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## Article

# Understanding the Determinants of Geologically Responsible Behaviour among Geotourists: A Multi-Destination Analysis

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**Abstract:** This study explores the drivers of geologically responsible behaviour among geotourists in three geoparks in the Greater China region: Danxiashan UNESCO Global Geopark in southern China, Hong Kong UNESCO Global Geopark, and Yehliu Geopark in northern Taiwan. On-site questionnaire surveys were conducted, collecting over 800 respondents in these geoparks, and structural equation modelling was applied for our analysis. The findings reveal that geologically responsible behaviour is positively associated with environmentally responsible attitudes, in line with some previous research. Notably, place attachment and visitor satisfaction were not directly related to geologically responsible behaviour but were positively correlated with environmentally responsible attitudes. This suggests that emotional connections to geoparks and visitor satisfaction indirectly nurture environmentally responsible attitudes, subsequently leading to geologically responsible behaviour. These results offer practical implications for geopark management practices. Providing informative guided tours and quality informational materials can enhance visitors' geological knowledge and foster environmentally responsible attitudes. The improvement of the visitor experience, combined with the dissemination of accurate environmental knowledge and conservation messaging, can enhance visitor satisfaction, deepen attachment to geoparks, and, ultimately, encourage more geologically responsible behaviours. Understanding these relationships can assist geotourism destinations in promoting geological resources' conservation while enhancing the visitor experience.

**Keywords:** geotourism; geologically responsible behaviours; place attachment; geoparks; Greater China region



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## 1. Introduction

Geology and landscapes have now been recognized as an important tourism resource. The rapid expansion of the Global Geoparks Network, which has been allowing geotourism since 2004, has received increasing attention among scholars and the public [1,2]. The annual number of tourist arrivals at national geoparks in China exceeds 500 million, and geopark visiting is becoming an essential niche of nature-based tourism in China. Since 2004, the number of global geoparks in China has increased to 41, accounting for nearly 1/4 of the total number of global geoparks worldwide (177) [3–5]. The establishment of a large number of global geoparks in China has drawn significant attention from both tourists and local people and has triggered significant increases in the number of visitors to said global geoparks. The increasing number of visitors is not only playing an essential role in enhancing financial incomes for these geoparks but also leading to potential adverse

impacts to the invaluable natural resources within them [6]. The attitudes and behaviours of geopark visitors have been a popular research topic in geotourism research. Geotourists' awareness of geological conservation is one of the focuses that scholars intend to explore when researching the determinants of attitudes and behaviours of geologically responsible behaviour [1,6–8] and employ to suggest strategies and approaches in education to enhance geopark visitors' geoethical awareness [9,10]. The findings of these studies can be helpful for the authorities to formulate better visitor management strategies in geoparks and eliminate visitors' potential negative impacts on the geological resources within them. To uncover the geologically responsible behaviours of visitors, this study adopts the structural equation model (SEM) to model the relationship of various potential determinants, including place attachment and visitor satisfaction, of Chinese geopark visitors' environmentally responsible attitudes and geologically responsible behaviours.

The results could offer an essential overview of Chinese geoparks' visitors, uncovering their environmentally responsible attitudes and geologically responsible behaviours and exploring determinants which are affecting said attitudes and behaviours, a topic on which limited research has been carried out in the Greater China region. The findings of this study can be a vital reference for global park visitor management practices, particularly for those geoparks which receive large amounts of Chinese tourists.

## 2. Literature Review

Various terms have been used to describe environmentally responsible behaviour, including environmentally responsible behaviour, pro-environmental behaviour, environmentally friendly behaviour, low-impact behaviour, conservation behaviour, etc. [8,11–14]; among all of these, the most common term is environmentally responsible behaviour. Various scholars have defined environmentally responsible behaviours. For example, Cottrell [15] believes that environmentally responsible behaviours include any behaviours that could minimize the adverse impact of human activities on the environment both in daily practice and in specific outdoor environments. He believes that, when individuals or groups are committed to adopting the proper practices to help protect the environment, their behaviour can be termed to be environmentally responsible behaviour. Sivek and Hungerford [16] believe that environmentally responsible behaviour refers to any behaviour through which individuals or groups help promote the sustainable use of natural resources, which can promote the conservation of tourism resources. Many researchers adopted Sivek and Hungerford's [16] definition of environmentally responsible behaviour, making it a description of environmentally responsible behaviour widely cited by scholars. In terms of tourism, visitor behaviour can either damage or protect a destination; therefore, several studies have been conducted to investigate what types of tourism behaviours can mitigate its negative impacts [17–19]. Environmentally responsible behaviour (ERB) is reflected in an individual's environmental concern, commitment, and ecological knowledge, and it contributes to avoiding damage to the ecological environment.

Scholars divide environmentally responsible behaviours into different categories. Stern [12] divides environmentally responsible behaviours into public environmental behaviours, nonradical environmental behaviours in public places, and environmental behaviours in private places. Smith-Sebasto and D'Costa [20] defined six types of environmentally responsible behaviours, namely, civic, educational, economic, legal, actual, and persuasive behaviours. These six basic behaviours cover all aspects of environmental conservation behaviour and form a classification of environmentally responsible behaviours recognized by most researchers [11,13,21–27].

The attitude–behaviour model is the most commonly used model to study environmentally responsible behaviour. In rational behaviour theory and planned behaviour theory, attitude significantly affects individual behaviour and is an essential factor in predicting behaviour. Ajzen and Fishbein [21] used sound behaviour theory to explain the relationship between attitude and behaviour. This theory holds that behavioural tendency is the best variable for predicting actual behaviour, and the tendency toward a particular behaviour

is caused by a person's attitude towards this behaviour and the subjective norms of other individuals towards this behaviour. However, measuring the actual environmentally responsible behaviour for a specific research object is difficult. Intention factors determine that the most critical factor in predicting individual behaviour is the person's intention to adopt a specific behaviour—which is determined by attitude, subjective norms, and perceived behaviour control [28]. Behavioural beliefs, normative beliefs, and control beliefs ultimately affect whether an individual does or does not implement a given behaviour. Behavioural beliefs refer to positive or negative results experienced by individuals when they perform a particular behaviour [29,30]. Normative beliefs are based on an individual's perception that those closest to him agree or disagree with implementing a given behaviour. These perceptions effectively trigger the individual's perceptual norms and the social pressure that the individual feels when deciding to implement a given behaviour. Control beliefs refer to personal or environmental factors that promote or prevent individuals from carrying out specific behavioural intentions. These beliefs reach their peak in perceptual behaviour control, which includes past behaviours and indicates whether a given behaviour can be implemented [21,30]. The combination of attitude, subjective norm, and perceived behavioural control leads to the formation of behavioural tendency, which, in turn, becomes the direct antecedent variable for implementing a given behaviour [28]. Overall, the more favourable the attitude and perception norms are, the stronger the perception behaviour control is, and the stronger the individual's tendency to implement a particular behaviour is. The effectiveness of the theory of planned behaviour in explaining different behaviours in different situations has been already verified [11,14,22,28]. Because it can effectively predict individual behavioural tendencies and actual behaviours, the theory of planned behaviour has become one of the most influential theories for predicting behavioural tendencies. It has been successfully used to predict behavioural tendencies in various recreational backgrounds, such as participation in recreational activities, international travel, destination selection, and environmentally friendly behaviours in hotel settings [12,13,18,31,32]. Most studies on environmentally responsible behaviour are based on the theory of planned behaviour.

### 3. Factor Affecting Environmentally Responsible Attitude and Behaviour

Environmentally responsible attitudes and behaviours can be shaped by a myriad of determinants, including demographic characteristics, psychosocial elements, emotional factors, and specific situational contexts [33–35]. Psychosocial determinants, particularly environmentally responsible attitudes, play a central role in shaping individual intentions to engage in environmentally responsible behaviours. Empirical studies have consistently confirmed the positive influence of these attitudes on the intention to adopt environmentally friendly actions [24,36,37]. Such attitudes are robust predictors of individuals' intentions to partake in environmental behaviours.

Place attachment has also been explored as a determinant of environmentally responsible attitudes and behaviours. Place attachment hinges on the emotional bond between individuals and a specific environment, profoundly impacting the attitudes and behaviours towards that environment. This concept signifies the emotional connection individuals form with particular places, influencing their sentiments and actions towards them [19,38,39]. In social psychology, "place" transcends mere physical geography, becoming a social construct imbued with significance and value for individuals and groups. Human geographer Tuan's definition of "place" as a social construct shaped through human experiences underscores the importance of emotional connections to spaces [40]. As individuals invest time in a specific geographical location, they attribute meaning to it, transforming it into a place which people can emotionally connect with, with the depth of this attachment tied to the amount of time spent.

As individuals invest specific values in a location and foster a positive emotional connection, a sense of place attachment materializes. Human geography and environmental psychology scholars recognize place attachment as a fundamental human need [19,22,40,41].

This attachment profoundly influences environmental attitudes, especially in tourism, where it encourages tourists to engage in behaviours which benefit the ecological environment [19,38]. Empirical research in an Australian national park validates the positive impact of place attachment on tourists' willingness to adopt environmentally responsible behaviours, with their satisfaction mediating this relationship [38,42].

Scholars have explored place attachment from various angles, using different terms to describe people's emotions towards places, including "rootedness", "topophilia", "place identity", "place attachment", "community attachment", and "place bonding". Despite terminology variations, "place attachment" remains the widely accepted term among scholars [43–45].

Place attachment extends beyond the physical environment and includes attachment to a specific place's social and cultural environment. Milligan suggested that place attachment, arising from the interaction between individuals and the environment, incorporates both the material and social dimensions. Research indicates that individuals are willing to allocate more resources, including time and money, to visit places they feel psychologically attached to [46,47]. Place attachment emerges as a primary driver for return visits in tourism studies, and heightened place attachment is linked to a reduced resistance to paid-use resources [41].

This paper assesses the relationships between different factors that may affect geologically responsible behaviour using structural equation modelling (SEM). The relationships between geopark visitors' place attachment (PA), satisfaction (SA), environmentally responsible attitudes (ERA), and geologically responsible behaviours (GRB) are explored. The term geologically responsible behaviour has been used in this paper to truly reflect the conservation behaviours towards the geological features of the geoparks observed. According to our literature review, the six core hypotheses were developed as follows:

**H1:** *Place attachment directly affects geologically responsible behaviour.*

**H2:** *Environmentally responsible attitudes directly affect geologically responsible behaviour.*

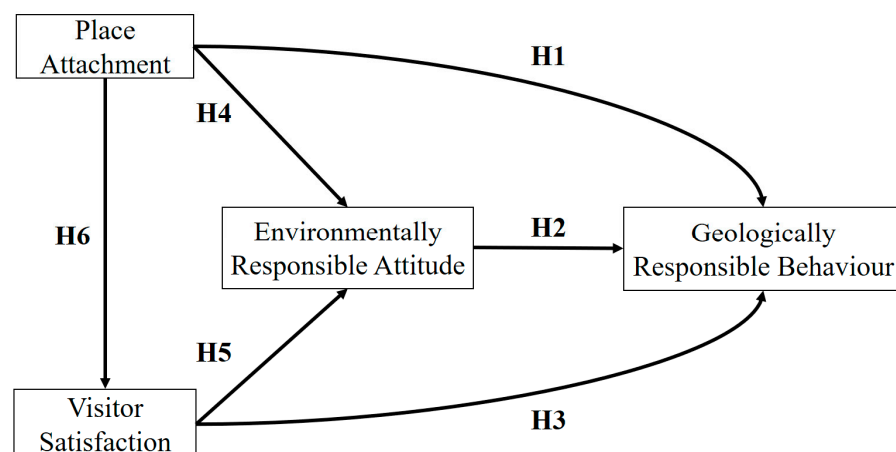
**H3:** *Visitor satisfaction directly affects geologically responsible behaviour.*

**H4:** *Place attachment directly affects environmentally responsible attitudes.*

**H5:** *Visitor satisfaction directly affects environmentally responsible attitudes.*

**H6:** *Place attachment directly affects environmentally responsible attitudes.*

The proposed theoretical framework is shown in Figure 1 to test these hypotheses.



**Figure 1.** Proposed theoretical framework of this study.

## 4. Methodology

### 4.1. Selection of Study Sites

The present study selects three geotourism destinations, including Danxiashan UNESCO Global Geopark (DXGP) in the southern region of China, Hong Kong UNESCO Global Geopark (HKGP), and Yehliu Geopark (YLGP) located on the northern coast of Taiwan (Figure 2). These geoparks have been officially designated as geotourism destinations owing to their exceptional geological and geomorphological attributes that have been attracting a high volume of tourists [5,7].



**Figure 2.** Geoparks in Hong Kong, Taiwan, and Guangdong, China.

### 4.2. Geopark Characteristics

The Danxiashan UNESCO Global Geopark (DXGP) is situated in the northern part of the Guangdong province in South China, encompassing a total area of 292 square kilometres. Red conglomerates and sandstones are the dominant geological composition of the DXGP [7]. The landforms have been shaped by the uplift of reddish beds followed by faulting and jointing during the Himalayan orogenic cycle. Some distinguished landforms were crafted by long-term effects of erosion and weathering. These unique geological features manifest as Danxia landforms, characterized by sub-rounded summits, canyons, prominent cliffs, and foot slopes [7]. It has been a vital geotourism destination in South China and was designated as a World Natural Heritage site by the UNESCO.

The Hong Kong UNESCO Global Geopark (HKGP) comprises two regions in the east of Hong Kong, specifically, the Sai Kung Volcanic Rock Region (e.g., High Island Geo-area) and the Northeast New Territories Sedimentary Rock Region (e.g., Tung Ping Chau Geo-Area), spanning approximately 150 square kilometres [5]. The Sai Kung Volcanic Rock Region mainly demonstrates outstanding acidic volcanic hexagonal rock columns with diameters of approximately 1.2 m, resulting from unusual folding and faulting attributed to tectonic forces [4,6] around 160 million ago. In contrast, the sedimentary rock formations in the New Territories date back to the Devonian era and continue through the Paleogene period, encapsulating over 400 million years of geological evolution [5]. There are spectacular coastal erosion features that attract both local and overseas visitors.

The Yehliu Geopark (YLGP) is a designated geopark located in northern Taiwan. It is situated on a sandstone peninsula encompassing an area of 4.57 square kilometres, with a

length of 1.7 km and varying widths ranging from 0.05 km to 0.25 km. It contains 0.53 square kilometres of land, and the sea area covers approximately 4.04 square kilometres [2]. The sandstone formations in the YLGP have undergone extensive sculpting by both internal and external forces, resulting in the creation of various coastal erosion features, including sea caves, wave-cut platforms, and potholes, which hold significant geological importance and are vital for the nature-based tourism of Taipei.

#### 4.3. Questionnaire Design

The questionnaire employed in this study comprises four sections. The first two sections investigate geotourists' place attachment (PA) and satisfaction (SA) using a five-point Likert scale, ranging from "strongly disagree" (score 1) to "strongly agree" (score 5). The questions to assess place attachment in this study are drawn from previous research [38,39], with some adaptations to suit the local context. There are seventeen question items to assess an individual's attachment to the geopark. The second section evaluates visitors' satisfaction using sixteen items, drawing from existing studies on tourist satisfaction [48,49]. The third section includes question items to assess the environmentally responsible attitudes (ERA) and geologically responsible behaviours (GRB) on which previous studies' designs were based. To evaluate the respondents' environmentally responsible attitudes, there are nine question items drawn from the well-known New Environmental Paradigm (NEP) scale. Fourteen question items were used to measure the geologically responsible behaviour of the respondents concerning previous studies by Kaiser et al. [50] and Cheung and Hui [39]. All these question items have been modified to fit this study's purpose, particularly to make it applicable to geopark visiting behaviours. The fourth section of the questionnaire collects demographic information about geotourists, including their gender, age, educational background, and monthly income.

#### 4.4. Questionnaire Survey and Data Analysis

On-site questionnaire surveys were administered between March and July 2019. A team of 15 student research assistants were recruited and trained on the procedure they needed to follow for the questionnaire survey and conducted the on-site survey during both weekends and weekdays. Data collection occurred at different geopark periods, including early March for the DXGP, May to June for the HKGP, and June to July for the YLGP. Paper-form questionnaires were distributed to the respondents at the rest areas and gathering spots near the exits in various geoparks. Participation in the survey was limited to geotourists above the age of 18, and completion of the questionnaire typically required approximately fifteen minutes, with the research assistants providing clarifications as needed. A total of 894 geotourists were approached at the three study sites, and 880 questionnaires were deemed valid, resulting in a response rate of 98.4%.

All the valid questionnaire data were cleared and coded and then entered into SPSS version 25.0 for statistical analyses. Descriptive statistics, including the calculation of means, were employed to understand the situation of the respondents' place attachment level, visitor satisfaction, environmentally responsible attitudes, and geologically responsible behaviours. A structural equation model was performed to explore the causal relationship between determinants and geologically responsible behaviour.

## 5. Results

### 5.1. Initial Model and Factor Loadings

The proposed theoretical framework's structural equation model was tested using AMOS 21. The rectangles represent the observed variables, and the ovals represent the latent variables. This study has four potential constructs: place attachment, satisfaction, environmentally responsible attitudes, and geologically responsible behaviour. The total number of observed variables is 56, i.e., the corresponding 56 items in the questionnaire.

Before running the SEM analysis, a reliability analysis was carried out using SPSS to test the reliability of the 56 items across the four constructs. The Cronbach's alpha values

were 0.897 (PL), 0.656 (ERA), 0.893 (GRB), and 0.931 (SA), all greater than 0.6, indicating that the variables in the questionnaire could be used for the factor analysis (Table 1).

**Table 1.** Factor loading of items for different constructs.

Variables	Factor Loading
<b>Place attachment (Cronbach <math>\alpha</math>: 0.879)</b>	
P1 Geo-tourism is meaningful to me <sup>a1</sup> .	0.55
P2 I identify strongly with this place <sup>a1</sup> .	0.59
P3 I am very attached to this place.	0.68
P4 I have a special connection to this place and other visitors who visit here <sup>a1</sup> .	0.59
P5 I enjoy visiting this place more than visiting any other place.	0.74
P6 I receive more satisfaction visiting this place than visiting any other place.	0.76
P7 Visiting this place is more important to me than visiting any other place.	0.73
P8 I would not substitute any other type of recreation for what I do here.	0.64
P9 I choose to visit this place because the admission fee is not expensive <sup>a1</sup> .	0.38
P10 I choose to visit this place because the location of the place is convenient <sup>a1</sup> .	0.42
P11 This destination is the best place for the activities I like to do <sup>a1</sup> .	0.57
P12 Visiting this destination makes me feel safe <sup>a1</sup> .	0.57
P13 I have a lot of memories at this place <sup>a1</sup> .	0.56
P14 I feel a general sense of well-being while visiting this destination <sup>a1</sup> .	0.55
P15 Visiting this place reminds me of my experiences in the past <sup>a1</sup> .	0.52
P16 This place has unique characteristics, such as architecture, historical monuments or a particular environment <sup>a1</sup> .	0.40
P17 When I am away, I miss this place <sup>a1</sup> .	0.57
<b>Environmentally responsible attitudes (Cronbach <math>\alpha</math>: 0.656)</b>	
A1 The Earth has plenty of natural resources if we just learn how to develop them. <sup>a1</sup> R	0.31
A2 For the sake of improved leisure opportunities, it is good to develop more recreation areas. <sup>a1</sup> R	0.21
A3 When economic growth is in conflict with environmental conservation, environmental conservation should be given priority.	0.61
A4 Humans have the right to modify the natural environment to suit their needs. <sup>a1</sup> R	0.01
A5 Plants and animals have as much right as humans to exist.	0.66
A6 Enjoying natural resources is a basic right. It is inappropriate for the government to make laws to control people's use of natural resources. <sup>a1</sup> R	0.11
A7 Human beings have the right to satisfy their own needs by altering the natural environment. <sup>a1</sup> R	0.01
A8 When human beings engage in any leisure and recreational activities, they should avoid disturbing the local natural environment.	0.67
A9 The balance of nature is very delicate and easily upset.	0.71
<b>Geographically responsible behaviour (Cronbach <math>\alpha</math>: 0.893)</b>	
B1 I do not take any rocks, fossils or minerals.	0.74
B2 I do not dig up, damage or deface any rocks at this geopark.	0.80
B3 I do not climb the rock columns or trample.	0.67
B4 I try to keep quiet during the trip.	0.76
B5 I try to maintain the quality of the local environment.	0.81
B6 I take all my clutter and garbage.	0.65
B7 I try to protect the fauna and flora during my trip.	0.80
B8 I accept the control policy of not entering the core area of the geopark <sup>a1</sup> .	0.57
B9 I report to the park administrator if I encounter any environmental pollution or destruction <sup>a1</sup> .	0.58
B10 I prefer to join tours guided by professional and skilled guides if there are any <sup>a1</sup> .	0.39
B11 I will share my experience with my friends or family <sup>a1</sup> .	0.59
B12 I will encourage my friends or family to join in geopark conservation <sup>a1</sup> .	0.57
B13 I will join in volunteering to help the public learn more about geo-tourism and geoparks <sup>a1</sup> .	0.42
B14 I will donate money to support this geopark <sup>a1</sup> .	0.33

Table 1. Cont.

Variables	Factor Loading
<i>Tourism satisfaction (Cronbach <math>\alpha</math>: 0.931)</i>	
S1 Unique geological features <sup>a1</sup> .	0.49
S2 Attractive mountainous areas <sup>a1</sup> .	0.54
S3 Diverse species of flora and fauna <sup>a1</sup> .	0.58
S4 Whole scenery and landscape <sup>a1</sup> .	0.58
S5 Convenient public transport <sup>a1</sup> .	0.57
S6 Clear and useful maps that display locations.	0.72
S7 Clear visiting signposts.	0.73
S8 Maintenance of geo-trails.	0.68
S9 Interesting information boards.	0.75
S10 Easy access to toilets.	0.66
S11 Sufficient security facilities (e.g., parapets, warning signs).	0.68
S12 Sufficient educational information about rocks and biological species.	0.79
S13 Sufficient recreational facilities (e.g., tables and benches, shelters).	0.75
S14 Sufficient conservation information about rocks and biological species.	0.81
S15 Integrated conservation strategy.	0.79
S16 Overall satisfaction.	0.70

R, reverse-coded. Items were excluded after the factor analysis because of factor loadings below 0.6 <sup>a1</sup>.

In Table 1, AMOS 21 was adopted to conduct the factor analyses. The results of the factor analyses show a high correlation coefficient for all fifty-six questionnaire items, with only five items below 0.3, but the CFI could not reach 0.9. Therefore, the items with values below 0.6 were deleted, and 29 items were deleted to ensure the internal consistency of the constructs. The CFI of the structural model could reach the threshold of 0.9.

Nearly half of the items were deleted. Apart from the relevance of the specific content of the items, it is also possible that the large sample size increased the probability of rejection. From the calculation formula of the chi-square fitting index  $(N - 1) \times F$ ,  $N$  is the sample size, and  $F$  is the minimum appropriate function of the model covariance matrix and the sample covariance matrix. It can be seen that the larger the sample, the greater the likelihood that the model will be rejected. The chi-square fitting index is also susceptible for rejecting the assumption of multivariate normality. This study's sample size was relatively large, with 879 valid questionnaires. Therefore, 29 question items had to be deleted to achieve a better index supporting model fitness.

AMOS 21 was then used to carry out a confirmatory factor analysis to test the rationality of the scale composition fitness index. Path analysis was carried out. Finally, structural equation modelling of the Chinese geopark visitors' geologically responsible behaviour was performed to explore the causal relationships between the constructs.

### 5.2. Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis (CFA) is used to judge the fitting ability of the initial model to the actual data, and it is often used to test the rationality of the construct validity of a scale. When AMOS 21 software is used for CFA, the main indexes for judging the fitness of the model include the following:

- CFI (comparative fit index): The close fit index is between 0 and 1. When the value is more significant than 0.9, the model is acceptable.
- $\chi^2/df$ : This is called the relative chi-square value. A value greater than ten indicates that the model is not ideal, a value less than five indicates that the model is acceptable, and a value less than three indicates that the model is better.
- GFI (goodness of fit index): This index ranges from 0 to 1. The GFI should be equal to or greater than 0.85 to accept the model.
- NFI (normed fit index): The specification adaptation index is an increased value adaptation measurement. The general recommended value of an acceptable model is above 0.85.

- RMSEA (root mean square error of approximation): This model adaptation index has received considerable attention in recent years. When the RMSEA is less than or equal to 0.05, it means a perfect fit; the range of 0.05–0.08 indicates a good fit; a moderate fit is in the field of 0.08–0.1, and a bad fit is more than 0.1.

The structural model of this study is evaluated based on the above indexes (Table 2).

**Table 2.** The fitness indexes of the proposed structural model of this study.

	CFI	GFI	NFI	RMSEA	<i>p</i>	CMIN/DF
Default model	0.905	0.873	0.885	0.068	0.000	5.087

As indicated in Table 2, the CMIN/DF ratio is 5.087, which is close to 5. The CFI is more significant than 0.9, and the GFI and NFI are greater than the threshold of 0.85, indicating that the model is acceptable and has a good fit. The RMSEA is 0.068, i.e., less than 0.08, which indicates a good fit. *P* is equal to 0, and the model is acceptable. In summary, several fit indexes all confirm the fitness of the current proposed structural model. The model has a good fit and can be used for path analysis.

### 5.3. Correlation between Constructs

#### 5.3.1. Correlation Analysis

Only when the correlation analysis between two variables shows a significant correlation can SEM analysis be carried out. Therefore, before the structural equation modelling test, a correlation analysis was performed to explore the relationships between place attachment (PA), satisfaction (SA), environmentally responsible attitudes (ERA), and geologically responsible behaviour (GRB). The results of the correlation analysis are shown in Table 3. There is a significant correlation between each factor. Therefore, structural equation modelling can be used to test the hypothetical theoretical model in this study.

**Table 3.** Correlation analysis results of the latent variables.

	PA	ERA	GRB	SA
PA	1			
ERA	−0.104 **	1		
GRB	0.385 **	0.178 **	1	
SA	0.512 **	0.002	0.478 **	1

\*\* Correlation is significant at the 0.01 level (two-tailed).

#### 5.3.2. Structural Equation Model

In this study, 0.6 was used as the critical value of the discrimination index, and 29 items were deleted, with 27 observed variables remaining. The remaining items were grouped into four constructs with twenty-seven items, as shown in Table 4. Five items were used to measure place attachment (PA); eleven items were used to measure geopark visitor satisfaction (SA); four items were used to measure environmentally responsible attitudes (ERA), and seven items were used to measure geologically responsible behaviours (GRB). The items in the measurement scale were taken as the composite variables for a further analysis. The composite reliability (CR) values of PA, ERA, GRB, and SA were 0.836, 0.758, 0.899, and 0.938, respectively. Although a CR value greater than 0.6 is generally acceptable, Hair (1997) argued that 0.7 is the acceptable threshold. In addition, the standard AVE value suggested by Fornell and Larcker (1981) should be approximately 0.5. Therefore, the data show that the model has a high reliability.

**Table 4.** Factor loadings, average variance extracted (AVE), and composite reliability (CR) of the SEM model.

	Variables	Range	Mean	Factor Loading	Average Variance Extracted	Composite Reliability
<b>Place attachment</b>						
P3	I am very attached to this place.	1–5	3.59			
P5	I enjoy visiting this place more than visiting any other place.	1–5	4.07	0.68	0.51	0.836
P6	I receive more satisfaction from this place than visiting any other place.	1–5	3.59	0.74		
P7	Visiting this place is more important to me than visiting any other place.	1–5	3.63	0.76		
P8	I would not substitute any other type of recreation for what I do here.	1–5	3.47	0.73		
			3.26	0.64		
<b>Environmentally responsible attitudes</b>						
			3.43		0.44	0.758
A3	When economic growth conflicts with environmental conservation, environmental conservation should be prioritized.	1–5	4.34	0.61		
A5	Plants and animals have as much right as humans to exist.	1–5	4.32	0.66		
A8	When people engage in leisure and recreational activities, they should avoid disturbing the local natural environment.	1–5	4.28	0.67		
A9	The balance of nature is very delicate and easily upset.	1–5	4.25	0.71		
<b>Geologically responsible behaviour</b>						
			4.60		0.56	0.899
B1	I do not take any rocks, fossils, or minerals.	1–5	4.67	0.74		
B2	I do not dig up, damage, or deface any rocks at this geopark.	1–5	4.71	0.80		
B3	I do not climb the rock columns or trample.	1–5	4.54	0.67		
B4	I try to keep quiet during the trip.	1–5	4.64	0.76		
B5	I try to maintain the quality of the local environment.	1–5	4.67	0.81		
B6	I take all my clutter and garbage.	1–5	4.34	0.65		
B7	I try to protect the fauna and flora during my trip.	1–5	4.60	0.80		
<b>Visitor satisfaction</b>						
			3.77		0.54	0.928
S6	Clear and useful maps that display locations.	1–5	3.81	0.72		
S7	Clear visiting signposts.	1–5	3.87	0.73		
S8	Maintenance of geo-trails.	1–5	3.95	0.68		
S9	Interesting information board.	1–5	3.54	0.75		
S10	Easy access to toilets.	1–5	3.67	0.66		
S11	Sufficient security facilities (e.g., parapets, warning signs).	1–5	3.84	0.68		
S12	Sufficient educational information about rocks and biological species.	1–5	3.66	0.79		
S13	Sufficient recreational facilities (e.g., tables and benches, shelters).	1–5	3.68	0.75		
S14	Sufficient conservation information about rocks and biological species.	1–5	3.68	0.81		
S15	Integrated conservation strategy.	1–5	3.74	0.79		
S16	Overall satisfaction.	1–5	4.02	0.70		

A structural equation model was constructed to explore the relationships between the latent variables and the observed variables. As shown in Figure 3, place attachment

(PA), geopark visitor satisfaction (SA), and environmentally responsible attitudes (ERA) are independent variables, and geologically responsible behaviour (GRB) is the dependent variable. The SEM-based path analysis suggests that place attachment (PA) and geopark visitor satisfaction (SA) have a significant positive correlation with environmentally responsible attitudes (ERA), implying that visitors' higher attachment to geoparks leads to a better level of environmentally responsible attitudes. Similarly, visitors more satisfied with their geopark visiting experience exhibit a higher level of environmentally responsible attitudes (ERB). However, neither PA nor ERA indicates a significant association with geologically responsible behaviour (GRB). Regarding the influence of environmentally responsible attitudes (ERA) on geologically responsible behaviour (GRB), the results of the path analysis suggest that ERA is positively correlated with GRB, meaning that the higher the environmentally responsible attitudes of geopark visitors are, the higher their intention to adopt geologically responsible behaviour is. Although the results of path analysis suggest that PA and SA do not directly associate with GRB, the indirectly positive relationship with GRB, with ERA as the mediator, is supported.

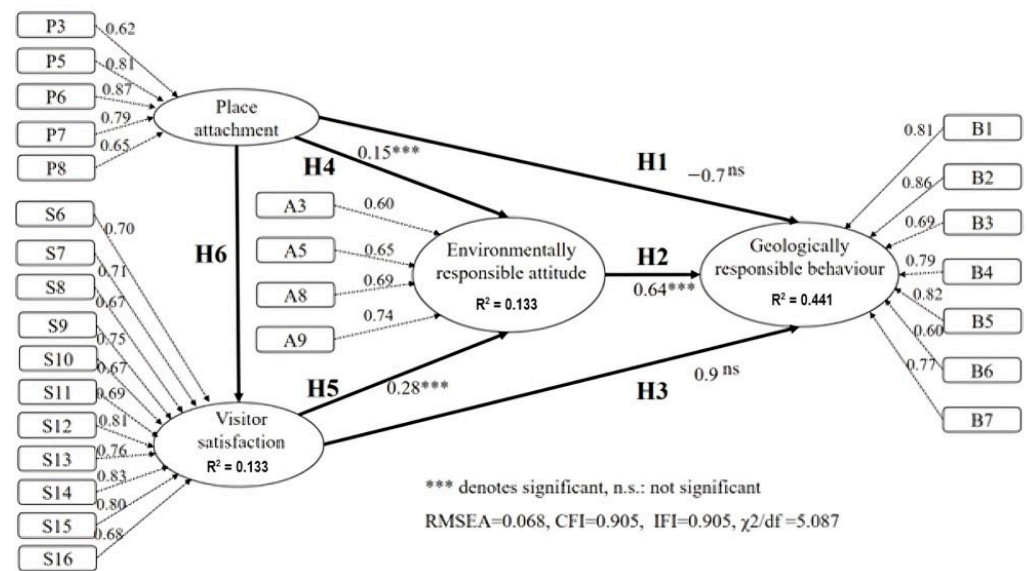


Figure 3. The structural model of Chinese geopark visitors' GRB, ERA, PA, and VS.

Based on the SEM results (Table 5 and Figure 3), H2, H6, H7, and H8 are supported, and H1 and H3 are rejected. Specifically, H1 is rejected; that is, place attachment cannot directly affect geologically responsible behaviour. H3 is rejected; visitor satisfaction does not directly affect geologically responsible behaviour. H2 is supported; that is, environmentally responsible attitudes directly affect geologically responsible behaviour. H4 is supported; that is, place attachment directly affects environmentally responsible attitudes. H5 is supported; visitor satisfaction directly affects environmentally responsible attitudes. Finally, H6 is supported; that is, place attachment directly affects visitor satisfaction.

Table 5. Summarized results of the path analysis.

		Estimate	S.E.	C.R.	p
H1	PA-->GRB	-0.055	0.026	-2.111	0.035
H2	ERA-->GRB	0.534	0.037	14.253	***
H3	Satisfaction-->GRB	0.072	0.037	1.935	0.053
H6	PA-->ERA	0.14	0.039	3.643	***
H7	Satisfaction-->ERA	0.349	0.055	6.311	***
H8	PA-->Satisfaction	0.251	0.028	8.893	***

\*\*\* Coefficient is significant at the 0.01 level.

#### 5.4. Discussion and Conclusions

The SEM results confirmed the validity of the proposed theoretical framework, indicating that environmentally responsible attitudes (ERA) positively correlated with geologically responsible behaviour (GRB), which has generally been supported by many previous studies [22,24,26,29,37,51]. This is not surprising because geopark visitors with higher levels of environmentally responsible attitudes are more likely to adopt positive behaviour regarding the conservation of the geological resources in geoparks, as most of them are aware of the fact that they are obligated to conserve natural resources and are willing to take pro-environmentally responsible actions. However, some previous research findings have suggested that good environmental attitudes do not directly translate into pro-environmental behaviour [13,18,52], as many other factors may be motives which encourage an individual to adopt pro-environmentally responsible behaviour, such as economic incentives [53,54] and motivations [1,8,27]. Dunlap et al. [55] suggested that environmental attitudes do not directly translate into pro-environmentally friendly behaviours. An individual has to enhance their pro-environmental intentions before adopting pro-environmentally responsible behaviours. They believe that there is a process for nurturing an individual to consistently adopt environmentally responsible behaviours [56,57]. Cheung, Chow, Fok, Yu, and Chou [54] suggested that economic incentives were an essential factor in facilitating the adoption of pro-environmental behaviours for household energy saving. Peer influence has also been discussed as an essential factor that enhances the likelihood of park visitors adopting pro-environmental behaviours [58,59]. By taking pro-environmental actions, such as picking up rubbish along a hiking trail, some visitors can serve as role models for other visitors, discouraging them from doing something harmful to the environment. However, Chinese nature tourists were found to be comparatively passive when they identified the misbehaviour of other visitors in a park. These behaviours are usually ignored, and tourists seldom take further interventions to stop such behaviours or to report them to the relevant authorities [37].

The findings show that place attachment (PA) and geopark visitor satisfaction (SA) are not correlated to geologically responsible behaviour (GRB). These findings contradict other previous studies that suggested that place attachment is positively associated with pro-environmental behaviours [25,27,38] and that visitor satisfaction affects pro-environmental behaviours [60]. However, PA and SA indicate a positive correlation with environmentally responsible attitudes (ERA), allowing ERA to act as a mediator linking PA and SA with GRB. This may be because place attachment and visitor satisfaction need to be built up through more extended periods of time spent in the geoparks visited. Visiting geoparks can enhance visitors' understanding of the importance of geoheritage and their awareness of geoconservation, nurturing their environmentally responsible attitudes towards geoparks [27]. Visiting geoparks can provide visitors with an opportunity to learn geological knowledge and establish a link between visitors and invaluable geological resources. This can equip visitors with a sense of belonging to the geological heritage they have been exposed to and trigger their concern for conserving these resources in geoparks [39].

This study further confirms that place attachment, satisfaction, and environmentally responsible attitudes are influential in geologically responsible behaviour. The findings can be helpful for geopark managers to improve the visitor services in their geoparks. Visitor activities such as a good-quality guided tour can be important for offering an experiential learning opportunity for visitors. Visitors can gain geological knowledge and be nurtured to be environmentally friendly, aware geopark visitors. In addition, good-quality informational materials, including interpretation boards, leaflets, and promotion materials, play a similarly important role in enhancing awareness for those visitors who do not participate in guided tours [61]. Accurate environmental knowledge together with conservation messages are essential for disseminating environmental conservation concepts and messages to visitors. A better visitor experience can simultaneously improve visitors' experience, satisfaction, and sense of belonging, ultimately leading to environmentally responsible attitudes. Although the study has offered important findings and considerable

theoretical contributions and policies implications, there are still some limitations which can be improved and warrant further research. The data of this study were collected before the COVID-19 pandemic, which means that the characteristics, attitudes, and behaviours of geopark visitors may have potentially changed. Such changes could limit the validity of the current analytical framework adopted in this study. Therefore, further research, conducted after the pandemic, should be carried out to explore differences in geopark visitors' environmentally responsible attitudes and behaviours.

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