records
public environmental occupational health	205
environmental studies	152
environmental sciences	104
urban studies	100
transportation	99
regional urban planning	60
geography	58
engineering civil	55
green sustainable science	50
transportation science	49

As can be seen from Figure 1, although there was a significant decline in 2017, the number of articles published and cited per year shows an overall increasing trend in this area. The decline implies that the research development was slowed down by methodological and topical constraints, which will be discussed later using the analysis results in CiteSpace.

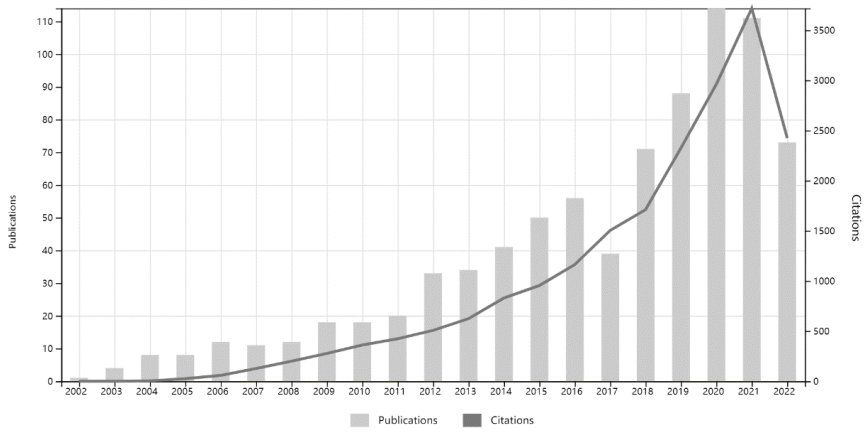

Figure 1. Published items and citations trend. Source: Web of Science.

3.2. Hotspot

Keyword frequency analysis can help to indicate the research hotspot in the academic field. It refers to a method of extracting keywords that "express the core content of the document from the document's information and distribute them in high and low order" (Meng *et al.*, 2020). The CiteSpace software is used to carry out this keyword analysis. Articles from the database built previously are analysed with a time slice of 1 year from 2002 to 2022. The most frequent keywords are spotted and 10 keywords co-occurrence clustering was detected.

According to Table 2, the keywords "perception", "physical activity", "built environment", "environment", "walking" and "health" all have a frequency of greater than 100. Among the six keywords, the centrality of "perception" and "environment" are above 0.1, which indicates their important role in the knowledge network. As to the other four keywords, they show diverse aspects of the study field. For "physical activity" and "walking", the two keywords show the focus on health action which can be promoted by improving the perceived environmental attributes in the neighbourhood (Sugiyama *et al.*, 2009; Berger *et al.*, 2019). "Built environment" is of great interest in this field because it is not only the physical object that people perceive, but also the environment in which they commute and engage in community interaction (Hassen and Kaufman, 2016). As to "Health", it mainly points out the relationship between the environmental attributes and physical and mental conditions (Song *et al.*, 2007; Leslie and Cerin, 2008).

Table 2. The top 10 most frequent keywords. Source: CiteSpace.

	Frequency	Centrality	Year	Keywords
1	223	0.20	2003	Perception
2	194	0.06	2005	Physical activity
3	186	0.07	2005	Built environment
4	130	0.12	2005	Environment
5	120	0.05	2005	Walking
6	119	0.08	2005	Health
7	69	0.06	2005	Association
8	69	0.04	2008	Behaviour
9	58	0.02	2013	Impact
10	51	0.09	2005	design

The clusters which illustrate the diverse research topics are extracted by the keyword clustering algorithm. The Q-value of this clustering is 0.3982 > 0.3 and the S-value is 0.7391 > 0.7, indicating that the result is in the confidence interval and the clustering is of high quality. According to Figure 2, the first eight clusters contain a large volume of literature and are more closely interlinked while "alcohol" and "topographic disorientation" lack connection with them.

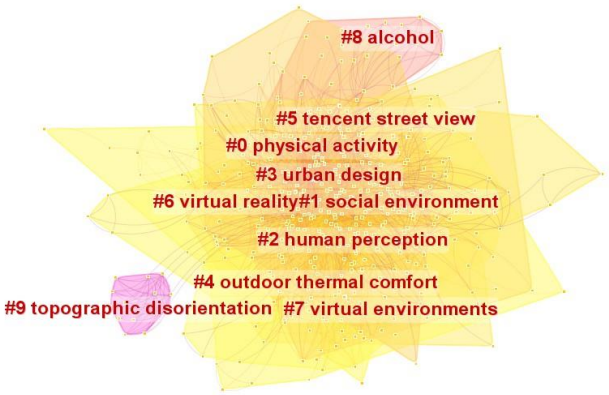

Figure 2. Keywords co-occurrence clustering graph. Source: CiteSpace.

Similar to the analysis based on the keyword frequency, the evolution path analysis based on emergent words can also discover the emerging fields and development trends of scientific research. This analysis method is called burst detection in CiteSpace. Figure 3 shows the top 25 keywords with the highest rate of word frequency burst over the past twenty years. The keywords vary as the research interest changes. It is found that the big data approach using deep learning boosts the research in this area in 2018, which can explain the fluctuation in the number of literatures during this period (Zhang *et al.*, 2018).

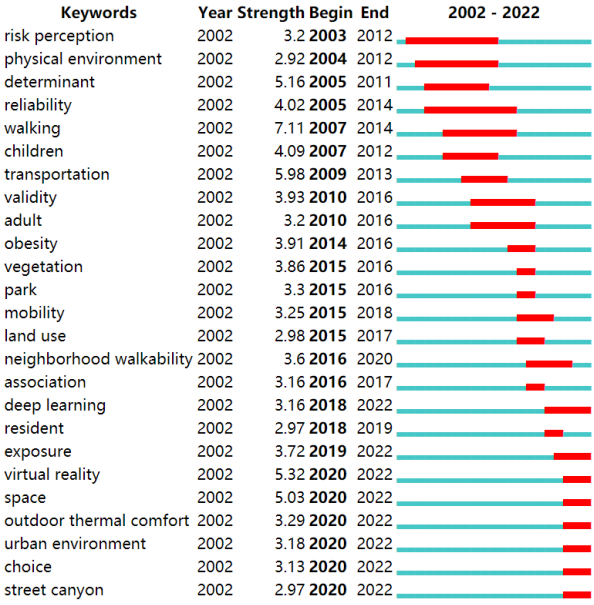

Figure 3. Top 25 keywords with the strongest citation bursts. Source: CiteSpace.

4. Results: research areas

Some important insights and mandates can be found by combining the results of bibliometric analysis and the reading of literatures with high citation rate. These have implications for urban planners, architects and even citizen groups, for their concern about the relationship between the street environment and human well-being. Here, we group the studies and their insights into three main areas.

1) Health issues related studies

As is noted in keywords analysis, perception of the street environment influences frequencies of physical activity and walking, behaviours that facilitates public health in the neighbourhood (Sugiyama *et al.*, 2009; Berger *et al.*, 2019). Besides, cycling has also attracted researchers' attention as a health behaviour (Pooley *et al.*, 2013; Liao *et al.*, 2015; Zhao *et al.*, 2018), albeit much later. The relationship between built environmental attributes and the health actions were widely discussed early on, with the measures of perceived and objective attributes, and the observations of people's behaviours being important (Duncan and Mummery, 2005; Hoehner *et al.*, 2005). Some articles take the demographic characteristics into account in their statistical analysis (Hoehner *et al.*, 2005) while the others limit the research scope on a single type of people such as children (Holt *et al.*, 2008; Loptson, Muhajarine and Ridalls, 2012) and girl (Mota *et al.*, 2011). After 2010, the choice of walking route has become another important indicator of people's health behaviour (Brookfield and Tilley, 2016). Other sustainable travel modes related to environmental perception has also been noticed (Larsen, Buliung and Faulkner, 2013; Park, Deakin and Lee, 2014).

In addition to articles exploring health behaviours, many other studies shed light on environmental influences on physical and mental issues. The researchers have used disease rating scale to determine the extent of people's illness and then discuss its relationship to the perceived environment (Timperio *et al.*,

2005; Ying, Ning and Xin, 2015; Malambo *et al.*, 2016). Thermal comfort, the fifth cluster in the Figure 2 showed above, is a critical concern in recent five years (Mayer *et al.*, 2008; Kardan *et al.*, 2015), with travel safety as its counterpart (Ozhanci, Yilmaz and Yilmaz, 2014; Harvey *et al.*, 2015). The psychological problems of vulnerable groups also receive frequent attention, especially for the elderly (Rantakokko *et al.*, 2010).

2) Place attachment related studies

There is no doubt that place attachment is a psychological topic, but it is far beyond the health concern. Place attachment refers to the bonds that people have with places. In general, there are three components of place attachment: affective, cognitive, and behavioural (Lewicka, 2008).

As to the literature in perception of street environment, place attachment has been discussed over a long period time. Some settings in the street can contribute to place identity (Jorgensen, Hitchmough and Dunnett, 2007; Abass and Tucker, 2018) while the neighbourhood morphology has great impact on socio-behavioural time-spent that influences the memory of place (Khosravi, Bahrainy and Tehrani, 2020).

Another relevant study is spatial recognition, which is closely bonded with city image. The tenth cluster, topographic disorientation, showed in Figure 2 refers exactly to this field. Some articles put emphasis on the clarification of relationship between physiological characteristics and street recognition (Rosenbaum *et al.*, 2004). Others explores how to relieve the lost issues in the street (Mendez and Cherrier, 2003; Lee and Pai, 2012).

3) Social issues related studies

Street quality is correlated with the social and economic environment of a society (Wood *et al.*, 2008; Zhang *et al.*, 2021). Many street environment attributes have been proved to be associated with crime (Sohn, 2016). Neighbourhoods with more lighting has an appreciable reduction in night-time crime (Chalfin *et al.*, 2022). Also, neighbourhood-level place attachment contributes to individual crime risk reduction (Brown, Perkins and Brown, 2004). At the same time, there is a bias between people's perceptual and the real social safety, which may result in mis-judgment of safety (Zhang *et al.*, 2021).

The perception of streets differs by race, disease susceptibility, age and economic level, and is correlated with social justice (Cutts *et al.*, 2009). The perceived quality of the social environment is generally lower for disadvantaged groups, including the poor and the homeless, and this social space differentiation and the underlying social equity issues have been a focus of research (Thompson *et al.*, 2006; Kelly *et al.*, 2007). In addition, there are studies on the relationship between street perception and socio-economic attributes, such as studies on the impact of street greening on housing prices (Zhang and Dong, 2018) and the relationship between social capital and the environment (Wood *et al.*, 2008).

5. Conclusion and discussion

The analysis using Citespace leads to the following conclusions: Firstly, the release of street environment perception literatures decreased in 2017 due to the maturation of traditional street discussions, but the application of new technologies such as machine learning and street data after 2018 led to a renewed increase that has continued to this day. In addition, the four keywords, physical activity, built environment, walking and health should be pointed out due to its high frequency.

Combined with the reading of literatures, studies on perception of street environment can be divided into three areas: health issues, place attachment and social issues related studies, reflecting the multiple roles of streets in influencing residents' health, sense of belonging and social benefits.

The research areas provide us with different perspectives on the street environment. They can significantly expand the starting points for street design and neighbourhood planning, thus broadening approaches to urban design.

We note that most of the existing articles study the relationship among existing street elements, human perceptions, physical and mental effects, but there are few studies on the enhancement of perceived environment by specific design methods. Future studies can promote the attention on comparing the changes in people's various perceptions before and after urban design to further enrich the science of design methods.

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