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Fuzzy Set Applications in Behavioral Research: An fsQCA Case Study of Tourist Commitment

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ABSTRACT

Understanding how tourists develop commitment toward heritage destinations requires approaches that capture configurational and asymmetric causality. Traditional linear models overlook the interplay among experiential, cognitive, and identity-based drivers of behavioral outcomes. This study applies fuzzy-set Qualitative Comparative Analysis (fsQCA) to uncover multiple sufficient pathways leading to high tourist commitment in cultural heritage tourism. Data collected from 150 visitors to heritage sites in Hanoi were calibrated into fuzzy sets, producing parsimonious, intermediate, and complex solutions. The results reveal equifinal pathways in which strong tourism media influence and identity congruence frequently act as core conditions, while perceived heritage value and cultural experience operate as complementary mechanisms. Notably, commitment can emerge even when certain factors such as social cognition or heritage value are absent, underscoring the compensatory dynamics among causal conditions. This study advances theoretical understanding by conceptualizing tourist commitment through a fuzzy-mathematical lens and demonstrates the explanatory power of configurational logic over symmetric analytical assumptions. Practical implications are proposed for destination managers to tailor strategies to distinct commitment-driving configurations.

Keywords: FsQCA, Tourist commitment, Cultural heritage tourism, Causal configurations, Fuzzy set.

Introduction

Tourist commitment represents a pivotal behavioral outcome in tourism, closely linked to revisit intention, destination attachment, word-of-mouth advocacy, and long-term loyalty (Cohen *et al*., 2014; Prayag, 2024). In cultural heritage contexts, commitment becomes even more consequential, as destinations rely heavily on emotionally and symbolically engaged visitors to sustain cultural preservation, repeat visitation, and community-based value creation (Fahmi & Inayah, 2025). As global tourism becomes increasingly competitive and digitally mediated, understanding the drivers of commitment is essential for designing meaningful heritage experiences and effective engagement strategies (Liu *et al*., 2023). Cultural heritage tourism is inherently complex, shaped by the interplay of experiential, cognitive, emotional, and identity-based evaluations. Tourists do not respond solely to the physical attributes of heritage sites but interpret them through personal meaning-making, socio-cultural narratives, and exposure to mediated representations (Qiu *et al*., 2019). This complexity challenges traditional behavioral research, which frequently assumes linear and independent influences among predictors. Growing evidence suggests that heritage tourism decisions are multifaceted, nonlinear, and contingent on the combinationnot merely the magnitude of antecedent factors (Moreno *et al*., 2016; Pappas & Woodside, 2021).

The intersection of mathematics and the social sciences has grown increasingly significant, especially in efforts to model causal complexity in human behavior (Abdullah *et al*., 2004). One such context is tourist commitment behavior,

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where multiple psychological, social, and experiential factors interact in non-linear and combinatorial ways (Jafari, 2024). Traditional statistical models, such as linear regression or structural equation modeling (SEM), often assume additive and independent effects among predictors, assumptions that may not hold in real-world decision-making contexts (Moreno *et al*., 2016).

To better capture such configurational complexity, fuzzy-set Qualitative Comparative Analysis (fsQCA) combines logic-based minimization with fuzzy membership to identify multiple sufficient combinations of conditions that lead to tourist commitment. This method has been increasingly applied alongside SEM in tourism research, evidenced by studies such as (Zheng *et al*., 2023), who combined SEM and fsQCA to examine tourist resource saving intentions in rural tourism, (Lin *et al*., 2025), used fsQCA to analyze the tourists' perceptions of proximity tourism, and (Seyfi *et al*., 2024) explored the tourist behavioral intentions with the combination of PLS-SEM and fsQCA approaches. Despite growing attention to cultural heritage tourism, existing behavioral studies are predominantly grounded in symmetric, net effect approaches (e.g., SEM), assuming linear and independent influences among predictors. Recent research combining SEM and fsQCA highlights the value of configurational reasoning; however, most studies have focused on intentions or satisfaction, while the causal complexity behind tourist commitment remains underexplored. Moreover, the interactive role of media influence and personal identity critical to Gen-Z heritage tourists has not been systematically examined in a fuzzy-mathematical context.

To address these gaps, this study applies fsQCA to identify multiple sufficient causal configurations leading to strong tourist commitment in heritage destinations. Fuzzy set theory enables a graded conceptualization of behavioral membership, while Boolean minimization reveals how different experiences, value perceptions, media influences, cognitive evaluations, and identity alignments combine to shape commitment. This study offers three main contributions: Introduces a configurational framework that conceptualizes commitment as the outcome of compensatory and conjunctural mechanisms, challenging linear behavioral assumptions. Demonstrates fuzzy-mathematical reasoning as a robust alternative for modeling behavioral complexity in tourism. Identifies distinct commitment-driving pathways, offering segmentation-based strategies for enhancing heritage loyalty. Together, these contributions emphasize that tourist commitment is not driven by isolated determinants but by interactive causal recipes, highlighting the need for nuanced, personalized destination management strategies.

Literature Review

Cultural heritage tourism is defined as travel activities that are based on the cultural, historical, and identity-related values of local communities, encompassing both tangible heritage (monuments, sites) and intangible heritage (customs, arts, traditions) (Santa-Cruz & López-Guzmán, 2017). Tourists engaging in this form of tourism typically seek cultural understanding, authenticity, and experiences that are educational or symbolic in nature (Dey *et al*., 2020; Behboodi *et al*., 2022). Research shows that cultural heritage tourism not only generates economic benefits but also plays a crucial role in heritage preservation and the reinforcement of community identity. In an increasingly competitive destination environment and rapidly evolving digital media landscape, cultural heritage tourists' behaviors are shaped by the interplay of experiential engagement, perceived value, media influence, social norms, and the degree of personal identity alignment (Park, 2013; Remoaldo *et al*., 2014; Santa-Cruz & López-Guzmán, 2017; Wu & Li, 2017; Graziano & Privitera, 2020; Wang *et al*., 2021). This indicates that commitment-related behaviors are inherently complex and cannot be fully explained through traditional linear models.

Tourist commitment in the context of heritage destinations refers to the intention, willingness, and psychological attachment of tourists to revisit or recommend a destination (Liu *et al*., 2023). Commitment is considered a key behavioral outcome that signifies long-term engagement and loyalty, particularly important for the sustainable development of cultural heritage sites. Drawing on relationship marketing and psychological commitment theory (Morgan & Hunt, 1994), tourist commitment is conceptualized as a multidimensional construct that includes affective, calculative, and normative components. In heritage tourism, this commitment is shaped by a combination of experiential, symbolic, and social factors. Several theoretical lenses help explain the antecedents of commitment: Experiential Value Theory (Holbrook, 1999): emphasizes that memorable and emotionally rich experiences (e.g., Cultural Heritage Tourism Experience – CHTE) contribute to affective commitment. Perceived Value Framework (Sweeney & Soutar, 2001): highlights the importance of Perceived Heritage Value (PHV) in influencing the tourists'

willingness to maintain their relationship with the destination. Self-Congruity Theory (Sirgy & Su, 2000): suggests that Personal Identity (PI) alignment with the heritage site's image reinforces psychological bonding. Social Identity Theory (Tajfel, 2010) posits that Social Cognition (SC) and group belongingness can also shape destination attachment and collective commitment. In addition, Tourism Media Influence (TMI) plays a growing role in reinforcing destination image, expectations, and post-visit evaluations, which in turn foster revisit intentions. The interaction between digital narratives and visitors' perceived authenticity shapes their evaluative judgments and behavioral intentions.

By integrating these perspectives, this study investigates how configurations of tourist perceptions, rather than isolated factors, lead to high levels of commitment in heritage tourism contexts. This configurational view reflects the causal complexity and equifinality often observed in real-world tourist behavior. From the theoretical model, three major pathways are expected:

Proposition 1: Media-Driven Pathways

Tourism media influence, when aligned with high perceived value or supportive social cognition, forms sufficient configurations that lead to tourist commitment. Rationale: Media functions as a meaning amplifier, reinforcing value perceptions and shaping how tourists interpret their heritage experiences (Gretzel *et al*., 2020).

P1: High tourist commitment can emerge from configurations in which strong tourism media influence interacts with high perceived heritage value, favorable social cognition, or moderate experiential involvement.

Proposition 2: Identity-Anchored Pathways

The alignment between experience, value, or social influence and personal identity generates pathways that lead to strong commitment.

Rationale: Identity congruence is a central mechanism driving loyalty and commitment in heritage tourism (Tajfel, 2010).

P2: Tourist commitment can arise from configurations where personal identity alignment combines with experiential strength, perceived heritage value, or media reinforcement.

Proposition 3: Cognitive–Emotional Pathways

When strong emotional heritage experiences (CHTE) combine with perceived value (PHV) and supportive social cognition, they can produce commitment even without the presence of media influence or identity alignment. Rationale: Emotional resonance together with perceived value forms the basis of attachment and commitment (Dmitrović *et al*., 2009).

P3: Configurations driven by cultural heritage experience, perceived heritage value, and supportive social cognition are sufficient to generate high tourist commitment, even in the absence of tourism media influence or personal identity alignment.

Materials and Methods

This study applies fuzzy-set Qualitative Comparative Analysis (fsQCA) to identify causal configurations leading to high tourist commitment in heritage destinations. The methodological process involves four key steps: data collection, fuzzy-set calibration, truth table construction, and logical minimization**.**

Construct operationalization

Six conceptual constructs were measured through multi-item scales adapted from existing literature in heritage tourism and consumer behavior. Each construct was assessed through three to five items on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree). **Table 1** presents the full list of constructs, variable codes, and corresponding survey items.

Table 1. Constructs, items, and measurement codes

Construct	Code	Survey Items	Source
	CHTE1	I felt excited while visiting cultural heritage sites.	(Seyfi *et al*., 2020)
	CHTE2	I actively searched for information about the heritage during the trip.	

Cultural Heritage Tourism Experience (CHTE)	CHTE3	I enjoyed engaging with cultural activities at the heritage site.	
	CHTE4	The experience at the heritage site was personally meaningful to me.	
Perceived Heritage Value (PHV)	PHV1	This cultural heritage site holds significant historical value for me.	(Rasoolimanesh *et al*., 2016)
	PHV2	I appreciate the artistic and architectural value of this heritage.	
	PHV3	This heritage reflects the cultural identity of the nation.	
	PHV4	I feel a personal connection to this heritage site.	
	PHV5	I believe this heritage deserves preservation and promotion.	
Tourism Media Influence (TMI)	TMI1	I often search for heritage information on social media.	(Tham *et al*., 2020)
	TMI2	Tourism apps help me better understand cultural heritage.	
	TMI3	VR/AR technologies make me feel immersed in heritage experiences.	
	TMI4	Online content (blogs, videos) increases my interest in the heritage.	
Social Cognition (SC)	SC1	I have a better understanding of history and culture after the visit.	(Qiu *et al*., 2019)
	SC2	I recognize the importance of preserving cultural heritage.	
	SC3	I gained deeper insight into national heritage values.	
	SC4	I feel responsible for maintaining cultural values.	
Personal Identity (PI)	PI1	I feel that my personal identity is connected to this heritage.	(Olson, 2016)
	PI2	I feel proud of my national culture.	
	PI3	I want to contribute to preserving and promoting cultural heritage.	
Outcome variable:			
Commitment to Revisit (CR)	CR1	I feel a strong connection to this cultural heritage site.	(Li & Petrick, 2010)
	CR2	I want to revisit this site in the future.	
	CR3	I am willing to recommend this heritage site to others.	
	CR4	I feel responsible for the conservation of this heritage.	

To reduce measurement error, each construct score was calculated as the arithmetic mean of its respective items. These composite scores served as the basis for fuzzy-set calibration.

Data collection and reliability analysis

Data were collected from a sample of 150 valid respondents who had visited cultural heritage sites in Hanoi, Vietnam. Participants were recruited via purposive sampling and completed the questionnaire voluntarily. The sample includes domestic tourists only. Demographic information (e.g., age, gender, visit motivation) was also collected to ensure sample diversity. **Table 2** presents the demographic and behavioral characteristics of respondents.

Table 2. Demographic and behavioral characteristics of respondents

Characteristics		Frequency	Percent
Gender	Male	67	44.7
	Female	83	55.3
Age Group	18-20	45	30.0
	21-23	70	46.7
	24-25	35	23.3
Education Level	University	74	49.3
	College	41	27.3
	High school	35	23.3
Main Motivation	Photography and checking in	41	27.3

	Learning about history and culture	62	41.3
	Entertainment and relaxation	47	31.3
Visit Frequency	First-time	38	25.3
	Second time	63	42.0
	Third-time or more	49	32.7
Total		450	100.0

Table 2 presents the demographic and behavioral characteristics of the 150 respondents who participated in the survey. The distribution is as follows:

Gender: The sample was relatively balanced, with 55.3% identifying as female and 44.7% as male. This slight predominance of female respondents aligns with typical participation patterns in cultural tourism surveys.

Age Group: Most participants (46.7%) were in the 21–23 age range, followed by 30.0% aged 18–20 and 23.3% aged 24–25. This suggests that the study primarily captured the perceptions of young adult tourists, particularly from the Gen Z cohort.

Education Level: Nearly half of the respondents (49.3%) were university students, with 27.3% at the college level and 23.3% having completed high school. The educational background indicates a relatively high level of academic attainment, which may influence their cognitive and cultural interpretations of heritage experiences.

Main Motivation: The most reported travel motivation was learning about history and culture (41.3%), followed by entertainment and relaxation (31.3%), and photography and social media check-ins (27.3%). This highlights a blend of intrinsic and extrinsic motivations among heritage tourists.

Visit Frequency: While 25.3% of respondents were first-time visitors, a majority (74.7%) had visited the site at least once before—42.0% were on their second visit, and 32.7% had visited three times or more. This indicates a considerable level of repeat visitation, reflecting potential commitment behavior and experiential attachment to the heritage destination.

These demographic and behavioral insights provide a meaningful context for interpreting the configurational patterns derived from fsQCA analysis in later sections.

To assess the internal consistency of the measurement scales, Cronbach's Alpha coefficients were calculated for each construct. As shown in **Table 3**, all values exceed the commonly accepted threshold of 0.70 (Nunnally & Bernstein, 1994), indicating satisfactory reliability. These results confirm that the survey items reliably measure their respective latent constructs.

Table 3. Cronbach's Alpha for measurement scales

Variables	Number of items	Cronbach's Alpha
Cultural Heritage Tourism Experience	4	0.738
Perceived Heritage Value	5	0.896
Tourism Media Influence	4	0.788
Social Cognition	4	0.885
Personal Identity	3	0.875
Commitment to Revisit	4	0.830

Reliability of the constructs was assessed using Cronbach's Alpha. All values exceeded the commonly accepted threshold of 0.70 (Nunnally & Bernstein, 1994), indicating acceptable to high internal consistency across all measurement scales. Specifically, Perceived Heritage Value ($\alpha = 0.896$), Social Cognition ($\alpha = 0.885$), and Personal Identity ($\alpha = 0.875$) showed excellent reliability, while the remaining constructs demonstrated good internal consistency (α ranging from 0.738 to 0.830). Thus, all constructs were deemed reliable for further analysis.

FsQCA Analysis

Fuzzy-Set Calibration

The raw Likert-scale data were converted into fuzzy-set membership scores using Ragi's (2008) direct method. For each condition and the outcome, three qualitative anchors were specified:

0.95 = full membership

0.50 = crossover (maximum ambiguity)

0.05 = full non-membership

Calibration thresholds were theoretically derived and informed by prior research on heritage tourism behavior. This procedure ensured that fuzzy scores reflected substantively meaningful distinctions among tourists based on their perceptions, experiences, and identity-related evaluations.

Necessity Analysis

Before assessing sufficiency, the analysis examined whether any individual causal condition constitutes a necessary condition for high tourist commitment. A condition is deemed necessary when the outcome cannot occur in its absence, even though the condition alone may not be sufficient (Ragin, 2008). Following Schneider and Wagemann (2012), a consistency threshold of 0.90 was adopted.

Table 4 presents the results for both the presence and absence of each antecedent. None of the five causal conditions—CHTE_fs, PHV_fs, TMI_fs, SC_fs, or PI_fs—reaches the 0.90 threshold. The negated conditions also fall well below this benchmark. Thus, no single condition, nor its absence, is necessary for high tourist commitment.

Table 4. Necessity analysis results for high commitment (CR_fs)

Condition	Consistency	Coverage	Conclusion
CHTE_fs	0.679	0.785	Not necessary
PHV_fs	0.728	0.709	Not necessary
TMI_fs	0.799	0.759	Not necessary
SC_fs	0.633	0.787	Not necessary
PI_fs	0.700	0.728	Not necessary
~CHTE_fs	0.661	0.665	Not necessary
~PHV_fs	0.572	0.686	Not necessary
~TMI_fs	0.548	0.679	Not necessary
~SC_fs	0.630	0.598	Not necessary
~PI_fs	0.597	0.664	Not necessary

Among the presence conditions, TMI_fs exhibits the highest necessity consistency (0.799), followed by PHV_fs (0.728) and PI_fs (0.700). Although not strictly necessary, these results indicate that high commitment is frequently accompanied by stronger media influence, perceived value, and identity alignment. These findings reinforce the configurational premise of fsQCA that the outcome is best explained by combinations of conditions rather than by any isolated factor. Accordingly, the analysis proceeds to sufficiency assessment using truth table construction.

Truth Table Construction

A truth table was constructed using the calibrated fuzzy-set scores of the five antecedent conditions. Following best practice (Ragin, 2008; Schneider & Wagemann, 2012), two decision rules were applied: Frequency threshold: 1 case; Consistency threshold: 0.80

Under these criteria, 21 empirical configurations met the frequency requirement, of which 20 exhibited high membership in the outcome. The distribution of truth table rows indicates substantial equifinality and confirms the absence of a dominant causal pattern. Based on these parameters, the complex, intermediate, and parsimonious solutions were computed using the Quine–McCluskey Boolean minimization algorithm.

Boolean Minimization and Solution Derivation

Boolean minimization was conducted to derive three solution types:
Complex solution: based strictly on observed combinations, without logical remainders
Parsimonious solution: incorporates all logical remainders to identify core conditions
Intermediate solution: uses theoretically plausible remainders and serves as the primary interpretive model
The parsimonious solution identified four core conditions: TMI_fs, PHV_fs, SC_fs, and PI_fs, representing the essential causal building blocks of tourist commitment. The intermediate solution yielded nine sufficient configurations grouped into three overarching patterns: media-driven, identity-anchored, and cognitive–emotional pathways, which form the basis for the results and discussion presented in Section 4.

Results and Discussion

Parsimonious Solution

The parsimonious solution identifies the most essential causal conditions associated with high tourist commitment, regardless of whether these conditions appear in any complex or intermediate configuration.

Table 5. Parsimonious solution for tourist commitment

No.	Core Condition	Raw Coverage	Unique Coverage	Consistency
1	Perceived Heritage Value (PHV_fs)	0.728	0.033	0.709
2	Tourism Media Influence (TMI_fs)	0.799	0.048	0.759
3	Social Cognition (SC_fs)	0.633	0.007	0.787
4	Personal Identity (PI_fs)	0.700	0.025	0.728

Solution coverage: 0.956
Solution consistency: 0.655

Table 5 presents the parsimonious solution, which identifies the core causal conditions underlying high tourist commitment. Four antecedents: PHV_fs, TMI_fs, SC_fs, and PI_fs emerge as core conditions, each appearing across multiple minimized pathways. Among them, Tourism Media Influence shows the strongest explanatory contribution (raw coverage = 0.799), highlighting its foundational role in shaping evaluative and identity-relevant meanings. Although the consistency values (0.709–0.787) fall below typical sufficiency thresholds, they reflect the aggregated nature of parsimonious minimization and serve primarily to distinguish core from contributing conditions. These core determinants form the causal backbone for the intermediate configurations reported later.

Intermediate Solution

Table 6. Configurational pathways leading to high tourist commitment (Intermediate Solution)

Config.	CHTE	PHV	TMI	SC	PI	Raw Cov.	Unique Cov.	Consistency
C1	⊗	○	●	⊗	○	0.404	0.021	0.772
C2	⊗	●	●	⊗	⊗	0.457	0.017	0.869
C3	●	⊗	○	○	●	0.363	0.006	0.840
C4	⊗	●	●	○	○	0.404	0.006	0.824
C5	●	⊗	○	⊗	●	0.387	0.002	0.786
C6	⊗	⊗	⊗	●	⊗	0.206	0.006	0.919
C7	⊗	●	○	○	●	0.317	0.000	0.806
C8	○	●	⊗	●	⊗	0.403	0.021	0.772
C9	●	⊗	●	○	●	0.591	0.092	0.810

Table 6 summarizes the nine configurational pathways leading to high tourist commitment. Filled circles (●) indicate core conditions appearing in both parsimonious and intermediate solutions, while open circles (○) represent contributing conditions. Crossed symbols (⊗) denote the absence of a condition. The consistency values of all

configurations exceed the recommended threshold of 0.75, confirming their sufficiency. Raw coverage values indicate the empirical relevance of each configuration, whereas unique coverage shows the share of the outcome explained exclusively by that pathway.

Configuration Analysis

The intermediate solution identifies nine causal configurations (C1–C9) sufficient for producing high tourist commitment, with a solution consistency of 0.732 and a solution coverage of 0.857. These results from **Table 7** demonstrate strong causal complexity and confirm the fsQCA principles of equifinality and asymmetric causality, indicating that different combinations of experiential, cognitive, and identity-based conditions can generate similarly high levels of commitment.

Table 7. Configurational Pathways Leading to High Tourist Commitment

Pattern A: Media-driven pathways					
Config	**CHTE**	**PHV**	**TMI**	**SC**	**PI**
C1	⊗	○	●	⊗	○
C2	⊗	●	●	⊗	⊗
C4	⊗	●	●	○	○
Pattern B: Identity-anchored pathways					
C5	●	⊗	○	⊗	●
C6	●	⊗	○	○	●
C8	○	●	⊗	●	⊗
C9	●	⊗	●	○	●
Pattern C. Cognitive–emotional pathways					
C3	●	⊗	○	○	●
C7	⊗	⊗	⊗	●	⊗

Notes: ● core condition; ○ contributing condition; ⊗ absence of condition.
CHTE = Cultural Heritage Tourism Experience; PHV = Perceived Heritage Value;
TMI = Tourism Media Influence; SC = Social Cognition; PI = Personal Identity
Table 7 expresses three broader causal patterns that emerge:
Pattern A: Media-driven pathways (C1, C2, C4)

Tourism Media Influence (TMI_fs) appears as a core or contributing condition across multiple configurations. Whether paired with Personal Identity (PI_fs) or high Perceived Heritage Value (PHV_fs), strong media exposure consistently enhances commitment. This suggests that digital narratives, online storytelling, and immersive media (e.g., AR/VR) play a central role in reinforcing affective ties to heritage sites.

Pattern B: Identity-anchored pathways (C5, C6, C8, C9)

Several configurations highlight Personal Identity (PI_fs) as a decisive condition. In these pathways, commitment arises even when PHV_fs or CHTE_fs is weaker. This indicates that self-congruity, cultural pride, or identity alignment can independently generate strong behavioral attachment to heritage tourism, reflecting deeper symbolic engagement beyond the immediate experience.

Pattern C: Cognitive-emotional pathways (C3, C7)

These configurations emphasize the role of value judgments (PHV_fs) and social meaning-making (SC_fs). Interestingly, commitment can still emerge under conditions with low PHV_fs or ~TMI_fs, suggesting compensatory mechanisms whereby cognitive appreciation or social identity cues substitute for weaker experiential or media-based drivers.

Taken together, these findings show that tourist commitment does not rely on any single determinant but results from multiple, functionally equivalent causal recipes. For destination managers, this implies that strategies to enhance commitment should be tailored to distinct causal pathways—strengthening digital engagement for some visitors, deepening identity alignment for others, and enhancing heritage value interpretation for yet another segment.

The fsQCA results reveal that tourist commitment in cultural heritage settings is shaped not by isolated determinants but by multiple, functionally equivalent causal configurations. This supports the principle of equifinality, indicating that different visitors may arrive at high commitment through distinct combinations of experiential, cognitive, and identity-related conditions. Three overarching causal patterns emerge from the intermediate solution.

First, media-driven pathways (Pattern A) demonstrate that TMI frequently acts as a core driver of commitment. When TMI is combined with either strong PHV or PI, commitment is consistently high even in the absence of CHTE or SC. This underscores the persuasive power of digital narratives and mediated imagery in shaping attachment, aligning with the growing recognition that online and social media environments significantly construct tourist meaning-making (Gretzel *et al*., 2020; Tham *et al*., 2020). These findings suggest that media influence can substitute for weak onsite experiences, amplifying symbolic value and emotional anticipation.

Second, identity-anchored pathways (Pattern B) highlight the centrality of PI. Several configurations show that tourists can become highly committed even when PHV or CHTE is low, provided that the destination aligns closely with their identity, cultural roots, or self-concept. This aligns with experiential value theory (Holbrook, 1999) and research on self-congruity in tourism, which demonstrates that psychological resonance can outweigh purely evaluative or functional assessments. Such pathways reinforce the idea that heritage destinations function not only as sites of learning but also as spaces where visitors negotiate belonging, memory, and identity.

Third, cognitive–emotional pathways (Pattern C) involve combinations centered on value-driven or meaning-driven cognition. In these configurations, SC or PHV interacts with contributing conditions such as TMI or PI. Interestingly, some pathways also show that commitment arises even when multiple positive conditions are absent, indicating compensatory mechanisms among causal factors. This aligns with Sweeney and Soutar's (2001) view of perceived value as multifaceted and context-dependent, and with studies showing that cognitive appraisals can offset gaps in experiential or informational inputs (Li & Petrick, 2010; Rasoolimanesh *et al*., 2016).

Methodologically, the study reinforces the value of fsQCA as a tool for unveiling causal complexity. Unlike symmetric approaches (e.g., regression or SEM), fsQCA reveals how different combinations, not net effects, shape behavioral outcomes (Ragin, 2008). This aligns with recent tourism behavior research employing configurational methods (Seyfi *et al*., 2020; Pappas & Woodside, 2021; Seyfi *et al*., 2024), showing that high commitment results from interdependent, conjunctural conditions rather than isolated predictors. By applying fuzzy set logic, the present study integrates qualitative interpretability with quantitative transparency, offering a methodological contribution to tourism scholarship.

Overall, these findings underscore that heritage tourist commitment is driven by interlocking experiential, symbolic, and identity-based mechanisms. The results broaden theoretical perspectives on tourist loyalty by emphasizing heterogeneity and multifinality, while also providing actionable insights for practitioners designing targeted engagement strategies.

Conclusion

This study demonstrates the value of adopting a configurational perspective to understand tourist commitment in cultural heritage tourism. Using fsQCA, the findings show that commitment is not driven by any single determinant but emerges from multiple, equifinal combinations of experiential, cognitive, and identity-related conditions. These interdependent pathways highlight the heterogeneous ways in which visitors form lasting attachments to heritage destinations, underscoring the theoretical importance of causal complexity in tourism behavior.

Across the three overarching pathways identified, media-driven, identity-anchored, and cognitive–emotional, this study reveals that tourists may arrive at commitment through different psychological mechanisms. Some visitors anchor their commitment in digitally mediated interpretations; others rely on personal identity congruence; and yet others draw meaning from emotionally resonant experiences and perceived heritage value. These findings highlight the diversity of commitment trajectories and support the need for flexible, segmentation-based engagement strategies.

From a scholarly perspective, this research contributes to the literature in three meaningful ways: First, it positions tourist commitment as a configurational outcome shaped by heterogeneous causal “recipes,” challenging linear behavioral assumptions prevalent in symmetric tourism models. This responds to longstanding calls to recognize causal complexity within tourism behavior. Second, by integrating experience, perceived value, media influence,

social cognition, and personal identity into a single fsQCA framework, the study provides a more holistic theoretical explanation for commitment formation in heritage tourism. It shows that each condition may serve as a core or peripheral contributor depending on the causal pathway. Third, the study introduces fuzzy-mathematical reasoning as a rigorous tool for modeling behavioral dynamics in tourism, demonstrating its ability to capture equifinality, conjunctural causation, and causal asymmetry. This methodological enhancement complements symmetric approaches such as SEM and enriches the broader behavioral research agenda.

From a managerial perspective, the results offer actionable insights for heritage destination managers, tourism authorities, and digital marketing practitioners. First, pathways involving media influence suggest that curated narratives, visual storytelling, and social-media-based engagement can significantly strengthen commitment among digitally oriented visitors. Authentic and emotionally resonant content should be prioritized. Second, identity-anchored configurations highlight the importance of designing activities that allow visitors to express, affirm, or explore personal identities. Programs that emphasize meaning-making, cultural relevance, and personalization may enhance long-term loyalty. Third, cognitive–emotional pathways underscore the necessity of delivering high-quality, immersive heritage experiences that enhance perceived value and stimulate emotional connection. Interpretive guides, experiential installations, and participatory activities can reinforce this effect. Collectively, these implications call for segmented and pathway-specific strategies rather than one-size-fits-all interventions.

Limitations and Dimensions for Future Research

Despite its contributions, several limitations warrant caution. The use of a single-destination, cross-sectional dataset may restrict generalizability, and fuzzy-set calibration, although theoretically grounded, inevitably involves judgment that may influence the resulting configurations. Additionally, commitment was examined at a single point in time, omitting potential changes in visitors' attitudes or motivations.

Future studies could expand this line of inquiry by incorporating larger and more diverse samples, refining calibration anchors through expert consensus or qualitative inquiry, and adopting longitudinal or multi-wave designs to capture the evolution of commitment over time. Comparative analyses employing both fsQCA and symmetric approaches may also enhance methodological triangulation and theory refinement. Extending the configurational perspective to related outcomes such as cultural conservation behavior, heritage activism, or sustainable visitation would further enrich tourism scholarship.

Overall, this study reinforces the utility of fsQCA for unpacking the complex pathways that shape heritage tourists' commitment and provides actionable insights for designing more targeted and meaningful viFsitor engagement strategies.

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