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Relationship Between Perceived Authenticity, Place Attachment, and Tourists' Environmental Behavior in Industrial Heritage

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Abstract: As a crucial component of cultural heritage, industrial heritage possesses considerable cultural, historical, and economic significance. The key challenge for industrial heritage sites is to foster eco-conscious actions among visitors while boosting tourism spending. Based on the S-O-R theory, we constructed a relationship model between authenticity, place attachment and environmental responsibility behavior through structural equation modeling and tested it with the survey data of tourists in Maoming open-pit mine ecological park. Findings reveal that both the object-related authenticity and the existential authenticity of the experience enhance the sense of reliance and belonging to the place, with the former also directly promoting visitors' eco-conscious actions. In contrast, experiential authenticity does not exert a direct effect on eco-conscious actions. The sense of place reliance and identity are found to be significantly and positively linked to eco-conscious behavior. Furthermore, place reliance and identity act as intermediaries in the relationship between object authenticity, experiential authenticity, and eco-conscious behavior, serving as a sequential mediating factor. The study suggests strategies such as augmenting financial support to preserve the authenticity of the site, prioritizing the enhancement of infrastructure and the creation of cultural offerings to elicit emotional responses, and reinforcing emotional bonds to encourage eco-conscious actions.

Keywords: industrial heritage; perceived authenticity; place attachment; environmentally responsible behavior

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1. Introduction

In recent years, industrial heritage tourism has become a popular leisure activity. This is a new type of tourism integrating heritage tourism and industrial civilization, and it can not only satisfy the "new and realistic" tourists but also satisfy the "intellectual and reflective" tourists [1]. With the rapid development of industrial heritage tourism, the local ecology will undoubtedly face the threat of the influx of tourists. At this stage, researchers have begun to pay attention to the environmental responsibility behavior of tourists, to encourage tourists to assume environmental responsibility, so that they become the builders of ecological civilization and the protectors of industrial heritage, reducing the negative impact of tourism on the industrial heritage environment and promoting the sustainable development of industrial heritage tourism resources. Therefore, studying the formation mechanism of tourists' environmental responsibility behaviors in industrial heritage is beneficial to the protection and inheritance of industrial heritage. Authenticity is a concept of social construction and personal experience [2]. The authenticity of industrial heritage may provide tourists with different experiences and meanings. The rapid development of

modern society makes people alienated and eager to find authentic experiences in tourism. Tourists yearn for the original tourism experience that is untouched and close to nature and history. Industrial heritage, with its unique originality and simplicity, provides tourists with a space for a short escape from the modern hustle and bustle. Current research has focused on the influence of individual tourist characteristics, such as environmental attitudes [3], place attachment [4], and human–place relationship factors on tourists' environmentally responsible behavior. However, the attributes of tourist destinations themselves, such as service quality [5] and environmental landscape qualities [6], also have an impact on the implementation of tourists' environmentally responsible behaviors. Among them, tourism authenticity, as one of the important attributes of tourist destination characteristics, has received attention from some scholars. Tourism authenticity not only triggers tourists' emotional experiences, such as attachment [7] and satisfaction [8], but these emotions further influence tourists' behaviors (intentions), such as revisiting and recommending [9] and environmental protection [10]. A study by Sun-Bowen Zhang et al. showed that the perception of authenticity not only has a direct effect on tourists' environmentally responsible behavior, but also has an indirect effect through place attachment [11].

Place attachment, as a positive human–place emotional connection, has a significant effect on tourists' attitudes and willingness to implement environmentally responsible behaviors. Tourism authenticity, as an effective predictor of place attachment [12], may also have an impact on tourists' environmentally responsible behavior [10]. Chao Xiaojing et al. pointed out that place attachment and perceived tourism authenticity play a mediating role in the relationship with tourists' environmentally responsible behavior [12].

Currently, some scholars have researched cultural heritage [13], but there is a relative lack of research on industrial heritage tourism. This paper expands the theoretical scope of industrial heritage tourism variables. More importantly, based on the S-O-R model, the mediating roles of place dependence and place identity between the two types of perceived authenticity and environmentally responsible behavior are explored. The results of this study can provide a useful reference for harmonizing the relationship between tourism development and environmental protection and promoting the sustainable development of industrial heritage tourism.

2. Literature Review and Theoretical Foundation

2.1. Perceived Authenticity

Authenticity is fundamentally about ensuring that cultural heritage is maintained and conveyed in a manner that is true to its origins, emphasizing genuineness over imitation or falsehood. The concept of authenticity has its origins dating back to 1973, when Mac Cannell posited that authenticity imparts a real and true impression of the local culture to visitors [14]. Regarding the conceptual paradigm of "authenticity", there are three dominant views: object-related, constructivist, and existentialist [15]. Objective relevance suggests that authenticity is a characteristic inherent in the object itself [16]. Constructivism holds that authenticity is not an absolutely objective existence, but is the result of visitors' construction based on subjective understanding and through social interaction. Existentialism, on the other hand, transcends the dependence on the object and regards authenticity as the presentation of the personal real state of the tourist during the tourism process [17]. In Wang's view, the intrinsic structure of tourism authenticity can be composed of two parts: object-related authenticity and existential authenticity [15]. The former integrates object-related authenticity and constructivist authenticity, emphasizing the importance of tourism objects; the latter focuses on the subjective experience of tourism subjects [18]. Since most empirical studies have adopted the "object–existence" dichotomy [16,19], this paper focuses on object-related authenticity and existential authenticity.

2.2. Place Attachment

The notion of place attachment stems from attachment theory, a prominent psychological framework that posits attachment as a relatively enduring characteristic of an individual's personality. Place attachment encapsulates the idea of the bond that individuals form with places that hold significance and meaning to them [20]. This bond engenders a sense of belonging and attachment, akin to feeling at home or being rooted in a particular locale [21]. The concept of place attachment has garnered extensive interest across the fields of geography and psychology, and it is recognized as a multifaceted construct. It encompasses various dimensions, including place dependence and place identity. Place dependence captures the degree to which a particular location fulfills the tourists' needs by supplying essential social and material resources [22]. On the other hand, place identity pertains to the tourists' sense of affiliation with the place or its symbolic significance [23]. This multidimensional perspective of place attachment underscores its complexity and the various ways in which people can connect with and value different places.

2.3. Environmentally Responsible Behavior (ERB)

The concept of environmentally responsible behavior is pivotal within the realm of environmental psychology, initially introduced by Borden and Schettino in 1979 [24]. According to Cottrell and Graefe, this behavior is primarily characterized by individuals' environmental concern, commitment, and ecological literacy [25]. Iwata further observed that environmentally responsible behavior can manifest in various forms of actions, including waste recycling and energy conservation [26]. Lee expanded on this by defining environmentally responsible behavior as any initiative by individuals or collectives aimed at fostering environmental sustainability, mitigating adverse environmental effects, and adopting suitable measures to safeguard the environment [27]. In the context of tourism, the environmentally responsible behavior of tourists is of paramount importance for the preservation of the ecological integrity of tourist destinations [3]. Extensive research has demonstrated that nurturing such behavior is essential for the sustainable management of these destinations and is considered a best practice for the upkeep of scenic areas [28]. This underscores the significance of instilling eco-conscious practices among tourists, as their actions can contribute to the conservation of natural and cultural heritage sites [29].

Given the critical role that environmentally responsible behavior plays in the pursuit of sustainable development, the academic community has extensively studied the eco-conscious actions of tourists across various settings, including museums, hotels, camping grounds, and beaches [30–32]. These investigations have utilized theoretical frameworks to dissect the influence of demographic traits, psychological predispositions, and environmental conditions on tourists' environmentally responsible behavior. This approach has contributed to a more nuanced comprehension of the factors that drive such behavior.

2.4. S-O-R Modelling

The S-O-R model considers elements of the environment as stimuli (S) that influence an individual's internal state (O), leading to behavioral responses (R), which can be either approach (seeking closer interaction) or avoidance (stepping back from interaction) (Figure 1). This model has seen broad application across a spectrum of research domains. However, due to the diverse interests of scholars in the aspects of stimuli and organisms, the S-O-R framework has yielded a range of application outcomes. For instance, Şahin and Kılıçlar employed the S-O-R model to demonstrate that tourists' emotions and the value of their experiences can foster intentions to behave in certain ways [33]. Historically, the S-O-R model has been applied to research concerning smartphones, online shopping, or online communities. In contrast, its application to the study of industrial heritage destina-

tions has been more limited. This presents an opportunity for new research to explore the applicability of the S-O-R theory in understanding interactions between tourists, the industrial heritage environment, and behaviors resulting from these interactions, particularly in promoting environmentally responsible tourism practices.

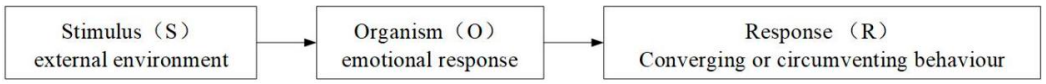


Figure 1. Stimulus–organism–response model.

This research delves into the application of the S-O-R framework within the realm of industrial heritage tourism, examining the interplay between environmental cues—such as the authenticity of the object and the authenticity of the experience—and the psychological and emotional states of tourists, including their dependence on and identification with the place. Furthermore, it investigates how these factors influence tourists' behavior towards environmental sustainability.

3. Research Hypotheses and Model Proposal

3.1. Perceived Authenticity and Tourists' Environmentally Responsible Behavior

Authenticity plays a dual role in tourism: it both results from and facilitates the tourism experience, often motivating tourist visits. Zhang et al., through a case study of Nanjing Tangshan Mining Park, developed a framework to understand perceived authenticity. They explored how it interacts with positive and negative emotions, tourist memories, and environmentally responsible behavior, revealing that high perceived authenticity enhances tourists' environmentally friendly actions [1]. Yang et al. investigated this relationship in the Huangshan Scenic Area and found that perceived authenticity positively impacts environmentally responsible behavior [34]. In addition, according to Wang Liangju and Wang Yaping, two dimensions of tourism authenticity, namely object-related authenticity and existential authenticity, significantly contribute to tourists' environmentally responsible behavior [35]. The following hypotheses are proposed:

H1. *Object-related authenticity has a significant positive effect on environmentally responsible behavior.*

H2. *Existential authenticity has a significant positive effect on environmentally responsible behavior.*

3.2. Object-Related Authenticity and Existential Authenticity

Since "authenticity" was introduced into tourism studies, scholars have increasingly examined its meaning and implications. Wang identified two types of authenticity: object-related and existential, suggesting they may be unrelated. He proposed that existential authenticity is not connected to objects but rather to activities, which can be categorized into intra-personal (bodily sensations) and inter-personal (self-construction) dimensions [17]. Resigned and Steiner also affirmed the distinct nature of these concepts [36]. Furthermore, Kolar found a statistically significant positive relationship between object-related and existential authenticity in their research on Roman heritage sites across Europe [2]. The following hypotheses are proposed:

H3. *Object-related authenticity has a significant positive effect on existential authenticity.*

3.3. Perceived Authenticity and Place Attachment

Tourists' perceptions of value and experience quality at a destination are important indicators of place attachment. Perceived authenticity is frequently examined as a factor influencing place attachment. Liu studied Hangzhou and Wuhan and found that perceived

authenticity enhances place dependence and place identity [37]. Remission similarly identified a positive effect of perceived authenticity on place dependence in African island destinations [8]. Zhao noted that both object-related and existential authenticity positively affect place attachment in traditional village tourism. When a destination meets tourists' authenticity expectations, it strengthens their connection and identity with the place [38]. The following hypotheses are proposed:

H4a. *Object-related authenticity has a significant positive effect on place attachment.*

H4b. *Object-related authenticity has a significant positive effect on place identity.*

H5a. *Existential authenticity has a significant positive effect on place attachment.*

H5b. *Existential authenticity has a significant positive effect on place identity.*

3.4. Place Attachment and Environmentally Responsible Behavior

Research indicates that place attachment has a substantial effect on individual behavior intentions and is a strong predictor of environmentally responsible actions. Tourists with a deeper attachment to a destination are more likely to engage in eco-friendly behaviors. Strait et al. found a positive correlation between place attachment and environmentally responsible behavior in a study of national park visitors over three months [12]. Cheng et al. discovered a direct positive effect of place attachment on environmentally responsible actions among visitors to six prominent tourist sites in Shaanxi Province [39]. In addition, Cheng Weijin et al. showed that when tourists develop a higher degree of attachment to the environment of a place, they tend to show a stronger willingness to protect the environment. This attachment not only prompts tourists to form a commitment to environmental protection, but also makes them more inclined to take the initiative to implement environmentally responsible behaviors [40]. The following hypotheses are proposed:

H6. *Place dependence has a significant positive effect on place identity.*

H7. *Place dependence has a significant positive effect on environmentally responsible behavior.*

H8. *Place identity has a significant positive effect on environmentally responsible behavior.*

3.5. The Mediating Role of Place Attachment

The S-O-R model posits that the environment stimulates tourists' cognitive and emotional processes, which in turn affect their behavior. Perceived authenticity arises from interactions with the environment, services, and other tourists, and can trigger various cognitive, emotional, and behavioral responses. Place attachment reflects the multifaceted relationship between individuals and places, incorporating both material and social aspects. In the field of tourism research, Guo Anxi et al. explored the relationship between tourism authenticity and place attachment [41]. In addition, the study confirmed the significant contribution of place attachment to tourists' environmentally responsible behavior [39]. According to Chao Xiaojing et al. on the other hand, place attachment played a key mediating role in the relationship between destination attractiveness and tourists' environmentally responsible behavior [10]. The following hypotheses are proposed:

H9a. *Place dependence mediates the relationship between object-related authenticity and environmentally responsible behavior.*

H9b. *Place identity mediates the relationship between object-related authenticity and environmentally responsible behavior.*

H9c. *Object-related authenticity influences place identity through place dependence, which in turn impacts environmentally responsible behavior.*

H10a. *Place dependence mediates the relationship between existential authenticity and environmentally responsible behavior.*

H10b. *Place identity mediates the relationship between existential authenticity and environmentally responsible behavior.*

H10c. *Existential authenticity influences place identity through place dependence, which in turn impacts environmentally responsible behavior.*

In summary, guided by the S-O-R theoretical framework, this study combines the established research hypotheses and constructs a hypothetical model (shown in Figure 2). This model involves tourism authenticity (including object-related authenticity and existential authenticity), place attachment (covering place dependence and place identity), and tourists' environmentally responsible behaviors. It simultaneously incorporates environmental factors of the tourist destination and tourists' individual emotional factors into the scope of consideration, aiming to explore the formation mechanism of tourists' environmental responsibility behavior.

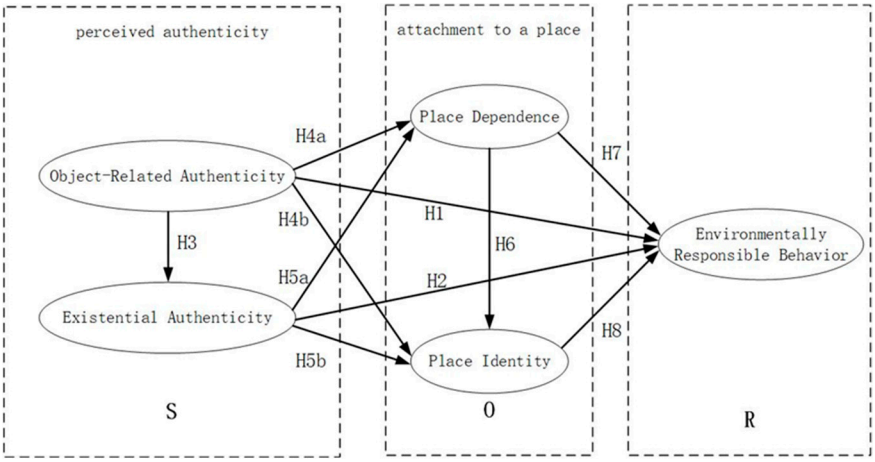


Figure 2. Research model.

4. Research Design

4.1. Overview of the Case Study Site

The Maoming open-pit mine ecological park, located in the Maonan District, is the second-largest open-pit mine site in China, formed due to the early extraction of oil from shale, as shown in Figure 3. The park covers an area of 10.07 square kilometers and is rich in mineral resources. Within the park, visitors can enjoy scenic spots such as the mine Pit Lake, German-style wooden houses, and wind chime flower fields [42]. It also features facilities like a museum and a children's playground. The park regularly hosts activities, including ecological restoration, afforestation, and popular science education on mining culture. In 2023, it was designated as a demonstration unit for environmental education bases in Guangdong Province and was included in the "Seventh Batch of China's 20th Century Architectural Heritage". Therefore, surveying park visitors provides valuable

references for academic research and management experience for similar tourism projects nationwide, helping more industrial sites achieve ecological revival and cultural heritage.

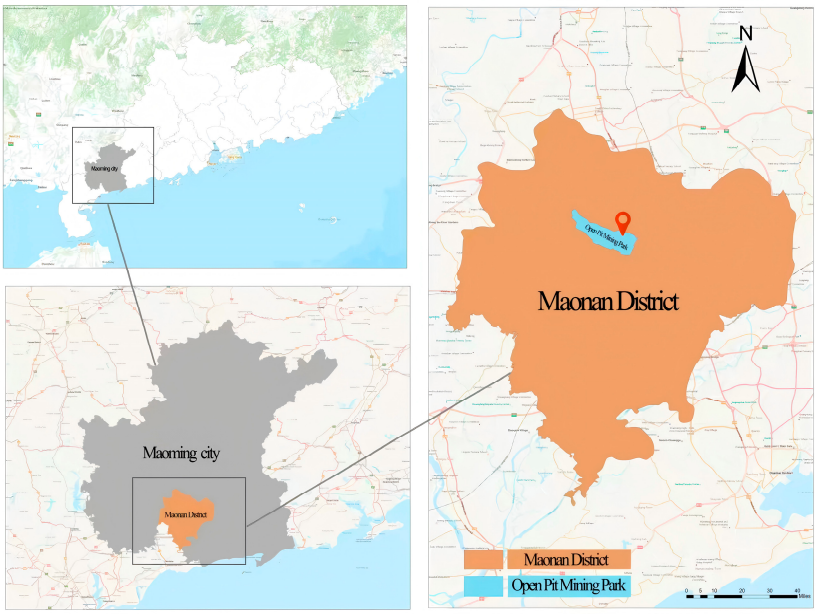


Figure 3. Maoming open-pit mine ecological park.

4.2. Questionnaire Design

The questionnaire of this study is divided into two parts. The first part covers the respondents' basic personal information, such as gender, age, education level, and personal monthly income. The second part focuses on three structurally measured variables, namely authenticity perception, place attachment, and environmentally responsible behavior. To ensure the validity and completeness of the questionnaire, the study carefully selected validated scales from the existing literature in the field and contextualized the scales to address the unique local tourism scenarios. The perceived authenticity scale, adapted from Kolar and Zabkar [2] and Zhang and Yin [43], consists of ten items covering two dimensions: object-related authenticity and existential authenticity. The place attachment scale, adapted from Williams and Vase [44], includes ten items across two dimensions: place dependence and place identity. The environmentally responsible behavior scale, adapted from Cheng [39] and Steg and Vlek [45], contains five items. All items are rated on a 7-point Likert scale, where "7" indicates "strongly agree" and "1" indicates "strongly disagree".

4.3. Data Collection

On 20 August 2023, the survey team took the lead in selecting 20 tourists to conduct the pre-test in Maoming open-pit mine ecological park and collected opinions from three tourism industry experts and destination managers. Based on the results of the pre-test, the questionnaire was adjusted and improved accordingly. This paper adopts the convenience sampling method, which is a non-probability sampling method. In order to enhance the accuracy of sampling, this study selects relatively active and structurally more complete clusters in the study area for sampling. The entrances and exits of the park, the children's playground, the German-style cabins, and the sea of wind chimes and flowers were taken as the main investigation sites, as these areas are not only the necessary way for tourists to enter the park but also popular places for tourists to recreate and gather for communication with a large flow of people, thus helping to improve the overall representativeness of the sample and the accuracy of the sampling. In addition, in order to guarantee the quality of data collection, before the questionnaire was distributed, the researchers were uniformly

trained to gain an in-depth understanding of the objectives and specific requirements of the study. Data collection began on 5 September 2023, and lasted until 15 October, during which a total of 420 questionnaires were distributed, and 382 valid questionnaires were finally returned, with the effective recovery rate of the questionnaires reaching 91%.

Harman's one-way analysis of variance was used to test for homoscedastic errors. Factors were extracted by exploratory factor analysis without rotating the factors. The results showed that five factors were extracted, and the first factor explained 43.58% of the variance. According to the common criterion, if the amount of variance explained by the first factor does not exceed 50%, there is no serious homoscedastic error. The data in this study meet this criterion and can be analyzed subsequently.

5. Results

5.1. Descriptive Statistics of the Sample

Table 1 shows that there were more women, 53.7%. Those between the ages of 23 and 35 accounted for 35.6%. A total of 30.1% of the tourists had a high school education or less, while the rest (69.9%) had an associate's degree or higher. About one-quarter of the visitors (27.5%) indicated that their occupation was a business employee. About 90% of the tourists indicated that their personal monthly income exceeded RMB 2000.

Table 1. Basic sample information.

Variable	Description	Frequency	Percentage
Gender	Male	177	46.30%
	Female	205	53.70%
Age	18–22	62	16.20%
	23–35	136	35.60%
	36–45	83	21.70%
	46–55	58	15.20%
	56 years old and above	43	11.30%
Educational Attainment	High school and vocational school	115	30.10%
	College and undergraduate	214	56%
	Postgraduate and above	53	13.90%
Occupation	Government and public institution employees	74	19.40%
	Enterprise/Company employees	105	27.50%
	Students	53	13.90%
	Freelancers	86	22.50%
	Retired employees	38	9.90%
	Other	26	6.80%
Income Situation	Below 2000	42	11%
	2001–5000	136	35.60%
	5001–8000	92	24.10%
	8001–10,000	67	17.50%
	Above 10,000	45	11.80%

5.2. Measurement Model Evaluation

To evaluate the fit and reliability of the measurement model, confirmatory factor analysis was conducted using Amos 24.0. Validation factor analysis is a statistical method used to test the consistency between theoretical models and data. It is based on the researcher's predetermined theoretical relationships and verifies whether the observed variables accurately reflect the underlying factors, and the method is widely used in social sciences, psychology, and other fields. The results, shown in Table 2, indicate that all fit indices are within acceptable ranges, demonstrating that the model fit is satisfactory. The results in Table 3 reveal that factor loadings range from 0.633 to 0.892, all exceeding 0.6, indicating a strong relationship between the measured item and the factor. Furthermore, the Cronbach's α values for the latent variables range from 0.870 to 0.921, all above 0.7; this indicates that the scales for each latent variable have good reliable reliability. The composite reliability (CR) values range from 0.874 to 0.922, all above 0.6; this indicates good internal consistency across latent variable scales.

Table 2. Model fit.

Indicator	CMIN/DF	RMSEA	GFI	AGFI	NFI	CFI	TLI	IFI
Standard	<3	<0.08	>0.90	>0.90	>0.90	>0.90	>0.90	>0.90
Output	2.87	0.036	0.978	0.97	0.979	0.986	0.983	0.986
Judgement	Favorable	Favorable	Favorable	Favorable	Favorable	Favorable	Favorable	Favorable

Table 3. Confirmatory factor analysis results.

Variable and Measurement Items	Factor Loading	t-Value	CR	AVE	Cronbach's α
Object-Related Authenticity (OA)	—	—	0.906	0.658	0.901
The original appearance of the open-pit mine ecological park left a deep impression on me.	0.868	—	—	—	—
I am very interested in the historical and cultural heritage of the open-pit mine ecological park.	0.892	23.455 ***	—	—	—
I think the open-pit mine ecological park has unique local customs and practices.	0.798	19.391 ***	—	—	—
I like the overall layout and greenery of the open-pit mine ecological park.	0.831	20.74 ***	—	—	—
I enjoy the environment of the open-pit mine ecological park, which offers many interesting places to visit.	0.643	14.055 ***	—	—	—
Existential Authenticity (EV)	—	—	0.876	0.588	0.870
I am very interested in the tourism activities of the open-pit mine ecological park.	0.824	—	—	—	—
I think the open-pit mine ecological park helps me understand industrial heritage.	0.818	18.098 ***	—	—	—
I enjoy the unique natural experience in the open-pit mine ecological park.	0.750	16.105 ***	—	—	—
I believe the open-pit mine ecological park provides a good spiritual experience.	0.774	16.804 ***	—	—	—
I think the open-pit mine ecological park is closely related to human civilization.	0.654	13.531 ***	—	—	—
Place Dependence (PD)	—	—	0.879	0.595	0.871
I think the open-pit mine ecological park is the ideal place for leisure.	0.829	—	—	—	—
I believe no other place can provide the environment and facilities that match the open-pit mine ecological park.	0.788	12.583 ***	—	—	—
Compared to other places, I prefer the open-pit mine ecological park.	0.808	12.889 ***	—	—	—

Table 3. *Cont.*

Variable and Measurement Items	Factor Loading	t-Value	CR	AVE	Cronbach's α
The open-pit mine ecological park is more suitable for various activities than other places.	0.782	12.662 ***	—	—	—
Visiting the open-pit mine ecological park is more satisfying than visiting any other place.	0.633	13.122 ***	—	—	—
Place Identity (PI)	—	—	0.922	0.704	0.921
I really like the open-pit mine ecological park.	0.786	—	—	—	—
The open-pit mine ecological park is very special to me.	0.875	19.259 ***	—	—	—
The open-pit mine ecological park is full of wonderful memories for me.	0.881	19.428 ***	—	—	—
Visiting the open-pit mine ecological park helps me reflect on the relationship between humans and nature.	0.834	18.084 ***	—	—	—
The experience activities in the open-pit mine ecological park are very meaningful to me.	0.815	17.557 ***			
Environmentally Responsible Behavior (ERB)	—	—	0.874	0.583	0.921
I comply with the regulations to not damage the ecological environment of industrial heritage during my visit.	0.682	—	—	—	—
I do not litter while visiting the open-pit mine ecological park.	0.708	16.082 ***	—	—	—
I discuss the environmental protection issues of the open-pit mine ecological park with my companions.	0.842	16.485 ***	—	—	—
I am willing to participate in environmental protection activities at the open-pit mine ecological park.	0.822	13.687 ***	—	—	—
I use my spare time to learn about environmental protection.	0.750	13.143 ***	—	—	—

Note: *** indicates $p < 0.001$.

The validity of the scales for object-related authenticity, existential authenticity, place dependence, place identity, and environmentally responsible behavior was assessed using the average variance extracted (AVE) method. As shown in Table 4, the AVE values for each latent variable range from 0.583 to 0.704, all above 0.5, indicating good convergent validity. Additionally, the square root of the AVE values for each latent variable ranges from 0.764 to 0.839, all higher than the correlations with other variables, indicating good discriminant validity.

Table 4. Discriminant validity.

Variable	AVE	OA	EV	PD	PI	ERB
OA	0.658	0.811				
EV	0.588	0.199	0.767			
PD	0.595	0.296	0.753	0.771		
PI	0.704	0.544	0.518	0.569	0.839	
ERB	0.583	0.525	0.513	0.653	0.675	0.764

Note: Diagonal is open root value of AVE value.

5.3. Direct Effect Test

The R2 value of two types of authenticity perceptions affecting tourists' environmentally responsible behavior is 0.517, indicating that two types of authenticity perceptions in the model explain 51.7% of the variance in environmentally responsible behavior. The R2 value of two types of authenticity perception affecting place dependence is 0.477. The R2 value of two types of authenticity perception affecting place identity is 0.541. The R2 value of object-related authenticity perception affecting existentialism related authenticity

perception is 0.474. The R2 value of two types of authenticity perception affecting place identity is 0.541. The R2 value of two types of authenticity perception affecting place dependence is 0.477. Furthermore, the statistical significance and correlation of path coefficients were verified using the non-parametric percentile Bootstrap method (N = 5000), as shown in Figure 4 and Table 5. Object-related authenticity had a significant positive effect on environmentally responsible behavior (β = 0.288, t = 4.411, $p < 0.001$), existential authenticity perception (β = 0.199, t = 3.527, $p < 0.001$), place dependence (β = 0.146, t = 3.442, $p < 0.001$), and place identity (β = 0.420, t = 8.615, $p < 0.001$), and H1, H3, H4a, and H4b held. Existential authenticity perception did not have a significant direct positive effect on environmentally responsible behavior (β = −0.037, t = −0.475, $p > 0.05$), and H2 did not hold. Existential authenticity perception had a significant positive effect on place dependence (β = 0.754, t = 10.968, $p < 0.001$), and place identity (β = 0.223, t = 2.750, $p < 0.01$), and H5a and H5b both held. Place dependence had a significant positive effect on place identity (β = 0.270, t = 3.176, $p < 0.01$) and environmentally responsible behavior (β = 0.430, t = 4.874, $p < 0.001$), and H6 and H7 are valid. Local identity has a significant positive effect on environmental responsibility behavior (β = 0.326, t = 5.161, $p < 0.001$), and H8 is valid.

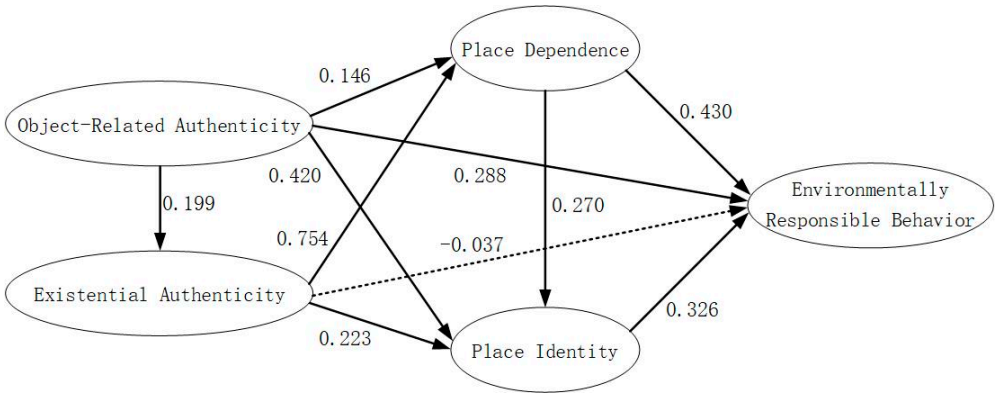


Figure 4. Statistical model.

Table 5. Hypothesis test results.

Hypothesis Path	Standardized Path Coefficient	Standard Error	t-Value	*p*-Value	Conclusion
H1: OA → ERB	0.288	0.047	4.411	***	Supported
H2: EV → ERB	−0.037	0.075	−0.475	0.635	Unsupported
H3: OA → EV	0.199	0.054	3.527	***	Supported
H4a: OA → PD	0.146	0.03	3.442	***	Supported
H4b: OA → PI	0.42	0.043	8.615	***	Supported
H5a: EV → PD	0.754	0.05	10.968	***	Supported
H5b: EV → PI	0.223	0.074	2.75	0.006	Supported
H6: PD → PI	0.27	0.106	3.176	0.001	Supported
H7: PD → ERB	0.43	0.114	4.874	***	Supported
H8: PI → ERB	0.326	0.065	5.161	***	Supported

Note: *** indicates $p < 0.001$.

5.4. Mediating Effect Test

The mediating effects of place dependence and place identity were tested using the Bootstrapping method, with at least 5000 repetitions and a 95% confidence interval. If the confidence interval does not include 0, the mediating effect is considered significant;

otherwise, it is not. The results, shown in Table 6, indicate that object-related authenticity does not influence tourists' environmentally responsible behavior through place dependence, thus rejecting H9a, while the other hypotheses are supported. Notably, the chain mediating effect from perceived authenticity types (object-related authenticity and existential authenticity) → place dependence → place identity → environmentally responsible behavior is established.

Table 6. Mediating effect test results.

Effect	Hypothesis Path	Estimate Value	Path Product Relationship		Bias-Corrected 95% CI		Conclusions
			Standard Error	Z-Value	Lower	Upper	
Indirect Effect	H9a: OA → PD → ERB	0.012	0.002	1.500	−0.012	0.034	Unsupported
	H9b: OA → PI → ERB	0.057	0.028	2.035	0.018	0.124	Supported
	H9c: OA → PD → PI → ERB	0.125	0.047	2.660	0.044	0.226	Supported
Total	OA → ERB	0.194	0.053	3.660	0.100	0.300	Supported
Indirect Effect	H10a: EV → PD → ERB	0.063	0.031	2.032	0.011	0.153	Supported
	H10b: EV → PI → ERB	0.307	0.103	2.981	0.150	0.559	Supported
	H10c: EV → PD → PI → ERB	0.069	0.034	2.029	0.009	0.188	Supported
Total	EV → ERB	0.439	0.102	4.304	0.284	0.684	Supported

6. Conclusions and Recommendations

6.1. Conclusions and Discussion

First, object-related authenticity, place attachment, and place identity all positively influenced tourists' environmentally responsible behavior. Specifically, the relationships between object-related authenticity and existential authenticity with the two dimensions of place attachment (place dependence and place identity) and tourists' environmentally responsible behaviors fit with the findings of previous scholars. The findings show that object-related authenticity and existential authenticity can significantly enhance tourists' place attachment and place identity. In his study on nature reserves, Sun Bo-Wen Chang pointed out that these two perceptions of authenticity have a significant positive effect on two dimensions of place attachment [11]. Rakić also mentioned that the relationship between authenticity and place attachment is reflected in the duality between tourists' cognitive and affective perceptions of the significance of their experiences [46]. In addition, object-related authenticity can effectively promote tourists' environmentally responsible behaviors, while there is no significant correlation between existential authenticity and tourists' environmentally responsible behaviors. This finding differs from that of scholars such as Jin Hongyan [47]. The reason for this is that existential authenticity is based on the interaction between individuals and destinations. In order to maintain the originality and integrity of the destination, the open-pit mining ecological park minimizes the construction of unnecessary supporting facilities in order to avoid damage to the local environment caused by construction. At the same time, for some areas that are difficult to restore in the short term, the manager adopts the strategy of letting some scenic spots "rest" in order to enhance the sustainability of the industrial heritage destination. Therefore, the relatively low degree of development of tourism facilities in the destination and the inability of tourists to experience some of the scenic spots have affected tourists' tourism behavior to a certain extent, which also explains why existential authenticity has a negative effect on tourists' environmentally responsible behavior.

Second, place attachment and place identity have a significant and direct contribution to environmentally responsible behavior. The present study further validates the idea put forward by Williams et al. that individuals' psychological attachment to place can significantly contribute to their positive environmentally responsible behavior [44]. In

addition, Vaske and Kobrin's study also showed that when individuals develop an emotional attachment to the local natural environment, they tend to show a stronger sense of environmental responsibility in their daily activities, and this emotional attachment drives them to adopt behaviors that are more conducive to environmental protection [48]. Specifically, tourists who are highly attached to their destinations will not only consciously avoid environmentally destructive behaviors, but will also actively persuade others to take actions that benefit the destination environment. This suggests that place attachment is an important precondition for tourists' environmentally responsible behavior. Meanwhile, this study also found that place attachment has a significant positive effect on place identity. After assessing the authenticity of the destination and confirming that their functional needs are met, tourists will closely associate the destination with their personal emotions and identity. This finding is consistent with the findings of Chao Siu King et al. [10] that tourists develop a strong emotional response after perceiving the authenticity of a place, which leads to the formation of a geographic identity. This identity further strengthens tourists' sense of responsibility for the environment and motivates them to participate more actively in environmental protection behaviors.

Third, place dependence and place identity both play a partial mediating role and show a chain mediating effect between object-related authenticity, existential authenticity, and environmentally responsible behavior. On this basis, scholars such as Zhang Sunbo Wen further tested the mediating role of place dependence and place identity between perceived authenticity and tourists' environmentally responsible behaviors in a nature reserve context [11]. This suggests that the mediating elements between authenticity and environmentally responsible behaviors are mainly focused on individual–situation associations. Therefore, enhancing the perception of authenticity and place attachment can effectively enhance the environmentally responsible behavior of destination tourists.

6.2. Theoretical Contributions

First, this study focuses on the influence of perceived authenticity of industrial heritage on tourists' environmentally responsible behaviors, expanding the scope of application of related research. Past studies have mostly focused on exploring antecedent variables of tourists' environmentally responsible behavior, such as environmental attitude, recreational involvement, perceived value, and destination imagery. In recent years, the perception of authenticity of industrial heritage and tourists' environmentally responsible behavior have become hot spots in tourism research, but the research on the association between the two is still relatively scarce. In this study, we found that the higher the object-related authenticity of industrial heritage, the stronger the tourists' "desire to protect" the destination; in other words, when tourists perceive industrial heritage as having a high level of historical and cultural significance, they are more willing to make efforts to protect it. This finding not only enriches the application of research on the environmentally responsible behaviors of industrial heritage tourists, but also highlights the important value of perceived authenticity for the sustainable development of industrial heritage.

Second, this study focuses on the role of place dependence and place identity in tourists' environmental responsibility behavior, revealing their important value in the context of industrial heritage tourism. Currently, although there are some results in the academic research on place dependence and place identity, the related exploration is still insufficient in the field of industrial heritage tourism. The existing literature has not yet fully clarified the specific roles of these two psychological factors in the formation of tourists' environmentally responsible behavior. Through empirical analysis, this study finds that both types of perceived authenticity have a significant positive effect on place dependence and place identity, which further positively act on tourists' environmentally

responsible behavior. This suggests that place dependence and place identity are key factors in motivating tourists to practice environmentally responsible behavior, which can significantly enhance their environmental awareness and actions. Given the key position of place dependence and place identity in industrial heritage tourism, how to effectively stimulate tourists' positive dependence and identity has become a hot topic for researchers. This study not only explores this issue in depth, but also provides a useful supplement to the existing literature and offers new perspectives and ideas for subsequent research.

Third, the use of the S-O-R model provides a new perspective for the study of the mechanism of tourists' environmentally responsible behavior and enriches the theoretical system in this field. Previous studies have mostly explored the intrinsic mechanism of tourists' environmentally responsible behavior from the perspective of the theory of planned behavior, often ignoring the important role of individual psychological factors. Taking the open-pit mine ecological park in Maoming City as the research object, this paper provides an in-depth analysis of how the perception of authenticity of the two types of industrial heritage affects tourists' environmentally responsible behaviors through place dependence and place identity through questionnaire surveys and data analysis. This transmission path reveals the inner state and psychological reaction of the recipient of the stimulus, which makes up for the shortcomings of existing studies and demonstrates the unique value of the S-O-R model in explaining tourists' behavior. Meanwhile, this study also lays a solid foundation for future related studies and provides theoretical support for scenic area managers to formulate environmental protection strategies.

6.3. Practical Implications

Firstly, funding should be increased to maintain the destination's authenticity. Tourists' genuine experiences in industrial heritage settings can enhance their perceived value of the site, promoting positive environmentally responsible behaviors. Therefore, strict natural environment protection regulations should be enforced, with necessary modifications and optimizations based on overall environmental needs. Adequate funds should be allocated for the daily upkeep of authentic landscapes. In unopened areas, virtual reality technology can simulate and recreate ecological landscapes, enabling tourists to fully perceive the site's authenticity and raise their awareness of environmentally responsible behavior. However, it is essential to use new technology wisely to prevent overreliance that might diminish the authentic experience of industrial heritage sites.

Secondly, focus on infrastructure development and cultural product creation to evoke emotional experiences. Positive emotional experiences encourage tourists to engage in responsible behaviors. To effectively stimulate positive emotions and promote environmentally responsible behavior, management should improve infrastructure, enhance service quality, and implement measures that foster internal emotions and cognition. Collaborating with local governments to expand roads, add new transportation routes, and develop three-dimensional transportation networks can improve the destination's accessibility. Integrating local Lady Sin's culture and mining heritage into creative products can effectively convey the unique symbols and cultural imprints of industrial heritage. Providing personalized services and responding promptly and efficiently to tourists' needs can also promote place identity among tourists.

Thirdly, given that place attachment can effectively promote tourists' environmentally responsible behaviors, destination managers should actively guide tourists to form emotional ties to their localities. In the case of open-pit mining ecological parks, for example, the parks should increase their efforts to protect the mining cultural heritage, and ensure that this precious cultural heritage is intact through regular inspections and maintenance, so that tourists can continuously come into contact with and learn about the mining culture.

In addition, tourists have emotional resonance with mining culture because what they see and feel in the park echoes their personal experiences. Therefore, scenic spots can invite local villagers as volunteers to have in-depth exchanges with tourists, and by sharing local stories and memories evoke the tourists' associations with past good experiences, thus stimulating their warm emotions and attachment to the scenic spots.

6.4. Research Limitations and Future Directions

While the study provides new suggestions for encouraging tourists to adopt ERB at industrial heritage sites, there are some shortcomings. First, due to time and manpower constraints, a single-objective self-report method was used to obtain cross-sectional data, which may affect the generalizability of the findings. Future research could expand the temporal and regional scope of the sample to provide stronger explanatory power for exploring causal relationships between variables. Second, this study constructs a model from the perspectives of place dependence and place identity. Future research could introduce additional variables from different theoretical perspectives, such as satisfaction and awe, to verify their mediating effects, thereby clarifying and strengthening the relationship between perceived authenticity and tourists' ERB. Third, the triggering of tourists' environmentally responsible behavior is not limited to the variables discussed in this study (perceived authenticity in relation to the object, perceived authenticity of presence, place dependence, place identity). Future research could explore other factors, such as environmental fit and embodied cognition, in order to reveal the different effects of the tourism environment on tourists' environmentally responsible behavior. Fourth, this study did not utilize basic information such as income status, literacy level, and occupation to conduct a difference analysis between different groups. This limits the in-depth exploration of potential associations between different group characteristics and environmentally responsible behavior, and affects the explanatory power and applicability of the study results at the group level. Future studies may consider incorporating such basic information and conducting stratified or interaction analyses to reveal the influencing factors more comprehensively.

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Abbreviations

The following abbreviations are used in this manuscript:

GFI	Goodness of fit index
NFI	Normed fit index
TLI	Tucker–Lewis index
AVE	Average variance extracted
RMSEA	Root mean square error of approximation
AGFI	Adjusted goodness of fit index
CFI	Comparative fit index
IFI	Incremental fit index
CR	Composite reliability

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