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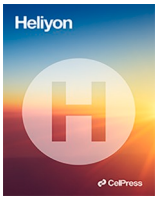

Ecological experiential learning and tourists' pro-environmental behavior intentions: The mediating roles of awe and nature connection

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ABSTRACT

Due to the important role of tourists' behavior plays in marine protected areas (MPAs) and the increasing popularity of ecological experiential learning (EEL) journeys, this study aims to investigate whether and how EEL impact tourists' pro-environmental behavior (PEB) intentions through both emotional and cognitive pathways. To achieve this, four nature education trips with EEL content were organized, and PEB intentions of 228 tourists to MPAs were analyzed using surveys. The findings revealed that the low-effort PEB intentions of individuals under 24 years old were significantly lower compared to those of older tourists. Furthermore, EEL was positively associated with both low and high effort PEB intentions. The sense of awe acted as a mediator between EEL and low-effort PEB intentions, whereas nature connection was found to mediate the relationship between EEL and both low and high-effort PEB intentions. This study contributes to the growing body of research on the drivers of tourists PEB and provides a theoretical framework for promoting PEB intentions in MPAs.''''

1. Introduction

Marine protected areas (MPAs) have been set up to protect vulnerable species and ecosystems, with the main goal of preserving biodiversity and preventing harmful human activities [1]. On the premise of protection, moderate tourism activities can be carried out to realize its education and national welfare functions and contribute to the sustainable livelihood of local community residents [2]. MPAs are important and popular ecotourism destinations in many countries and play a role in enhancing environmentally friendly

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lifestyles [3]. In recent years, emerging ecotourism activities, such as nature education, popular science tourism, and some other learning tourisms based on protected areas, have been widely welcomed by the market and are considered as an effective way to spread knowledge of biodiversity protection, improve tourists' satisfaction, and better publicize conservation information [4]. There are various types and forms of these ecotourism activities, all of which have the common characteristics of paying attention to the tourists' participation experience activities based on nature, and emphasizing learning from nature to promote the harmony between human and nature. Therefore, such tourism activities are essentially ecological experiential learning (EEL) journeys.

Compared with traditional industries, tourism primarily involves the showcasing of scenic landscape and is known as a smokeless industry due to its lower emissions and less pollution [5]. However, its development still brings negative impacts on the ecological environment of the destination. Among which, tourist behavior is a key factor affecting the ecological circumstances of the destination [6], inappropriate tourist behavior may bring direct or indirect negative impacts on the ecosystem [7]. Studies shows that PEB of tourists can improve destination governance and community resilience [8]. How to encourage tourists to adopt pro-environment behavior (PEB) is an overall key strategy for tourist destinations to achieve effective environmental protection and sustainable development [9]. As an important ecotourism destination, tourists' PEBs are of great significance to the healthy and sustainable development of MPAs.

Tourists' pro-environment behaviors (PEBs), which can be divided into low-effort PEB and high-effort PEB, are a series of behaviors carried out by tourists to reduce the negative impact on the ecological environment of the tourist destination and promote the sustainable utilization of its resources [10] Low-effort PEB refers to behaviors that do not need high commitment to carry out activities (e.g., sorting trash and recycling), while high-effort PEB refers to behaviors that require relatively more time and attention (e.g, volunteer time for conservation projects). PEB intention has been recognized as a complex psychological behavior process [11]. Cognition, which refers to the mental activity of organisms adapting to their environment, is influenced by embodiment and situational behavior [12, 13]. Cognitive processes are also influenced by physical and environmental factors [14]. In the context of tourism activities, when tourists actively engage with the natural environment, it promotes their rational perception of the importance of maintaining harmony between nature and human beings [15]. Additionally, there is a strong correlation between tourists' participation experiences and their environmentally responsible behavior [16]. Close contact with nature during tourism activities can facilitate a multi-channel sensory experience for tourists [17], strengthening their environmental awareness [6]. It is worth noting that situational, cognitive, and emotional factors may have varying effects on different types of PEBs. For example, social interaction has a more substantial impact on tourists' high-effort PEB intentions [18]; place satisfaction promotes low-effort PEB intentions but reduces high-effort PEB intentions [10,19], the emotion of connectedness to nature has a more substantial influence on the low-effort PEB intention [20]. People often process information based on two independent and interactive systems: emotional response and cognitive response [21, 22]. In terms of cognition, the influencing factors and forming mechanism of PEB were discussed mainly from the rational mechanism of environmental protection attitude [23], sustainable intelligence [24], place attachment [25], social norms and personal norm [26,

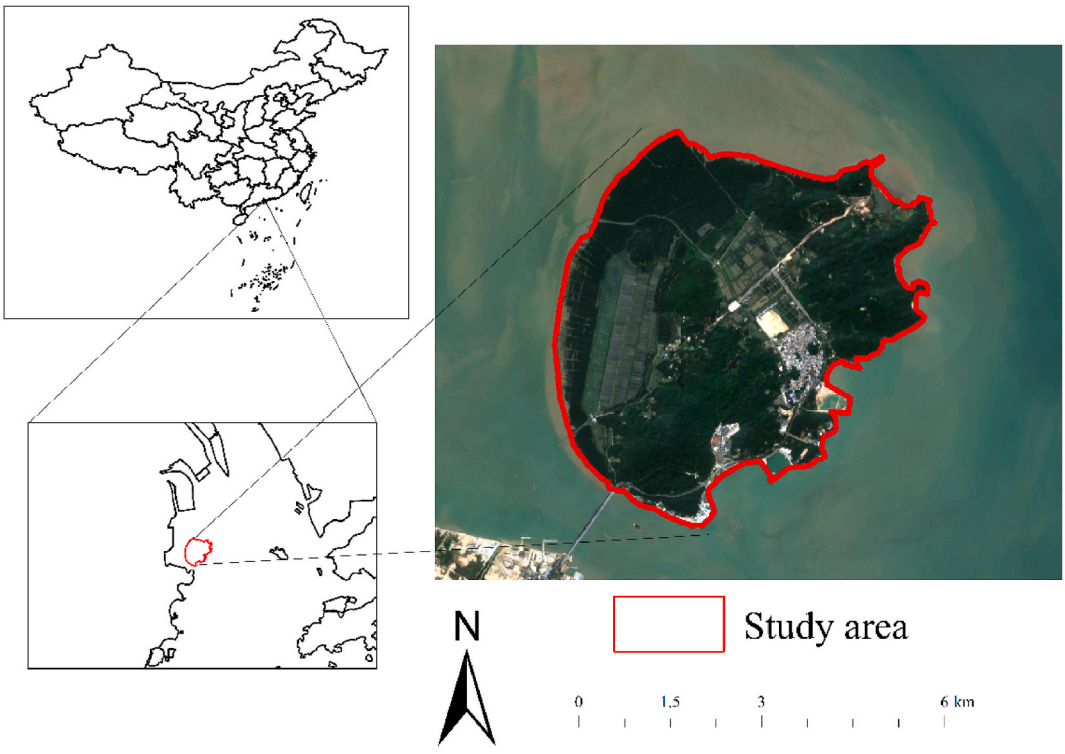

Fig. 1. Study area.

27]. In terms of emotion, the influence of environmental guilt [28] pride [29], anticipatory emotion [21], and other mechanisms on PEB were discussed. EEL is not only the objective contact between the individual body and the environment, but also the subjective feeling caused by the individual body should significantly impact tourists' intention of PEB. However, there is a lack of research on the relationship between EEL and PEB and its mechanism. Since individual cognitive and emotional responses are intertwined to drive various behaviors [30,31], when tourists joining EEL are embedded in nature and have physical contact with nature, will their PEB intentions be enhanced in such activities? Do the two types of PEBs respond in the same way? If EEL significantly affects the PEBs of tourists, does it do so through emotional and cognitive responses?

This study aims to address two significant issues, one is to assess whether EEL affect tourists' two types of PEB intentions, and the other is to explore how EEL affects tourists' two types of PEB intentions. Given the emotional path, we choose awe to represent the rapid and spontaneous emotional response individuals generate during ecological experiential learning. When tourists participate in EEL, they have closer contact with nature [32], which enables them to compare the grand nature with the small self [12], thus inspiring the awe and influencing the intention of PEB [33]. Given the cognitive response path, we choose nature connection (NC) to represent the cognitive response of the individual to analyze the reality that the self is inseparable from the environment. When tourists have complete contact with nature during research and tourism, they may have stronger self-efficacy and empathy for nature [34], resulting in a stronger intention of nature contact [16]. To this end, we take two nature reserves along the southeast coast of China as a case study and conduct research on the pro-environmental behavior of tourists in MPAs by organizing four nature education trips. We hypothesized that 1) EEL is positively related to tourists' low-effort (1a) and high-effort (1b) PEB intentions; 2) awe mediates the relationship between EEL and low-effort (2a) and high-effort (2b) PEB intentions; and 3) NC mediates the relationship between EEL and low-effort (3a) and high-effort (3b) PEB intentions.

2. Methodology

2.1. Study area

In this study, two MPAs named Pearl River Estuary Chinese White Dolphin National Nature Reserve (WDNR) (22°11′00"-22°24′00" N, 113°40′00"-113°52′08.8E) and Guangdong Qi'ao-Dangan Island Provincial Nature Reserve (QDNR) (113°36′40" ~113°39′15"E, 22°23′40"~22°27′38" N) were selected as the research sites (Fig. 1). The two MPAs locate on Qi'ao Island, Zhuhai, the southeast coast of China. WDNR was established in 1999 and became a member of the great family of Man and Biosphere Program in November 2007. The total area of the reserve is 460 km^2. The main protection object is the Chinese white dolphin, a national first-class protected animal. Activities such as ecological tourism, scientific investigation and teaching practice may be appropriately organized within the designated scope. Established in 2000, QDNR covers an area of 5103.77 hm^2. The main protection objects are mangroves, birds and their ecological environment. Qi'ao Island is a famous coastal tourist destination and an important biological practice base in South China, attracting 190,000 eco-tourists in 2019.

2.2. Design and organization of ecological experiential learning activities

According to the characteristics of the two MPAs and their protected species, we designed two ecological tourism products including EEL content of nature education tours (see Table 1), and held four large-scale nature education tours. The activities included two nature education activities of "Cognition of Mangrove Reserves and Protected Species" in QDNR and two beach cleaning activities in WDNR.

Table 1
The design of the nature education activities.

Theme	Place	EEL content	Number
Marine debris removal activities	WDNR	1.Introduction of biodiversity-related knowledge. Focus on MPAs and their effects on Chinese white dolphins. 2. Organize a visit to the Chinese White Dolphin Science Museum in the reserve to intuitively understand the biological habits of Chinese white dolphins and the harm to them caused by garbage generated by human activities. 3. Beach clearing activities. Like the clear beach, to feel the threat to marine ecology caused by human activities generated garbage, thus arousing tourists' sense of responsibility to protect the environment.	170 tourists
Cognition of mangrove reserves and their protected species	QDNR	1. Biodiversity-related knowledge training. The setting up of mangrove reserves and its effect on the protection of the mangrove ecosystem is emphatically explained. 2. Make field observations on the popular science trail in the mangrove reserve, and tell the „stories" of each species and their „adventures" with the species in a vivid and interesting language. 3. Go deep into the protected area to learn about mangroves and clean up garbage, call on more people to pay attention to the problem of marine pollution, and take practical actions to protect the marine ecological environment.	130 tourists

2.3. Procedure and measures

From June to July 2021, volunteers were organized to carry out marine environmental protection and public tourism activities to clean the beach. After each activity, we used semi-structured interviews to obtain fifteen participants' understanding of marine environmental protection knowledge, activity experience and future intentions of PEB. Written informed consent was obtained from all the participants prior to the enrollment. The interview results showed that most participants gained environmental knowledge mainly through mobile phones, schools, and other online and offline institutions, and participating in beach cleaning also improved their knowledge of marine environmental protection. Most participants mentioned that "this activity made me feel one with the environment around me", "plants and animals have the same right to life as human beings", and expressed concern about environmental damage, "the balance of nature is very fragile and easy to be destroyed". In addition, participants also expressed a high willingness to follow up with environmentally friendly behaviors, such as "when shopping, I will replace plastic bags with cloth bags or reuse plastic bags" and "I will pay more attention to resource recycling and garbage sorting.". On the whole, the semi-structured interview preliminarily verified the theoretical hypothesis of this study in the context of beach cleaning, and provided certain field evidence for the subsequent verification of the scale.

In this study, a questionnaire was developed to evaluate 'participants' PEB and the factors affecting it. When distributing the questionnaire, we informed the participants of the main purpose of this study in advance and asked them to sign an informed consent form. The participants were acknowledged of our research purpose and consent in taking initiative of this event. The questionnaire is divided into two parts: demographic variables and research variable measurement. We selected mature scales previously tested and used in existing literature and adjusted the expression of items to fit the context of this study better. We included Robina-Ramírez and Medina-Merodio's EEL items [35], and mainly used the awe scale developed by Tian et al. and Niu & Liufor measuring awe [12,36]. The scale measuring NC was from Mayer and expressed a person's degree of identification with nature, including cognitive, emotional and spiritual aspects [37,38].'. We made appropriate revisions based on the research of Peng et al. [39], considering the understanding ability of the population, as students and families are the main tourists for natural education. For measuring the participants' intention to engage in PEB, we used Wu et al.'s (2021) PEB intention scale.

To ensure the accuracy and effectiveness of our survey questionnaire, we sent our initial scale to experts in tourism management, as well as individuals with experience in nature education, ecological research, or ecotourism for their feedback. Based on their input, we made adjustments to improve the questionnaire's clarity and ease of use. We then conducted a pre-survey with individuals who had participated in nature education activities in Zhuhai within the past year to further refine the questionnaire. This process was completed in April 2022, with 110 valid responses obtained through the nature education institution's WeChat public platform. After

Table 2
The results of confirmatory factor analysis.

Construct/Indicators	Factor Loadings	Cronbach's α	CR	AVE
Ecological Experiential Learning (EEL) A learning experience here,		0.943	0.812	0.945
EEL1: Help me better understand how to use water and energy responsibly	0.951			
EEL2: Help me consider climate change and environmental issues when using water, energy and transportation	0.93			
EEL3: Help me better respect biodiversity and waste management	0.935			
EEL4: Help me better understand how to be an environmentally friendly citizen	0.777			
AWE The experience made me feel		0.927	0.927	0.719
AWE1: Amazing	0.791			
AWE2: Exceeded expectations	0.861			
AWE3: Extraordinary	0.852			
AWE4: Unforgettable	0.894			
AWE5: revere the nature	0.837			
Nature Connection (NC)		0.946	0.949	0.674
NC1: I often feel a sense of oneness with the natural world around me	0.91			
NC2: Calms my mind in the natural environment	0.879			
NC3: I have a deep understanding of how my actions affect the natural world	0.817			
NC4: I feel very connected with all living things and the earth	0.766			
NC5: I feel close to animals and plants	0.88			
NC6: I feel sad when animals (pets, birds) suffer	0.847			
NC7: Humans are part of nature	0.801			
NC8: Without animals and plants, humans cannot survive	0.792			
NC9: Human beings have no right to destroy the natural environment	0.673			
Low-effort PEB(LEP) intention		0.908	0.716	0.910
LEP1: I will protect resources and the environment	0.874			
LEP2: I will recycle garbage	0.883			
LEP3: I will sort garbage	0.801			
LEP4: I will use green (non-plastic) garbage bags	0.823			
High-effort PEB(HEP) intention		0.87	0.714	0.881
HEP1: I will persuade others not to destroy the environment	0.944			
HEP2: I am willing to donate to help the nature reserve protect the environment	0.766			
HEP3: I volunteer for activities related to protecting the environment	0.814			

conducting a principal component analysis, we refined the scale by removing items that had a single factor load of less than 0.5 or multiple factors loading more than 0.4. Additionally, we optimized the wording of the questions based on feedback from the pre-survey participants. The final optimized scale consists of 25 questions.

2.4. Participants and statistical analysis

The official survey was conducted in May 2022, we organized four nature education activities in the two selected reserves. After each activity, questionnaires were distributed to the participants and collected on site. A total of 300 questionnaires were sent out, and 228 valid questionnaires were received, with a recovery rate of 76 %. Among the participants, there were 70 males (31 %) and 158 females (69 %). Among them, 54 (24 %) were under the age of 18, 53 (23 %) were between 18 and 24, 96 (42 %) were between 25 and 44, and 25 (11 %) were over 44. Among them, 62 (27 %) were in junior high school or below, 31 were in high school (14 %), 32 were in junior college (14 %), 97 were in bachelor degree (43 %), and 6 were in graduate school master degree or sbove (3 %). Among them, 125 people (55 %) had participated in similar activities less than 3 times before, 59 people (26 %) had participated in 3–4 times, 15 people (6 %) had participated in 5–6 times, and 29 people (13 %) had participated in 6 times or more, indicating that more than half of them participated in EEL activity for the first time. On the whole, the descriptive statistics of the field survey samples objectively reflect the demographic characteristics of the organizational activities of this study.

We performed the data analysis in four steps. First, we compared the PEB of tourists in MPAs to various demographic characteristics to obtain a comprehensive preliminary assessment. Second, we utilized SPSS 25.0 and Amos 24.0 to assess the reliability of our scales and ensure high-quality measurement and structural models through confirmatory factor analysis. We also employed structural equation modeling to investigate the relationship among EEL, awe, NC, and PEB intentions. Lastly, we followed the guidelines outlined by Hayes [40,41] and used the PROCESS macro and Bootstrapping method to delve into the underlying mechanism of EEL on PEB intentions. Whenever the bootstrapped confidence intervals did not contain 0, we confidently rejected the null assumption.

3. Results

3.1. Reliability and validity tests

To test the fitting effect of the measurement model, a confirmatory factor analysis was performed with SPSS 25.0 and Amos 23.0. Confirmatory factor analysis showed that the model had a good fitting effect ($\chi 2/df = 2.257$, RMSEA = 0.074, TLI = 0.927, IFI = 0.936, CFI = 0.936). Cronbach's α and composite reliability (CR) were further used to test the reliability of the questionnaire. According to the results of the measurement model in Table 2, Cronbach's α coefficients and CR were all higher than 0.7, indicating sufficient reliability and internal consistency of each dimension index. The validity test was further conducted through convergence validity and discriminant validity. Among them, the convergent validity is mainly reflected by the standardized factor loading number and average variance extraction (AVE) values. The results show that the standardized factor loading number and AVE are over 0.6, suggesting that the scale has high convergence validity.

In addition, as shown in Table 3, the discriminant validity of this study was adequate because the AVEs square root values of the constructs were all higher than their intercorrelations with other values.

3.2. The relationship between tourist demographic characteristics and PEB intentions'

Table 4 shows the means and standard deviations of the seven items used to measure tourists' intentions for the two types of PEBs. Judging from the mean value, a score higher than 4 indicated that tourists have a high PEB intention on the whole [42]. As shown in Table 4, the average value of each item was higher than 4, indicating that the tourists have formed better PEB intention after participating in EEL in MPAs. Among them, the average score of "I will protect resources and the environment" in the low-effort PEB intention is the highest (M = 4.55, SD = 0.645), while the average score of "volunteering to participate in environmental protection-related activities" in the high-effort PEB intention is the highest (Mean = 4.47, SD = 0.723).

An independent sample *t*-test was first performed to compare whether there was a significant difference in PEB intention between male and female tourists. Results showed that gender differences had a "marginally" significant p value for low-effort PEB intention (p = 0.052), and were not significant for high-effort PEB intention (p = 0.949). Furthermore, one-way analysis of variance was used to test whether age, education level, and experience affect the two types of PEB willingness of tourists (see Table 5). The age of tourists

Table 3
Discriminant validity of measures.

Factors	1	2	3	4	5
1.Ecological Experiential Learning	**0.972**				
2.Awe	0.556***	**0.848**			
3.Nature connection	0.67***	0.668***	**0.821**		
4.Low-Effort PEB intentions	0.495***	0.485***	0.532***	**0.954**	
5.High-Effort PEB intentions	0.53***	0.511***	0.625***	0.368***	**0.939**

Note: The square root of the AVE is shown on the diagonal (in bolds); *** significant at level of 0.001.

Table 4
The mean value of tourists' pro-environmental behaviors.

Construct	Item	Mean	Std. deviation
Low-effort PEB intention	I will protect resources and the environment	4.55	0.645
	I will recycle garbage	4.50	0.667
	I will sort garbage	4.41	0.719
	I will use green (non-plastic) garbage bags	4.41	0.737
High-effort PEB intention	I will remind others to avoid doing environmentally harmful behaviors	4.42	0.714
	I will donate money to support environmental conservation	4.31	0.771
	I will volunteer my time to projects that help the environment	4.47	0.723

Table 5
Comparison of tourists' PEB intentions.

	Low-effort PEB intention		High-effort PEB intention	
Sex	Mean	SD	Mean	SD
Male	4.35	0.633	4.40	0.631
Female	4.52	0.599	4.40	0.668
T	−1.95		0.064	
Age	Mean	SD	Mean	SD
Under 18 years old	4.347	0.716	4.407	0.666
18 to 24	4.307	0.558	4.371	0.688
25 to 44	4.573	0.595	4.420	0.631
Above 44 years old	4.670	0.413	4.373	0.696
F	3.909**		0.080	
LSD	Below 24<Above 24			
Education	Mean	SD	Mean	SD
Junior high school or below	4.367	0.679	4.387	0.573
High School	4.605	0.520	4.441	0.701
Junior college	4.531	0.556	4.594	0.591
Bachelor Degree	4.456	0.608	4.340	0.704
Master Degree or above	4.667	0.701	4.278	0.743
F	1.060		0.988	
Experience	Mean	SD	Mean	SD
Less than 3 times	4.452	0.647	4.368	0.682
3-4 times	4.411	0.590	4.390	0.635
5-6 times	4.667	0.430	4.556	0.720
More than 6 times	4.552	0.584	4.483	0.553
F	0.902		0.536	

Note: ** significant at the level of 0.01.

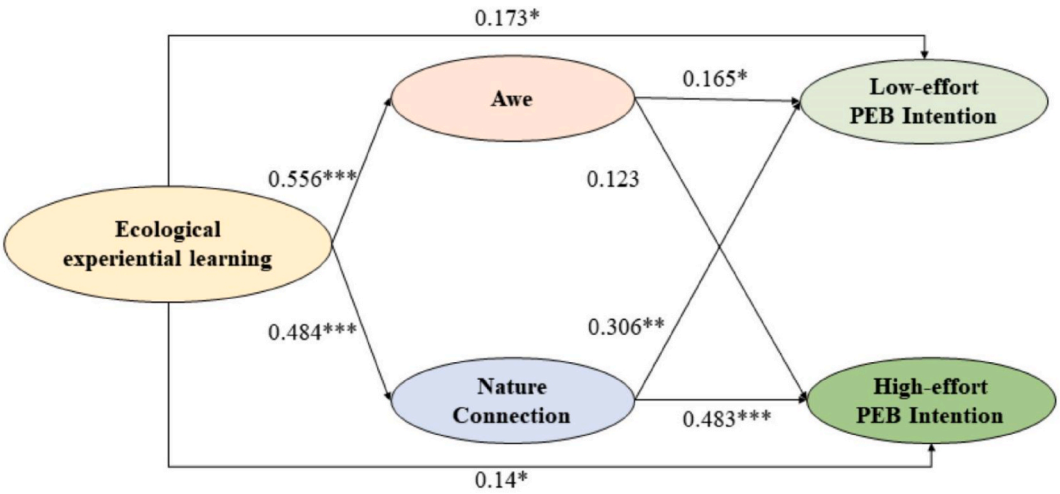

Fig. 2. The results of structural equation model test. Note: ***Statistically significant at $p < 0.001$; **Statistically significant at $p < 0.01$; *Statistically significant at $p < 0.05$; n = 228.

had a significant impact on low-effort PEB intentions, which showed that tourists under 18 years old and those aged 18 to 24 had significantly lower environmental maintenance intentions than those aged 25 and above ($F = 3.909$, $p = 0.01$). However, the age of tourists did not have a significant impact on high-effort PEB intentions. The results showed that the educational level and experience of tourists had no significant influence on their high and low PEB intentions (Table 5).

3.3. The relationship between ecological experiential learning and tourists' PEB intentions

We used the structural equation model to fit the data of ecological experiential learning and tourists' PEB, and the results fit well ($\chi 2/df = 2.414$; RMSEA = 0.079, TLI = 0.918, IFI = 0.928, CFI = 0.927). For specific results, see Fig. 2. The results of structural equation modeling showed that EEL was positively correlated with tourists' willingness to perform low-effort PEB ($\beta = 0.173$, $p < 0.05$), indicating that EEL could stimulate tourists to perform low-effort PEB. Hypothesis 1a was supported. The results of structural equation modeling showed that EEL was positively correlated with tourists' high-effort PEB willingness ($\beta = 0.140$, $p < 0.05$), indicating that EEL could stimulate tourists' High-effort PEB, and Hypothesis 1b was supported.

3.4. The mediating effect of awe

In this study, the confidence intervals of the total effect, direct effect, and indirect effect were calculated with the 95 % confidence interval to explore the significance of the mediating effect of awe [41]. The absence of 0 in the confidence interval indicates that the effect is significant [12]. The results from Table 6 showed that the confidence intervals of the total effect and the direct effect of "EEL → low effort PEB intention "did not contain 0, nor did the confidence intervals of the indirect effect of "EEL → awe → low effort PEB", suggesting that the effect was significant and awe played a mediating role between EEL and low-effort PEB intention, supporting Hypothesis 2a. As for high effort PEB, the confidence interval for both the total effect and the direct effect of "EEL → high effort PEB intention" didn't contain 0, while the confidence interval for the indirect effect of "EEL → awe → high effort PEB intention" contained 0, suggesting that the mediating effect was not significant and the role of awe between EEL and high effort PEB intention was not significant, so Hypothesis 2b was rejected. The findings suggested that EEL could inspire tourist's sense of awe in tourists, but only significantly affected tourists' low-effort PEB intention.

3.5. The mediating effect of nature connection

We further calculated the confidence interval of the total effect, direct effect and indirect effect with the 95 % confidence interval to explore the significance of the mediating effect of NC (Table 6). Neither the confidence interval of the total effect nor the direct effect of "EEL→ low-effort PEB intention" included 0, and the confidence interval of the indirect effect of "EEL→ NC→ low-effort PEB intention" did not include 0. It suggested that NC plays a mediating role between EEL and low-effort PEB intention, supporting Hypothesis 3a. At the same time, neither the confidence interval of the total effect nor the direct effect of "EEL→ high-effort PEB Intention" contained 0, and the confidence interval of the indirect effect of "EEL → NC → high-effort PEB Intention" did not contain 0, suggesting that the mediating effect was significant and the role of NC between EEL and high effort PEB intention was also significant, supporting Hypothesis 3b. The results showed that EEL strengthened NC, and NC had a positive effect on both low-effort and high-effort PEB.

4. Discussion

Enhancing tourists' willingness to engage in PEB is crucial for the sustainable development of marine protected areas (MPAs), which serve as a vital ecotourism destination. Nature-based environmental education plays a key role in promoting ecological behavior [43]. However, it remains unclear if such education influences PEB and how it works [44]. Our study examines the relationship between nature-based environmental education and tourists' PEB in MPAs. We have created a causal hypothesis to gain a better understanding of the interactive mechanism between nature-based environmental education and tourists' PEB intentions.

4.1. Demographic characteristics and tourists' PEB intentions

The behavioral preferences of different tourist groups were obviously different, but demographic characteristics such as gender,

Table 6
The results of mediation effect test.

Explained Variable	Effect	Hypothesized Path	Indirect Effect	Lower Bound	Upper Bound	Results
Low-effort PEB intention	Total effect	EEL→LEP	0.401	0.297	0.504	
	Direct effect	EEL→LEP	0.196	0.066	0.325	
	Indirect effect	EEL→AWE→LEP	0.081	0.011	0.155	Accepted
		EEL→NC→LEP	0.124	0.031	0.229	Accepted
High-effort PEB intention	Total effect	EEL→HEP	0.478	0.369	0.588	
	Direct effect	EEL→HEP	0.166	0.295	0.254	
	Indirect effect	EEL→AWE→HEP	0.060	−0.006	0.133	Rejected
		EEL→NC→HEP	0.252	0.159	0.347	Accepted

education level and experience of participation had no significant influence on PEB [42], such a result was also obtained from the data in this study (Table 5). However, the data in this study showed that there were significant differences in low-effort PEB intentions of tourists in different age groups, and the low-effort PEB intentions of people under 24 years old was significantly lower than that of tourists of older age (Table 5), which is different from some previous studies and also beyond our expectation [45]. Otto et al. [46] suggested that environmental attitudes and behaviors experience a trough between the ages of 13 and 18, but rise again in adulthood, which is consistent with our data. Wiernik et al.'s meta-analysis study showed that older people are more likely to be motivated by social norms [47], which may be responsible for the higher low-effort PEB intentions among people over 24 years old. Additionally, most individuals under the age of 24 are primarily in the student phase, where they may be subject to fewer societal norms compared to those who are already in the workforce. Otto and Kaiser's study further substantiates these age-related differences, indicating that it is learning—not maturation—that drives the relationship between age and self-reported ecological behavior [48].

Otto et al. reported that educating children about the natural environment could increase their awareness and connection with nature, ultimately leading to more environmentally friendly behavior, and mmersing children in nature education can greatly increase their future engagement [46]. Evans et al. also explored the impact of childhood experiences on young adults' environmental behavior [49]. They hypothesized that exposure to the natural environment during childhood can have long-term effects on environmental behaviors in adulthood. The study measured this through an indicator called "ecological footprint" which refers to an individual's daily use of natural resources and impact on the environment. Results showed that participants who had contact with nature during childhood demonstrated better environmentally friendly behaviors as young adults, with a lower ecological footprint. These studies highlighted the importance of childhood exposure to nature in shaping environmental behavior in adulthood [48,49]. This underscored the role of education and home environment in fostering environmental awareness and responsibility in the next generation. Encouraging children to interact with nature and participate in environmental activities can help develop a sense of responsibility for the planet and ecosystems, leading to more environmentally conscious actions in the future. These findings highlight the need for managers of MPAs to focus on EEL activities targeting young people to improve their PEB intention.

4.2. EEL and tourists' PEB intentions

Our research highlighted the pivotal role of EEL in motivating tourists to engage in PEB within MPAs, as evidenced in Fig. 2. Duerden & Witt's study compared the impact of direct and indirect experiences of the natural environment on environmental attitudes and behaviors among students, concluding that direct experience was more effective in converting environmental knowledge into behavior [50]. Andrade et al. recommended expanding the scope of learning spaces to increase residents' support for environmental protection [51]. Ballantyne et al. reported that nature-based tourism experiences could improve tourists' knowledge of environmental protection, awareness, and responsibility [52]. Our findings further revealed that EEL had a greater impact on low-effort PEB intentions than high-effort PEB intentions, as shown in Fig. 2. This difference may be due to the fact that high-effort PEB requires significant financial, time, and energy investments, leading tourists to be more cautious and deliberate in their decision-making. This aligns with Kafyri et al.'s research, which found that tourists' willingness to pay for protected areas is generally lower than their willingness to acquire environmental information [7]. Overall, our research supports the idea that the level of effort required for PEB can influence tourists' intentions and decision-making processes. In conclusion, EEL activities that involve deep contact with nature significantly enhance tourists' willingness to engage in PEB, which is especially relevant for tourism in MPAs. Therefore, we strongly recommend that MPAs develop EEL activities in their management to achieve the objectives of protected areas and promote sustainable development.

4.3. The mechanism of EELand tourists' PEB intentions

Information processing in individuals typically involves the utilization of both emotional and cognitive pathways [21,22]. Our research discovered that EEL has two pathways, awe and NC, that encourage tourists to intend to practice PEB. Our study combines cognition and emotion theories [20] to shed light on the "black box" mechanism linking EEL and tourists' PEB intention. We looked at both the external natural environment and the internal self, and developed a dual explanatory chain to clarify how EEL motivates tourists to practice PEB.

This study confirmed that exposure to EEL might have a positive relationship with low-effort PEB intentions by inducing feelings of awe, supporting the idea of Jonathan and William's that people's sense of awe can be stimulated by the knowledge they gain from wildlife experiences [53]. However, we found that high-effort PEB intentions were not affected in the same manner that awe was difficult to stimulate high-effort PEB, which expanded the existing literature on awe and PEB intention [54]. Our study showed that emotional responses to natural environments, including mangrove science and beach cleaning, could increase intentions to protect the environment. This is significant for managing tourism destinations, particularly marine protected areas. Nevertheless, it's worth noting that experiencing awe alone may not lead to high-effort PEB due to its resource-intensive nature. Further research is needed to fully understand the role of awe in promoting environmental behavior.

Based on our cognitive analysis, we discovered that EEL has a strong positive relationship with NC, which in turn influences the two types of PEB intentions. Previous studies [15,16,55] also shown a positive correlation between NC and PEB. However, our study is the first to identify the link between EEL and PEB, and the role of NC in this relationship. Our data indicates that NC plays a partial mediating role in the relationship between EEL and the two types of PEB intentions. By immersing tourists in nature, EEL effectively enhances their NC, not only encouraging them to protect the environment but also motivating them towards behavioral intentions such as donation and voluntary service. Pirchio et al.'s research on Italian primary and secondary school students demonstrated that

outdoor education programs had a positive impact on physical and mental health, connection with nature, and prosocial behavior [34]. Similarly, Peng et al. found that contact with nature can improve children's NC, leading to pro-environmental behavior [39]. Our study also highlighted that NC has a stronger relationship with high-effort PEB intention than on low-effort PEB intention.

5. Practical implications

The results of this study have practical implications for MPAs and other destinations. One key finding is that reserve managers should prioritize engaging with the youth demographic, as they have the potential to enhance PEB intentions. To achieve this, reserve managers can collaborate with junior high schools and senior high schools to organize nature-focused experiential activities. This will enable students to connect more closely with nature, fostering their understanding and appreciation of the environment. Moreover, the reserve can implement further experiential nature education initiatives specifically designed for young individuals, such as nature performances and game projects, to capture their interest and promote love and connection towards nature.

Additionally, there is a plan to arrange activities for parents and children through a partnership between the reserve institution and school. These activities will serve as a third-class installation, offering engaging and collaborative programs that instill interest, inspiration, and teamwork. They will incorporate a deeper understanding of PEB and its daily applications, aimed at fostering healthy habits for both parents and children.

Further, drawing inspiration from the concept of an "ecological footprint", which measures an individual's daily use of natural resources and impact on the environment, could create a unique and engaging animation to teach children and young adults how to track their daily activities related to ecology, environmental damage, and consumption. A mobile app could also be developed for those who watch the video, allowing them to record their own ecological footprint. A yearly competition could be held to identify the family with the smallest ecological footprint, who would receive special environmental protection parent-child tourism entertainment as a reward.

Furthermore, EEL may contribute to the sustainable development of tourist destinations in many cases. By incorporating EEL activities that involve interaction with natural organisms, tourist destinations can promote PEB intentions for visitors. EEL may also play a significant role in promoting tourists' PEB in MPAs and other nature reserves, and can be integrated into the daily management of these protected areas. For instance, nature reserves can collaborate with research institutions to organize regular small ecological learning activities and ecological experience courses within the reserve, such as marine garbage cleaning and classification activities, marine animal and plant painting, and hands-on courses. These activities can enhance tourists' experiential activities in the reserve and enrich their overall experience.

To ensure that tourists practice pro-environment behaviours, two key factors must be considered - awe and NC. Firstly, inspiring a sense of awe in tourists can awaken their consciousness towards environmental protection. Creating unique EEL sites that showcase the biodiversity of the nature reserve comprehensively can achieve this. Secondly, promoting NC by incorporating EEL strategies such as interpretation, education, and game experience is essential. This approach will equip tourists with knowledge and skills related to environmental protection, fostering a belief in harmonious coexistence between man and nature and ultimately leading to a cognitive belief in NC.

Both Awe and NC encompass cognitive and emotional aspects, although awe tends to be more associated with the emotional aspect for measurement purposes, while NC is more closely linked to cognition. Nonetheless, it is crucial for researchers and protected area managers to acknowledge that both variables play a significant role in the cognitive and emotional experiences of tourists. Consequently, careful consideration is necessary in the planning and guidance of various activities.

6. Limitations and suggestions for future research

In this paper, there are still some deficiencies for future research. First, this study found marginally significant gender differences in low-effort PEB intentions. Future research should be sure to examine whether there are gender differences in low-effort PEB intentions, so as to adopt more targeted EEL for different groups of people. Second, the study's data being cross-sectional didn't establish causal relationships between variables. Future studies need a control group that wants to have an EEL to examine causality or longitudinal tracking to improve the results. Third, the research case site only consisting of two MPAs is insufficient. It is necessary to further investigate whether the study's conclusions can be applied to other ecotourism destinations and nature education scenarios since tourists' experiences can differ significantly. Forth, the boundary conditions of the impact of EEL on tourists' emotions and PEB can be explored based on environmental characteristics. For example, research has found that perceived crowding can reduce joy, thereby affecting tourist satisfaction and loyalty [56]. Future research can explore the relationship between destination crowding perceptions on EEL, tourist experience, and their PEB intentions. Lastly, this study only focused on tourists' PEB intentions due to limited time and resources. To gain a more comprehensive understanding, it is crucial to include discussions on PEB among the residents living around the reserve, who are also key participants.

Ethics statement

This study was reviewed and approved by Ethics Committee of Sun Yat-sen University School of Business, with the approval number: BS20231103005.

Consent to participate

Written informed consent was obtained from all the participants prior to the enrollment of this study.

Data availability statements

The data underlying this article cannot be shared publicly due to the privacy of individuals that participated in the study. The data will be shared on reasonable request to the corresponding author.

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CRediT authorship contribution statement

Jiaman Liu: Writing - review & editing, Writing - original draft, Methodology, Formal analysis, Conceptualization. **Lichen Yuan:** Writing - review & editing, Investigation, Conceptualization. **Meiyun Li:** Methodology, Funding acquisition, Data curation, Conceptualization. **Shang-Jen Li:** Writing - review & editing. **Yulu Sun:** Investigation. **Jiangang Yuan:** Writing - review & editing, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2023.e23410.

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