

Article

Interconnected Eco-Consciousness: Gen Z Travelers' Intentions toward Low-Carbon Transportation and Hotels

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Abstract: Generation Z (Gen Z) is widely acknowledged for their heightened eco-consciousness. Nevertheless, a notable research gap persists in the empirical examination of eco-friendly preferences within this demographic group, particularly concerning low-carbon transportation and hotel selections. Utilizing structural equation modeling and data collected from 357 Gen Z travelers, this study investigates the interconnected factors influencing Gen Z travelers' intentions toward adopting low-carbon transportation and making low-carbon hotel choices based on the theory of planned behavior (TPB). The results indicate that perceived value and environmental concern exert significant influence on the formation of attitudes, subjective norms, and perceived behavioral control among Gen Z travelers. As a result, these psychosocial constructs make a substantial contribution to the intention of Gen Z travelers of adopting low-carbon tourism behaviors. Additionally, the study uncovers a positive correlation between the propensity to use low-carbon transportation and the inclination to choose low-carbon hotels for accommodation. These findings underscore the interconnected facets of Gen Z's preferences for low-carbon tourism, thereby indicating the prospect for collaborative efforts to bolster sustainability within the tourism industry.

Keywords: Gen Z; low-carbon tourism; perceived value; environmental concern



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1. Introduction

Global warming currently stands as one of the foremost critical global challenges. The extensive energy consumption stemming from industrialization and urbanization has culminated in significant carbon emissions, thereby exacerbating global warming [1]. The imperative to establish a low-carbon society becomes increasingly urgent as the concurrent escalation of extreme climate change, resource depletion, ecological degradation, and species extinction necessitates a harmonious coalescence of economic and environmental progress [2]. The latest data reveal that the travel and tourism sector contributes to 8.1% of the global greenhouse gas emissions [3]. Hence, the inextricable linkage between tourism and global warming has propelled both tourism industry and academia to express a keen interest in advocating low-carbon tourism behaviors.

Low-carbon behaviors, a subset of pro-environmental behaviors [4], encompass actions and choices that directly or indirectly yield a positive impact on the utilization of substances and energy, fostering a favorable transformation in the structure and dynamics of ecosystems and the biosphere [5]. Within the realm of tourism, transportation and accommodation constitute the primary domains that consume energy and contribute to carbon emissions [6]. Notably, transportation, particularly modes reliant on high fossil fuel consumption including air travel and fuel-intensive vehicles, exerts a disproportionately significant environmental burden owing to its substantial greenhouse gas emissions [7]. Similarly, the extensive range of facilities and operations in hotels renders them among the most energy-intensive segments, necessitating continuous energy usage for functions like 24 h operations and heating, ventilation, and air-conditioning systems [8,9]. Consequently,

the adoption of low-carbon transportation modes and hotels represent a proactive measure to mitigate the detrimental global warming impact associated with tourism. Low-carbon transportation options such as walking, cycling, buses, and subways contribute to reduced carbon dioxide emissions and minimized pollution [10]. Likewise, low-carbon hotels, often referred to as green hotels, prioritize environmentally friendly practices and sustainability across their operations [11,12]. The promotion of low-carbon travel and hotels aligns with governmental environmental goals and international commitments to reduce emissions.

Prior research on sustainable tourism behaviors and intentions has predominantly focused on collecting data from baby boomers, generation X, and millennials, leaving a dearth of comprehensive investigations into Gen Z's pro-environmental tourism behaviors and intentions [6]. This study aims to address this gap by specifically examining the behavioral intentions of Gen Z toward low-carbon transportation and hotels. Previous research has consistently highlighted the distinct characteristics and preferences of Gen Z in comparison to preceding generations. These distinctions have significant implications for their consumer behavior and lifestyle choices, as evidenced by several studies [13–15]. Wee (2019) emphasized that Gen Z is particularly concerned about societal and sustainability issues, actively participating in sustainable consumption and engaging in sustainable tourism practices [13]. Similarly, Ribeiro et al. (2023) illustrated Gen Z's strong commitment to sustainable travel behavior, underpinned by their positive attitudes toward sustainable tourism and their willingness to make environmental sacrifices [15]. Paradoxically, despite Gen Z's pronounced pro-sustainability views, research by Prayag et al. (2022) indicates that its members exhibit fewer environmentally friendly behaviors compared to older generations [14]. Therefore, a deeper understanding of their low-carbon behavioral intentions is essential for guiding them toward sustainable tourism. Recognizing that behavioral intention is a crucial precursor to actual behavior, we employ the well-established theory of planned behavior (TPB) model. The TPB model explores personal, social, and non-volitional determinants influencing intention, extensively utilized in prior research on sustainable tourist behaviors [16–18]. It holds potential to enhance predictions of Gen Z's intentions regarding sustainable tourism behaviors. In light of the environmental consciousness commonly attributed to generation Z [19] and of its members being more value oriented than previous generations [20], this study incorporates environmental concern and perceived value as additional variables into the TPB model. Furthermore, Whitmarsh and O'Neill (2010) suggest that sustainable behaviors are interconnected [21]. However, there is currently a lack of substantial evidence. Therefore, in this article, we investigate the relationship between the intention to use low-carbon transportation and the intention to stay at low-carbon hotels.

The purpose of this study is to explore the sustainable tourism behaviors of Gen Z. Understanding these behaviors is essential to encourage its members to opt for low-carbon transportation and eco-friendly accommodation such as low-carbon hotels. Hence, the objectives of this study are as follows: (1) to develop an extended TPB model to better predict Gen Z's behavioral intentions toward low-carbon tourism, (2) to examine the role of perceived value and environmental concern in shaping Gen Z's cognitive framework and how these factors impact their intentions toward low-carbon transportation use and hotel visits, (3) to explore the interconnectedness of sustainable travel decisions among Gen Z, particularly the relationship between the intention to use low-carbon transportation means and the intention to stay at low-carbon hotels. We employ structural equation modeling (SEM) to empirically test our research hypotheses and analyze how these factors influence the low-carbon travel and accommodation behavioral intentions of Gen Z.

The remainder of this study is structured as follows. Section 2 conducts an extensive review of the pertinent literature, culminating in the formulation of a theoretical framework and the derivation of hypotheses. Section 3 delineates the questionnaire design, introduce the data collection process, and expounds upon the research methodology employed. Section 4 provides a comprehensive presentation of the empirical results. Finally, Section 5 engages in an in-depth discussion, synthesizing the findings and proffering theoretical and

practical implications, highlighting the limitations of the study and proposing avenues for future research.

2. Literature Review and Hypotheses Development

2.1. Gen Z and Low-Carbon Intention

According to generational theory, individuals can be classified into distinct groups based on their birth cohort, sharing common experiences and events throughout their lifetime. Consequently, these individuals are likely to exhibit similar values, preferences, attitudes, and behaviors. Gen Z refers to the cohort of young people born since 1995. This generation's members are characterized as true digital natives, having grown up with technology and the internet as an inseparable aspect of their daily lives [22]. Their exposure to a multicultural and interconnected world through online platforms and social media has rendered them more diverse and distinct compared to preceding generations, presenting substantial marketing challenges for industries [23]. Given that Gen Z is the largest consumer group of the future, possessing substantial potential purchasing power [24], and given the scarce attention paid to tourism research within the Gen Z context [15], it becomes paramount for researchers and marketers to devote their attention and efforts to comprehending and engaging this demographic.

Within the domain of tourism research, previous studies have investigated tourists' pro-environmental travel behaviors [25,26] and green hotel consumption [8,27–29]. Baumeister et al. (2022) discovered that passengers with environmental concerns exhibit a higher inclination to opt for environmentally friendly flights [25]. Furthermore, the inclusion of eco-labels with supplementary information elucidating their purpose has been shown to significantly enhance passengers' willingness to choose environmentally friendly flights. Notably, Gen Z is often characterized as being more environmentally conscious and attuned to sustainability issues [19], exhibiting a heightened awareness and inclination toward environmentally friendly practices in comparison to previous generations [22]. Moreover, individuals belonging to Gen Z who possess a strong affinity with green consumption are more predisposed to manifest positive attitudes, articulate environmental concerns, and actively partake in pro-environmental travel behaviors [15]. According to a report by Statista (2020), Gen Z exhibits the highest percentage of individuals favoring eco-friendly travel options, surpassing previous generations [30]. X. Chen et al. (2023) also noted that, in comparison to preceding generations, Gen Z exhibits a stronger proclivity for environmentally conscious traveling and represents a significant potential advocate for sustainable modes of transportation [26].

With respect to travelers' intentions to stay at eco-friendly hotels, prior research conducted by M.-F. Chen and Tung (2014) reveals that environmental concerns and perceived moral obligations positively influence this intention [8]. Additionally, Assaker (2020) identified that a hotel's green practices directly impact the perceived value, subsequently shaping consumers' attitudes and behaviors toward the hotel [27]. However, a recent study by D'Arco et al. (2023) explored the inclination of Gen Z to prioritize sustainable travel choices over the selection of green hotels [6]. Therefore, additional evidence is still needed to further explore Gen Z's preferences for low-carbon transportation and hotel choices.

2.2. Perceived Value

The perceived value holds a subjective significance within consumer contexts and is recognized as a pivotal determinant of consumer purchasing behavior. An emblematic interpretation of perceived value, as put forth by Zeithaml (1988), posits it as an overall assessment made by consumers regarding a product or service [31]. This assessment hinges upon a balance struck between the benefits accrued and the costs incurred during the transaction. The paramount role of perceived value extends to both marketing practitioners and consumers alike. It not only serves as a cornerstone for the nurturing of enduring customer relations, but also exerts a substantial sway over consumers' intentions to make purchases. In its quantification, the perceived value has been gauged using either a

unidimensional scale [27] or a multidimensional scale [32]. The latter delves into the utilitarian facet of value, gauging the perceived quality vis-à-vis the price paid [27]. Such a multidimensional approach has found application within the domain of tourism, capturing travelers' cognitive responses [33].

The concept of perceived value has been extensively harnessed across diverse facets of tourism research, encompassing domains like tourism destination image [34], Airbnb reuse intention [35], tourist loyalty [27], and tourist satisfaction [36,37]. Empirical research undertaken by Castellanos-Verdugo et al. (2016) underscores the notable influence of green perceived value on attitudes [37]. Similarly, within the sphere of organic purchase behavior, Roh et al. (2022) shows that green perceived value has significant influence on attitude [38]. Han (2015) indicates that subjective norms, perceived behavioral control, and attitudes mediate the linkage between behavioral intentions and the antecedents [39].

Additionally, perceived value has consistently emerged as a robust predictor of behavioral intentions [40]. Recently, Li et al. (2022) revealed that tourists' perceived value significantly boosts low-carbon consumption intentions [41]. Likewise, Liao et al. (2023) demonstrated that multidimensional perceived value directly and indirectly shapes intentions for low-carbon travel [42]. Building upon these empirical insights, we posit the following hypothesis:

Hypothesis 1a (H1a). *Gen Z's perceived value has a positive influence on attitude.*

Hypothesis 1b (H1b). *Gen Z's perceived value has a positive influence on subjective norm.*

Hypothesis 1c (H1c). *Gen Z's perceived value has a positive influence on perceived behavioral control.*

Hypothesis 1d (H1d). *Gen Z's perceived value has a positive influence on intention to use low-carbon modes of transportation.*

Hypothesis 1e (H1e). *Gen Z's perceived value has a positive influence on intention to sojourn in low-carbon hotels.*

2.3. Environmental Concern

Environmental concern refers to individuals' positive or negative attitudes toward climate change and environmental issues [43]. It is a crucial factor influencing individuals' engagement in environmental protection behaviors [44]. Research by Hartmann and Apaolaza-Ibáñez (2012) confirms the impact of environmental concern on consumers' attitudes toward purchasing environmentally friendly products or services [45]. Similarly, Han et al. (2010) found that consumers with higher levels of environmental concern exhibit a more positive intention to purchase environmentally friendly products and services [16].

In the field of tourism research, scholars have indicated that tourists with positive environmental attitudes and awareness are more likely to engage in pro-environmental behaviors compared to those who are less concerned about the environment [46,47]. However, some researchers argue that tourists can still engage in pro-environmental behaviors even without a high level of environmental concern [48]. Y. Kim and Choi (2005) highlight the controversial relationship between environmental concern and behavior [49], and a meta-analysis conducted by Hines et al. (1987) hints at the relatively low impact of environmental concern on behavior [50]. However, M.-F. Chen and Tung (2014) propose that environmental concern influences behavioral intentions through variables of the TPB model [8]. They conducted a study on the factors influencing tourists' intention to stay at green hotels and found that consumers' environmental concern has a positive impact on their attitudes, subjective norms, and perceived behavioral control toward staying at green hotels. Paul et al. (2016) also demonstrate a significant influence of environmental concern on consumers' attitude, subjective norms, and perceived behavioral control [44]. Recent research highlights environmental concern as a pivotal factor influencing the preference for

night trains, considered to be a more eco-friendly option for long-distance traveling [51]. Similarly, Zhang et al. (2024) found that environmental concerns strongly influence intentions toward sustainable travel behaviors in the post-pandemic era [52]. Based on the above literature, the influence of environmental concerns on behavioral intentions remains debated. Therefore, it is imperative to examine whether environmental concern affects intentions related to two specific low-carbon tourist behaviors. Hence, the following hypotheses are proposed:

Hypothesis 2a (H2a). *Gen Z's environmental concern has a positive influence on attitude.*

Hypothesis 2b (H2b). *Gen Z's environmental concern has a positive influence on subjective norm.*

Hypothesis 2c (H2c). *Gen Z's environmental concern has a positive influence on perceived behavioral control.*

Hypothesis 2d (H2d). *Gen Z's environmental concern has a positive influence on the intention to use low-carbon modes of transportation.*

Hypothesis 2e (H2e). *Gen Z's environmental concern has a positive influence on the intention to sojourn in low-carbon hotels.*

2.4. Attitudes, Subjective Norms, and Perceived Behavioral Controls

According to the theory of planned behavior (TPB), proposed by Ajzen (1991), human behavior is determined by behavioral intentions, which are influenced by three main factors: individual attitudes, subjective norms, and perceived behavioral control [53]. Variables such as gender, personality, occupation, and age do not directly impact behavioral intentions; rather, they exert indirect effects through attitudes and subjective norms. The TPB model has been extensively applied in the context of consumer behavior studies [54,55]. In the context of tourism, the TPB has been utilized to predict travel destinations [56], Airbnb reusing intentions [35], intentions toward drone food delivery services [57], slow tourism intentions [58], bicycle tourism intentions [18], and choices of green hotels [16].

In the TPB model, the attitude denotes an individual's favorable or unfavorable stance toward a specific behavior [53]. Prior research by Hultman et al. (2015) demonstrates a significant correlation between tourists' positive attitudes toward green products and their willingness to pay a premium for environmentally friendly options [17]. Subjective norms refer to the perceived social pressure that individuals experience when contemplating a particular behavior, encompassing their recognition and judgment of prevailing social norms [53]. Especially in collectivist cultural backgrounds, individuals are highly concerned about the opinions of significant others and strive to avoid disappointing them [59]. Perceived behavioral control involves an individual's assessment of the ease or difficulty associated with executing a specific behavior [53].

Existing studies have indicated positive associations between the variables in the theory of planned behavior (TPB) and intention, such associations being crucial to elucidate individuals' decision-making processes. For instance, Han et al. (2017) developed an extended TPB model to predict individuals' intentions for bicycle tourism, revealing the significant effects of attitude, subjective norms, and perceived behavioral control on tourists' intention to engage in bicycle traveling [18]. Similarly, Han et al. (2010) verified that travelers' choices of pro-environmental lodging products appear to be significantly influenced by attitude, subjective norms, and perceived behavioral control [16]. Furthermore, Qiu et al. (2022) demonstrated that attitude, subjective norms, and perceived behavioral control directly impact the pro-environmental behavior intentions of Gen Z and older generations [60]. Based on these findings, we propose the following hypotheses:

Hypothesis 3a (H3a). *Attitude has a positive influence on Gen Z's intention to use low-carbon modes of transportation.*

Hypothesis 3b (H3b). *Subjective norms have a positive influence on Gen Z's intention to use low-carbon modes of transportation.*

Hypothesis 3c (H3c). *Perceived behavioral control has a positive influence on Gen Z's intention to use low-carbon modes of transportation.*

Hypothesis 4a (H4a). *Attitude has a positive influence on Gen Z's intention to sojourn in low-carbon hotels.*

Hypothesis 4b (H4b). *Subjective norms have a positive influence on Gen Z's intention to sojourn in low-carbon hotels.*

Hypothesis 4c (H4c). *Perceived behavioral control has a positive influence on Gen Z's intention to sojourn in low-carbon hotels.*

2.5. Intentions Toward Low-Carbon Transportation and Hotels

Previous research has identified the existence of eco-conscious travel segments within Gen Z [6]. These individuals have a more sustainable lifestyle than other generations [19] and are more likely to seek out sustainable travel options and experiences that align with their values [61]. Puntiroli et al. (2022) discovered that customers with strong environmental values consistently engage in sustainable behaviors, which, in turn, drive the adoption of other sustainable practices [62]. Thus, their positive intention to use low-carbon transportation may also translate into a greater intention to sojourn in low-carbon hotels as part of their overall eco-conscious travel behavior. A study by Whitmarsh and O'Neill (2010), exploring the predictive relationship between specific behaviors [21], found that engaging in pro-environmental behavior was a noteworthy indicator of other broader pro-environmental actions among the respondents. Therefore, the following hypothesis is suggested:

Hypothesis 5 (H5). *Gen Z's intention to travel in a low-carbon manner increases their intention to sojourn in low-carbon hotels.*

2.6. The Mediating Role of TPB

Recent research highlights TPB constructs as crucial mediators shaping consumer behavioral intentions. Paul et al. (2016) [44] and Alam et al. (2023) [63] identified the mediating roles of attitude, subjective norms, and perceived behavioral control in linking environmental concern to intention to purchase green products. Xie and Madni (2023) similarly demonstrated that perceptions of the environment and subjective norms significantly mediate the intention to purchase green products [64]. In the field of tourism, Meng and Cui (2020) found that attitude plays a crucial mediating role between external variables and tourists' intention to revisit [65]. Additionally, Tavitiyaman et al. (2024) examined attitude as a mediator, showing that it mediates the relationship between environmental knowledge and the intention to stay at environmentally friendly hotels [66]. The studies mentioned above suggest that TPB constructs mediate the relationship between behavioral intention and external variables. Accordingly, this study explores the mediating role of TPB constructs with respect to linking external variables (perceived value and environmental concern) to two low-carbon behavioral intentions. Therefore, the following hypotheses are suggested:

Hypothesis 6a (H6a). *There is a mediating effect of attitude on the association between perceived value and intention to use low-carbon transportation.*

Hypothesis 6b (H6b). *There is a mediating effect of subjective norms on the association between perceived value and intention to use low-carbon transportation.*

Hypothesis 6c (H6c). *There is a mediating effect of perceived behavioral control on the association between perceived value and intention to use low-carbon transportation.*

Hypothesis 6d (H6d). *There is a mediating effect of attitude on the association between perceived value and intention to visit low-carbon hotels.*

Hypothesis 6e (H6e). *There is a mediating effect of subjective norms on the association between perceived value and intention to visit low-carbon hotels.*

Hypothesis 6f (H6f). *There is a mediating effect of perceived behavioral control on the association between perceived value and intention to visit low-carbon hotels.*

Hypothesis 7a (H7a). *There is a mediating effect of attitude on the association between environmental concern and intention to use low-carbon transportation.*

Hypothesis 7b (H7b). *There is a mediating effect of subjective norms on the association between environmental concern and intention to use low-carbon transportation.*

Hypothesis 7c (H7c). *There is a mediating effect of perceived behavioral control on the association between environmental concern and intention to use low-carbon transportation.*

Hypothesis 7d (H7d). *There is a mediating effect of attitude on the association between environmental concern and intention to sojourn in low-carbon hotels.*

Hypothesis 7e (H7e). *There is a mediating effect of subjective norms on the association between environmental concern and intention to sojourn in low-carbon hotels.*

Hypothesis 7f (H7f). *There is a mediating effect of perceived behavioral control on the association between environmental concern and intention to visit low-carbon hotels.*

Based on the literature review and the developed hypotheses, a conceptual research framework of this study is proposed (see Figure 1).

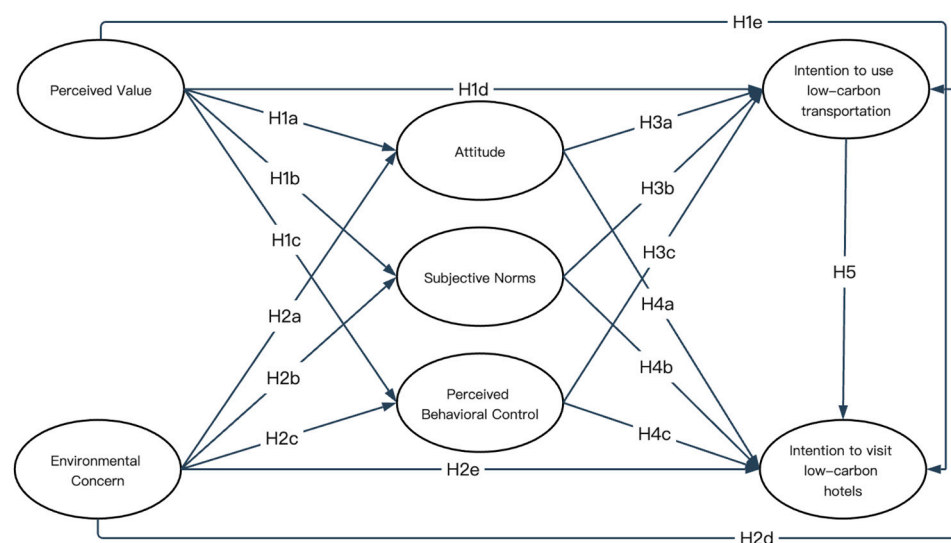


Figure 1. Conceptual research framework.

3. Methodology

3.1. Scale Design

The questionnaire comprises three distinct sections. The initial section provides a succinct overview of the study. The subsequent section deals with participants' demographic information, encompassing variables such as gender, age, level of education, and occupation. The subsequent section encompasses 26 measurement items that pertain to seven constructs, employing a seven-point Likert scale that ranges from 1 (strongly disagree) to 7 (strongly agree). All measurement items were derived and adapted from existing literature. Specifically, the measurement of the perceived value regarding the utilization of low-carbon transportation and the patronage of low-carbon hotels entailed three items each, sourced from Al-Ansi and Han (2019), Assaker (2020), and Castellanos-Verdugo et al. (2016) [27,37,67]. Environmental concern and attitude were adapted and modified from Paul et al. (2016) [44], with each construct comprising four items. The measurement of subjective norms employed three items from Meng and Choi (2016) [58]. The construct of perceived behavioral control consisted of three items, which were modified based on the scales developed by Han et al. (2017) [18]. Finally, the intention to use low-carbon transportation and the intention to sojourn in low-carbon hotels each has three items, adapted from D'Arco et al. (2023) and Han et al. (2010) [6,16].

The original survey was initially created in English and later translated into Chinese. Subsequently, a back-translation version was generated and scrutinized to ensure the accuracy of the measurement items. To ensure the instrument's validity, the questionnaire was subjected to pretesting, involving the distribution of the survey to 30 undergraduate students and three tourism scholars. Following the pretest, minor adjustments to the wording were made for certain items.

3.2. Data Collection and Respondents' Demographics

The questionnaires were developed online using Wenjuanxing, a well-known professional online survey design platform in China. In July 2023, convenience sampling was used to gather responses by taking advantage of the authors' social connections. Additionally, the questionnaires were distributed through travel group chats on popular Chinese social media platforms, including Weibo and Xiaohongshu, targeting individuals with a keen interest in traveling. To enhance the external validity of the study and increase the response rates, respondents were encouraged to share the questionnaire with their network upon completion [68].

A screening question was utilized to ensure that all respondents were born in 1995 or later, with participants born before 1995 being excluded from the dataset. A total of 357 valid responses were collected from the participants. According to Hair et al. (2011), the sample size in structural equation modeling should be at least ten times the number of latent variables to ensure reliable results [69]. With a total of 25 measurement items, our survey's sample size of 357 surpasses the recommended sample size.

Table 1 provides an overview of the demographic characteristics of the sample, comprising a total of 357 participants. The gender distribution of the respondents was relatively balanced, with 45.7% of the study population being male and 54.3% being female. In terms of educational attainment, the majority of the participants held an undergraduate degree (48.7%, $n = 174$). Upon examination of the occupational composition of the sample, only 23.2% ($n = 83$) of respondents were students, while the remaining individuals were already employed. Turning to the personal annual income, 31.1% of respondents ($n = 111$) reported an income falling within the range of 3000–5000 RMB, while 37.8% ($n = 135$) had incomes ranging from 5000 RMB to 8000 RMB. With respect to travel frequency, 44.0% ($n = 157$) of participants reported traveling once every six months, and 31.4% ($n = 112$) indicated traveling once a year or less.

Table 1. Respondents' demographics (n = 357).

Variable	Category	Frequency	Percentage
Gender	Male	163	45.7%
	Female	194	54.3%
Education	High school or below	59	16.5%
	College diploma	96	26.9%
	Undergraduate	174	48.7%
	Graduate or above	28	7.8%
Occupation	Student	83	23.2%
	Employees of state-owned enterprises and institutions	57	16.0%
	Private owner	73	20.4%
	Enterprise staff	144	40.3%
Personal annual income (Unit: RMB)	3000 and below	62	17.4%
	3000–5000	111	31.1%
	5000–8000	135	37.8%
	Above 8000	49	13.7%
Travel frequency	Once a month or more	17	4.8%
	Once every quarter	71	19.9%
	Once every six months	157	44.0%
	Once a year or less	112	31.4%

3.3. Common Method Bias

To assess the presence of potential common method bias (CMB) among the latent variables, Harman's single factor test was conducted. According to Podsakoff et al. (2003), it is recommended that the proportion of variance explained by a single factor through principal component analysis be less than 50% [70]. In our research model, the percentage of variance explained by a single factor was found to be 31.85%, which is below the 50% threshold. This outcome indicates that CMB was not a significant concern in our study.

3.4. Data Analysis

The data in this study were analyzed using the SPSS 25.0 and AMOS 24.0 software. Following the two-step approach proposed by Anderson and Gerbing (1988), the analysis began with the estimation of a measurement model using confirmatory factor analysis (CFA) [71]. The adequacy of the measurement model was assessed, and, subsequently, structural equation modeling (SEM) was employed to identify the most suitable model and examine causal relationships. SEM offers an effective means of evaluating the interrelationships among multiple constructs simultaneously, particularly when testing a theoretical model that involves numerous dependent and independent variables, as well as mediators [72].

4. Results

4.1. Measurement Model Assessment

The evaluation of the measurement model encompassed an examination of its internal consistency reliability, convergent validity, and discriminant validity, following the guidelines proposed by Hair et al. (2019) [73]. Table 2 shows the factor loadings, Cronbach's α , average variance extracted (AVE), and composite reliability (CR) value.

The model's internal consistency reliability was evaluated using Cronbach's α and the CR value. The CR values ranged from 0.820 to 0.919. According to Hair et al. (2019), reliability values between 0.7 and 0.9 are deemed to be "satisfactory to good," thus indicating that the measurement model displayed sufficient internal consistency and reliability [73].

Table 2. Results of the measurement model.

Latent Variable	Measurement Item	Cronbach's α	AVE	C.R.	Standard Factor Loading
Perceived Value					
PV1	The use of low-carbon transportation is great.	0.919	0.6542	0.919	0.827
PV2	Low-carbon transportation is reasonably priced.				0.805
PV3	The use of low-carbon transportation meet my travel needs.				0.809
PV4	Sojourning in low-carbon hotels is great.				0.817
PV5	Low-carbon hotels are reasonably priced.				0.76
PV6	Sojourning in low-carbon hotels meet my travel needs.				0.833
Environmental Concern					
EC1	I think environmental issues are related to human survival.	0.875	0.6359	0.875	0.779
EC2	I think people should protect the environment.				0.805
EC3	I think people must live in harmony with nature.				0.783
EC4	I am very concerned about the environment.				0.822
Attitude					
AT1	When I travel, I consider whether my tourism behaviors are low-carbon.	0.850	0.5865	0.850	0.773
AT2	I think low-carbon tourism can help solve the problem of environmental pollution.				0.777
AT3	I think low-carbon tourism is meaningful.				0.748
AT4	I have a favorable attitude toward low-carbon tourism.				0.765
Subjective Norm					
SN1	Most people who are important to me understand that I go for low-carbon tourism.	0.820	0.6035	0.820	0.764
SN2	Most people who are important to me agree with me about going for low-carbon tourism.				0.764
SN3	Most people who are important to me recommend I go for low-carbon tourism.				0.802
Perceived Behavioral Control					
PBC1	Whether or not I engage in low-carbon tourism is completely up to me.	0.826	0.6138	0.827	0.796
PBC2	I am confident that, if I want to, I can participate in low-carbon tourism.				0.792
PBC3	I have enough resources, time, and opportunities to engage in low-carbon tourism.				0.762
Intention to use low-carbon transportation					
INTa1	I am willing to use low-carbon transportation, although this might require more time.	0.836	0.6294	0.836	0.795
INTa2	I am willing to take fewer flights in the future to limit my carbon footprint.				0.786
INTa3	I will make an effort to use low-carbon transportation when traveling.				0.799
Intention to sojourn in low-carbon hotels					
INTb1	I am willing to stay at a low-carbon hotel when traveling.	0.847	0.6477	0.846	0.796
INTb2	I plan to stay at a low-carbon hotel when traveling.				0.825
INTb3	I will make an effort to stay at a low-carbon hotel when traveling.				0.793

For the assessment of convergent validity, the AVE of all seven constructs was calculated, ranging from 0.5865 to 0.6542. Additionally, the factor loadings of all 26 items were examined, ranging from 0.748 to 0.833. The obtained AVE and factor loading values ex-

ceeded the recommended thresholds of 0.5 and 0.7, respectively, confirming the satisfactory convergent validity of all items.

For the evaluation of the model's discriminant validity, we employed the heterotrait–monotrait ratio of correlations (HTMT). As displayed in Table 3, all HTMT ratios were lower than 0.85, aligning with the suggested threshold value. The results indicate that the model exhibited satisfactory discriminant validity. Thus, this measurement model is valid and reliable.

Table 3. Heterotrait–monotrait ratio of correlations (HTMT) analysis.

	PV	EC	AT	SN	PBC	INTa	INTb
PV							
EC	0.413						
AT	0.420	0.512					
SN	0.413	0.465	0.470				
PBC	0.424	0.414	0.403	0.400			
INTa	0.461	0.438	0.451	0.448	0.430		
INTb	0.501	0.554	0.504	0.556	0.500	0.541	

Note: PV = perceived value, EC = environmental concern, AT = attitude, SN = subjective norm, PBC = perceived behavioral control, INTa = intention to use low-carbon transportation, INTb = intention to sojourn in low-carbon hotels.

4.2. Structural Model Assessment

Structured equation modeling (SEM) was employed to assess the hypothesized relationships, and the SEM results are presented in Table 4 and Figure 2. The findings demonstrate that the structural model aligns well with the data, as indicated by several goodness-of-fit indices ($\chi^2/\text{df} = 1.155$, $\text{RMR} = 0.106$, $\text{RMSEA} = 0.021$, $\text{NFI} = 0.938$, $\text{IFI} = 0.991$, $\text{TLI} = 0.990$, $\text{CFI} = 0.991$). Specifically, the results provide support for 15 out of the 17 hypothesized direct relationships (Table 4). Perceived value was found to exert a positive impact on attitude, subjective norms, and perceived behavioral control, with respective path coefficients of 0.252, 0.268, and 0.305 (supporting H1a, H1b, and H1c). Similarly, environmental concern was found to exhibit significant effects on attitude, subjective norms, and perceived behavioral control, with path coefficients of 0.304, 0.372, and 0.423, respectively (supporting H2a, H2b, and H2c). Notably, perceived value, attitude, subjective norms, and perceived behavioral control collectively wielded significant influence on the intention to use low-carbon transportation, with path coefficients of 0.201, 0.165, 0.171, and 0.168, respectively (supporting H1d, H3a, H3b, and H3c). Furthermore, perceived value, environmental concern, subjective norms, perceived behavioral control, and intention to use low-carbon transportation significantly impacted the intention to sojourn in low-carbon hotels, with path coefficients of 0.134, 0.197, 0.181, 0.22, and 0.16, respectively (supporting H1e, H2e, H4b, H4c, and H5).

The subsequent phase involved the evaluation of the squared multiple correlations (R^2) for each construct, serving as an indicator of the model's explanatory capability [73]. The established benchmarks for interpreting the R^2 values in the model are 0.75 for large effects, 0.50 for medium effects, and 0.25 for minor effects [69,73]. Particularly in behavioral studies, an R^2 value of 0.2 is considered to be acceptable [74]. The R^2 values in this study revealed that the model accounted for 33.1%, 29.3%, 26.2%, 35.6%, and 51.8% of the variance in attitude, subjective norm, perceived behavioral control, intention to use low-carbon transportation, and intention to sojourn in low-carbon hotels, respectively. In comparison to the suggested thresholds, this model exhibited a satisfactory level of explanatory power.

Table 4. Results of structural model.

Hypotheses	Paths	Standard Coefficient	S.E.	C.R.	<i>p</i>	Results
H1a	PV→AT	0.252	0.051	4.225	***	Supported
H1b	PV→SN	0.268	0.06	4.321	***	Supported
H1c	PV→PBC	0.305	0.058	4.806	***	Supported
H2a	EC→PBC	0.304	0.061	4.695	***	Supported
H2b	EC→SN	0.372	0.064	5.726	***	Supported
H2c	EC→AT	0.423	0.056	6.598	***	Supported
H1d	PV→INTa	0.201	0.064	2.985	0.003	Supported
H2d	EC→INTa	0.123	0.075	1.602	0.109	Not Supported
H3a	AT→INTa	0.165	0.077	2.372	0.018	Supported
H3b	SN→INTa	0.171	0.067	2.492	0.013	Supported
H3c	PBC→INTa	0.168	0.069	2.523	0.012	Supported
H1e	PV→INTb	0.134	0.055	2.182	0.029	Supported
H2e	EC→INTb	0.197	0.065	2.812	0.005	Supported
H5	INTa→INTb	0.181	0.062	2.796	0.005	Supported
H4a	AT→INTb	0.11	0.067	1.745	0.081	Not Supported
H4b	SN→INTb	0.22	0.06	3.45	***	Supported
H4c	PBC→INTb	0.16	0.06	2.631	0.009	Supported

Note: PV = perceived value, EC = environmental concern, AT = attitude, SN = subjective norm, PBC = perceived behavioral control, INTa = intention to use low-carbon transportation, INTb = intention to sojourn in low-carbon hotels. *** the path reached statistical significance at $p < 0.001$.

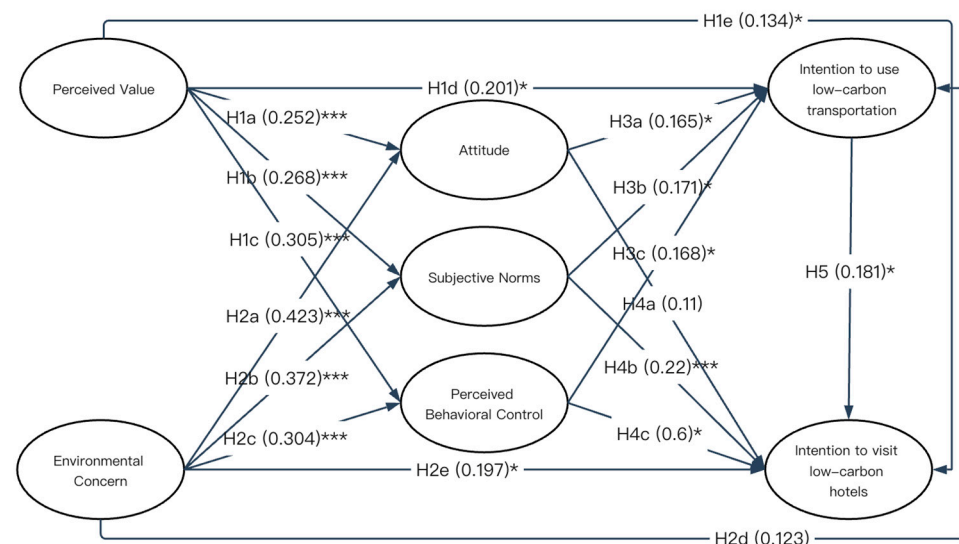


Figure 2. Results of hypotheses testing. Note: * the path reached statistical significance at $p < 0.05$; *** the path reached statistical significance at $p < 0.001$.

The research hypothesis postulates that attitude, subjective norm, and perceived behavioral control serve as mediators in the relationship between the two independent variables, perceived value, and environmental concern, on one hand, and the two dependent variables representing distinct behavioral intentions, on the other. To validate the indirect effects intrinsic to the model, the bootstrapping method was employed, chosen for its non-assumption of normality in the sampling distribution and established robustness in prior studies. The results of 5000 re-sampling iterations, presented in Table 5, were analyzed with 95% confidence intervals to assess the significance of the indirect effects. Following the criteria outlined in Zhao et al. (2010), when both the bias-corrected 95% confidence intervals (BCI) and the percentile 95% confidence intervals (PCI) indicated non-crossing of zero for the lower and upper bounds, the mediation effect was considered to be significant [75]. Consequently, the findings reveal the identification of 10 significant indirect links: PV→AT→INTa, PV→SN→INTa, PV→PBC→INTa, PV→SN→INTb, PV→PBC→INTb, EC→AT→INTa, EC→SN→INTa, EC→PBC→INTa, EC→SN→INTb

and $EC \rightarrow PBC \rightarrow INTb$ (supporting H6a, H6b, H6c, H6e, H6f, H7a, H7b, H7c, H7e, and H7f). The results indicate that perceived value and environmental concern exert a positive indirect influence on Gen Z's willingness to engage in low-carbon tourism behaviors through the mediation of attitude, subjective norms, and perceived behavioral control. However, the paths $PV \rightarrow AT \rightarrow INTb$ (BCI: $[-0.005, 0.069]$; PCI: $[-0.007, 0.068]$) and $EC \rightarrow AT \rightarrow INTb$ (BCI: $[-0.008, 0.012]$; PCI: $[-0.01, 0.109]$) did not receive support, indicating that attitudes do not have a significant mediating effect on the relationship between perceived value and environmental concern in Gen Z's intention to stay at low-carbon hotels.

Table 5. The mediation test results via the bootstrapping method.

Hypotheses	Specific Indirect Path	SE	Standardized Coefficient	BCI		PCI		Support
				Lower	Upper	Lower	Upper	
H6a	$PV \rightarrow AT \rightarrow INTa$	0.02	0.042	0.007	0.086	0.004	0.083	Yes
H6b	$PV \rightarrow SN \rightarrow INTa$	0.023	0.046	0.01	0.104	0.008	0.099	Yes
H6c	$PV \rightarrow PBC \rightarrow INTa$	0.024	0.051	0.014	0.11	0.01	0.104	Yes
H6d	$PV \rightarrow AT \rightarrow INTb$	0.019	0.028	−0.005	0.069	−0.007	0.068	No
H6e	$PV \rightarrow SN \rightarrow INTb$	0.024	0.059	0.021	0.119	0.019	0.113	Yes
H6f	$PV \rightarrow PBC \rightarrow INTb$	0.022	0.049	0.011	0.098	0.01	0.095	Yes
H7a	$EC \rightarrow AT \rightarrow INTa$	0.032	0.07	0.01	0.135	0.007	0.132	Yes
H7b	$EC \rightarrow SN \rightarrow INTa$	0.028	0.064	0.014	0.125	0.012	0.122	Yes
H7c	$EC \rightarrow PBC \rightarrow INTa$	0.023	0.051	0.014	0.103	0.01	0.099	Yes
H7d	$EC \rightarrow AT \rightarrow INTb$	0.03	0.047	−0.008	0.112	−0.01	0.109	No
H7e	$EC \rightarrow SN \rightarrow INTb$	0.029	0.082	0.032	0.149	0.028	0.142	Yes
H7f	$EC \rightarrow PBC \rightarrow INTb$	0.022	0.049	0.012	0.099	0.009	0.096	Yes

Note: BCI= bias-corrected 95% confidence intervals, PCI= percentile 95% confidence interval. PV= perceived value, EC = environmental concern, AT = attitude, SN = subjective norm, PBC = perceived behavioral control, INTa = intention to use low-carbon transportation, INTb = intention to sojourn in low-carbon hotels.

5. Discussion, Conclusions and Implications

5.1. Discussion

This study designed an extended TPB model to investigate the determinants of Gen Z's intention toward low-carbon transportation and hotels. The analysis yielded mostly supportive results for the proposed hypotheses.

The results show that attitude, subjective norms, and perceived behavioral control are positively associated with Gen Z's intention to use low-carbon transportation and sojourn in low-carbon hotels. Consistent with prior research [16,39,60], the findings of this study confirm that individual attitudes, subjective norms, and perceived behavioral control are influential predictors of Gen Z's behavioral intentions. Nevertheless, a notable exception was observed, with Gen Z's attitudes failing to significantly predict their intention to sojourn in low-carbon hotels. This departure from previous literature, which often associates attitudes with pro-environmental behavior, suggests a nuanced relationship. While Gen Z may hold favorable attitudes toward eco-friendly practices like low-carbon accommodations, other factors, such as cost considerations and a desire for novel experiences [6], could impact their actual intention to sojourn in such hotels. Moreover, it is apparent that attitudes alone might not adequately capture the intricate interplay of multifaceted determinants that collectively shape behavioral intentions, especially within the hospitality context [37]. Echoing similar findings by Prayag et al. (2022), potential disconnections between environmental attitudes and practical sustainability actions among Gen Z members are indicated [14].

The research findings indicate that perceived value has a direct positive impact on attitudes, subjective norms, and perceived behavioral control. Moreover, perceived value also exerts direct and indirect positive influence on Gen Z's low-carbon behavioral intentions. These findings highlight the pivotal role of perceived value in shaping Gen Z's cognitive framework, leading to favorable attitudes, subjective norms, and perceived behavioral control, ultimately fostering the intention to use low-carbon transportation and sojourn in

low-carbon hotels. This aligns with existing literature emphasizing perceived value as a crucial cognitive factor in predicting tourist sustainable behavioral intentions [36,76].

The results also indicate that environmental concern has a direct positive impact on attitudes, subjective norms, and perceived behavioral control. In addition, environmental concern exerts a direct and indirect positive influence on low-carbon tourism behavior among Gen Z members. The mediating role of environmental concern is notable, evident through significant associations with perceived behavioral control, subjective norms, and attitudes. This underscores the impact of environmental concern on the shaping of Gen Z's cognitive constructs, influencing their intentions toward low-carbon transportation and hotel stays. However, the absence of a direct link between environmental concern and low-carbon travel intentions implies that Gen Z's environmental consciousness may be channeled through other determinants, such as attitudes, subjective norms, and perceived behavioral control. This suggests a complex interplay of factors driving Gen Z's motivation for using low-carbon transportation, extending beyond a singular environmental concern [8,77].

A positive relationship was found between the intention to use low-carbon transportation and the intention to sojourn in low-carbon hotels, highlighting the interrelated nature of these behaviors. This finding is consistent with Whitmarsh and O'Neill (2010), who demonstrated that specific pro-environmental behaviors predict other environmentally conscious actions, suggesting a coherence in Gen Z's sustainable travel decisions [21].

5.2. Contribution

This study builds upon the theory of planned behavior (TPB) model, focusing specifically on understudied Gen Z tourists. This study explores how the direct and indirect influences of perceived value and environmental concern affect Gen Z's choice of low-carbon transportation and hotels. Additionally, this study investigates how attitude, subjective norms, and perceived behavioral control mediate the relationship among perceived value, environmental concern, and Gen Z's engagement in low-carbon tourism behaviors. Furthermore, a positive link was found between their intention to engage in low-carbon travel and stay in low-carbon hotels. The majority of the hypotheses was supported and, based on these findings, the study offers both theoretical and practical implications.

5.3. Theoretical Contributions

This study presents numerous theoretical insights. First, to the best of our knowledge, this is the first academic paper to investigate the relationship between Gen Z's intention to use low-carbon transportation and the intention to sojourn in low-carbon hotels. The positive relationship between the intention to use low-carbon transportation and the intention to sojourn in low-carbon hotels points to the interconnectedness of these behaviors. This finding reflects a coherence in Gen Zs' sustainable travel decisions, echoing the notion that specific pro-environmental behaviors often predict other environmentally conscious actions. This holistic understanding of behavioral intentions highlights the potential for leveraging one eco-friendly behavior to drive another.

Second, this study highlights the direct and significant influence of perceived value on attitudes, subjective norms, and perceived behavioral control, underscoring its pivotal role in molding Gen Zs' cognitive framework. Perceived value emerges as a crucial catalyst, fostering positive attitudes, subjective norms, and perceived behavioral control, thereby nurturing support for low-carbon transportation use and hotel stays.

Third, the results extend the existing literature on the mediating role of environmental concern on this new generation. The mediating role of environmental concern takes center stage, illuminating its impact on shaping Gen Z's cognitive constructs. The results highlight that environmental concern influences subjective norms, perceived behavioral control, and attitudes, all of which subsequently impact support for low-carbon transportation use and hotel stays. However, the lack of a direct link between environmental concern and low-carbon travel intentions underscores the multifaceted nature of Gen Z's motivation, with other determinants, such as attitudes and subjective norms, playing intermediary roles.

Forth, all three TPB variables (attitudes, subjective norms, and perceived behavioral control) positively impact Gen Z's low-carbon tourism behavioral intentions. This finding is in line with Verma and Chandra (2018), who found that the three TPB constructs are the key factors influencing young people's intention to sojourn in green hotel [78]. However, our findings underscore the complexity of Gen Z's attitudes toward environmentally friendly practices, specifically low-carbon accommodations. While attitudes have been commonly linked to pro-environmental behavior [16,39,60], this study reveals that favorable attitudes might not singularly translate into intentions to sojourn in low-carbon hotels. This nuanced relationship suggests that other factors, such as cost considerations and the desire for unique experiences, may intervene in shaping Gen Z's actual behavioral intentions.

5.4. Practical Implications

This study also provides several practical implications. First, the positive relationship observed between the intention to use low-carbon transportation and the intention to sojourn in low-carbon hotels underscores the interconnected nature of sustainable travel decisions by Gen Z. Destination planners and policymakers can leverage this synergy by offering integrated packages that promote both low-carbon transportation and eco-friendly accommodation. By bundling these experiences, they can amplify Gen Z's commitment to sustainable tourism and potentially create a virtuous cycle of environmentally conscious choices.

Second, recognizing the influential role of perceived value in shaping Gen Z's cognitive framework and intentions, practitioners can strategically enhance the perceived value of low-carbon travel and accommodation options. By emphasizing the tangible benefits, positive experiences, and personal gains associated with eco-friendly transportation and accommodation, stakeholders in the tourism industry can encourage Gen Z to embrace sustainable choices more willingly.

Third, the mediating role of environmental concern, intertwined with attitudes, subjective norms, and perceived behavioral control, indicates the need for integrated strategies to address Gen Z's motivation to use low-carbon transportation. Acknowledging that environmental concern alone may not fully predict their intention to engage in sustainable traveling, practitioners should explore multifaceted approaches. Collaborative efforts involving education, social influence, and contextual support can work synergistically to amplify Gen Z's commitment to low-carbon transportation.

Fourth, the nuanced relationship between Gen Z's attitudes and their intention to sojourn in low-carbon hotels suggests that interventions aimed at promoting sustainable traveling in this demographic group should adopt a more comprehensive approach. While addressing attitudes remains important, it is equally crucial to consider additional factors such as cost-effectiveness and the allure of unique experiences [6]. This holistic approach can guide destination managers and marketers in crafting persuasive campaigns that resonate with Gen Z's multifaceted preferences.

Lastly, China's goals of achieving carbon neutrality by 2050 and curbing carbon emissions by 2023 prioritize industrial sectors in policy measures, while specific efforts for the low-carbon transformation of the tourism industry are lacking. Traditional Chinese cultural values emphasize the harmony between humans and nature, aligning closely with the principles of a low-carbon lifestyle. Therefore, enhancing environmental education is crucial to instill awareness and promote habits of low-carbon consumption among the younger generation, thereby fostering Gen Z's environmental concern and encouraging them to adopt low-carbon travel practices. Furthermore, opinion leaders and influencers on platforms like Weibo and Xiaohongshu wield significant influence over Gen Z. Leveraging their social sway can effectively promote the value of low-carbon travel behaviors, thereby encouraging Gen Z to opt for low-carbon traveling and accommodation.

5.5. Limitations and Future Research Directions

While this study provides valuable insights into Gen Z's low-carbon tourism behavioral intentions, the below limitations highlight areas for future research to enhance the depth and applicability of the extended TPB model with respect to understanding and promoting support for low-carbon traveling and accommodations among younger generations. First, the participants in this study were all Gen Z members from China. Therefore, the findings are based on a specific geographical and cultural context, which may limit the generalizability of the results to other regions or populations with distinct socio-cultural backgrounds. Cultural variations in environmental concerns and travel preferences could influence the applicability of the model in diverse settings. Second, this study used self-report questionnaires to collect data. Future studies should incorporate more objective measures or behavioral observations that could enhance the accuracy and reliability of the findings. Third, while the study identifies the mediating roles of perceived value and environmental concern, the precise mechanisms through which these factors interact and influence Gen Z's behavioral intentions remain complex. Further research exploring the underlying processes and potential moderators of these mediating effects could offer a more comprehensive understanding of the relationships within the extended TPB model.

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