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PRO-ENVIRONMENTAL BEHAVIORS AND BEHAVIORAL SPILLOVER AMONG BICYCLE TOURISTS

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ABSTRACT: This study investigates various pro-environmental behaviours and their relationships among bicycle tourists. These behaviours encompass preferences for cycling and walking, energy conservation, waste separation, and environmentally friendly tourism product purchases. Additionally, the study investigates past carbon emissions due to motorised transportation as bicycle tourists and their moderating effect on indicated behaviours. According to the results obtained from structural equation modelling, the adoption of carbon-free modes of transportation for environmental purposes is significantly related to segregation, conservation, and environmentally friendly tourism product purchases among bicycle tourists. The result shows evidence of behavioural spillover among bicycle tourists. Furthermore, the study reveals that the moderating effect of past motorised transportation usage is particularly pronounced in the case of segregation behaviour. Finally, the study calculated the minimum overall carbon emissions rate for an individual by transportation and discussed potential reasons.

KEYWORDS: sustainable tourism, pro-environmental behavior, behavioral spillover, bicycle tourism

Introduction

Environmental issues and the negative impacts of tourism on these issues have been of interest to researchers for decades (Green et al., 1990; Kousis, 2000; Brida & Zapata, 2010; Gössling & Peeters, 2015; Eyuboglu & Uzar, 2020). These researchers have addressed the environmental impacts of tourism, both at the local and global scales, encompassing various aspects of tourism, including whole tourism as well as specific types, such as cruise tourism, over the years. The increasing visibility of environmental problems in daily life has further heightened this interest. In order to control and reduce environmental problems, both tourism products and services and tourist behaviours need to evolve in a more environmentally conscious direction. At this point in evolution, bicycle tourists who use bicycles as their primary mode of transportation have emerged as an essential tourist type with two features (Neun & Haubold, 2016).

Firstly, bicycle tourists tend to have more interaction with the natural environment compared to other types of tourists, as they travel by bicycle. This is important for observing the impact of human activity on the natural environment. According to Pine and Gilmore (1998), direct and active experiences are more impactful on individuals compared to passive experiences. In the same vein, Maiteny (2002) indicated the importance of direct experience for changing pro-environmental behaviour compared to regulations and incentives for long-term success. For instance, Kim and Hall (2022) found that individuals who engage in walking or biking activities, specifically as tourists, demonstrate a higher level of concern regarding improving air quality and mitigating climate change compared to those who participate in these activities solely for recreational purposes. Additionally, individuals who ride bicycles and walk as recreationalists exhibit greater support for both personal and public health compared to their tourist counterparts. In their study, Martin et al. (2020) examined a sample population of 4960 adults in the United Kingdom. The findings revealed a positive association between visiting natural environments and engaging in pro-environmental behaviours at the household level. Additionally, the study demonstrated that watching and listening to nature documentaries had a positive impact on fostering pro-environmental behaviours. Moreover, according to Dolnicar and Leisch (2008), individuals who tend to engage in pro-environmental behavior are likely to spend their vacations in nature and participate in sports rather than opting for luxury and entertainment. The literature indicates relationships that can be interpreted as evidence supporting the tendency of bicycle tourists to engage in pro-environmental behaviours in both general and vacation contexts. By spending time in nature as active participants, bicycle tourists have the opportunity to witness the negative consequences of harmful behaviours and develop a greater sense of connectedness to the natural environment throughout their tours.

Secondly, the choice of transportation mode has a profound impact on the environment, primarily due to carbon and non-carbon emissions associated with different modes of transport. Within the realm of tourism, calculations by Peeters and Schouten (2006) revealed that approximately 70% of the carbon footprint attributed to tourism arises from transportation, including both travel to the destination and the return journey back home. This finding underscores the significant role that long-haul air travel plays in contributing to greenhouse gas emissions. In the same vein, Xiao et al. (2023) emphasise the significant role of transportation in contributing to the carbon footprints associated with tourism in Chenzhou City, a mountainous region in central China. Their research, employing the Life Cycle Assessment method and data collected from 2014 to 2019, reveals that transportation alone accounts for more than 80% of the total carbon emissions generated by both domestic and international tourists visiting the city. The study highlights the importance of optimising tourism resources, reducing travel distances, and transitioning to low-carbon transportation modes as effective strategies to mitigate the carbon footprints of tourism in Chenzhou and similar regions. Furthermore, a report from the World Travel Association and the International Travel Forum (UNWTO, 2019) revealed that in 2016, the proportion of carbon emissions from transportation in the tourism sector accounted for over 70% of all carbon emissions attributed to tourism. This highlights the critical importance of addressing the environmental impact of transportation in the industry. As highlighted in the literature on the importance of transportation, the utilisation of bicycles as the primary mode of conveyance presents a pivotal opportunity for reducing carbon emissions in various ways. First, cycling to the destination and then cycling back to the origin contribute to reducing carbon emissions.

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Second, using motorised transportation to reach the starting destination and then cycling along a route, and finally, using motorised transportation to return to the origin also contributes to decreasing carbon emissions. Third, a combination of cycling and using motorised transportation along the route can be employed to contribute to decreasing carbon emissions. These ways are not strict and can be combined as needed. However, increasing cycling and decreasing motorised transportation along the route ultimately lead to a reduction in carbon emissions.

Bicycle tourism not only has the significant potential to enhance environmental awareness and foster a stronger connection to nature but also to reduce carbon emissions associated with travel transportation. In addition to all these benefits of bicycle tourism, there are criticisms concerning its contribution to the increase in carbon emissions (Dickinson & Lumson, 2010; Weed et al., 2014). In the context of tourism, it is not uncommon for individuals who identify themselves as environmentalists to still take vacations that need long-haul flights. This phenomenon can be attributed to cognitive dissonance, as explained by Juvan and Dolnicar (2014). Despite their environmental awareness and activism, individuals may experience a psychological conflict when it comes to reconciling their beliefs and behaviours in the context of tourism. To explore this potential inclination towards pro-environmental behaviours, we have chosen bicycle tourists as the focal point of our study. The main reason for selecting bicycle tourists as our target audience is their previous experience of using bicycles as their primary mode of transportation during previous vacations, coupled with their tendency towards sustainable types of tourism. We think that they have a strong connection to nature and a relatively high awareness level in the first place, and their past experience(s) as bicycle tourists have contributed to their environmental awareness and connectedness to nature. Therefore, we expect a strong relation between their choice of modes of transport for environmental purposes and various pro-environmental behaviours, both in general and within the context of tourism.

In tourism literature, some studies have examined the social, economic, and environmental impacts of bicycle tourism (Neun & Haubold, 2016; Ho et al., 2015; Soyalp, 2017). Others have aimed to create frameworks for understanding bicycle tourism and its dimensions (Ritchie, 1998; Simmonsen et al., 1998; Pratte, 2006), while some researchers have argued for viewing bicycle tourism from a postmodernist perspective (Lamont & McKay, 2012). Ritchie et al. (2010) developed profiles of bicycle tourists using the enduring involvement approach, and Han et al. (2017) focused on measuring bicycle tourists' intentions towards unsustainable alternatives. Aragón-Mladosich et al. (2022) developed a scale for measuring the motivation of bicycle tourists in the Mexican context. This potential merits more comprehensive exploration within the existing literature; however, there is a noticeable dearth of research addressing this topic. Consequently, the present study seeks to bridge this gap by investigating various behaviours and their spillover effects on bicycle tourists. These behaviours include water and electricity conservation, segregation behaviours, carbon-free mode of transport preferences for environmental purposes in general and tourism context, as well as the purchase of environmentally friendly products and services for only tourism context and their spillover effects. The following sections are devoted to the literature review for the formulation of hypotheses, the delineation of research methods, the presentation of results, the discussion of findings, the formulation of conclusions, the identification of research limitations, and the provision of recommendations for future research directions.

Literature Review

Bicycle Tourism: Characteristics, Benefits, and Motivations

Bicycle tourism can be categorised as a type of special interest tourism. Lamont (2009) presents a comprehensive framework for bicycle tourism, which encompasses six dimensions. Firstly, the cycling activity should occur away from the participant's home. Secondly, it can span either a single day or multiple days, potentially requiring accommodation during the activity. Thirdly, competitive objectives should be absent, meaning that participating in bicycle races or similar competitive events does not qualify as bicycle tourism. Fourthly, the main focus of the events should be on cycling. Fifthly, active participation in cycling is a key element, distinguishing it from simply observing events or races. Lastly, bicycle tourism falls within the realm of leisure or recreational activities. Indeed, the six dimensions presented by Lamond are crucial characteristics that help define bicycle tourism. These

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dimensions provide a framework for understanding the specific features and nature of bicycle tourism experiences. From an individual standpoint, Ritchie (1998) defines a bicycle tourist as *a person who is away from their home town or country for a period not less than 24 hours or one night for the purpose of a vacation or holiday and for whom using a bicycle as a mode of transport during this time away is an integral part of their holiday or vacation.*

Bicycle tourists typically opt for side roads or dedicated bicycle paths to minimise their exposure to car traffic, as motorised vehicle crashes constitute a significant cause of fatalities among cyclists (Vanparijs et al., 2015). Therefore, bicycle tourism has the potential to boost rural tourism. It creates an opportunity for less-developed places, such as villages, towns, or similar areas, to benefit from tourism. Additionally, bicycle tourism provides an opportunity to discover local people and the local culture (Dickinson & Lumsdon, 2010). Furthermore, Neun and Haubold (2016) calculated that the overall benefits of bicycle tourism for Europe amounted to approximately 44 billion euros in 2016. Moreover, when considering the cumulative benefits, such as those related to health, time, space and the economic value generated by cycling, the total surpasses Belgium's gross domestic product for the same year. Soyalp's (2017) study reveals that individuals are primarily motivated to engage in bicycle tourism by their desire for freedom and eagerness to discover unexplored areas. Moreover, they are driven by a notable factor of seeking a unique and distinct experience. Additionally, participating in these activities is perceived as an opportunity for social interaction and as a means to promote personal health and well-being among the participants. In the same vein, Lin and Xu (2022) identified several values generated from cycling experiences, including body and mind recovery, social interaction, and the creation of self-authenticity. They found that these aspects contribute significantly to the overall cycling experience. Han et al. (2017) conducted a study where they tested an extended version of the theory of planned behaviour in the context of bicycle tourism. The findings indicated significant relationships between attitude toward behaviour, subjective norm, and perceived behavioural control with a behavioural intention for future bicycle tours among bicycle tourists. Surprisingly, past behaviours did not show a significant correlation with intention, while personal norms exhibited a strong correlation with the subjective norm and behavioural intention. The overall model demonstrated a better fit, particularly for individuals who displayed a lower inclination towards non-environmentally friendly forms of tourism. Han et al. (2017) study is important because it investigates bicycle tourists' perceptions of unsustainable tourism alternatives.

Understanding the Role of Environmental Awareness and Connectedness to Nature on Pro-Environmental Behaviors of Bicycle Tourists

Environmental awareness is defined as *knowing of the impact of human behaviour on the environment* (Kollmuss & Agyeman, 2002). Basically, it is one of the simplest definitions of the phenomenon in literature and when people possess a deep understanding of how their actions impact the environment, they might be more likely to adopt behaviours that promote sustainability and conservation. This term is also defined more comprehensively by the United Nations Economic and Social Commission for Western Asia (2013) as *involves the gradual understanding of environmental issues, and the recognition of the connections among human actions, development, sustainability and human responsibility in these processes. Environmental awareness involves the realization that humans and ecosystems co-exist in a shared environment, which is ultimately the biosphere.* Environmental awareness may serve as the foundation for fostering a sense of responsibility towards the natural world. It involves recognising the interconnectedness between human activities, development, and the well-being of ecosystems. With heightened awareness, individuals can make informed choices, embrace environmentally friendly practices, and actively contribute to mitigating environmental challenges. By understanding the direct relationship between their actions and environmental outcomes, tourists may become motivated to adopt pro-environmental behaviours such as reducing energy consumption, practising recycling, and opting for sustainable transportation.

The past literature has extensively discussed the impact of environmental awareness on various variables. Within the framework of the theory of planned behaviour, Paul et al. (2016) discovered a positive effect on the intention to purchase green products. Moreover, Chen and Tung (2014) highlighted that environmental awareness exerts a positive influence on the three independent variables of the theory of planned behaviour. Kim and Stepchenkova (2020) found a significant positive correlation between increased knowledge about environmental issues and favourable attitudes toward

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eco-travel as well as environmentally responsible behaviour. Therefore, raising environmental awareness is crucial in driving the transition towards a more sustainable and ecologically conscious society. According to the experimental study conducted by Berger and Wyss (2021), individuals who possess an awareness of the adverse effects of their behaviour on the natural environment demonstrate a significantly greater propensity to engage in pro-environmental actions. This relationship is exemplified by the observed increase in carbon emissions rates associated with transportation modes in the study. Environmental awareness may influenced by different kinds of factors. Chawla (1999) found in her research that a combination of childhood experiences in nature, encounters with environmental destruction, family's pro-environmental values, and education have an influence on environmental awareness. Environmental awareness is inherently linked to connectedness to nature. Spending time immersed in natural environments can positively influence environmental awareness. Bicycle tourists, in particular, have abundant opportunities to witness the side effects of human behaviour as they often spend extended periods in rural and natural settings.

Connectedness to nature is a term commonly used to indicate the relationship between nature and individuals. The effect of connectedness to nature has been studied with different aims and contexts (Mayer & Frantz, 2004; Mayer et al., 2009; Martin & Czellar, 2017; Mandic et al., 2023). This term is defined as *the extent to which an individual includes nature within his/her cognitive representation of self* by Schultz (2002). This connection may open the way to increase people's behaviour in a more environmentally friendly way. For instance, Mandic et al. (2023) conducted a study examining the relationships between connectedness with nature, well-being (hedonic and eudemonic), and pro-environmental behaviour among Generation Z tourists, particularly within Eastern societies. The findings of the study revealed a positive association between connectedness with nature and both well-being and pro-environmental behaviour. Furthermore, the study identified well-being as a moderator in the relationship between connectedness with nature and pro-environmental behaviour. Cycling as a mode of transportation may allow tourists to immerse themselves in the natural surroundings and experience the landscapes up close as Pine and Gilmore (1998) suggested active participation. Not only cycling during vacation but also camping, and different interactions during the tours also may increase this connection. This intimate interaction with the environment can enhance the sense of connectedness to nature. As a result, bicycle tourists may develop a strong connection to nature that encourages them to engage in more pro-environmental behaviours.

Pro-environmental Behaviors and Behavioral Spillover

Kollmuss and Agyeman (2002) define the term pro-environmental behaviour as *consciously seeks to minimize the negative impact of one's actions on the natural and built world.* The important aspects of this definition are consciously performing behaviours and minimising negative impacts. Engaging in environmentally friendly behaviours can be an indicator of the importance given to the environment, but solely reducing negative effects restricts the scope of this definition. In this regard, Steg and Vlek (2009) provide a broader definition for the term pro-environmental behaviour. They define it as *a form of consumption that harms the environment as little as possible or even benefits the environment*. This definition implies that focusing only on negative impacts is not sufficient and that behaviours that benefit the environment are also included in this scope. From these two definitions, we can reach the following general definition: pro-environmental behaviours can be defined as consciously performed actions that aim to minimise harm to the environment but go beyond that by also encompassing behaviours that are beneficial to the environment. Those behaviours could be conservation, segregation, choosing a sustainable mode of transportation such as walking and cycling, going to nature to collect trash from the ground, and choosing non-plastic-based materials for daily use. From a tourism perspective, pro-environmental tourists aim to minimise their negative effects on the environment and nature during their vacations. They may achieve this by taking fewer vacations, opting for destinations closer to home, offsetting their vacation's carbon footprint, avoiding unsustainable modes of transportation, using certified environmentally sustainable tourism providers, refraining from engaging in harmful activities at the destination and refusing to use the services of unsustainable tourism providers (Juvan & Dolnicar, 2014).

The phenomenon of spillover effects, wherein various pro-environmental behaviours mutually influence each other positively or negatively, has been investigated by multiple researchers (Lanzini & Thøgersen, 2014; Ling et al., 2023; Truelove et al., 2016; Dolan & Galizzi, 2015; Jessoe et al., 2021).

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Spillover effects are defined as *the extent to which engaging in one behavior influences the probability of conducting a subsequent behavior* (Nilsson et al., 2017). According to them, one of the spillover effects is behavioural type and performing a behaviour influences another behaviour performing probability. Han (2021) identified the importance of pro-environmental behaviours in everyday life as an influential factor for promoting sustainable consumer behaviour. Gao et al. (2022) demonstrated the transferability of daily green behaviour habits to diverse spatial contexts, including the realm of tourism.

In this study, we acknowledge the participants' inclination towards cycling, especially for tourism purposes. As a result, our research primarily focuses on their general preferences for walking and cycling in terms of environmental purposes. Moreover, we include how their mode of transport preferences are shaped for environmental purposes, even when they go on vacation without a bicycle. This preference serves as an initial indicator. Then, the study investigates multiple aspects of pro-environmental behaviour, encompassing the purchase of sustainable products and services specifically within the tourism context. Additionally, the study investigates the moderating effects of individuals' past usage of motorised transportation modes. The study tests several hypotheses related to the correlations between mode of transport, waste segregation behaviour, conservation behaviour in general and tourism, and the preference for purchasing environmentally friendly products in the context of tourism.

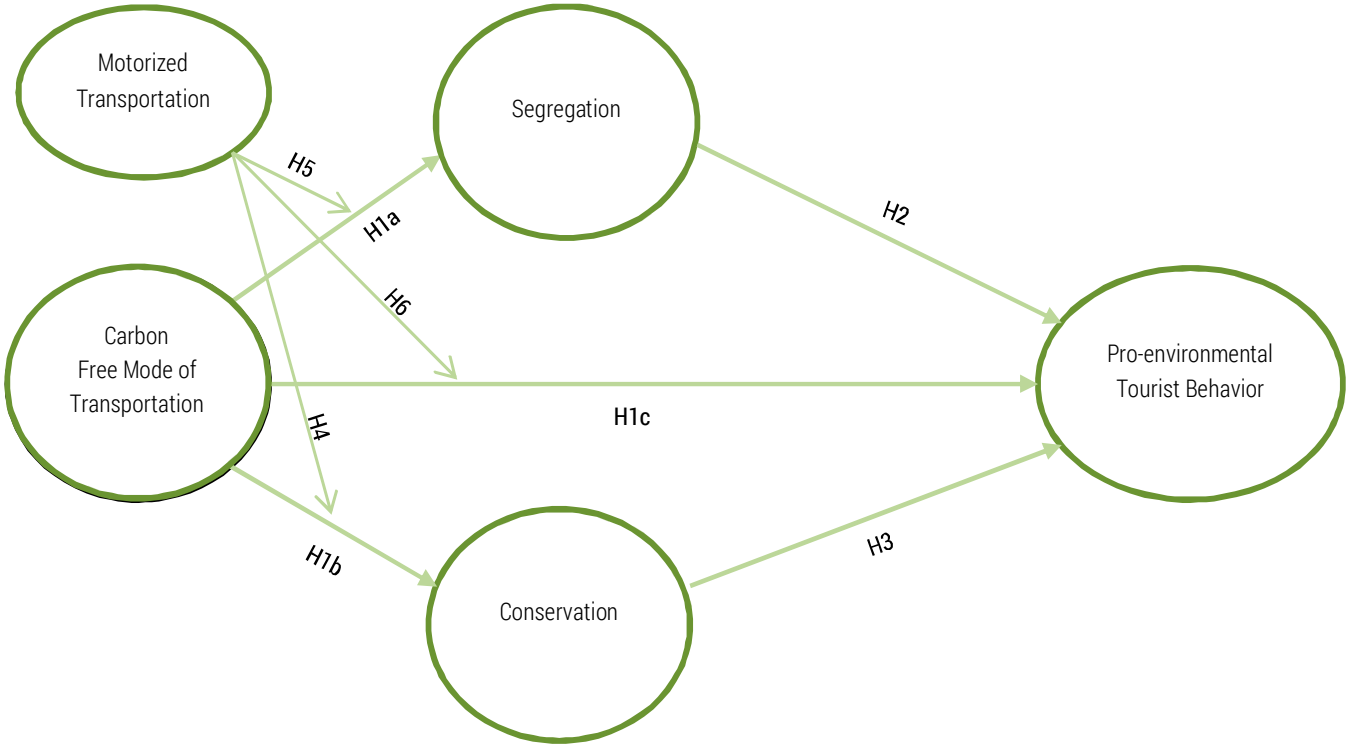

Figure 1. Proposed Relations Between Behaviors

The following relation ships are proposed to be tested in the study among bicycle tourists and are presented in Figure 1.

- **H1:** There is a positive and significant correlation between carbon free modes of transport and pro-environmental behaviors.
- **H1a:** There is a positive and significant correlation between carbon free modes of transport and waste segregation behaviour.
- **H1b:** There is a positive and significant correlation between carbon free modes of transport and conservation behaviour.
- **H1c:** There is a positive and significant correlation between carbon free modes of transport and tourist pro-environmental behaviour.

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- **H2:** There is a positive and significant correlation between the behaviour of waste segregation and tourist pro-environmental behaviour.
- **H3:** There is a positive and significant correlation between conservation behaviour (in terms of electricity and water) and pro-environmental behaviour in tourists.
- **H4:** The total number of past transportation usages negatively moderates the correlation between carbon free mode of transport and conservation.
- **H5:** The total number of past transportation usages negatively moderates the correlation between carbon free modes of transport and segregation.
- **H6:** The total number of past transportation usages negatively moderates the correlation between carbon free modes of transport and pro-environmental behaviour.

Research Methods

We conducted an online survey using Google Forms to collect data from participants. We aimed to enhance accessibility, efficiency, and data accuracy while reducing costs and environmental impact through the utilisation of digital platforms and automation when preparing an online survey. The main criteria for participating in the survey were as follows: individuals must have had at least one night of accommodation experience on a bicycle tour, with the bicycle serving as the primary mode of transportation, and the tour should not have been for competitive purposes. The study used a convenience sampling approach. To identify eligible participants, we used Facebook groups. In order to achieve the study's objectives, we employed keywords such as "bicycle touring", "international bicycle touring", "bike-packing", and similar terms in two different languages. This search enabled us to identify over a hundred bicycle tours through which we shared the survey. By the end of the data collection process, we obtained a total of 227 English versions and 134 Turkish versions and a total of 361 completed surveys from the target population. After conducting data cleaning procedures, we identified 336 surveys that were suitable for analysis, excluding those with incomplete or inconsistent responses. Throughout the data collection phase, no incentives were offered to participants to encourage survey participation. To mitigate the impact of social desirability bias (Milfont, 2009), the survey items were intentionally intermixed, introducing a level of ambiguity and reducing potential biases stemming from participants' inclination to provide socially desirable responses. Furthermore, a coding system was implemented to ensure participant confidentiality.

While designing the survey, we used several previous studies (Larson et al., 2015; Sudbury-Riley & Kohlbacher, 2016; Gupta & Agrawal, 2017). However, it is important to note that our approach was not confined solely to these studies. The survey was prepared in two languages: English and Turkish. The purpose of doing so is to foster diversity among participants by including both developed and developing countries in the context of environmental awareness, connectedness to nature, and bicycle infrastructure. The original version of the survey was developed in English and proofread by a native English language scholar. Subsequently, it was translated into Turkish by two Turkish scholars. To ensure translation quality, the translated surveys were then back-translated into English. After the translations of the survey, we conducted a pilot survey involving 65 (30 Turkish version) participants. In early July 2022, we utilised SPSS software to examine the results for internal consistency. Subsequently, based on the findings from the pilot study, we revised the questionnaire and eliminated certain questions that exhibited unstable responses or low loadings. This revision was undertaken in preparation for the main research phase. Following the questionnaire refinement, we commenced data collection in early August 2022 and successfully concluded it by the end of November 2022.

Initially, we provide an explanation of the aim and scope of the study, and we kindly request participants to indicate their acceptance on the first page of the survey. This ensures that participants are aware of the purpose of the study and gives them an opportunity to consent to participate before proceeding with the survey. The final version of the questionnaire comprises three sections. The first section employs a 7-point Likert scale. This section consists of 15 questions encompassing various general and tourism-related contexts. The questions pertain to environmentally friendly product and service buying (3 questions), mode of transport (3 questions), segregation behaviour (2 questions), water and electricity conservation (4 questions). Additionally, one dummy question is included to

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monitor the consistency of participants' responses and one question for buying souvenirs to examine the perception of participants.

The second section of the questionnaire focuses on the mode of transportation used in past travels, specifically related to planes, cars, buses, and trains. For instance, one question asks, "In the last three years, how many times did you use a plane as a bicycle tourist? Please indicate the duration of the flight. [< 3 Hours]." Regarding plane usage, we inquired about flight times, distinguishing between short, medium, and long-haul flights. For other modes of transportation, we requested information on distances travelled, such as less than 100 km, between 100 km and 200 km, and so on. To mitigate the potential impact of COVID-19 travel restrictions on the study, we extended the time frame to encompass a three-year period (2019-2022) in this section. Lastly, we included demographic questions, including citizenship, age, education, income, eating habits, and details regarding the participants' companions during their most recent bicycle vacation. The complete questionnaire can be found in the supplementary materials as annex-1.

Participants Profile

The study was conducted with a total of 336 participants from 32 countries, with the highest number of participants from Turkey (40.8%), followed by the United Kingdom (16.4%) and the United States (12.2%). The sample was predominantly male (70.8%) and mostly between the ages of 36 and 65, with similar distribution across three age groups of 36-45 (21.1%), 46-55 (22.9%), and 56-65 (28.9%). The majority of participants were highly educated, with 88.7% having at least a university degree and 26.8% having a master's degree. The highest proportion of income was 38.4% for "100% or higher than minimum wage," followed by "prefer not to say" at 17.3%. In terms of eating habits, over 73% of participants did not follow any specific diet, with the rest following vegetarian (8.9%), pescatarian (5.1%), vegan (1.2%), and other (11.6%) diets. For those who went on a bicycle vacation, the highest share was in the solo category (36.3%), followed by group (30.1%), partner (24.7%), and family (8.9%). All information is presented in Table 1.

Table 1. Demographic characteristics of the respondents' profile (N=336)

	n	%
Gender		
Female	96	28.6
Male	238	70.8
Prefer not to say	2	0.6
Total	336	100
Education		
High School	33	9.8
Master's degree	90	26.8
PhD	35	10.4
Pre-High School Education	5	1.5
University	173	51.5
Total	336	100
Income		
%100 or higher than Minimum Wage	129	38.4
%20 Higher than Minimum Wage	28	8.3
%50 Higer than Minimum Wage	38	11.3
%80 Higher than Minimum Wage	21	6.3

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	n	%
Below Minimum Wage	10	3
I don't have a salary	34	10.1
Minimum Wage	18	5.4
Prefer not to say	58	17.3
Total	336	100
Age		
>65	41	12.2
16-25	12	3.6
26-35	38	11.3
36-45	71	21.1
46-55	77	22.9
56-65	97	28.9
Total	336	100
Favorite Bicycle Type		
Electric Bike	14	4.2
Folding Bike	18	5.4
Mountain Bike	54	16.1
Other	17	5.1
Road Bike	77	22.9
Touring Bike	156	46.4
Total	336	100
Eating Habit		
No special preferences.	246	73.2
Other	39	11.6
Pescatarian	17	5.1
Vegan	4	1.2
Vegetarian	30	8.9
Total	336	100
Citizenship		
Turkey	137	40.8
Other European countries	60	17.9
United Kingdom	55	16.4
United States	41	12.2
Australia and New Zealand	16	4.8
Holland	13	3.9
Canada	10	3
Rest of the world	4	1.2
Total	**336**	**100**

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Data Analysis

For descriptive statistics, principal component analysis group comparisons, and calculation of carbon emissions, we utilised SPSS (Statistical Package for Social Sciences) software (version 28), while structural equation modelling was conducted using Smart-PLS 4.0 software.

Exploratory Factor Analysis

In order to identify the dimensions and their consistency in the questions that we asked in two surveys, we used exploratory factor analysis using principal component analysis (PCA) with varimax rotation (Worthington & Whittaker, 2006). We found four components which have higher than 1.0 eigen value in the English version of the survey. Those components' names are pro-environmental tourist behaviour (PRO), carbon-free mode of transportation (MOD), waste segregation (SEG), and conservation behaviour (CON). The Bartlett's test showed significant results (chi-sq = 1343.044, df = 66, $p < 0.001$) and the Kaiser Meyer-Olkin (KMO = 0.805) value indicates robustness. The commonalities and factor loadings also were higher than 0.5. The first component explains 40.864% of the total variance, which is less than the critical threshold of 50% (Hair et al., 2019), and all four components explain 76.634% of the total variance. For the Turkish version of the survey, we performed the same procedure to find components. We found four components that have higher than 0.9 eigenvalue. Those components reflect the same pattern, such as in the English version. The Barlett's test showed significant results (chi-sq = 1099.884, df=66, $p < 0.001$), and the Kaiser Meyer-Olkin (KMO = 0.861) value indicates robustness. The first component explains 51.990% of the total variance, and all four components explain 79.972% of the total variance. After obtaining similar results from two separate datasets, we decided to combine them and perform another round of PCA. Remarkably, the combined dataset revealed an identical pattern with four components exhibiting eigenvalues higher than 1.0. Bartlett's test showed significant results (chi-squ = 2331.217, df = 66, $p < 0.000$) and Kaiser Meyer-Olkin (KMO = 0.834). The first component explains 44.399% of the total variance, and all four components explain 77.348% total variance. These findings suggest that the selected components capture a substantial portion of the overall variance in the combined dataset (Hair et al., 2019). The factor loadings obtained from all three principal component analyses are provided in Table 2. Then, the next step is structural equation modelling, which tests the relations.

Table 2. Principal component analysis results

English Version Rotated Component Matrix[a]					Turkish Version Rotated Component Matrix[a]					Both Combined Version Rotated Component Matrix[a]				
	Component					Component					Component			
	Conservation	Pro-environmental Tourist	Carbon-free Transportation	Segregation		Conservation	Pro-environmental Tourist	Carbon-free Transportation	Segregation		Conservation	Pro-environmental Tourist	Carbon-free Transportation	Segregation
CON1	0.89				CON1	0.834				CON1	0.891			
CON2	0.812				CON2	0.863				CON2	0.848			
CON3	0.853				CON3	0.718				CON3	0.82			
CON4	0.859				CON4	0.688				CON4	0.81			
MOD1			0.863		MOD 1			0.867		MOD 1			0.85	
MOD2			0.838		MOD 2			0.813		MOD 2			0.84	
MOD3			0.708		MOD 3			0.706		MOD 3			0.714	
PRO1		0.81			PRO1		0.594			PRO1		0.752		
PRO2		0.699			PRO2		0.843			PRO2		0.759		
PRO3		0.796			PRO3		0.841			PRO3		0.817		
SEG1				0.912	SEG1				0.867	SEG1				0.903
SEG2				0.621	SEG2				0.871	SEG2				0.729
Extraction Method: Principal Component Analysis.					Extraction Method: Principal Component Analysis.					Extraction Method: Principal Component Analysis.				
Rotation Method: Varimax with Kaiser Normalization.					Rotation Method: Varimax with Kaiser Normalization.					Rotation Method: Varimax with Kaiser Normalization.				

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Structural Equation Modelling

We used partial least squares structural equation modelling (PLS-SEM) to assess the model we proposed, examining the relationships between carbon-free transportation, segregation, conservation, and pro-environmental tourist behaviours. PLS-SEM is generally used for small sample sizes or non-normal distributed data (Hair et al., 2017). We follow Hair et al. (2021) evaluation procedures for structural equation modelling in the study. Firstly, we checked indicator reliability, and all indicator loadings are above the threshold 0.708 value (Hair et al., 2019). It means that all the items explain more than 50 percent of the indicator's variance.

For internal consistency reliability, we checked Cronbach's alpha and composite reliability values. All the components have higher alpha values than the 0.7 threshold for 0.907 (CON), 0.821 (MOD), 0.803 (PRO) and 0.719 (SEG), which reflects internal consistency (Hair et al., 2019). In order to assess convergent validity, we check the average variance extracted (AVE). Item loads are presented in Table 3, and for all the constructs, it is more than the 0.50 threshold (Hair et al., 2021). Values for components are presented in Table 4.

Table 3. Internal consistency reliability results

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Conservation	0.907	0.945	0.933	0.778
Carbon-free Transportation	0.821	0.842	0.892	0.734
Pro-environmental Behavior	0.803	0.825	0.885	0.722
Segregation	0.719	0.777	0.874	0.776

Table 4. Outer loading of items in PLS-SEM

	Conservation	Carbon-free Transport	Pro-environmental behavior	Segregation
CON1	0.835			
CON2	0.833			
CON3	0.925			
CON4	0.930			
MOD1		0.826		
MOD2		0.867		
MOD3		0.876		
PRO1			0.738	
PRO2			0.876	
PRO3			0.923	
SEG1				0.838
SEG2				0.922

Then, to assess the discriminant validity of constructs, we checked the Fornell and Larcker criterion (1981). According to the Fornell and Larcker criterion (1981), the square root of the average variance extracted (AVE) for each construct should be higher than the construct's highest correlation with any other construct in the model. It is evident that none of the square roots of the AVE values are greater than the corresponding correlations (Table 5). Additionally, we checked heterotrait-monotrait ratio (HTMT), and all the ratios for the components are lower than the 0.85 threshold (Henseler et al., 2015). Based on the assessment results of the model, we have concluded that it is sufficient for further analysis.

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Table 5. Fornell-Larcker criterion

	Conservation	Carbon-free Transportation	Pro-environmental behaviour	Segregation
Conservation	0.882			
Carbon-free Transportation	0.399	0.857		
Pro-environmental behaviour	0.474	0.533	0.849	
Segregation	0.399	0.417	0.446	0.881

Results of the Research

Path Analysis and Hypotheses Testing

Initially, in order to prevent the collinearity problem, we checked the variance inflation factor (VIF) in the model. All items in the model are less than 3.0 value except CON3 and CON4 items; however, they are still less than the critical threshold 5.0 value (Hair et al., 2021). As an indicator of the explanatory power of the model, the r-square is checked, and values for conservation are 0.157, for segregation are 0.171, and for pro-environmental behaviour are 0.396. We bootstrapped the model test to hypotheses in the study and followed Streukens and Leroi-Werelds's (2016) recommendation for bootstrapping in PLS-SEM, and we implied 10000 bootstrap samples in two tails for the study. According to the bootstrapped results, Hypotheses H1a, H1b, H1c, H2 and H3 are supported by the empirical findings and presented in Figure 2.

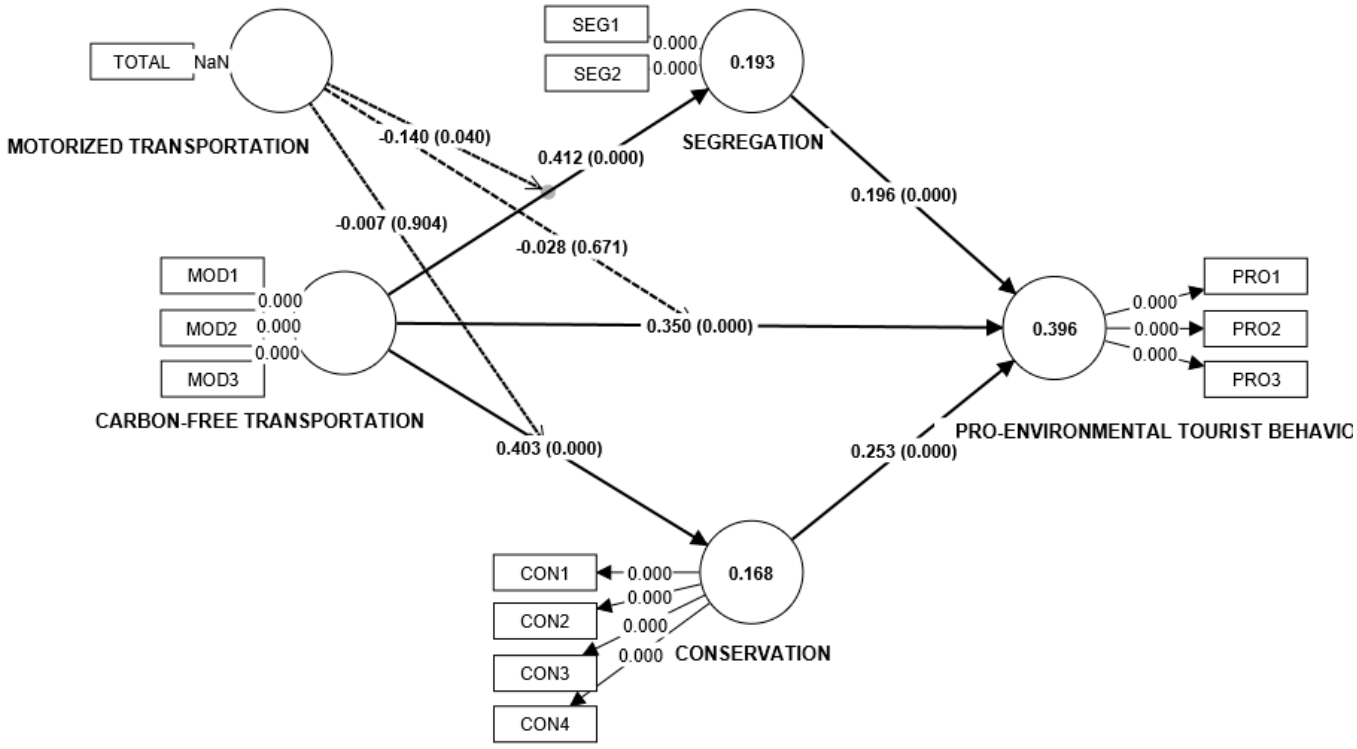

Figure 2. Path analysis results

Moderation Analysis

The study examined the moderation effect of past motorised mode of transport usage with moderation analysis, as outlined by Hair et al. (2021). The results of the moderation analysis indicate that the total number of transportation usages negatively moderates the relationship between mode of transport and segregation behaviour. Hence, H5 is supported (p-value= < 0.040, T-statistics= 2054),

and the corresponding effect is presented in Figure 3. However, empirical evidence does not support H4 and H6. The moderation analysis did not reveal a significant moderating effect of the total number of transportation usages on the relationship between the mode of transport and conservation behaviour (H4) and pro-environmental behaviour (H6).

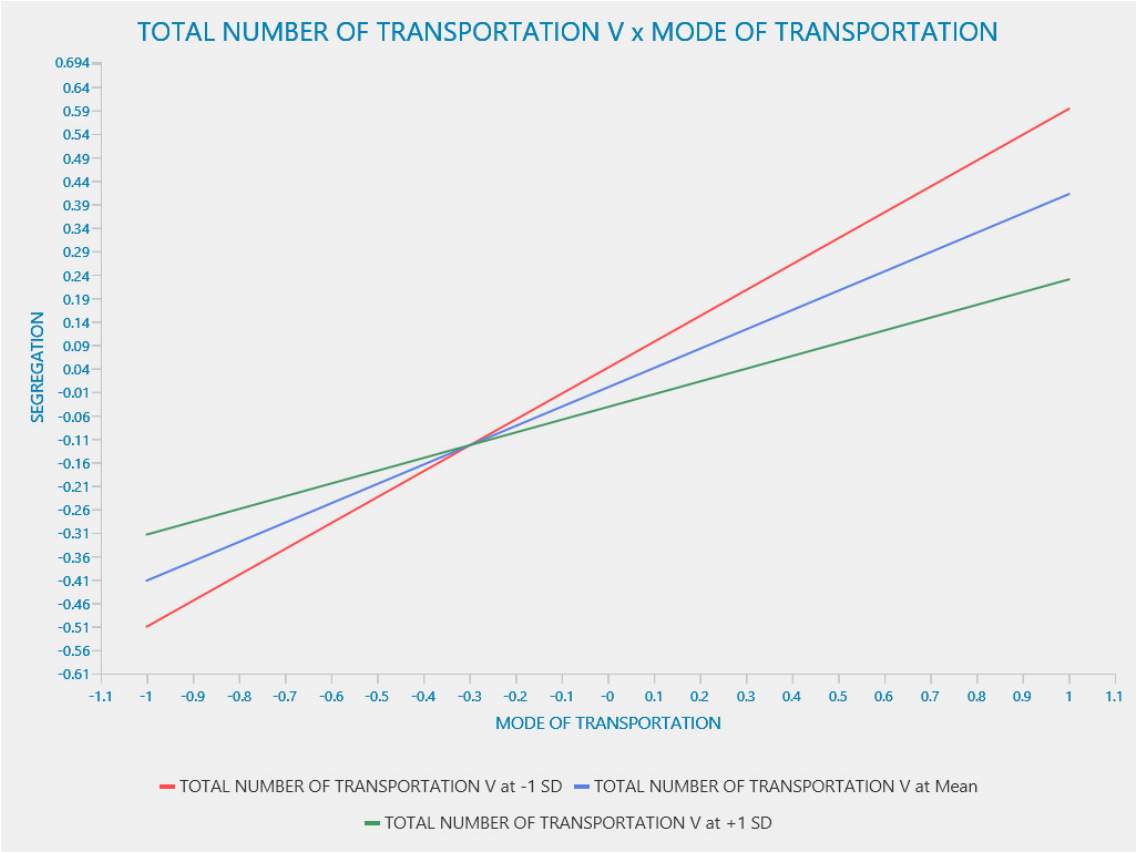

Figure 3. Moderation analysis result (segregation)

Modes of Transport Usage and Their Emissions

In order to calculate the carbon emission number for participants between August 2019 and November 2022, we employed four reference carbon-dioxide emission rates per kilometre according to corresponding to four modes of transportation: plane (244 grams), car (102 grams), bus (90 grams), and train (28 grams). These emission rates represent the carbon emissions generated per kilometre travelled by an individual using each mode of transport. For the calculation of carbon emissions from short-haul air travel (less than 3 hours flight), we utilised the flights from Berlin, Germany, to Izmir, Turkey, covering a distance of 1900 kilometres. For medium-haul air travel (between 3 to 6 hours flight), the reference flights were from Berlin, Germany, to Doha, Qatar, spanning a distance of 4400 kilometres. Lastly, for long-haul travel (longer than 6 hours flight), the reference flights were from Berlin, Germany, to New York, United States, covering a distance of 6400 kilometres. Between the range of August 2019 and November 2022, we calculated that the carbon emissions caused by plane usage amounted to 1103.737 kg per person. A total of 128 participants, who were bicycle tourists, utilised planes as a mode of transportation at least once.

To calculate carbon emissions resulting from car, bus, and train usage, our aim is to obtain conservative estimates. In the questionnaire, respondents provided their usage frequency for each mode of transportation within different kilometre ranges, ranging from “one time” to “five times or more.” To calculate carbon emissions, we adopted a minimum approach. For example, for car usage, we took 1 kilometre as the reference for distances less than 100 kilometres, 101 kilometres for distances between 100 and 200 kilometres, and 501 kilometres for distances exceeding 500 kilometres, etc. This conservative estimation allows us to account for the minimum carbon emissions associated with

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car, bus, and train transportation. During the same period, car usage by bicycle tourists resulted in a carbon emission of 110.13 kg per person, with a total of 237 participants utilising cars as a mode of transportation at least once. Additionally, bus usage as a mode of transport contributed to a carbon emission of 34.65 kg per person, while train usage resulted in 14.85 kg per person of carbon emissions. When considering the total carbon emission caused by all four modes of transportation, it amounted to 1263.38 kg per person. Furthermore, only 25 participants stated that they did not use any mode of transportation during the indicated period as a bicycle tourist.

Discussion

This study investigated different pro-environmental behaviours and their spillover effects, specifically on bicycle tourists. Apart from feeling a connection to nature and being aware of the impact of human behaviour on the environment, there are demographic, psychological, and social factors that shape pro-environmental behaviour. Engaging actively with nature is an effective way to improve the fundamental drivers of pro-environmental behaviour (Maiteny, 2002; Martin et al., 2020; Dolnicar & Leisch, 2008). Therefore, bicycle tourism provides an opportunity for a more sustainable form of tourism that not only preserves the rights of the present generation but also those of future generations and all living creatures in the world (UNWTO, 2019). We assume that bicycle tourists have a stronger connection to nature and a higher level of environmental awareness compared to different types of tourists, such as mass or casual tourists. Therefore, their profile could serve as a valuable benchmark tool for researching environmental tendencies, particularly for destination managers.

We highlighted the importance of choosing a carbon-free mode of transportation for bicycle tourists to predict their segregation, conservation and pro-environmental tourist behaviours. Especially choosing walking or cycling for environmental purposes in both general and tourism is an effective determinant for other pro-environmental behaviors for bicycle tourists. Additionally, segregation and conservation behaviours also influence tourist pro-environmental behaviour. Parallel to the discussion of the negative effects of bicycle tourism by Dickinson and Lumson (2010) and Weed et al. (2014), motorised vehicles are popular among bicycle tourists and specifically, American participants use planes as a mode of transportation enormously more than other nations. We have identified that prior motorised vehicle usage among bicycle tourists can serve as a negative moderator, particularly in relation to segregation behaviour. We think that when it comes to hedonistic behaviours such as travel, people generally do not think about their mode of transportation usage to get where they want to go for vacation, and it can be explained by cognitive dissonance. This is similar to Juvan and Dolnicar (2014) findings about environmental activists.

Bicycle tourists typically do not commonly opt for electric bicycles during their vacations. However, similar to the findings of Lagerstedt and Svensson (2022), electric bicycles can offer advantages to individuals who may not be enthusiastic about cycling while on vacation due to the effortless nature of electric assist. Consequently, destination managers should consider not only providing conventional bicycle rental stations but also implementing an electric bicycle rental system at the destination. This strategic move may aim to mitigate carbon emissions resulting from transportation within the destination, serving as a viable solution.

Previous studies have highlighted the importance of infrastructure investments in the development of bicycle tourism (Nilsson, 2019; Lee & Huang, 2014; Yeh et al., 2019). In particular, Pratte (2006) indicated that bicycle infrastructure functions as the frame of a bicycle, keeping all the necessary components together for the development of bicycle tourism. Therefore, the strength and durability of the frame ensure that all other components remain in place for the development of bicycle tourism. The European Cycle Route Network (Eurovelo) project, which has the potential to make one of the most important contributions to this change, is also one of the obvious examples of European countries' interest in this type of tourism. Eurovelo is a bicycle tourism project that aims to connect Europe with bicycle paths and comprises over 90,000 kilometres of bicycle routes (European Cyclists' Federation, 2023). At this point, the travel restrictions caused by the COVID-19 pandemic have led to a significant increase in the investments made by countries in bicycle infrastructure (Bernhard, 2020; Johnson, 2023; Küster, 2021; Belotti, 2022). These developments suggest that bicycle tourism is likely

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to continue growing in the coming years and become one of the most important forms of sustainable tourism.

Conclusion

The aim of this study was to examine various pro-environmental behaviours and their relationships among bicycle tourists in order to identify behavioural spillover effects. Our findings revealed strong associations between different pro-environmental behaviours, which may be specific to this particular group of participants. These associations can be attributed to their demographics, heightened awareness, and stronger connection with nature. The study highlights the potential of bicycle tourism as a more sustainable approach to tourism for a better future. However, it is essential for academics and researchers to pay closer attention to the development and progress of bicycle tourism. Projects similar to Eurovelo have the potential to boost this type of sustainable tourism in different parts of the world. Nevertheless, understanding the factors underlying the usage of motorised vehicles, particularly for flights, remains a challenge. By gaining a deeper understanding of the factors impacting transportation choices, especially in relation to flights, we can further promote and enhance sustainable practices within the realm of bicycle tourism. Furthermore, future research should examine different types of tourists and their behavioural spillover effects, particularly concerning high-impact behaviours such as transportation as an initial behaviour.

This research relies on self-reported measurements, which means that participants' responses may not always encompass their actual behaviour fully due to various contextual factors and the presence of desirability bias (Milfont, 2009; Kormos & Gifford, 2014). Due to the limited number of participants and the diverse range of backgrounds represented, it is challenging to draw generalised conclusions from the study findings. Therefore, future research should consider focusing on specific participant backgrounds and conducting comparative analyses of their pro-environmental behaviours. By examining the characteristics of different groups, researchers can gain deeper insights into commonalities and differences in terms of their environmental attitudes and behaviours. Due to the COVID-19 pandemic and the resulting international and national travel restrictions, we decided to extend the time period for capturing information about past modes of transportation usage. This extension covers the last three years (2019-2022). However, it is important to remember that using a longer timeframe may present challenges in accurately recalling past behaviours due to memory constraints.

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