Research on Library Space Facilitating Reading from the Perspective of Environmental Behavior Theory: A Postprint of a Sample Survey of Readers Under 50

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Abstract

[Purpose/Significance] By optimizing and reconfiguring reading-conducive elements in library spaces, readers' reading behavior can be promoted. By analyzing the relationship between library physical space factors and readers' reading behavior, this study provides evidence and reference for related research and practice. [Method/Process] Based on relevant theories of environmental behavior, propositions and a research model for library space promoting reading are proposed, and the impact of library space factors across different dimensions on readers' reading behavior is examined through descriptive statistical analysis, factor analysis, and regression analysis. [Results/Conclusion] The results indicate that library space equipment, spatial physiological environment, spatial design, spatial psychological environment, spatial activities, spatial vision, spatial services, and spatial network factors exert significant positive promotional effects on readers' reading behavior. Libraries should enhance their capacity to promote user reading through spatial interventions by establishing behavioral norms, controlling adverse factors, strengthening spatial planning, and intensifying spatial marketing.

Full Text

Preamble

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Research on Library Space Promoting Reading from the Perspective of Environmental Behavior Theory: A Sample Survey of Readers Under 50

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Abstract:
[**Purpose/Significance**] By optimizing and reconfiguring the elements in library space that facilitate reading, libraries can promote readers' reading behavior. Analyzing the relationship between library physical space factors and readers' reading behavior provides evidence and reference for related research and practice. [**Method/Process**] Based on relevant theories of environmental behavior studies, this paper proposes propositions and research models for library space promoting reading, and employs descriptive statistical analysis, factor analysis, and regression analysis to examine the impact of different dimensions of library space factors on readers' reading behavior. [**Results/Conclusion**] The results indicate that library space equipment, spatial physiological environment, spatial design, spatial psychological environment, spatial activities, spatial vision, spatial services, and spatial network factors all have significant positive effects on readers' reading behavior. Libraries should enhance their capacity to promote user reading through developing behavioral norms, controlling adverse factors, strengthening spatial planning, and intensifying spatial marketing.

Keywords: library space; reading behavior; environmental behavior theory
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Introduction

In recent years, libraries have been undergoing a transformation from providing reading facilities to creating learning environments. The international library community places great emphasis on leveraging libraries' function as urban third spaces for information exchange and sharing, and values the role libraries play in community education and culture. Providing reading-conducive spaces is also an important reason why libraries maintain their appeal. J.M. Donovan explicitly stated that "library space is an intrinsic facilitator of the reading experience," arguing that libraries' unique collections and environments can promote student reading. Moreover, readers perceive reading spaces through their physical and social characteristics, and certain motivating spatial factors can encourage students to use library spaces and facilities for reading. Some researchers have proposed that "the division between leisure behavior space and reading/study space is an absolute division," and in a group interview study provided descriptions of readers believing that libraries, as dedicated reading spaces and places, can better stimulate reading motivation compared to comfortable environments like home. For example: "I am very grateful for the time and space constraints of the library… mainly because of this special environment completely dedicated to reading" (CZ1); "When I see everyone else in the library space reading and

studying, I will join them" (CZ4).

Research on the relationship between reading environments constituted by space and reading is a key focus area in library and information science. Studies by Li Yining, Wang Zizhou, and Zhang Xiaofang confirmed the hypothesis that "there is a positive correlation between the reading environment of adults and their reading habit formation," treating reading spaces such as AH-Library as one variable affecting adult reading habits. Research on parent-child reading spaces in public libraries in Taiwan also shows that different reading environments affect parent-child reading time, reading willingness, and reading efficiency. Current library new construction and renovation projects featuring knowledge sharing spaces, maker spaces, and digital academic spaces represent bold attempts to expand spatial functions during this transformation period. However, problems have emerged where libraries overly pursue environmental comfort and aesthetics while neglecting the function of library reading environments to promote or motivate reading. Analyzing and sorting out the spatial influencing factors that promote reading during this critical period of advancing nationwide reading provides an important foundation for related practices. Currently, most domestic research on factors influencing user reading behavior focuses on mobile reading behavior and digital reading behavior, with less attention paid to the impact of library space on readers' reading. Existing research results on the relationship among readers, reading behavior, and reading environment have not yet produced effective theoretical outputs and practical guidance. Therefore, this paper proposes propositions and models for library space promoting reading based on environmental behavior theories, and uses questionnaire analysis to study the promoting effect of different dimensions of physical space factors on readers' micro-level reading behavior, thereby providing reference for subsequent research and practice on library space promoting reading.

2 Theoretical Foundation and Model Construction for Library Space Promoting Reading

2.1 Relevant Theoretical Foundation: Environmental Behavior Studies and Related Theories

Environmental behavior studies is a science that investigates the relationship between people and their surrounding physical environment, focusing on environmental and human factors to explore the elements that determine the nature of physical environments and their impact on behavior. The results are applied to behavior regulation through environmental policy, planning, design, and education, and are widely used in research on the relationship and interaction between human behavior and architecture/space. Its basic theories include: (1) Environmental determinism, which holds that environment determines human behavior; (2) Interactionalism, which believes that people can not only passively adapt to the environment but also actively select and utilize environmental elements to produce certain behavioral outcomes; and (3) Transactionalism,

which posits that people's influence on the environment extends beyond mere modification to potentially completely changing the nature and meaning of the environment. Although these basic theories have different emphases, they all recognize the important influence of external physical environments and their spatial elements on human behavior.

A representative view among these schools is that of Academician Li Daozeng from Tsinghua University's Department of Architecture, who argued that human behavior is a response to certain stimuli, which may originate from the organism itself (such as motives, needs, and drives) or from the external environment. Environmental behavior studies developed from environmental psychology, and theories such as arousal theory, stimulus load theory, environmental adaptation theory, ecological theory, situation theory, and space-behavior interaction theory also constitute important theoretical foundations for library space promoting reading research. These theories are characterized by their emphasis on external spatial or environmental factors as independent variables—factors that other studies would typically control and eliminate as extraneous variables—highlighting the role of environmental factors on human behavior. Drawing on Meyrowitz's media situation theory (unique behaviors require unique situations) and Chambers' reading environment theory (reading environment affects reading willingness and habits), we can see that environmental behavior theory's emphasis on human behavior being influenced by external environments aligns with the proposition of space promoting reading. Libraries naturally possess spatial elements that promote reading, and through rational configuration of spatial elements that determine the physical environment, they can create a motivating environment or atmosphere that, to a certain extent, prompts readers' behavioral consciousness to shift toward reading, thereby achieving the goal of library space promoting reading.

Reading itself also falls within the category of behavior. J.B. Watson, the founder of behaviorist psychology, proposed the stimulus-response theory (S-R theory), which states that complex human behavior can be decomposed into two parts: stimulus and response. Human behavior is a reaction to stimuli, which come from two sources: internal bodily stimuli and external environmental stimuli. This theory, together with the aforementioned environmental behavior theories, provides basic theoretical support for the research proposition of library space promoting reading and can guide the construction of the library space-reading behavior relationship model. Therefore, this study constructs a library space reading behavior influencing factors model (hereinafter referred to as the S-R model) based on environmental behavior studies and related theories. The S-R model draws on factor type classifications from related research, summarizing them into factors that directly affect readers and factors that indirectly affect reading through media such as technology, equipment, and services, providing a foundation for establishing the indicator framework for library space reading behavior influencing factors. The "bidirectional arrows" in the model reflect that the relationship between various library spatial factors and readers' reading behavior is one of interactive influence, rather than unidirectional effect.

[Figure 1: see original paper] Library Space Promoting Reading Research Model

Library space promoting reading takes new construction and renovation as opportunities to optimize and reconfigure the elements in library space environments that help promote reading, focusing on leveraging those factors in reading spaces that can directly or indirectly stimulate readers to generate certain reading motivations (such as hierarchy, conformity, social interaction, competition, participation, curiosity, recognition, emotion, attention-seeking, habit, information sharing, and social influence), thereby promoting reading behavior. The intensity of motivation can, to a certain extent, affect the duration, method, and effectiveness of individual reading. The S-R model includes direct influencing factors, which are various environmental information that directly act on readers' brains and are the most easily directly perceived elements for readers in library architectural spaces, including three categories: light/sound/temperature environment, visual environment, and humanistic environment. Indirect influencing factors refer to the convenience and assistance that technology facilities, equipment, collections, and services within the space bring to readers' reading behavior, indirectly acting on psychology to promote reading. For example, many newly built libraries now feature "5G reading spaces," "VR/AR reading spaces," and "smart reading spaces" that can stimulate users' curiosity and experiential motivations, thereby generating reading behavior.

3 Empirical Analysis of Library Space Promoting Reading

3.1 Research Design and Data Collection

This study reviews the research background on library space promoting reading since the 1990s and the environmental behavior theoretical foundation of this proposition, providing evidence and insights for colleagues in the field to understand this issue. To make the research more comprehensive and in-depth, the author used questionnaire surveys, selecting a library in Guangzhou as the distribution point, and with the assistance of library staff, invited readers in the reading spaces to complete paper questionnaires as the data source. The formal questionnaire was developed based on prior interviews with librarians and users, participant observation, literature review, and revisions from the pre-survey phase. The first part of the questionnaire collected basic personal information, and the second part contained a measurement scale for factors influencing readers' spatial reading behavior. Paper questionnaires were distributed and collected from November 8 to December 29, 2019. A total of 368 questionnaires were distributed, and 322 valid questionnaires were recovered, with an effective recovery rate of 87.5%, meeting the requirement that sample size for maximum likelihood data processing should be no less than 200.

The demographic characteristics of the survey participants are shown in Table 1 . As seen in Table 1, all participating readers were under 50 years old. The reasons are: (1) The surveyed library is a newly planned and constructed building located near an industrial development zone, so the user distribution is primar-

ily middle-aged and young people and children. The library's service objects are mostly middle-aged and young readers who tutor their children after school and young readers; (2) Elderly people, due to their physiological and psychological characteristics, tend to choose community branch libraries that are easier to access and more familiar, and most elderly people are not yet aware of routes to the new library; (3) Due to objective reasons such as vision and memory decline, limited education level, and comprehension ability, elderly readers and senior users are unable or unwilling to participate, and dozens of questionnaires they completed had "blank questions" and were classified as invalid.

3.2 Questionnaire Measurement Items and Testing

Environmental behavior theory posits that any behavior occurs within a certain physical environment, and environments that repeatedly produce certain behavior patterns must have factors suitable for that behavior. Therefore, the items in the second part of the questionnaire were designed to construct a framework of factors influencing library readers' reading behavior based on the basic ideas of the S-R model. The framework includes 3 dimensions, 9 variables, and 29 measurement items, which are shown with their descriptive statistical analysis in Table 2 . The questionnaire used a five-point Likert scale, assigning values of 1-5 to the five options of "strongly disagree," "disagree," "uncertain," "agree," and "strongly agree."

3.2.1 Descriptive Statistics of Reader Cognition As shown in Table 2, the descriptive statistical analysis of the 29 measurement items reveals that noise isolation in the library's sound environment, appropriate lighting in the light environment, good ventilation in the visual environment, and clean and sanitary conditions are the top four highest-scoring individual indicators, with mean values of 4.720, 4.608, 4.571, and 4.502, respectively. These four categories also have the largest minimum values and the smallest standard deviations among all options, ranging from 0.523 to 0.543, far below the overall mean standard deviation of 0.781. This indicates that the light, sound, and visual environment dimensions receive highly consistent recognition from readers regarding their role in promoting reading. Next are reading atmosphere, space temperature, and reading location, all scoring above 4.32. The four lowest-scoring indicators are motivational slogans, promotional marketing, listening devices, and reading-aloud devices, with mean values of 3.559, 3.484, and 3.403, respectively. This reflects that while various elements within the library space environment generally play a positive role in promoting reading, the degree of effect varies, requiring libraries to improve and perfect their reading-conducive space environments based on actual conditions.

3.2.2 Reliability and Validity Testing Twenty-nine questionnaire indicators in this study share nearly half the same or related items with the classic "Library Space Impact on Learning Satisfaction Scale," giving it certain credibility. Additionally, the closer the Cronbach's alpha coefficient is to 1, the higher

the internal consistency of the questionnaire and the more stable the measurement results. The Cronbach's alpha reliability analysis of this study's scale yielded a result of 0.902, indicating excellent internal consistency and meeting the reliability prerequisite for factor analysis.

Since some indicators in the library space promoting reading questionnaire were self-constructed, validity testing was also required (see Table 3). According to general evaluation criteria for KMO tests, factor analysis is appropriate when KMO $>$ 0.6. The KMO value obtained for this scale was 0.786, greater than 0.6, indicating suitability for factor analysis. Bartlett's test of sphericity requires significance at P $<$ 0.05, and the test result was far less than 0.05, reaching a highly significant level, allowing rejection of the hypothesis that the matrix of partial correlations is an identity matrix. This indicates that relatively many common factors exist among the questionnaire indicators, making it suitable for exploratory factor analysis.

3.3 Factor Analysis

3.3.1 Total Variance Analysis Principal component analysis was used to analyze the total variance of spatial factors promoting library reading, determining the number of main factors, variance explanation rate, and total explained variance (see Table 4). Table 4 shows that the initial factor solution extracted 29 factors. Based on eigenvalues, 8 factors with eigenvalues greater than 1 can be extracted, with explained variances of 28.106%, 9.547%, 5.802%, 5.057%, 4.887%, 4.600%, 3.775%, and 3.543%, respectively, and a cumulative explained variance of 65.317%. This indicates that these 8 factors jointly explain 65.317% of the total scale information, with relatively good overall exploratory factor analysis results and explanatory effect.

3.3.2 Rotated Component Matrix Principal component analysis with Kaiser normalization and varimax rotation was used to locate the 8 main factors, yielding rotation results (see Table 5), with convergence achieved after 8 iterations. Based on Table 5 and the actual connotations of each factor, the 8 extracted factors were named: Factor 1 involves spatial noise, temperature, air, and lighting, and can be named spatial physiological environment. Factor 2 involves reading promotion, motivation, and activities, and can be named spatial activities. Factor 3 involves reading equipment, listening devices, and collection inquiry equipment, and can be named spatial equipment. Factor 4 includes mobile phone interference isolation, overall reading atmosphere, and reading material accessibility, and can be named spatial psychological environment. Factor 5 focuses on collection arrangement, spatial uniqueness, reading location quantity, and chair/sofa comfort, and can be named spatial design. Factor 6 includes green plant placement, spatial color, and cleanliness, and can be named spatial vision. Factor 7 has high factor loadings on socket quantity/location and wireless network availability, and can be named spatial network. Factor 8 includes thematic book recommendations and librarian

services, and can be named spatial services.

Furthermore, combining the total variance explanation in Table 4 and the component matrix in Table 5, we can see that the overall influence degree of each spatial factor on reader reading varies slightly. The ranking of influence degree is: Factor 3 spatial equipment (3.698) > Factor 1 spatial physiological environment (2.897) > Factor 5 spatial design (2.663) > Factor 4 spatial psychological environment (2.469) > Factor 2 spatial activities (2.344) > Factor 6 spatial vision (1.922) > Factor 8 spatial services (1.837) > Factor 7 spatial network (1.663). Although the number of spatial factors covered by each factor partially determines the total factor score level, this is largely consistent with the aforementioned statistical description results of each specific factor. Regression analysis is still needed to further provide evidence for libraries to identify, differentiate, and explain the influence degree of each factor on reader reading.

3.4 Multiple Linear Regression Analysis

3.4.1 Variance Analysis A multiple linear regression model was introduced:

$$Y_i = \beta_0 + \beta_{1X_{1i}} + \beta_{2X_{2i}} + \cdots + \beta_{kX_{ki}} + \mu_i \quad (i = 1, 2, \ldots, n)$$

where Y = promotion effect index, X_1 = spatial physiological environment factor, X_2 = spatial activities factor, X_3 = spatial equipment factor, X_4 = spatial psychological environment factor, X_5 = spatial design factor, X_6 = spatial vision factor, X_7 = spatial network factor, X_8 = spatial services factor, and i = sample 1, sample 2, …, sample n. Using the spatial promotion of reading effect Y as the dependent variable and the 8 factors X_1-X_8 as predictor variables, variance analysis was conducted, with results shown in Table 6 . The F-value was 24.965, P-value = 0.00, the model passed the F-test, and the variable regression was statistically significant.

3.4.2 Regression Coefficients and Testing The regression coefficients for spatial physiological environment, spatial activities, spatial equipment, spatial psychological environment, spatial design, spatial vision, and spatial services factors were all significant at the 1% confidence level (P < 0.01). The factors ranked by regression coefficient from largest to smallest are: spatial services, spatial vision, spatial activities, spatial equipment, spatial design, spatial physiological and psychological environment factors, with regression coefficients of 0.930, 0.679, 0.678, 0.484, 0.463, 0.354, and 0.313, respectively (see Table 7). This indicates that for each one-unit increase in these factors, the index of promotion effect on reader reading increases by 0.930, 0.679, 0.678, 0.484, 0.463, 0.354, and 0.313 units, respectively. In actual practice, libraries should focus on strengthening spatial services and spatial design according to the input-output ratio of each element to achieve better space-promoted reading effects.

4 Conclusions and Recommendations

The purpose of this study is to theoretically, literature-wise, and data-wise address and answer three questions: Is library space necessary and capable of promoting reading? Which spatial factors can promote reading? How does space promote reading? The findings show: (1) Environmental behavior theory and reader cognition survey results support the promoting effect of library space on readers' reading behavior. Among these, factors such as lighting and noise control in the library's physical environment received highly consistent recognition from readers regarding their promotional effects. The eight spatial factors identified—spatial equipment, spatial physiological environment, spatial design, spatial psychological environment, spatial activities, spatial vision, spatial services, and spatial network—all have positive effects on promoting reading. (2) Regression analysis results show that libraries can achieve different promotional effects by strengthening different spatial factors. The three factors with the highest coefficients are spatial services (0.930), spatial vision (0.679), and spatial activities (0.678). This requires libraries to comprehensively consider both the existing promotional level and development potential of different spatial environmental factors when evaluating their reading spaces. (3) The mechanism lies in: various factors within the library space can form a specific environmental atmosphere, and readers in the space quickly judge the comfort, safety, and privacy of the reading environment through a series of processes including visual scanning, physiological perception, and brain processing, thereby generating or sustaining their reading behavior.

These conclusions have reference value for establishing and improving library space user behavior evaluation indicator systems, and provide reference materials for library space planning and design practices that promote reading, as well as for compiling related spatial standards, norms, and guidelines. Given the current development stage of libraries, a practical issue is how to implement the concept of space promoting reading in old library renovation or new library construction to realize library space that motivates and promotes reading. Therefore, based on the research conclusions, the following four actionable recommendations are proposed:

4.1 Develop Unified and Friendly Library Space Reading Behavior Norms

From the interactionalism and transactionalism of environmental behavior studies, we know that whether a library can provide readers with a reading-suitable and reading-promoting space is not only related to spatial functional layout but also inseparable from other readers' reading behaviors in the library. The S-R model reflects the interactive influence relationship between library space and readers' reading behavior. Mean analysis results also show that the library's humanistic reading environment and atmosphere have relatively high importance scores in promoting reading, all at the 4.5 level, with standard deviations less than 0.64. Libraries developing reader spatial reading behavior

norms and guidelines to educate and regulate related behaviors can prevent and avoid activities in the space that are not conducive to reading. Especially in the questionnaire's open-ended "questions and suggestions" section, readers reflected that children's noise and play, casual chatting and phone answering by readers or librarians cause significant interference and negative impact on reading and reading experience. In addition to general reader guidelines, user manuals, reading prompt sections, and signs, spatial reading behavior norms can also incorporate priority levels and prohibited matters for library space use into the library's "space reservation policy" for readers to follow. Some foreign libraries have detailed usage policies that prohibit photography, eating cooked food or strongly scented foods, etc. Some Chinese university libraries have also developed detailed space usage policies, such as the "Wuhan University Library Study Room Management Measures," "Beijing Normal University Library Research Room Reservation Rules," and "Nanjing University Research Room Use Instructions." These spatial usage norms can provide certain guarantees and guidance for creating reading-promoting spaces.

4.2 Control Adverse Factors Such as Noise and Strong Light in Library Space

Lighting, noise control, and other directly perceivable environmental factors in library architectural spaces are essential foundations for reader reading and important factors affecting reading experience and effectiveness. The study found that noise isolation and appropriate lighting are the two most important indicators, with relatively high scores in statistical descriptive analysis (4.608/4.720) and the smallest cognitive differences (0.536). A study on the nature of sound by the University of South Alabama also confirmed that constructing reading environments with graded sound levels that match human sound acceptance capacity is more conducive to promoting reading activities at different levels. Conversely, noise caused by reading promotion activities, visiting conversations, and improper behavior of librarians during work, as well as harsh light caused by inappropriate spatial decoration materials, reflective furniture, and glass curtain walls without sun shading, can greatly affect readers' reading. Environmental behavior theory also emphasizes that the spatial structure, layout, and nature of the environmental material level can have supportive, inhibitory, or restrictive effects on human behavior. Therefore, on the basis of dividing functional zones such as computer areas, group discussion areas, and silent reading areas, and controlling reader reading space density, libraries can also embed building materials with noise reduction functions in reading rooms and study rooms, such as installing soundproof doors and sound-absorbing panels to isolate external noise. They should also lay sound-absorbing carpets and rubber floors to reduce the volume of footsteps and furniture movement, eliminating all avoidable noise to the greatest extent and creating a space environment conducive to efficient and focused reading.

4.3 Enhance Planning of Library Space Environmental Factors That Motivate Reading

As an important equal, open, and inclusive new type of urban public reading space, libraries' micro-level physical reading spaces and macro-level external social-historical environments and language environments together constitute readers' reading environments. Strengthening the planning of reading-motivating factors to enhance space support and promotion of reader reading helps correct the current practice of some libraries overly pursuing luxurious external architecture and comfortable indoor environments. The study shows that library spatial physiological environment, spatial activities, spatial equipment, spatial psychological environment, spatial design, spatial vision, spatial network, and spatial services all have significant positive effects on readers' reading behavior. The factor with the highest reading promotion effect index is spatial services (0.930). This requires libraries to strengthen position setting, education and training, and clarify responsibilities to improve librarians' spatial operation, management, and service literacy, which is also key to librarian team building and service innovation development in libraries' future 2035 and "14th Five-Year" plans. Under this premise, the most direct method is to strengthen the planning and design of various spatial factors, such as ergonomically designed seats, reasonable spatial reading distances, and suitable lighting, colors, and signage. According to the Yerkes-Dodson law in environmental psychology, the optimal state for performance should be a moderate arousal level—when arousal is above or below the optimal point, performance deteriorates. Therefore, spatial factor design also needs to be reasonably and moderately configured according to certain levels, rather than being 越多越好 (more is better).

4.4 Strengthen Library Marketing Awareness and Methods for Reading Spaces

Environmental behavior science shifts reading research focus from "text reading" to "spatial reading," emphasizing the impact of external spatial environments on readers' micro-level reading behavior. How libraries can leverage space to provide support, motivation, and promotion during the reading process is also a common growth point for current spatial construction innovation and reading service development. Library space marketing can attract readers through a series of spatial reading promotions and is an effective way for library space to promote reading. The aforementioned study's mean analysis of spatial factor S1—librarians conducting reading promotion and marketing activities—also proves that it can promote reading to a certain extent and belongs to the service category of spatial factors with the highest reading promotion effect. Foreign libraries place great emphasis on the logo and signage design and promotion of information sharing spaces, special population reading spaces, and community reading spaces, with more diverse methods. They not only design specialized logos, eye-catching banners, bookmarks, flyers, and posters, and visual promotional materials for online, news, and social media promotion, but also create

an attractive reading environment by positively displaying and placing collection materials and emphasizing the use of visual signage, carpets with unique logos, and special collection identifiers. Using library space marketing to affect readers' reading psychology and exert the role of space in promoting reading is also a necessary path for the high-quality development of current library space services.

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Note: Figure translations are in progress. See original paper for figures.