

Correlation Between Street Space and Tourist Behavior in Tourism-Oriented Traditional Villages Under Distinct Development Models: A Case Study of Yuanjia Village, Shaanxi Province

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Abstract

Tourism development in traditional villages acts as a critical catalyst for local economic development, functions as an essential foundation for the conservation of historical and cultural heritage, and operates as a strategic mechanism for advancing rural revitalization. In recent years, alongside China's rapid economic growth and urbanization, traditional villages have confronted the dual pressures of modernization while simultaneously embracing unprecedented developmental opportunities. Tourism development in traditional villages plays a pivotal role in safeguarding cultural heritage. Leveraging tourists' experiential engagement in traditional villages to achieve the conservation and promotion of historical and cultural heritage under tourism-driven economic frameworks constitutes a critical strategy for the protection and sustainable development of tourism-oriented traditional villages. In the development of tourism-oriented traditional villages, distinct development models exert differential impacts on the functional integration of traditional cultural elements with modern tourism services in village streets and their corresponding spatial configurations, thereby shaping tourists' behavioral characteristics. Investigating this perspective constitutes a critical component in achieving the aforementioned objectives. Current research predominantly focuses on analyzing street space and tourist behavior under singular development models, yet it lacks a holistic exploration of how multiple development models organize the interplay between traditional cultural elements, modern tourism functions, and morphological configurations in tourism-oriented villages, as well as their collective impact on tourist behavior. This study addresses this gap by examining Yuanjia Village in Shaanxi Province, China, with a specific focus on street spaces under three development models: village collective-led development, developer-led development, and village-enterprise cooperative development. It investigates the correlation between the functional complexity and morphological diversity of street spaces and key tourist behavioral metrics—including walking speed, dwell time, and interaction patterns—across these development paradigms. In data collection, street space elements—comprising 13 objective indicators related to the integration of traditional cultural and modern tourism functions, as well as morphological diversity—were assessed through POI data crawling, field surveys, and scoring-based categorization, while behavioral metrics, including tourist walking speed, dwell duration, and interaction patterns, were captured via fixed-point video recordings to construct a composite subjective behavioral index. In data analysis, a multiple regression model was constructed to examine the relationships between tourist behavior and street space elements, enabling a quantitative assessment of the relative impacts of traditional cultural and modern tourism spatial elements on tourist behavior across distinct development models. Leveraging the empirical findings, this study further conducted a granular dissection of the causal mechanisms underlying the interplay between street space configurations and tourist behavior under the three development paradigms, thereby uncovering the nuanced interaction mechanisms inherent to these dynamics. This study applies a systematic analytical framework that integrates both subjective and objective elements, bridging the research void on the interplay between street space organization and tourist behavioral dynamics under multiple development models within an integrated tourism-oriented traditional village. It further delineates how the coordinated organization of multi-modal street spaces can harmonize tourism-driven growth with the safeguarding of cultural heritage. Methodologically, this study introduces a quantitative approach combining fixed-point video recording and POI data crawling, which enhances the comprehensiveness and precision of data acquisition, thereby providing a methodological framework for spatial-behavioral research in tourism-oriented traditional villages.

Keywords: Tourist Behavior; Street Space; Shareholding Cooperative

1. Introduction

In recent years, the Chinese government has introduced pivotal policy documents such as the Guidelines for Promoting Sustainable Rural Tourism Development and the 14th Five-Year Plan for Tourism Development, outlining explicit directives for rural tourism and revitalization. These policies emphasize core principles including "inheriting and promoting outstanding rural culture," "highlighting the cultural distinctiveness of rural tourism," and "preserving rural characteristics." Driven by these initiatives, the rural tourism industry has experienced rapid growth, with substantial capital inflows significantly boosting local economies. However, this capital-driven development model has also generated pronounced negative externalities, notably homogenization issues such as over-commercialization, convergence of development approaches, and redundancy in tourism offerings, ultimately leading to monotonous visitor experiences and the erosion of rural identity. This phenomenon has gar-

nered significant scholarly attention. Early research predominantly focused on the positive economic impacts of tourism, but since the 1960s, scholars have increasingly examined its ecological consequences. The seminal work of Wall and Wright (1977) conceptualized the "tourism environment" as natural ecosystems and rigorously analyzed impact mechanisms, methodologies, and environmental carrying capacities[1]. Subsequent studies expanded these discussions, with recent scholarship prioritizing the balance between economic, environmental, and social outcomes in sustainable development[2]. Notably, research on tourism's socio-cultural impacts has gained momentum, emphasizing resident attitudes, community perceptions, and evolving tourist behaviors—reflecting heightened concerns for cultural heritage preservation and vernacular authenticity[3].

In recent years, China's rural tourism development has exhibited a marked shift toward sustainability and place-based differentiation[4]. Against this backdrop, traditional villages such as Xidi[5] and Hongcun[6] in Anhui Province have garnered significant attention for their unique spatial value and sustainable development models. Academic research has advanced multidimensionally: theoretically, scholars employ the "spatial genome[7]" framework to decode vernacular spatial characteristics; methodologically, studies tracking tourist behavior[8] and emotional perceptions[9] reveal interaction mechanisms between built environments and visitor experiences[10]; and design-wise, innovative concepts such as regional identity integration, scale moderation, and user-need alignment[11] have been proposed. Furthermore, an increasing number of studies are exploring spatial environment design methods from the perspective of tourist behaviour. These studies suggest that tourist behaviour is influenced by a combination of individual tourism purposes, the built environment[12], the social environment[2], social governance[13] and other factors. Scholars have approached this topic from dual perspectives: On one hand, studies analyzing tourists' spatial usage patterns and behavioral activities[14] have elucidated the interplay between built environments and visitor behaviors [15]. On the other hand, research examining behavioral metrics like dwell time, walking speed, and spatial vitality has informed evidence-based design principles for optimizing pedestrian-oriented environments. On the other hand, studies analyzing behavioral metrics such as dwell time, walking speed [16], and spatial vitality [17], alongside their interactions with the built environment, have proposed critical design principles for pedestrian-centric spaces. However, current research exhibits significant limitations: most studies focus on spatial analyses or behavioral observations under irregular development models, lacking systematic comparisons of functional hybridity and morphological diversity across development paradigms. Furthermore, they fail to thoroughly investigate the specific mechanisms through which these spatial characteristics influence tourist behavior. This research gap critically impedes a holistic understanding of the spatial-behavioral interaction mechanisms in tourism-oriented traditional villages.

Building on this foundation, this study selects Yuanjia Village in Shaanxi Province as a representative case. Through POI data crawling and field surveys, we quantified 13 functional and morphological indicators of street spaces under three development models: village collective-led development, developer-led development, and village-enterprise cooperative development. Concurrently, fixed-point video recording technology was employed to document tourist behavioral metrics, including walking speed, dwell duration, and interaction patterns. This integrated approach establishes a hybrid analytical framework that synthesizes subjective behavioral data with objective spatial parameters. This study utilises a multiple regression model to quantitatively analyse the intensity of the influence of street space elements on tourists' behaviours under different development modes and their intrinsic mechanisms. This analysis addresses a research gap concerning the interaction between street space and tourists' behaviours in traditional villages under the background of multi-modal development. The study provides a theoretical basis and a practical guide to the planning and management of tourist-type traditional villages. Methodologically, the integration of POI (Points of Interest) data with video analytics techniques enhances the comprehensiveness and precision of data acquisition, offering novel methodological frameworks for advancing research in this domain. The present study aims to reveal the influence of different development modes on the street space of traditional villages and tourists' behaviours. To this end, the functional organisation and morphological characteristics of the street space under the three development modes will be systematically examined, and their correlation with tourists' behaviours will be analysed. The study will provide a scientific basis for balancing the cultural protection and economic benefits in the development of tourism to promote the sustainable development of traditional villages.

2. Study area and target audience

Yuanjia Village, situated in Liquan County, Xianyang City, Shaanxi Province, constitutes the second group of traditional villages to be included in the Chinese traditional villages list. It is a natural village with a long history in Guanzhong, Shaanxi Province. Yuanjia Village has a significant number of tourists. As of 2023, Yuanjia Village has witnessed annual tourist visits exceeding 8 million, with its total annual tourism output value surpassing 1.2 billion Chinese yuan[18], establishing itself as one of the villages in Shaanxi Province with the most consistent visitor numbers throughout the year. The year-on-year growth in tourist visits and tourism revenue demonstrates that Yuanjia Village has emerged as a representative case of traditional villages achieving successful tourism-oriented transformation. The substantial visitor influx provides robust support for data collection on visitor behavior. Furthermore, the spatial configuration of Yuanjia Village's streets and alleys has evolved organically alongside the village's developmental trajectory. Notably, the tourism-oriented street spaces originated from early initiatives by the collective shareholding cooperative, particularly the Snack Street (XC) and Kangzhuang Street (KZ). The sustained year-on-year growth in tourist visits and tourism revenue positions Yuanjia Village as a paradigmatic case of traditional villages achieving successful tourism-oriented transformation. The substantial visitor base provides a robust empirical foundation for behavioral data collection, while the spatial evolution of its street network reflects adaptive development aligned with phased growth strategies. Specifically, the tourism-oriented street system originated from early-phase initiatives led by the collective shareholding cooperative, including the Snack Street (XC) and Kangzhuang Street (KZ). This developmental trajectory progressed to an intermediate phase characterized by land lease agreements to address financing constraints, enabling external developers to independently construct heritage-themed commercial spaces such as Sanqin Ancient Street (SQ). The later phase witnessed collaborative developments between the village collective and external developers, yielding culturally hybrid spaces such as the Academy Street (SY), Hui Muslim Cultural Street (HM), and Ancestral Hall Street (CT). The collective shareholding cooperative model, unique to rural tourism street development, exhibits distinctive spatial production characteristics and operational mechanisms that diverge fundamentally from urban development paradigms. In contrast, the developer-led model epitomizes conventional urban development approaches, often plagued by homogenization and unsustainable overexploitation of cultural resources. The joint venture development model embodies hybrid urbanization characteristics, reflecting a coordinated approach that integrates rural-urban spatial governance. Accordingly, this study conducts an empirical investigation across six street spaces representing Yuanjia Village's three development models (Figure 1). Tourists across these streets were selected as study subjects, with spatial metrics including architectural interfaces, pedestrian flows, and cultural signage systematically documented and statistically analyzed. This study focuses on examining street spaces under distinct development models in Yuanjia Village. Within its physical built environment, these three models are interwoven, with each manifesting unique spatial configurations, operational mechanisms, and visitor engagement patterns that collectively shape heterogeneous experiential landscapes. Analyzing variations in visitor experiences holds critical implications for evaluating and reflecting on existing built environments, offering empirical insights and transferable frameworks for implementing moderate tourism development strategies in traditional villages.

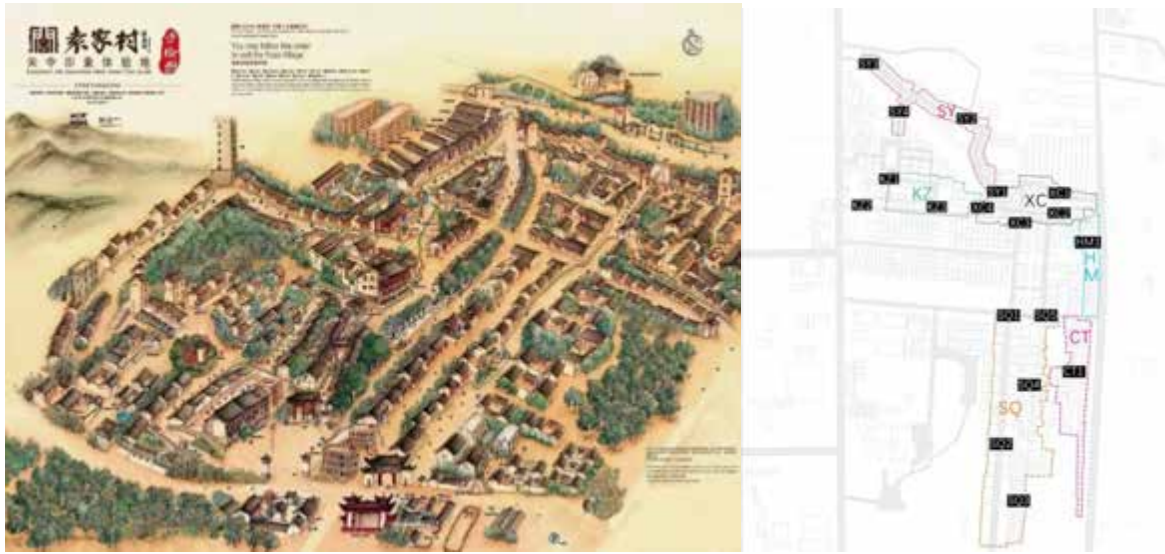


Figure 1 Yuanjia Village Illustrated Map (Left: Source: Yuanjia Village) and Key Street Plan(Right: Source: Author)

3. Research Methods

This study employs Yuanjia Village in Shaanxi Province as a case study, integrating fixed-position video recording with POI data analysis to systematically examine the dynamic interplay between street spatial configurations and visitor behavior patterns across three distinct development models: collective shareholding cooperative development, developer-led independent development, and joint venture collaborative development (as illustrated in Figure 2). The data collection protocol involved selecting representative streets under different development models within the core tourist area as observation sites. Between August and October 2024, video recording sessions were systematically conducted across weekdays and holidays using temporal segmentation (09:00-13:00; 13:00-17:00). Each observation site captured 5-10 minute behavioral episodes sampled hourly, ensuring temporal validity and comprehensive coverage of activity patterns. Video analytics were employed to extract behavioral metrics including pedestrian walking speed (calculated via fixed-distance traversal time), dwelling duration, and interactive acts such as consumption behaviors, photo documentation, and scenic observation. Concurrently, through the integration of POI data scraping and field investigations, thirteen quantitative indicators were systematically assessed to characterize the functional composition, environmental performance, and morphological patterns of street spaces. The analytical framework incorporates multiple regression modeling to quantify the influence of spatial metrics on behavioral characteristics, complemented by comparative analysis to unravel the mechanistic variations across distinct development paradigms. This research pioneers the integration of behavioral observation and spatial quantification methodologies, establishing an empirical foundation for spatial optimization in traditional village tourism development while also advancing a transferable methodological framework for related interdisciplinary studies.

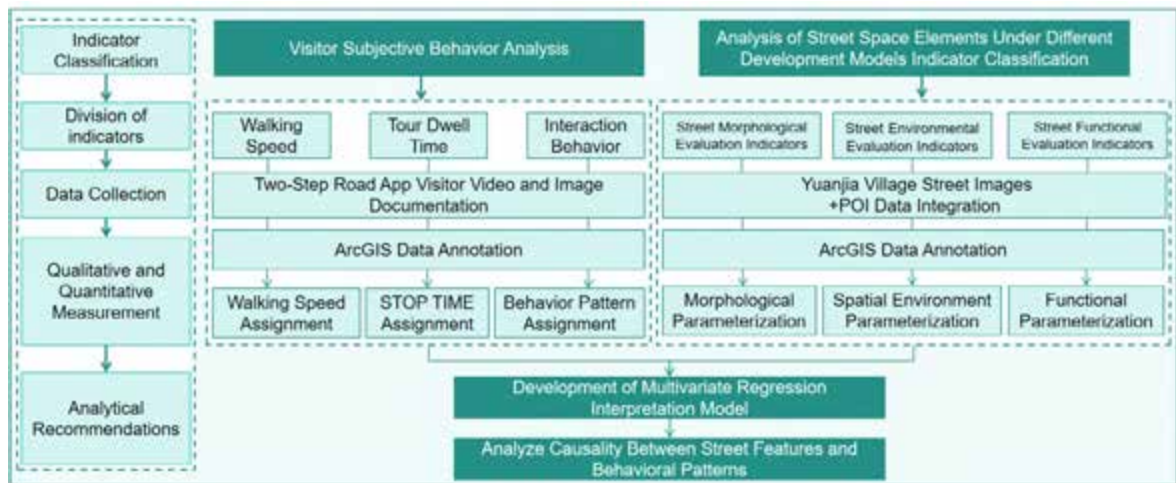


Figure 2 Methodological Framework

3.1 Construction of Perceptual Behavioral Metrics for Visitors

3.1.1 Assigning values to visitors' walking speed, length of stay and interaction pattern indicators

The post-processing of video recordings combined with crowd analytics yielded three principal behavioral metrics: walking speed (S), dwelling duration (D), and interaction patterns (J). Walking speed was categorized as slow pedestrian movement (<0.8 m/s), moderate pace (0.8–1.2 m/s), and accelerated transit (>1.2 m/s). Dwelling duration thresholds were defined as short-term stays (0–5 minutes), medium-term engagement (5–10 minutes), and prolonged occupation (10 minutes). Interaction patterns were quantified through proportional distributions of activity typologies across street segments, including commercial transactions, cultural engagements, and social congregation behaviors. The statistical outcomes of walking speed (S), dwelling duration (D), and interaction patterns (J) were systematically categorized and ranked using the Natural Breaks (Jenks) classification method. This analysis accounted for spatial heterogeneity across distinct street segments and temporal variations between morning and afternoon periods. A weighted ordinal scoring system (1, 3, 5, 7, 9) was applied to quantitatively characterize behavioral-spatial correlations, with values calibrated through iterative field validation cycles to reflect empirical observations of pedestrian-environment dynamics.

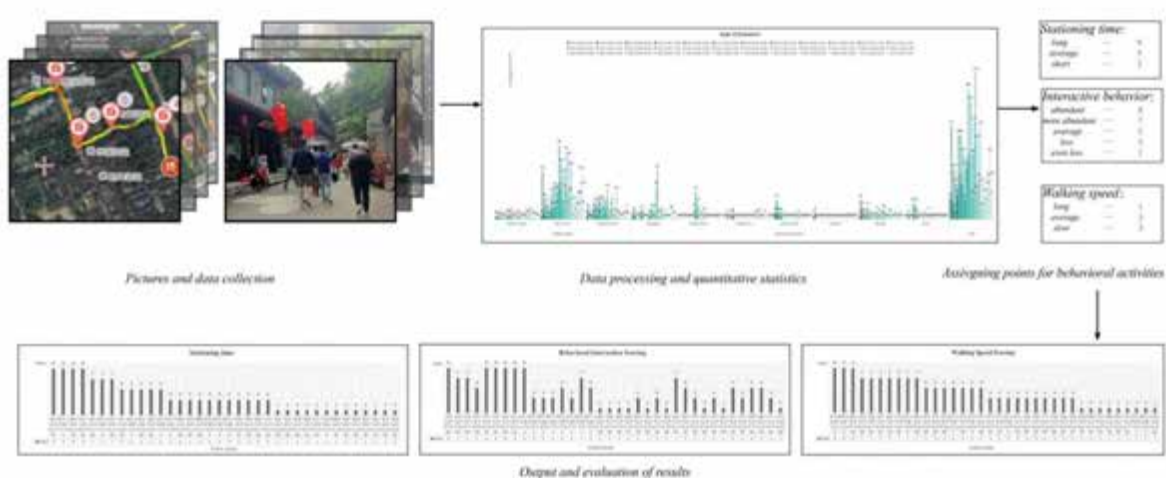


Figure 3 Behavioural and spatial data collection processes

3.1.2 Aggregate Subjective Behavioural Characteristics Index of Tourists

The composite subjective behavioural profile index (P) of tourists was influenced by walking speed (S), dwell time (D), and interaction mode (J). The amalgamation of the tourist interviews and the extraction of the subjective perception weights of these three factors ($\beta_1 = 0.18$, $\beta_2 = 0.35$, and $\beta_3 = 0.47$) resulted in the formulation of a formula for calculating the subjective behavioural index (see Equation 1). This subjective behavioural score was then used to correlate to the POI crawl points. It is evident that elevated scores on the Subjective Behavioural Characteristics Index (P) are indicative of enhanced behavioural dynamism, thereby signifying that visitors encounter a more positive experience in the village's street and shop environments.

$$P = \beta_1 * S + \beta_2 * D + \beta_3 * J \quad (1)$$

3.2 Indicators of spatial environment elements in streets

In this study, the work of Xu Leiqing [14], Zhang Zhang [8], Long Ying [20] and other experts in the field of street index measurement systems is referred to, in addition to the research group [9] in the Yuanjia Village street spatial elements of the system based on the proposed spatial elements of the index for the different development modes. In consideration of the aforementioned references and the premise of data availability, the indicators affecting the evaluation of street characteristics are classified into three major categories and 13 subcategories (see Figure 4). The first element to consider is the street spatial morphology, which includes the street width, street morphology, morphology scale, height-to-width ratio, and openness, amongst other factors. The second element is indicators of the street environment category, including street furniture and the green water system. The third element is indicators of the street functionality category, including the catering function, the entertainment function, leisure shopping function, attraction function, and accommodation function of the locality.

Category	Indicators	Label Name	Description	Scoring
Morphological Indicators	Overall Spatial Form (Length-Width Ratio)	CKB	Linear street form	1 (Linear Type)
			Enclosed street form (tending to cluster)	3 (Cluster-Leaning Linear)
			Independent clustered space	5 (Cluster Type)
	Single Store Scale	GM	Floor area $\leq 100 \text{ m}^2$	1 (Small Floor Area)
			Floor area $> 100 \text{ m}^2$	3 (Large Floor Area)
	Distinctive Features	TSFM	Modern urban style, non-local materials	1 (Weak Distinctiveness)
			Guangzhong rural characteristics, locally sourced materials	3 (Strong Distinctiveness)
			Average building height / street width: ≥ 2	1 (Weak Enclosure)
	Height-to-Width Ratio	GKB	Average building height / street width: 1-2	3 (Medium Enclosure)
			Average building height / street width: 0-1	5 (Strong Enclosure)
Environmental Indicators	Interface Openness	OD	OD = Open length / Total interface length: 0-0.25	1 (Compact Interface)
			OD = Open length / Total interface length: 0.25-0.5	3 (Moderate Interface)
			OD = Open length / Total interface length: 0.5-0.75	5 (Open Interface)
	Modern Street Furniture	ZYBD	Street furniture (tables, chairs, sunshades, etc.)	1 (None)
				3 (Available)
	Local Characteristic Furniture	DYTSBS	Traditional items (millstone, roller, oil press, etc.)	1 (None)
				3 (Available)
	Landscape Environment	JGSX	Water features, greenery	1 (None)
				3 (Available)
	Functional Indicators	Dining Function	CYGN	Diverse foreign cuisines (Korean, Western, desserts, etc.)
Local specialty cuisines (noodles, spicy noodles, dumplings, etc.)				3 (Available)
Entertainment (Gaming Experience)		YLGX	Foreign entertainment (haunted houses, amusement parks, live-action CS, etc.)	1 (None)
			Local experiential activities (tea drinking, opera, etc.)	3 (Available)
Leisure & Shopping Function		XXGW	Foreign goods (accessories, toys, general merchandise, etc.)	1 (None)
			Local specialty goods (chili powder, yogurt, tofu, sesame twists, etc.)	3 (Available)
Scenic Tourism Function		JDLY	Modern artificial attractions	1 (None)
			Historical-cultural attractions (Temple of Wealth, Guanyin Temple, Qin Qilong Tomb)	3 (Available)
Accommodation Function		ZSGN	Foreign modern lodging (large hotels)	1 (None)
			Local characteristic lodging (Guangzhong-style hotels, designer B&Bs, rural homestays)	3 (Available)

Figure 4 Indicators of the spatial environment elements of streets and description of the assigned values

4. Result

4.1 The analysis of visitor behavioral characteristics derived from empirical data collection

This study employs temporal-spatial sampling analysis of visitor behavior video data from Yuanjia Village (10:00-13:00 and 13:00-17:00 daily, with hourly sampling of 5-10 minute segments), yielding 1,112 valid visitor trajectories through behavioral recognition algorithms and manual verification. The data reveals pronounced disparities in visitor distribution across streets with distinct development models: Collective Shareholding Cooperative-led Food Streets demonstrated the strongest visitor attraction, accounting for 47.3% of total footfall. Collaborative Development Streets (SY/CT/HM) collectively captured 27.4% of visitor flows. Developer-operated Heritage Commercial Street (SQ) showed the lowest engagement at 25.3%, indicative of potential cultural authenticity dilution in externally managed spaces. With regard to behavioural characteristics, the movement status data of 755 visits revealed the walking rate characteristics, while the stopping status data of 357 visits (see Figure 5) was used to analyse the length of stay and interactive behavioural patterns (see Figure 6). This data collection scheme lays a solid empirical foundation for subsequent in-depth analysis of tourist behavioural characteristics. Statistical analysis of visitor behavioral data in Yuanjia Village reveals distinctive patterns across three dimensions: walking speed, dwelling duration, and interactive behaviors. Regarding locomotion metrics, Snack Street (XC/KZ) exhibits the highest proportion of slow-paced pedestrians ($\leq 0.8 \text{ m/s}$: 10.5%), significantly exceeding Sanqin Ancient Street (SQ: 5.1%) and collaboratively developed streets (SY/CT/HM: 5.4% combined). Notably, SQ demonstrates an exceptional prevalence of rapid pedestrian movement ($> 1.2 \text{ m/s}$: 8.9%), far surpassing the global average (1.7%), while collaborative development streets display polarized speed distribution ($\leq 0.8 \text{ m/s}$: 23% vs. $> 1.2 \text{ m/s}$: 1.7%). In temporal engagement patterns, Snack Street achieves superior visitor retention (69.27% dwell ≥ 10 minutes),

streetscape elements under distinct development models. Field-derived spatial metrics were quantified using a weighted scoring system calibrated via the Natural Breaks (Jenks) classification method. Following Equation (2), statistical modeling was conducted in SPSS (v26.0) to assess the impact of street indicators on visitor behaviors:

$$E_n = \beta_0 + \beta_1 * CKB + \beta_2 * GM + \beta_3 * TSFM + \dots + \beta_{13} * ZSGN + e \quad (2)$$

Where, E_n is the relationship between the subjective behaviour index and the street index under the three development modes (E_1 represents the independent development mode of the developer; E_2 represents the cooperative development mode of the village collectives and the developer; E_3 represents the development mode of the village collective share cooperatives). β_1 - β_{13} are the regression coefficients Beta, β_0 is the constant term, and e is the error term.

After establishing the multiple regression models for the three development models, the overall tolerance values were all greater than 0.1, indicating that there was no covariance; the models D-W met the data independence requirements (Table 1); and the three models were statistically significant as detected by ANOVA analysis (Table 2).

Combined with Table 3 Behavioural and spatial data collection processes, this can be illustrated by the analysis of the spatial correlation between the composite behavioural index E and the three types of streets:

(1) The currently constructed indicators of spatial elements of streets have an impact on the subjective behaviour of tourists, but the degree of influence is not high enough. The regression model we constructed has a high R^2 value and fair interpretability. It can be shown that the currently constructed spatial elements influencing tourists' subjective behaviours are more appropriate. Subsequently, more street spatial elements can be added to enrich the influence factors, and on the other hand, research can be carried out on other dimensions affecting tourists' behaviour.

(2) The spatial analysis of the developer-independent development model street shows that the JGSX element has the most significant impact on the perception of tourist behaviour (Beta=0.366), followed by the ZYBD element (Beta=0.096). This finding is at variance with established research, verified by field observation that the landscape water system area does effectively promote tourists to stay and rest, while the influence relationship of other morphological and functional elements is relatively ambiguous. It is worth noting that exotic goods shopping (XXGW) and attraction tourism functions (JDLY) also show high influence, and the research data show that such functions have special attraction to children groups (participation rate of 78%), while adult tourists mainly play the role of accompanying. Most alarmingly, the shop size element (GM) showed a significant negative effect (Beta = -0.763), indicating that too large a shop area would undermine tourists' perception of the appropriate scale of the countryside, a finding that is highly consistent with the results of the spatial experience assessment. In the street space of the cooperative development model between village collectives and developers, the recreational function element (YLGX) has the most prominent influence on tourist behaviour (Beta=0.719), followed by the ZSGN element (Beta=0.635). Meanwhile, the neighbourhood business (ZYBD) and attraction tourism function (JDLY) also showed moderate influence. However, the catering function element (CYGN) produced a negative effect (Beta=-0.294), and in-depth analyses revealed that the catering business operated by multiple small developers under this model lacked regional characteristics, resulting in lower satisfaction with the visitor experience. This phenomenon confirms the importance of localised operations in rural tourism development.

(3) In the street space of the village collective share cooperative development mode, the open space design element (OD) has the most significant influence (Beta=0.723), especially the open space in the east entrance area can effectively promote tourists to stay and take photos. The speciality food and beverage element (CYGN) also showed strong influence (Beta=0.527), contrasting with the other two development patterns. Further analysis reveals that the separate block space element (CKB) significantly lengthens visitors' dwell time and increases the frequency of interactive behaviours through the creation of a meandering touring dynamic line in conjunction with the featured snacking function. The successful practice of this model fully demonstrates the value of

synergistic optimisation of spatial form and territorial function. (3) In the street space of the village collective share cooperative development model, the influence of the open space design element (OD) is the most significant ($\text{Beta}=0.723$), especially the open space in the east entrance area can effectively promote tourists to stay and take photos. The speciality food and beverage element (CYGN) also showed strong influence ($\text{Beta}=0.527$), contrasting with the other two development patterns. Further analysis reveals that the separate block space element (CKB) significantly lengthens visitors' dwell time) and increases the frequency of interactive behaviours through the creation of a meandering touring dynamic line in conjunction with the featured snacking function. The successful practice of this model fully demonstrates the value of synergistic optimisation of spatial form and territorial function.

(4) In summary, the index system of street spatial elements constructed in this study demonstrates good explanatory power, especially the successful identification of key influencing elements under different development modes. The research findings not only provide empirical evidence for rural tourism spatial planning, but also highlight the importance of synergy between the elements of regional characteristics and spatial form design. It is suggested that the follow-up study can be carried out in two aspects: firstly, to expand the indicators of spatial factors, especially to increase the influencing factors of socio-cultural dimensions; secondly, to carry out a longitudinal tracking study to examine the characteristics of the influence of the factors in the temporal order of change.

Table 1 Model summary

Model	R	R ²	Adjusted R ²	Standard Skewness Error	Durbin-Watson
E1	0.803a	0.645	0.131	1.44501	1.602
E2	0.646a	0.417	0.188	1.108	2.548
E3	0.984a	0.899	0.826	0.85896	1.817

a. Predicted value: (constant), TSFM, GKB, YLGN, GM, OD, ZYBD, DYTSBS, XXGW, CKB, JGSX, JDLY, CYGN, ZSGN

b. Dependent variable: P

Table 2 Analysis of variance (ANOVA) a

Model	Sum of Squares	df	Mean Square (MS)	F	Significance
Regression	34.082	13	2.622	1.256	0.374b
E1 Residuals	18.793	9	2.088		
Statistics	52.875	22			

E2					
Regression					
29.022					
12					
2.232					
1.819					
Residuals	40.496	33	1.227		
Statistics	69.518	46			
Regression	117.912	13	9.07	12.293	0.000b
E3 Residuals	13.281	18	0.738		
Statistics	131.193	31			
a. Predicted value: (constant), TSFM, GKB, YLGN, GM, OD, ZYBD, DYTBSBS, XXGW, CKB, JGSX, JDLY, CYGN, ZSGN					
b. Dependent variable: P					

Table 3 The relationship between tourist perception and street space elements under three development modes

Model B	Unstandardized Coefficients		Standardized Coefficients	T	Significance
	Standard Error	Beta			
(constant)	7.379	2.679		2.755	0.022
DYTBSBS	-0.895	0.489	-0.447	-1.830	0.101
JGSX	0.554	0.463	0.336	1.197	0.262
ZYBD	0.215	0.556	0.096	0.387	0.707
CKB	-0.779	0.791	-0.389	-0.985	0.350
GM	-1.256	0.416	-0.763	-3.016	0.015
GKB	-0.043	0.345	-0.033	-0.126	0.903
TSFM	-0.107	0.629	-0.040	-.170	0.869
OD	-0.896	0.897	-0.241	-0.999	0.344
CYGN	-0.714	0.612	-0.449	-1.168	0.273
YLGN	-0.582	0.493	-0.291	-1.181	0.268
XXGW	0.185	0.539	0.092	0.343	0.739
JDLY	0.206	0.897	0.092	0.230	0.823
ZSGN	0.019	0.973	0.010	0.020	0.985

E_2	(constant)	3.849	1.865		2.064	0.047
	DYTSBS	0.432	0.366	0.291	1.181	0.246
	JGSX	-0.317	0.303	-0.261	-1.045	0.303
	ZYBD	-0.082	0.318	-0.057	-0.257	0.798
	CKB	0.262	0.425	0.201	0.616	0.542
	GM	-0.216	0.264	-0.137	-0.818	0.419
	GKB	0.016	0.237	0.014	0.069	0.945
	TSFM	-1.534	0.680	-0.248	-2.256	0.031
	OD	-0.297	0.297	-0.207	-1.000	0.324
	CYGN	-0.383	0.362	-0.294	-1.058	0.298
	YLGX	1.033	0.570	0.719	1.811	0.079
	XXGW	0.308	0.320	0.244	0.963	0.343
	JDLY	0.237	0.239	0.194	0.989	0.330
	ZSGN	0.795	0.469	0.635	1.695	0.099
E_3	(constant)	-4.452	1.605		-2.774	0.013
	DYTSBS	0.066	0.357	0.026	0.186	0.855
	JGSX	0.122	0.251	0.062	0.487	0.632
	ZYBD	0.991	0.291	0.324	3.411	0.003
	CKB	0.932	0.398	0.452	2.341	0.031
	GM	0.481	0.367	0.236	1.309	0.207
	GKB	-0.184	0.119	-0.157	-1.540	0.141
	TSFM	1.301	0.472	0.311	2.759	0.013
	OD	1.127	0.233	0.723	4.842	0.000
	CYGN	-1.470	0.591	0.527	-2.487	0.023
	YLGX	0.208	0.306	0.089	0.680	0.505
	XXGW	-0.919	0.449	-0.375	-2.045	0.056
	JDLY	0.216	0.208	0.099	1.043	0.311
	ZSGN	0.728	0.464	0.297	1.570	0.134

5. Discussion

5.1 Analysis of the environment and behaviour of the developer-independent development model

Launched around 2010, the developer's independently developed SQ Street adopts a typical urbanisation development pattern, presenting the following characteristics: in terms of the physical environment, the uniform building materials and construction pattern form a large-scale frame structure (building height of 12-15 metres), resulting in a serious homogenisation of the street space (similar shop sizes and repetitive functions); in terms of the spatial form, the 400-metre-long rectilinear layout. In terms of spatial form, the 400-metre-long rectilinear layout, together with the street aspect ratio of 0.83-1.16 (the widest being 8.88 metres and the narrowest 4.7 metres), conforms to the theoretical comfort zone, but due to the lack of local characteristic elements and rest nodes (the interface spaciousness value is only 0.16), the actual experience is monotonous and tedious. Behavioural data show that this development mode has brought significant negative impacts: visitors' walking rate is significantly accelerated (>0.8m/s accounted for 24%, much higher than other types of streets), the type of interactive behaviour is the most homogeneous (reduced by 58% compared to the collective model of the village), and stopping to watch and experience activities have almost disappeared. The reason for this is that the developer is only responsible for the construction of the house without participating in the later operation and

management, leading to serious competition in homogenisation of the industry (72% duplication rate with the existing business in the village), which not only destroys the original vernacular landscape, but also fails to form an effective commercial synergy effect. This purely commercialised development model of 'build-and-sell' has ultimately created a 'dilemma' space that lacks both rural characteristics and urban commercial vitality, providing an important case for reflection on traditional village tourism development.

5.2 Behavioural analysis of the co-development model between village collectives and developers

Although HM, CT, and SY Streets were developed in partnership between the Village and the developer between 2012 and 2016, the spatial construction still has the developer's uniform housing pattern, which is constructed using homogeneous brick-variegated antique structures, and the functional division of the housing is homogeneous due to the constraints of the construction space. The functionality of the street is intermediate between the functions of the two development modes. The business types in this part of the street are a mix of snacks from Guanzhong and other parts of the country, but the participation of local villagers is low and mostly in the form of recruitment. The SY Street and CT Street (including shops of gold and silver jewellery, ceramic bottles and porcelain, milk tea and beverages, cultural and creative toys, etc.) It is an exhibition of all kinds of gourmet products and raw materials processed and sold in factories across the country, and the commodities and spaces are uniform, forming a single commercial function. Tourist behavioural interactions were not only homogeneous but also produced a low number of types. In particular, visitors to CT1 not only stayed for a short period of time but also had fewer interactive behaviours. Secondly, the overall spatial intensification and sense of place of HM, CT and SY Streets, which were developed by the village collectives in cooperation with the developers, did not result in a large number of interactive behaviours and stops by tourists as in the case of XC and KZ Streets.

5.3 Environmental and Behavioural Analysis in the Village Collective Share Cooperative Model

Yuanjia Village has successively set up eight workshop co-operatives since around 2012, including oil workshop, tofu workshop, yoghurt workshop, chili workshop, mash workshop, vermicelli workshop, vinegar workshop and flour workshop, and the operators of these co-operatives, all of whom are craftsmen imported from the neighbouring villages and towns, have been gradually integrated into the tourism development and social life of Yuanjia Village. The deep localisation of commercial functions has been realised, and this composite mode of development has enabled XC Street and KZ Street to display significant environmental advantages: in terms of spatial form, the curved and folded street layout of the 'zigzag shape' (different from linear streets such as SQ Street), together with the distinctive spatial organisation of the 'shop in front and factory at the back' not only optimise the visitors' gastronomical experience of the dynamic line, but also promote the natural slowing down of walking speed; in terms of interface design, the eastern entrance is green, and the eastern entrance is green, with a green area on the east side of the street, which is the most beautiful. In terms of interface design, high openness areas such as the green landscape at the east entrance (KZ3) and the open space for tea breaks (XC4) provide material carriers for visitors' gathering and interactive behaviours. Behavioural data show that the frequency of visitor interaction in the XC1 (13:00-17:00) and XC2 (10:00-13:00) areas is significantly higher than that in the other streets, with the highest proportion of behavioural types focusing on snack tasting and photo-taking. This organic spatial form formed by villagers' independent deliberation avoids the standardised drawbacks of the foreign development model, and ultimately presents a quality experience effect with the richest variety of interactive behaviours (32% more than the cooperative/independently developed streets), and the longest length of stay of the tourists (on average, 40% longer than that of the other streets), which confirms the unique value of the localised development model in preserving the characteristics of the villages and enhancing the quality of the tourists.

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of spatial form, the curved and zigzag street layout in the shape of a zigzag (as opposed to linear streets such as SQ Street), together with the characteristic spatial organisation of a 'shop in front and a factory at the back' not only optimise the dynamic line of the visitor's culinary experience, but also promote the natural slowing down of the walking speed; and in terms of interface design, highly open areas such as the green landscape at the eastern entrance (KZ3) and the open space for tea breaks (XC4) provide material carriers for visitor gathering and interactive behaviours. In terms of interface design, high openness areas such as the green landscape at the east entrance (KZ3) and the open space for tea breaks (XC4) provide material carriers for visitors to gather and interact with each other. Behavioural data show that the frequency of visitor interaction in the areas of XC1 (13:00-17:00) and XC2 (10:00-13:00) is significantly higher than that of the other streets, with the highest percentage of behavioural types dominated by snack tasting and photo taking. This organic spatial form formed by villagers' independent deliberation avoids the standardised drawbacks of the foreign development model, and ultimately presents a quality experience effect with the richest variety of interactive behaviours (32% more than the cooperative/independently developed streets), and the longest length of stay of the tourists (on average, 40% longer than that of the other streets), which confirms the unique value of the localised development model in preserving the characteristics of the villages and enhancing the quality of the tourists.

In summary, the empirical analysis of the three modes of tourism development in Yuanjia Village yielded the following important findings in terms of the two dimensions of spatial environment characteristics and tourists' behavioural responses (Figure 7). First, the development mode led by the village collective joint-stock cooperative shows significant advantages, as its characteristic functional configuration (eight local workshops), intensive spatial form (the 'back' layout), and rich rural environmental atmosphere together shape the spatial characteristics of the streets and lanes in a 'small but exquisite' way, which encourages tourists to form a slow tour, a long stay, and a rich and interactive behavioural pattern. Secondly, the developer-independent development mode shows the opposite characteristics, with standardised functional configuration, low intensive spatial form and a weakened sense of rural environment, forming a 'big and wide' spatial interface without special features, which leads to the behavioural characteristics of tourists' quick passage, short stay and limited interaction. It is worth noting that the model of cooperation between the village collective and the developer shows an intermediate state, although the functional configuration has certain characteristics (integration of Guanzhong and national snacks), but due to the lack of spatial form intensification (uniform antique structure) and insufficient environmental creation, the visitors' behaviours are characterized by the transition of medium-speed visits, short stays, and medium interactions. The comparative analysis of these three models clearly reveals the mechanism by which the choice of development model influences the quality of the spatial environment and then significantly regulates the characteristics of tourist behaviour, providing an important typological reference for rural tourism spatial planning.

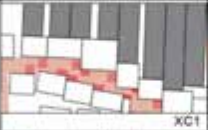
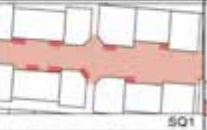
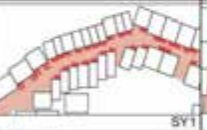
Spatial environment and behavior characteristics of street					
Development mode	Village collective cooperative mode	Developer independent mode	Village collective and developer cooperation mode		
Name of street	Xiao Chi Street/Kang Chong Street	San Qin Ancient Street	Shu Yuan Street	Ci Tang Street	Hui Min Street
Functional configuration	High functional features	Low functional features	Low functional features	Relatively high functional features	High functional features
Combination of morphology	Intensification is high	Low intensity	Less intensive	Intensification is higher	Intensification is higher
Space environment	stronger	weak	weaker	weaker	weaker
Walking rate	slow	fast	faster	faster	slower
Time of stop	long	short	shorter	shorter	longer
Interaction behavior	more	less	less	less	more
Part of the street space schematic					
					
Legend: Street  Shop  Factory  Commercial facilities 					

Figure 7 Spatial and Behavioural Characteristics of Streets under Different Development Patterns

5. Concluding remarks

China's rural tourism is in a stage of rapid development, but the destruction of rural landscape brought about by large-scale development and construction is often irreversible. Through a comparative analysis of the three development modes of Yuanjia Village, this study finds that the current mainstream blueprint planning (including the developer-led mode) is difficult to be effectively adjusted after completion due to the short construction period and large investment; while the villagers' self-organised incremental development mode demonstrates a significant dynamic adaptability advantage, which is able to continuously optimise the spatial layout and configuration of the industry according to the actual demand. It is worth noting that China has not yet established a perfect normative system for the construction of tourist-type villages, which directly leads to the lack of regional characteristics and spatial homogenisation (the duplication rate of SQ Street's businesses in this study is as high as 72%).

This study takes the built street space under different development modes in the countryside as the object, and constructs 13 objective element indicators in three aspects of street environment, function and form elements. Combined with the behavioural characteristics, we recorded the walking speed, length of stay and interaction mode of tourists through the video fixed-point filming, and constructed the comprehensive subjective behavioural characteristics indicators. The multiple regression model is used to analyse the influence between physical and spatial elements and behaviours under different development modes, and to analyse the reasons. The empirical evidence shows that intensive spatial patterns can increase tourists' interactive behaviours, regional characteristic functional layouts can enhance tourists' motivation, while excessive homogeneous spatial divisions can limit the diversity of tourists' behavioural activities. These findings provide important insights for rural tourism planning: firstly, a development model dominated by regional characteristics and moderately commercialised should be established; secondly, differentiated spatial modules should be designed for different types of tourists - for the gourmet tasting area, it is recommended to adopt a 'zig-zag' layout (with an openness of 0.4-0.6) and to install street furniture (spacing of 5-8m) to enhance the stay behaviour (Figure 8); for the recreation and leisure area, it is possible to arrange homogeneous spaces with a larger scale of division to facilitate the organisation of small open space functions; or multiple homogeneous group spaces can be combined into a larger space that can provide a variety of recreational possibilities. On the other hand, Yuanjia Village XC Street and KZ Street innovatively adopt the spatial organisation mode of 'shop in front and factory at the back' (Figure 9), which realises the industrial mode of 'integration of the three industries and local development' by integrating

the raw materials of agricultural products from the surrounding areas (from the neighbouring villages and Yixia Town, etc.), and then directly displaying them for sale after they are processed and produced in the village. This organic spatial combination of 'factory-shop-street' (represented by vinegar workshop, oil workshop, etc.) not only reconfigures the production and consumption space of traditional villages, but also significantly improves the enthusiasm and interactive experience of tourists. This study not only provides a quantitative basis for the spatial planning of rural tourism, but also points out the direction for the improvement of the construction evaluation and feedback mechanism, which is of great theoretical and practical value for the promotion of the sustainable development of rural tourism.

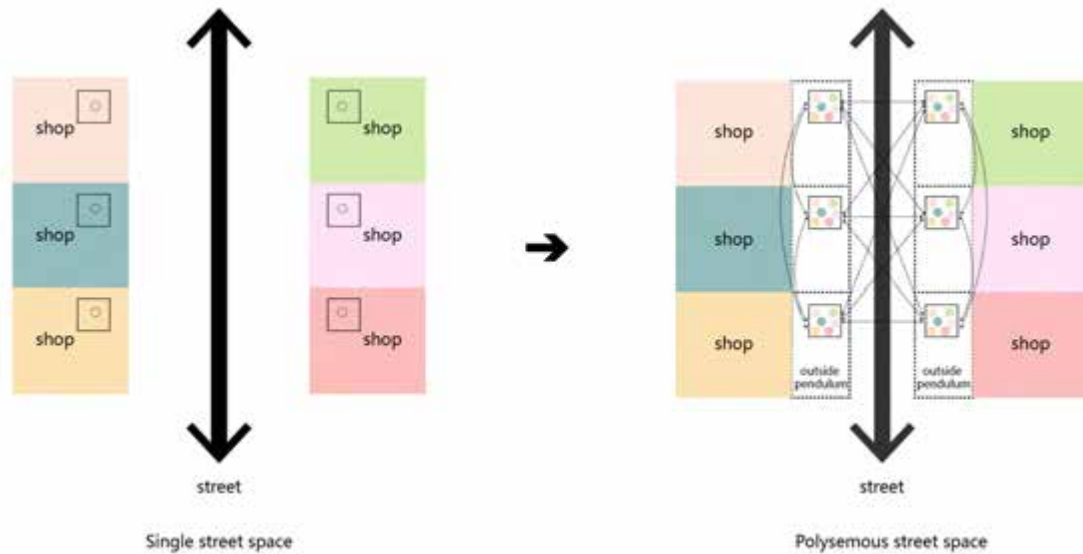


Figure 8 Schematic of commercial street furniture space in Yuanjia Village

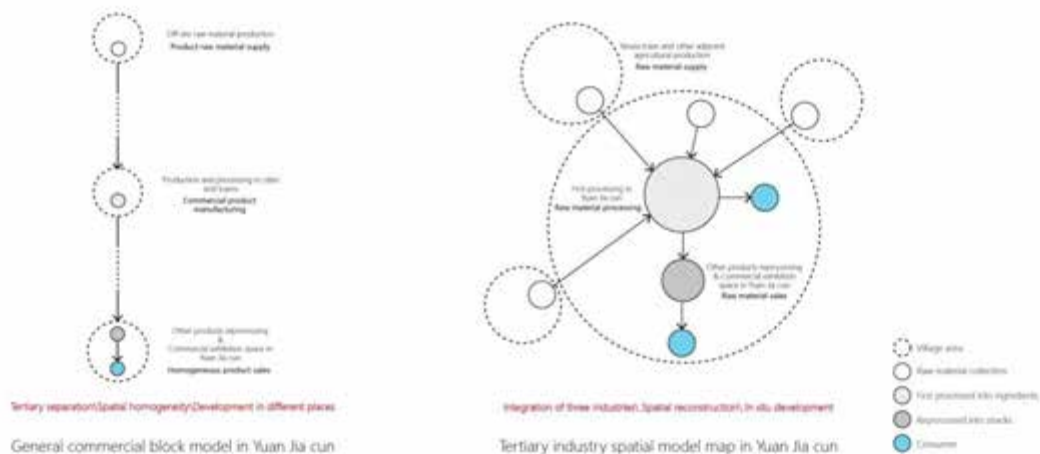


Figure 9 Spatial Organisation Patterns of Streets and Alleys in Yuanjia Village

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References

- [[1]] Ouyang, W. & Wu, B. (2017) Impact of Tourism Development on Rural Socio-Spatial Production. *Social Scientist*, (04), pp. 96-102.
- [[2]] Ouyang, W. & Wu, B. (2017) Impact of Tourism Development on Rural Socio-Spatial Production. *Social Scientist*, (04), pp. 96-102
- [[3]] Zhou, L., Zhang, X. & Yin, Q. (2022) Interaction Between Tourist Behavior and Village Space. *Development of Small Cities & Towns*, 40(02), pp. 40-48.
- [[4]] Duan, J., Jiang, Y., Li, Y. et al. (2022) The Connotation and Mechanism of Spatial Genes. *City Planning Review*, 46(03), pp. 7-14, 80.
- [[5]] Duan, J. et al. (2006) *Spatial Analysis of World Cultural Heritage Xidi Ancient Village*. Nanjing: Southeast University Press.
- [[6]] .Duan, J., Yin, M. & Tao, A. et al. (2021) 'Localized' Conservation: Cognitive Shift, Implementation Paths and Institutional Suggestions. *Urban Planning Forum*, (02), pp. 25-32.
- [[7]] Duan, J., Shao, R. & Lan, W. et al. (2019) Spatial Genes. *City Planning Review*, 43(02), pp. 14-21.
- [[8]] Zhang, Z., Xu, G. & Li, W. et al. (2019) Impact of Micro-Built Environment on Tourists' Walking Behavior in Historic Streets. *Architectural Journal*, (03), pp. 96-102.
- [[9]] Liu, Yixin, Zhimin Li, Yixin Tian, Bo Gao, Simin Wang, Yingtao Qi, Zejing Zou, Xuanlin Li, and Ruqin Wang. 2024. "A Study on Identifying the Spatial Characteristic Factors of Traditional Streets Based on Visitor Perception: Yuanjia Village, Shaanxi Province" *Buildings* 14, no. 6: 1815. <https://doi.org/10.3390/buildings14061815>
- [[10]] Liu, Yixin, Zhimin Li, Yixin Tian, Bo Gao, Simin Wang, Yingtao Qi, Zejing Zou, Xuanlin Li, and Ruqin Wang. 2024. "A Study on Identifying the Spatial Characteristic Factors of Traditional Streets Based on Visitor Perception: Yuanjia Village, Shaanxi Province" *Buildings* 14, no. 6: 1815. <https://doi.org/10.3390/buildings14061815>
- [[11]] Shang, W., Wu, Z. & Zheng, W. et al. (2021) Correlation Between Street Attractiveness and Walking Speed Change Rate in Modern Cities. *Architectural Journal*, (S2), pp. 99-105.
- [[12]] He, S., Tang, C. & Liu, Y. et al. (2017) Relationship Between Built Environment and Spatial Behavior in Rural Settlements. *Architectural Journal*, (S2), pp. 19-23.
- [[13]] Zhou, L. & Xi, Y. et al. (2021) Developing New Collective Economy in Resource-Scarce Villages. *Chinese Rural Economy*, (01), pp. 91-111.
- [[14]] Shang, W., Wu, Z. & Zheng, W. et al. (2021) Correlation Between Street Attractiveness and Walking Speed Change Rate in Modern Cities. *Architectural Journal*, (S2), pp. 99-105.
- [[15]] Shang, W., Wu, Z. & Zheng, W. et al. (2021) Correlation Between Street Attractiveness and Walking Speed Change Rate in Modern Cities. *Architectural Journal*, (S2), pp. 99-105.
- [[16]] Liu, S. & Li, P. (2023) Correlation Between Street Vitality and Commercial Formats in Historic Districts. *Modern Urban Research*, (01), pp. 56-63.

[[17]] Liu, S. & Li, P. (2023) Correlation Between Street Vitality and Commercial Formats in Historic Districts. Modern Urban Research], (01), pp. 56-63.

[[18]] Liu, S. & Li, P. (2023) Correlation Between Street Vitality and Commercial Formats in Historic Districts. Modern Urban Research, (01), pp. 56-63.

[[19]] Xu, G.; Zhong, L.; Wu, F.; Zhang, Y.; Zhang, Z. Impacts of Micro-Scale Built Environment Features on Tourists' Walking Behaviors in Historic Streets: Insights from Wudaoying Hutong, China. Buildings 2022, 12, 2248.

[[20]] Xu, G.; Zhong, L.; Wu, F.; Zhang, Y.; Zhang, Z. Impacts of Micro-Scale Built Environment Features on Tourists' Walking Behaviors in Historic Streets: Insights from Wudaoying Hutong, China. Buildings 2022, 12, 2248.