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RESEARCH ARTICLE

Environmental perception and tourist satisfaction in the activation and utilization of the Great Wall cultural heritage in Shanxi province under the context of cultural and tourism integration

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ABSTRACT

Under the background of deep integration of culture and tourism, this study explores the relationship between tourists' environmental perception and satisfaction in the process of activation and utilization of the Great Wall cultural heritage in Shanxi Province. Through questionnaire surveys and field interviews at three representative Great Wall sections (Yanmenguan, Niangziguan, and Pianguan Laoniuwan), data from 423 tourists were collected and analyzed using Structural Equation Modeling. The results demonstrate that tourists' perceptions of cultural landscape, atmosphere creation, facilities and services, and management services all positively affect their overall satisfaction, with cultural landscape perception exerting the most significant influence ($\beta=0.42$, $p<0.001$). Comparative analysis revealed distinctive perception patterns across the three sites, reflecting their unique characteristics and development priorities. Yanmenguan excelled in cultural landscape perception, Niangziguan performed best in facility services, and Pianguan Laoniuwan was distinguished by its unique landscape features. These findings provide empirical evidence for developing differentiated strategies that prioritize cultural authenticity and experiential quality while maintaining adequate supporting services. The research contributes to understanding environmental perception formation in heritage tourism contexts and offers practical guidance for the sustainable development of cultural heritage tourism under the cultural-tourism integration framework.

Keywords: cultural and tourism integration; Great Wall cultural heritage; activation and utilization; environmental perception; tourist satisfaction; Shanxi Great Wall

1. Introduction

The Great Wall, as a symbol of the Chinese nation and a World Cultural Heritage site, possesses extremely high historical, cultural, and artistic value. With the deepening of the cultural and tourism integration strategy, the activation and utilization of the Great Wall cultural heritage has become an important way to promote cultural inheritance and tourism development[1,2]. Shanxi Province has abundant Great Wall resources, with diverse types and unique frontier cultural characteristics. However, how to rationally develop and utilize its

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cultural tourism value, enhance tourist experience and satisfaction, while protecting the Great Wall itself, is an important issue currently faced.

Existing research mostly focuses on the protection, restoration, and tourism development of the Great Wall cultural heritage, and less systematically explores the relationship between tourists' environmental perception and satisfaction during their visit to the Great Wall from the perspective of tourists. Environmental perception is the subjective cognition and evaluation of tourists on the tourism destination environment, and is an important factor affecting tourists' satisfaction and behavioral intentions[3,4]. Recent research shows that the environmental settings of tourism destinations, such as natural scenery, cultural environment, and infrastructure, play an important role in determining tourist experience quality and satisfaction[5]. Especially in the case of cultural heritage tourism destinations, tourists' environmental perceptions are often intricately linked with their cultural experience and valuation [6].

In the framework of integration between culture and tourism, cultural heritage tourism has evolved from mere sightseeing to more sophisticated cultural engagements. Tourists pay attention not just to the physical manifestation of cultural heritage but also to its underlying meanings and their participatory experience[7,8]. In the case of tourism development of the Great Wall, the perception and satisfaction of tourists within the context of environmental creation and service enhancement, balanced with protection priorities, is central to the sustainable maintenance of these cultural heritage sites[9].

This study takes the Great Wall of Shanxi as a case study to analyze the relationship between tourists' environmental perception and satisfaction in the process of activating and utilizing the Great Wall cultural heritage under the context of cultural and tourism integration, aiming to provide scientific basis and decision-making reference for the sustainable development of the Great Wall in Shanxi. The research not only contributes to enriching theoretical studies on the relationship between environmental perception and tourist satisfaction in cultural heritage sites but also provides practical guidance for the protection, activation, and utilization of the Great Wall and similar cultural heritage sites.

2. Literature review

2.1. Cultural and tourism integration and cultural heritage activation and utilization

Cultural and tourism integration refers to the process of mutual penetration and integration of the two major industries of culture and tourism, aiming to achieve resource sharing, complementary advantages, and synergistic efficiency. As Gursoy et al. note, many nations have adopted this form of integration as a primary approach towards development to enrich cultural experiences within tourism[1]. Wu et al.'s research illustrates cultural tourism integration as an innovative approach towards cultural heritage activation—sustaining development through innovative methods, interpretation, and technology[2].

García-Hernández and de Miguel echo the mounting pressure for cultural heritage sites to reconcile protection and utilisation[9]. Estrada's work proposes a more sustainable model for cultural heritage tourism, advocating for authentic preservation while improving visitor engagement. Effective cultural heritage activation, as the researchers suggest, requires a balanced prioritisation of the conservation framework, stakeholder collaboration, and experience design. Arayawut further demonstrates the importance of cross-sectoral management in holistic approaches, noting significant environmental and non-environmental influences on satisfaction at cultural heritage destinations[10].

2.2. Environmental perception

Environmental perception describes one's cognitive appraisal and emotional appraisal of the surrounding environment. This concept took form separately in tourism research and has evolved from simple theories to

more complex ones encompassing different aspects of the tourism experience. According to Shen et al., environmental perception in a tourism context refers to tourists' cognitive appraisal and evaluation of cultural landscape elements, including natural environments, architectural heritage, and service facilities that collectively shape their overall destination experience[11].

New insights have also integrated environmental perception in heritage contexts. Erfanian et al. analysed environmental attitudes and tourist satisfaction in protected natural areas, demonstrating the perception of environmental conditions greatly affects overall satisfaction, particularly in highly visited areas[12]. Rasoolimanesh et al. constructed a model connecting perceptions of sustainability of a destination to satisfaction and intention to revisit, demonstrating that C-tion B positively affects tourism experiences[13].

The multifaceted aspect of environmental perception has been well documented. Su et al. found social and sustainable determinants of tourist satisfaction which include the cultural environment, the quality of the environment, and interactions with the community, showing they greatly influence perception formation[14]. Bhuiyan and Darda also classified aspects of environmental perception into the natural environment, the service facilities, and management practices and their use with satisfaction in heritage contexts[15].

2.3. Tourist satisfaction

The evaluation made by tourists pertaining to tourism services offered and products on sale is referred to as tourist satisfaction. This measurement also indicates how well the tourism destination has developed its services and infrastructure. The theory of expectation-confirmation by Oliver serves as the primary groundwork for the development of satisfaction understanding, whereby tourists evaluate their actual experience relative to what was expected[16]. Recently, Abid et al. studies have broadened this understanding by including experience quality, value perception, reasonable pricing, and involvement in regenerative tourism as core elements that determine satisfaction within cultural heritage frameworks[17].

Satisfaction and behavioural intention have always received a considerable amount of research focus. In their work, Yoon and Uysal discovered that satisfaction acts as a mediator in the relationship between loyalty to the destination and motivation-based factors[18]. To build on this, Cajiao et al. presented evidence that satisfaction with heritage experiences has a substantial impact on pro-environmental advocacy behaviour and site advocacy[19]. The findings from their study suggest that visitors who are satisfied with their experience tend to form deeper affective bonds with the heritage sites which in turn enhances their conservation advocacy and recommendation behaviours.

2.4. Research on the Great Wall in Shanxi

Research on the Great Wall in Shanxi has established a foundation focusing mostly on the historical sequence, the architecture, the military defence mechanisms, and the culture. Recent studies have begun addressing aspects related to the state of tourism development; however, their scope is still shallow. Chen examined how visitors perceive heritage value and its impact on satisfaction at architectural heritage sites, demonstrating that cultural landscape perception significantly influences visitor satisfaction through the perception of historical authenticity and cultural significance[20].

The distinct features found in the different portions of the Great Wall of Shanxi present unique opportunities for investigation. These subsections contain remarkably preserved military defensive features, a range of structural designs, and combination with scenic natural topography. Nonetheless, systematic research focusing on perception of the environment and tourist satisfaction in the described frameworks is absent. Zhang et al. (2023) emphasize that different types of heritage sites generate distinct visitor perceptual responses and

satisfaction patterns, indicating the importance of site-specific studies to develop tailored tourism management strategies[21].

The absence of empirically informed analytical studies provides a gap in the literature, yet diverse context approaches create multi-angled explanations for the case at hand. Limited systematic research addresses the activation and utilization of Great Wall cultural heritage within the cultural-tourism integration framework. Additionally, investigations into the relationship between tourists' environmental perception and satisfaction at Great Wall sites remain insufficient, particularly concerning Shanxi's unique Great Wall resources. This study addresses these gaps by examining the multidimensional relationships between environmental perception factors and visitor satisfaction in Shanxi's Great Wall heritage sites.

3. Research methods

3.1. Study area

This study selects representative sections of the Great Wall in Shanxi Province as the research area. Shanxi Province contains approximately 1,500 kilometers of Great Wall sections spanning from the Warring States Period to the Ming Dynasty, presenting diverse architectural styles and preservation conditions. Three distinctive sections were selected based on their historical significance, preservation status, geographical characteristics, and tourism development level.

As shown in **Figure 1**, Yanmenguan Great Wall is located in Daixian County, Xinzhou City, representing one of the best-preserved and most representative sections in Shanxi. This strategic pass features complete defense systems including city walls, watchtowers, and beacon towers, demonstrating the military genius of ancient Chinese architecture. The surrounding landscape consists primarily of loess plateau topography with sparse vegetation, creating distinctive northern frontier scenery.

Niangziguan Great Wall is situated in Pingding County, Yangquan City, known for its precipitous geographical position and unique architectural characteristics. Often described as the "Throat of Jin-Hebei," this section was constructed along steep mountain ridges, creating an imposing natural barrier. The architectural style combines northern defensive structures with central plains cultural elements, with wall sections ingeniously integrated into natural rock formations.

Pianguan Great Wall is located in Pianguan County, Xinzhou City, featuring the remarkable confluence of the Great Wall and Yellow River. This section creates a distinctive "T-shaped" intersection where the Wall meets the Yellow River, forming a natural and human-made barrier system often described as "Outer Wall, Inner River." The complex topography encompasses both loess plateau gullies and Yellow River alluvial plains, resulting in a uniquely dramatic landscape.

Figure 1. Geographic distribution of the three studied Great Wall sections in Shanxi province.

3.2. Data collection

This research employed mixed methods for data collection, combining quantitative questionnaire surveys with qualitative field interviews to obtain comprehensive insights into tourists' environmental perception and satisfaction.

The questionnaire was designed based on extensive literature review and preliminary field observations, encompassing four main sections: (1) demographic information; (2) environmental perception evaluation; (3) tourism experience assessment; and (4) overall satisfaction evaluation. The environmental perception section measured four dimensions: cultural landscape perception (8 items), facility service perception (7 items), atmosphere creation perception (6 items), and management service perception (7 items). Each item was measured using a five-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (5).

Cultural landscape perception items assessed tourists' perceptions of the Great Wall's physical integrity, surrounding natural environment, historical and cultural value, architectural style, landscape distinctiveness, cultural interpretation, conservation status, and authenticity. Facility service perception items evaluated transportation accessibility, signage systems, rest facilities, sanitation facilities, catering and shopping facilities, safety facilities, and interpretive facilities. Atmosphere creation perception items measured cultural activities, display methods, interactive experiences, cultural and creative products, participation opportunities, and immersive environments. Management service perception items assessed staff service attitudes, management standardization, safety guarantees, information services, crowd management, emergency response capabilities, and personalized services.

Data collection occurred between May and September 2023, encompassing both weekdays and holidays to ensure representational sampling. Trained researchers conducted random sampling at entrance/exit points and main scenic locations, checking questionnaire completeness in real-time. Both offline paper questionnaires and online electronic questionnaires accessed via QR codes were utilized. A total of 450 questionnaires were distributed, yielding 423 valid responses (94% effective return rate).

Additionally, in-depth interviews were conducted with 45 selected tourists (15 from each site) to gather detailed qualitative insights regarding their perceptions, experiences, and satisfaction with the Great Wall cultural heritage activation and utilization. Interviews followed a semi-structured format, allowing emergence of unanticipated themes while maintaining consistent inquiry areas. Interview data provided contextual understanding for interpreting quantitative findings.

3.3. Data analysis

Statistical analysis was performed using SPSS 26.0 and AMOS 24.0 software packages. Descriptive statistical analysis examined sample characteristics and variable distributions. Reliability assessment employed Cronbach's alpha coefficients, with values exceeding 0.7 considered acceptable. Validity testing utilized factor analysis, with Kaiser-Meyer-Olkin (KMO) values and Bartlett's sphericity test confirming sampling adequacy and factor structure appropriateness.

Structural Equation Modeling (SEM) analyzed relationships between environmental perception dimensions and overall tourist satisfaction. The two-step approach recommended by Anderson and Gerbing was implemented, first establishing measurement model validity before testing structural relationships. Model fit was evaluated using multiple indices: chi-square/degrees of freedom ratio ($\chi^2/df < 3.0$), Root Mean Square Error of Approximation (RMSEA < 0.08), Comparative Fit Index (CFI > 0.90), Tucker-Lewis Index (TLI > 0.90), and Incremental Fit Index (IFI > 0.90).

Path coefficient significance testing utilized critical ratios with p-values determining statistical significance levels. Following Hair et al.'s guidelines, path coefficients were classified as weak effect (<0.2), moderate effect (0.2-0.5), or strong effect (>0.5). Additionally, parameter comparison tests assessed significance of differences between coefficient magnitudes, providing more nuanced understanding of relative impact differences.

Qualitative interview data underwent thematic content analysis using NVivo 12 software, identifying recurrent themes and patterns. The integration of quantitative and qualitative findings enabled methodological triangulation, enhancing result reliability and providing deeper insights into tourists' experiential assessments.

3.4. Research model

Based on theoretical foundations and empirical evidence from literature review, a conceptual model was developed proposing relationships between environmental perception dimensions and tourist satisfaction (**Figure 2**). The model hypothesizes that tourists' perceptions of cultural landscape, facilities and services, atmosphere creation, and management services positively influence their overall satisfaction with the Great Wall heritage experience.

The following hypotheses were formulated:

·H1: Tourists' perception of cultural landscape positively affects their overall satisfaction.

·H2: Tourists' perception of facilities and services positively affects their overall satisfaction.

·H3: Tourists' perception of atmosphere creation positively affects their overall satisfaction.

·H4: Tourists' perception of management services positively affects their overall satisfaction.

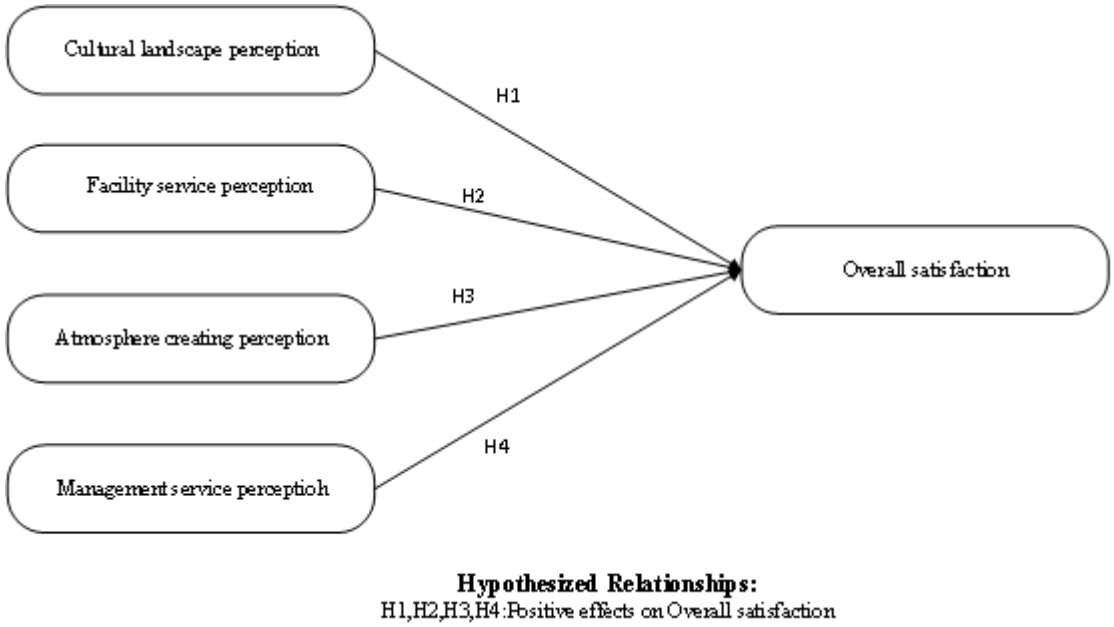

Figure 2. Conceptual model showing relationships between environmental perception dimensions and tourist satisfaction.

This research model allows systematic examination of how different environmental perception dimensions contribute to tourist satisfaction in the context of Great Wall cultural heritage activation and utilization, providing empirical evidence for theoretical advancement and practical applications.

4. Results analysis

4.1. Sample characteristics

A total of 450 questionnaires were distributed across the three Great Wall research sites, with 423 valid responses recovered, yielding an effective recovery rate of 94%. **Table 1** summarizes the demographic characteristics of the sample.

Table 1. Demographic characteristics of respondents.

Characteristic	Category	Frequency	Percentage (%)
Gender	Male	225	53.2
	Female	198	46.8
Age	18-25 years	138	32.6
	26-35 years	175	41.4
	36-45 years	77	18.2
	46 years and above	33	7.8
Education	High school and below	58	13.7
	College diploma	77	18.2
	Bachelor's degree	217	51.3
	Postgraduate and above	71	16.8
Occupation	Students	126	29.8
	Enterprise employees	151	35.7
	Freelancers	69	16.3
	Others	77	18.2

Travel purpose	Historical exploration	185	43.7
	Leisure and relaxation	143	33.8
	Educational experience	62	14.7
	Others	33	7.8

As shown in **Table 1**, the sample exhibits a balanced gender distribution with slightly more male respondents (53.2%) than female respondents (46.8%). Age distribution reveals predominance of younger and middle-aged visitors, with 74% of respondents between 18-35 years. Educational background indicates a well-educated visitor population, with 68.1% holding bachelor's degrees or higher qualifications. Occupational distribution shows diversity, with enterprise employees comprising the largest group (35.7%), followed by students (29.8%).

Travel purpose analysis reveals that historical exploration constitutes the primary motivation (43.7%), followed by leisure and relaxation (33.8%) and educational experience (14.7%). This emphasis on historical exploration aligns with the cultural heritage nature of the Great Wall sites and reflects the growing interest in cultural experiences within the context of cultural-tourism integration.

This demographic profile aligns with typical cultural heritage tourism patterns, where educated younger and middle-aged visitors often demonstrate higher interest in historical sites with cultural significance. Understanding these characteristics provides essential context for interpreting environmental perception patterns and satisfaction outcomes within the cultural-tourism integration framework.

4.2. Reliability and validity test

Rigorous assessment of measurement instrument quality confirms strong reliability and validity across all constructs. Cronbach's alpha coefficients exceeded the recommended 0.7 threshold for all variables: cultural landscape perception (0.892), facility service perception (0.847), atmosphere creation perception (0.863), management service perception (0.832), and overall satisfaction (0.901). These values demonstrate high internal consistency of the measurement scales.

Table 2. Reliability and validity test results.

Construct	Cronbach's Alpha	KMO Value	Bartlett's Test (p-value)	AVE	CR
Cultural landscape perception	0.892	0.861	<0.001	0.673	0.896
Facility service perception	0.847	0.839	<0.001	0.625	0.853
Atmosphere creation perception	0.863	0.845	<0.001	0.642	0.868
Management service perception	0.832	0.827	<0.001	0.618	0.841
Overall satisfaction	0.901	0.875	<0.001	0.712	0.908

As shown in **Table 2**，construct validity assessment through factor analysis yielded KMO values exceeding 0.8 for all variables, with statistically significant Bartlett's sphericity tests ($p<0.001$), confirming appropriate factor structure. Convergent validity was established through Average Variance Extracted (AVE) values exceeding 0.6 and Composite Reliability (CR) values exceeding 0.8, demonstrating that measurement items effectively represent their respective theoretical constructs. These robust psychometric properties establish a solid foundation for subsequent structural relationship analysis in the context of Great Wall cultural heritage activation and utilization.

4.3. Descriptive statistical analysis

Analysis of environmental perception and satisfaction variables reveals differential evaluations across dimensions, providing insights into tourists' experiences of the Great Wall in Shanxi. As shown in **Figure 3**, tourists expressed highest satisfaction with the cultural landscape dimension (M=4.23, SD=0.76), followed by atmosphere creation perception (M=3.98, SD=0.82), facility service perception (M=3.65, SD=0.88), and management service perception (M=3.42, SD=0.91). Overall satisfaction achieved a positive evaluation (M=3.89, SD=0.83), indicating generally favorable tourism experiences.

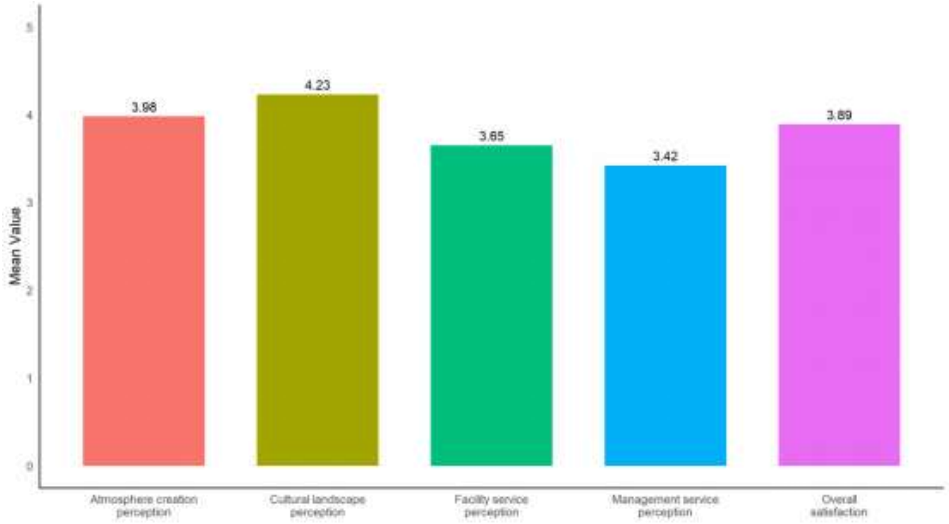

Figure 3. Mean values of environmental perception dimensions and overall satisfaction.

Within cultural landscape perception, historical cultural value received the highest rating (M=4.42, SD=0.71), reflecting strong appreciation for the Great Wall's historical significance. Among atmosphere creation aspects, historical atmosphere authenticity earned the highest assessment (M=4.15, SD=0.76), demonstrating effective preservation of authentic historical ambiance. For facility services, sanitation facilities received the highest evaluation (M=3.81, SD=0.83), while transportation convenience received the lowest (M=3.48, SD=0.95). In management services, staff service attitude rated highest (M=3.68, SD=0.88), while crowd management received the lowest score (M=3.21, SD=0.98).

These findings indicate that tourists highly value the cultural and historical dimensions of the Great Wall experience, while perceiving relatively lower satisfaction with certain facility and management aspects. The higher evaluation of cultural landscape and atmosphere creation aligns with the core value proposition of cultural heritage tourism in the context of cultural-tourism integration, where authentic cultural experiences constitute the primary attraction. Conversely, the relatively lower ratings for facility and management dimensions suggest potential areas for improvement in enhancing the overall tourist experience.

Comparison across the three study sites revealed site-specific perception patterns reflecting distinct characteristics of each location. Yanmenguan Great Wall received highest ratings for cultural landscape perception (M=4.35) and atmosphere creation perception (M=4.02), consistent with its well-preserved historical structures and cultural interpretation. Niangziguan Great Wall performed best in facility service perception (M=3.76), reflecting recent infrastructure improvements. Pianguan Laoniuwan Great Wall earned highest evaluation for landscape distinctiveness (M=4.28), corresponding to its unique setting at the Great Wall-Yellow River confluence.

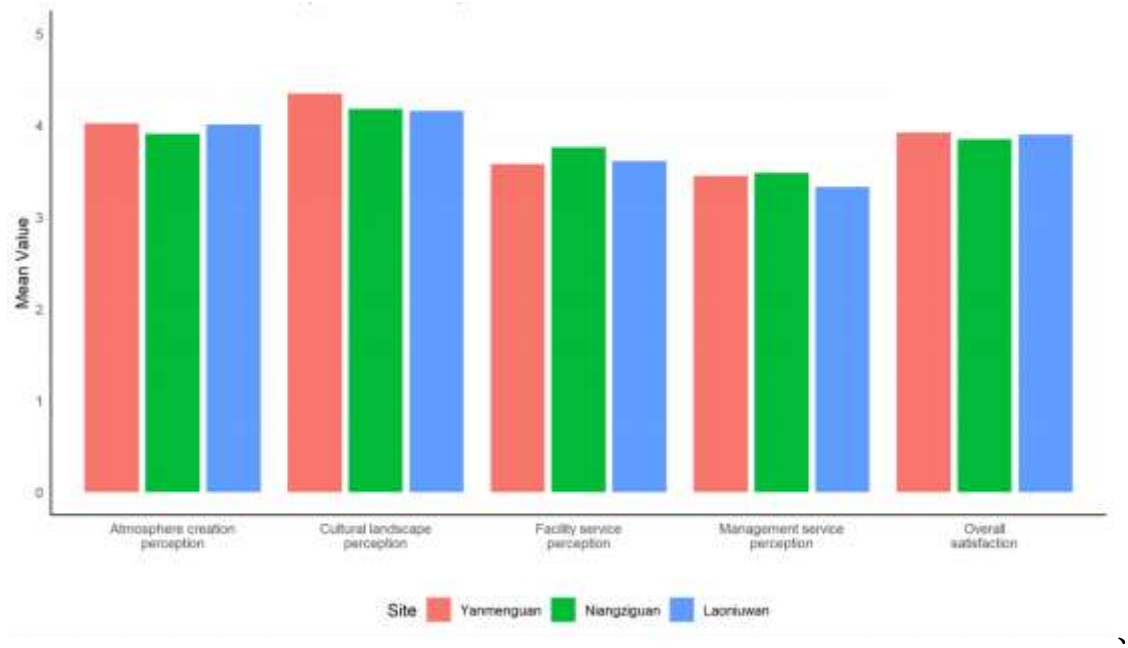

Figure 4. Comparison of environmental perception dimensions across three Great Wall sites.

Figure 4 illustrates the differential evaluation patterns across the three research sites. Yanmenguan Great Wall received highest ratings for cultural landscape perception (M=4.35) and atmosphere creation perception (M=4.02), consistent with its well-preserved historical structures. Niangziguan Great Wall performed best in facility service perception (M=3.76), reflecting recent infrastructure improvements. Pianguan Laoniuwan Great Wall was rated highest for landscape distinctiveness (M=4.28), attributable to its unique setting at the Great Wall-Yellow River confluence. These differences reflect the distinctive characteristics and development priorities of each site.

These descriptive findings establish preliminary understanding of tourist perceptions and satisfaction in the Great Wall cultural heritage context, providing foundation for subsequent analysis of structural relationships between environmental perception dimensions and overall satisfaction.

4.4. Structural Equation Modeling Analysis

Structural Equation Modeling analysis examined hypothesized relationships between environmental perception dimensions and overall tourist satisfaction. Model fit assessment demonstrated excellent fit to empirical data ($\chi^2/df = 2.56$, RMSEA = 0.061, CFI = 0.952, TLI = 0.941, IFI = 0.953), all within recommended thresholds. **Table 3** presents path coefficient analysis results with hypothesis testing outcomes.

Table 3. Structural equation model analysis results.

Hypothesis	Path	Path coefficient	Standard error	P-value	Support status	Effect strength
H1	Cultural landscape perception→Overall satisfaction	0.42	0.08	<0.001***	Supported	Moderate
H2	Facility service perception→Overall satisfaction	0.28	0.07	<0.001***	Supported	Moderate
H3	Atmosphere creation perception→Overall satisfaction	0.35	0.06	<0.001***	Supported	Moderate
H4	Management service perception→Overall satisfaction	0.19	0.05	<0.01**	Supported	Weak

***Note:** ***p<0.001,* *p<0.01

Following Hair et al.'s guidelines for effect size interpretation, path coefficients were classified as weak effect (<0.2), moderate effect (0.2-0.5), or strong effect (>0.5). All hypothesized relationships received empirical support, with varying effect magnitudes. As shown in **Table 2**, cultural landscape perception demonstrated strongest influence on overall satisfaction (β=0.42, $p<0.001$), followed by atmosphere creation perception (β=0.35, $p<0.001$), facility service perception (β=0.28, $p<0.001$), and management service perception (β=0.19, $p<0.01$).

Parameter comparison tests revealed statistically significant differences between effect magnitudes. The difference between cultural landscape perception and management service perception effects was significant ($\Delta\chi^2$=8.76, $p<0.01$), as was the difference between cultural landscape perception and facility service perception effects ($\Delta\chi^2$=6.32, $p<0.05$). These findings confirm that cultural landscape aspects exert significantly stronger influence on tourist satisfaction compared to facility and management factors in the Great Wall cultural heritage context.

Supplementary analysis examined potential indirect relationships, revealing that cultural landscape perception positively influences facility service perception (β=0.31, $p<0.001$) and atmosphere creation perception (β=0.39, $p<0.001$). This suggests that positive cultural landscape perceptions enhance evaluations of other environmental aspects, highlighting the foundational role of cultural landscape elements in shaping overall environmental perceptions and subsequent satisfaction.

These structural relationship findings align with theoretical expectations in cultural heritage tourism, where authentic cultural experiences typically constitute core value elements. The results demonstrate that in the context of Great Wall cultural heritage activation and utilization under cultural-tourism integration, cultural landscape perception plays the most critical role in determining tourist satisfaction, followed by experiential aspects of atmosphere creation. While facility and management factors demonstrate positive influence, their relatively weaker effects suggest prioritization of cultural authenticity and experiential quality in heritage tourism development.

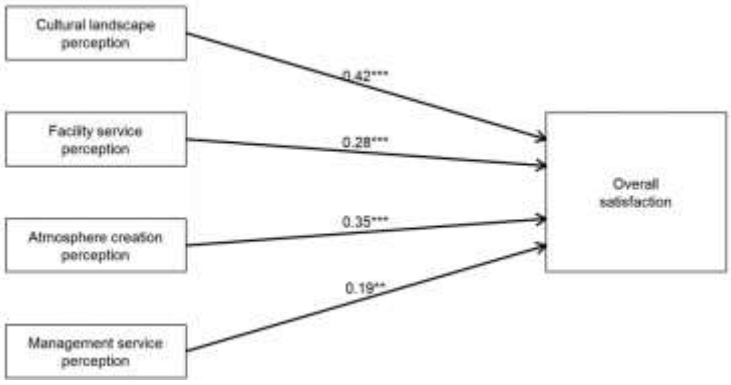

Figure 5. Structural equation model path diagram with standardized path coefficients.

Note:*p<0.001,**p<0.01*

As illustrated in **Figure 5**, the structural equation model path diagram visually represents the relationships between environmental perception dimensions and overall satisfaction. Cultural landscape perception demonstrates the strongest influence on overall satisfaction (β=0.42, $p<0.001$), followed by atmosphere creation perception (β=0.35, $p<0.001$) and facility service perception (β=0.28, $p<0.001$), while management service perception exerts a relatively weaker effect (β=0.19, $p<0.01$). These findings align with the cultural heritage tourism context, where authentic cultural experiences typically constitute core satisfaction drivers.

5. Discussion

The results of this study illuminate the relationship between environmental perception and tourist satisfaction in the context of cultural and tourism integration at the Great Wall cultural heritage sites in Shanxi Province. It is clear that a tourist's overall satisfaction is greatly influenced by the direct perception of the environment, with some aspects being more impactful than others. The most influential driver of tourist satisfaction was cultural landscape perception (β=0.42, $p<0.001$). This supports Arayawut, who argued that cultural and religious factors strongly affect visitor satisfaction at heritage sites[10]. The overwhelming impact of cultural landscape perception denotes the historical and cultural authenticity of a site's region which visitors expect to experience at cultural heritage sites and is central to their tourism activities. Visitors to the Great Wall expect far more than the mere appreciation of a preserved artefact; they demand engaging historical cultures, distinct architecture, and seamless landscape amalgamation as fundamental constituents of their experience.

Atmosphere creation perception had the second strongest effect on satisfaction (β=0.35, $p<0.001$), further confirming the role of experiential factors. This finding is consistent with Hsu et al.'s findings on the role of atmosphere creation in travel and tourism experiences[22]. The rather strong importance of atmosphere creation implies that tourists appreciate active participation in the cultural heritage and therefore spend less time watching. Aspects like the authenticity of historical atmosphere (M=4.15) and cultural activities were important to the overall experience.

Facility service perception positively impacted satisfaction to a moderate degree (β=0.28, $p<0.001$), confirming its supportive effect in the tourism experience. This aligns with Bhuiyan and Darda, who noted that service quality is a key determinant of satisfaction[15]. While essential for onsite visitor comfort and ease of access, facility services at heritage sites seem subordinate to the cultural and experiential components. The relatively lower score on the transportation convenience measure (M=3.48) points to more directly actionable areas for infrastructure improvement. Perception of management service had the least effect on satisfaction compared to other factors (β=0.19, $p<0.01$), indicating its core yet largely inconspicuous impact on tourist experiences. This parallels findings by Su et al., where management aspects had notable but, in relation to other factors, quite weak influences on overall visitor satisfaction[14]. The lower mean score for crowd control (M=3.21) suggests that the management of visitor flow during peak times could be optimally refined.

The varying impact patterns of the detailed environmental perception dimensions align with Rasoolimanesh et al.'s work on the order of importance underpinning sustainability perception factors[13]. These findings also attributed to cultural authenticity a foremost position as a primary satisfaction driver and placed service and management factors as secondary contributors. This hierarchy resembles the core-periphery pattern of heritage tourism experiences, with the central proposition of value framed around the preserved essence of culture, accompanied by facilitating services and management provided. Inter-site comparison analysis uncovered distinct perception patterns shaped by specific characteristics of particular sites. The Yanmenguan Great Wall Cultural landscape perception score is particularly compelling with a high mean score of 4.35, supported by the region's historical structures. In contrast, Niangziguan Great Wall's 3.76 average facility service perception score indicates more recent servicing of infrastructure. These findings support, reference Erfanian et al. in supported site-specific environmental perception patterns relative to protected areas emphasising geographical and developmental features determining visitor perceptions[12].

The finding that cultural landscape perception influences facility service perception (β=0.31) and atmosphere creation perception (β=0.39) suggests potential halo effects, where positive cultural perceptions enhance evaluations of other environmental aspects. This aligns with Cajiao et al.'s observation that positive

cultural experiences can enhance broader environmental attitudes and perceptions[19]. The interrelationship among perception dimensions indicates the integrated nature of environmental perception formation in heritage tourism contexts.

These results provide empirical support for prioritizing cultural authenticity and immersive atmospheres in the activation and utilization of Great Wall cultural heritage, while maintaining adequate facility and management services. The findings suggest that within the cultural-tourism integration framework, development strategies should emphasize cultural landscape protection and interpretation, experiential design, infrastructure improvement, and management enhancement, in descending priority order.

6. Conclusion and recommendations

6.1. Conclusion

This research explored the connection between tourists' perceived environment and their satisfaction in the activation and utilisation of Great Wall cultural heritage in Shanxi Province within the framework of cultural-tourism integration. The study found that the perceptions of the cultural landscape most strongly impact overall satisfaction; however, all four aspects of environmental perception: cultural landscape, atmosphere creation, facilities and services, and management services, were found to have a positive impact on satisfaction. The research carried out demonstrated that in regards to Great Wall heritage sites, profound background atmospheres, as well as authentic cultural furnishings, determine visitor satisfaction, whereas managed facility aids had an impact, albeit secondary. The comparative analysis conducted across the three research sites also exposed distinct perception patterns which represent the sites' individual character, as well as developmental focus and characteristics which in turn reflect distinct enhancement needs for each site.

6.2. Recommendations

Addressing the gaps identified in the multidisciplinary analyses conducted above highlights the gaps the element gap the above where gaps appear during socio-economic development, and finding new solutions towards bridging them, enhancing the cultural tourism of the Great Wall in Shanxi Province resonates with heritage conservation issues deeply intertwined with socio-economic challenges. Custom makeover where basic cultural protective landscapes should Fictional Restoration of physical structures designed along with restoration Frameworks and multi-sequential meaning constructing commemoration systems needs deep focus. Diffusion and reciprocation deepening cultural engagement should be accomplished through interactive participation, historical reenactments and other theme-related programmes. Enhancements in tourism construction should lay particular emphasis on means of access and supporting installations with a reservation on panoramic historical view interference. Enhancements in managed services should focus primarily on crowd information systems via smart tourism technologies and professional refresher training courses. Preserving physical heritage while enriching visitor experience through digital means like virtual and augmented reality offers vast evolving opportunities. Each site such as the culturally rich Yanmenguan, infrastructurally developed Niangziguan, and the uniquely landscape integrated Pianguan Laoniuwan should be provided differentiated development policies based on their respective resources and site-specific advantages.

6.3. Limitations and future research directions

This study has several limitations that suggest directions for future research. The geographic scope was limited to three Great Wall sections in Shanxi Province, indicating the value of expanded comparative studies across broader contexts. The cross-sectional research design captured perceptions at a specific point, suggesting benefits from longitudinal studies tracking perception changes over time and seasons. Future

research could incorporate additional variables such as tourist motivation and cultural background, examine perception differences between domestic and international tourists, and investigate relationships between environmental perception, satisfaction, and behavioral intentions, further contributing to sustainable heritage tourism development under the cultural-tourism integration framework.

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