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Pro-Environmental Behaviors and Environmental Improvement:
What Information Do We Have Based on a Survey of the Young Generation?

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ABSTRACT

Fostering pro-environmental behaviors (PEBs) among the young generation is imperative. Based on a micro-survey of Chinese college students, the authors used Logit and ordered Logit model to obtain empirical information on perceived past environmental quality and current PEBs. The authors found that environmental improvement positively impacted various PEBs, including green travel, plastic bag use, garbage sorting, and energy conservation. Better perceived environmental quality leads to increased environmental expectations, motivation to adopt PEBs, and awareness of environmental responsibility. The positive effect is more pronounced for individuals engaged in environmental protection activities, familiar with environmental advocacy, and with a family consensus on environmental protection. These findings were corroborated through robustness tests of alternative methods, samples, and measures. There is a positive feedback loop between a sustainable environment and human behavior. Policy recommendations are offered to further strengthen this symbiotic relationship.

KEYWORDS

Environmental expectations, Environmental improvement, Past experiences, Perceived environmental quality, Pro-environmental behaviors

1. INTRODUCTION

In recent years, environmental problems caused by human activities have become increasingly prominent. Pro-environmental behaviors (PEBs) have been argued to reduce environmental damages or benefit the environment (He et al., 2022; Jia & Yu, 2021; Steg & Vlek, 2009). PEBs range from simple actions (such as saving food or recycling plastic waste) to hard work (such as changing non-

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motorized vehicles or participating in initiatives to mitigate climate change). With growing concern for environmental sustainability, environmental protection behavior is critical (Bonasia et al., 2022; Ge & Lin, 2021; Panzone et al., 2021), especially as many businesses are developing eco-friendly products or packages (Song et al., 2022; Su et al., 2022; J. Zhu et al., 2022). Furthermore, residents have great potential in terms of environmental protection as end consumers (Jeanson et al., 2021; Lin & Wei, 2022; Si et al., 2022), particularly as a growing body of literature have studied influencing factors that affect residents' environmental protection behavior, such as personal values (Pagliuca et al., 2022; Shulman et al., 2022), the influence of family members (Grønhøj & Thøgersen, 2017; Jia & Yu, 2021), and policy guidance (Ornaghi et al., 2018; Peng et al., 2021).

However, most of the research has focused on the influence of individual values and beliefs on PEBs, while relatively little attention paid to the role of the natural environment. The natural environment is important (Hidalgo-Crespo et al., 2022; M. Liu et al., 2022) because people's willingness and behaviors to protect the environment are heavily influenced by their perception of the environment (Mohanty et al., 2021; Soares et al., 2021). Environmental perceptions are typically subjective assessments of environmental characteristics (Berthold et al., 2022; Dong et al., 2018). Furthermore, although research has found that early experiences of individuals have a long-term effect on psychological and economic behaviors (Hoynes et al., 2016; Malmendier et al., 2011), the impact of past environmental perception on present pro-environmental behaviors is yet to be investigated. This study aims to fill this gap.

The improvement of environmental quality varies from place to place, and people from different hometowns have different perceptions. Following the Air Pollution Prevention and Control Action Plan in 2013, China's air quality generally improved, with the average concentration of $PM_{2.5}$ and SO_2 falling by 68 percent in the first 74 cities to implement the Ambient Air Quality Standard (Lin & Zhu, 2018). Residents living in different places experienced various emotions regarding environmental quality. According to the broken window theory, an untidy environment will lead more people to cause environmental damage (Carley, 2022; C. Wang et al., 2019). But, those who experienced a pro-environmental practice may be more motivated and willing to protect the environment (Y. Wang et al., 2021). Therefore, considering the variability in the perception of environment, the survey data used in this paper interviewed young people from over 300 prefecture-level cities in China. The extensive coverage can assist us in developing a comprehensive understanding of the impact of environmental quality.

Using micro-survey data from a sample of Chinese college students, we investigate the association between past environmental quality in hometowns and a range of PEBs, including green travel, the use of plastic bags, garbage sorting, and energy conservation. There are three major contributions. First, while previous studies have examined the influencing factors of environmental behaviors based on current personal factors (such as income, attitude, education level, gender, and so on) and the current external environment (such as policies, facilities, peer influence, and so on), few studies have focused on the impact of past experiences on environmental behaviors. This paper expands on the impact of an individual's prior experiences. Second, this paper relies on questionnaires completed by college students from more than 300 Chinese prefecture-level cities. Because college students come from all over the country, they have experienced varying levels of environmental quality in their hometowns and in their college city. Moreover, when choosing a university, college students focus primarily on the university's ranking and score. To some extent, this helps to reduce the endogenous problem of existing estimates (Engel-Cox & Chapman, 2023; Martínez-Espiñeira & Lyssenko, 2011). Third, while some studies of environmental perception focus on the impact of the current environment, this paper examines the long-term impact of environmental improvement. This article examines whether the young generation who have witnessed environmental quality improvement will have strong pro-environmental awareness and behaviors, and how policy and education can guide their pro-environmental behaviors in the long-term growth process.

The remainder of this paper is organized as follows. Part 2 is a literature review, summarizing the impact of environmental perception, personal characteristics, and other external factors; Part 3 is the study design, introducing the empirical model, and describing the basic characteristics of the dataset; Part 4 is to discuss the empirical regression results, explore potential mechanisms, and conduct heterogeneity analysis; Part 5 is to conduct robustness tests to improve the credibility of the conclusion; and Part 6 is to summarize the finding.

2. LITERATURE REVIEW

2.1. The Impact of Environmental Perception on PEBs

Many studies that focus on environmental perception have found that the perceived environment has a greater impact on human behavior than the actual environment (M. Liu et al., 2022; Zhou et al., 2020) and that different people may have different perceptions of the same external environment (Ewing & Handy, 2009). A good living environment can improve the happiness of residents and reduce their motivation of residents to migrate (Hidalgo-Crespo et al., 2022; Jeanson et al., 2021; McCunn et al., 2018), as tangible green features help educate and motivate people's environmental protection behavior (J. (Snow) Wu et al., 2021; D. Zhang & Tu, 2021).

In particular, when people perceive the scarcity of ecological resources, they exhibit more pro-environmental behaviors (Berthold et al., 2022; Gu et al., 2020; Yoon et al., 2021). Perception of climate issues related to sustainability can indirectly promote environmental behaviors through environmental enthusiasm, environmental responsibility and environmental commitment (Berger & Wyss, 2021; J. Wang et al., 2021). Individual preferences for nature and cities differ, with people with natural preferences reporting higher pro-environment attitudes and pro-environmental behaviors (Chen & Lin, 2022; Wilkie & Trotter, 2022). Gratitude for nature is related to the intention to exhibit environmental protection actions and give substantial donations to environmental causes (Tam, 2022).

Public perception of energy policy and implementation can influence consumer perceptions and behaviors (Cohen et al., 2021; He et al., 2022; Mohanty et al., 2021). Many studies investigated that individuals with high trust in political institutions are more willing to make sacrifices for the environment (Gu et al., 2020). Correspondingly, negative attitudes toward the government may reduce individuals' willingness to support waste management practices (Swami et al., 2011), while satisfaction with government policies has a positive impact on residents' waste sorting behavior (He et al., 2022; Y. Zhang et al., 2022).

2.2. The Influence of Personal Values on PEBs

Many empirical studies suggest that pride and guilt are psychological forces that influence pro-environment behavior (Manika et al., 2021; Yang & Weber, 2019). Green ethical motivations (self-identification and green personal norms) are determinants of collaborative pro-environmental behaviors (de Groot et al., 2021; Shang & Wu, 2022). Self-transcendent values, such as reverence, compassion, and gratitude, can be inspired by nature, and conversely promote prosocial behavior (Pagliuca et al., 2022; Shafiei & Maleksaeidi, 2020; Steel, 1996; Zelenski & Desrochers, 2021). Besides, feelings of guilt associated with the experience can be used to predict people's behavior (Shipley & van Riper, 2022; Yoon et al., 2021).

Since most environmental protection effects are not immediately visible and require additional costs for future environmental quality, individual patience and time preferences also influence environmental protection behavior (Silvi & Padilla Rosa, 2021; Videras et al., 2012; Ziegler, 2020). Residents' pro-environmental attitudes to protecting the natural environment were positively associated with their attitudes toward social cooperation (Owen & Videras, 2006; Ziegler, 2020). As altruism is significantly associated with daily pro-environmental behaviors (Lades et al., 2021).

2.3. The Role of External Interventions on PEBs

Interventions such as training, advocacy and education can help in environmental information access (Mauerhofer, 2016). Environmental knowledge is a prerequisite psychological factor for pro-environment behavior (Bamberg & Möser, 2007; P. Liu et al., 2020). When people gain accurate knowledge about environmental issues, they are more likely to be concerned about the environment and act pro-environmentally (Gautam, 2020; Soares et al., 2021). Green training and development alongside green discipline management of employees can be carried out within enterprises (Neessen et al., 2021; Nisar et al., 2021). The empirical results show that after publicity and education, the rate of garbage sorting behavior doubles (Peng et al., 2021). Energy-saving knowledge delivered to residents will affect the energy consumption styles of residents, as the effect is long-lasting (Ornaghi et al., 2018; Shen et al., 2022).

Individual environmental protection behavior is also affected by the people around them. Parental behavior and family norms impact young people's pro-environmental attitudes and behaviors (Grønhøj & Thøgersen, 2017; Jia & Yu, 2021). Understanding the behavior of neighbors helps residents sort waste and save energy (Schultz et al., 2015; Videras et al., 2012; B. Wang et al., 2021). Celebrity demonstrations can effectively promote pro-environmental behaviors (Ho et al., 2022).

2.4. Summary

In conclusion, current research mainly analyzes the pro-environmental behaviors of residents from three aspects. First, studies analyze the impact of environmental perception, which has a greater impact on people than the actual environment. The perceived environmental quality, resource scarcity, natural vulnerability, and environmental policy effectiveness influence people's environmental protection behaviors. Secondly, personal pride, guilt, self-transcendence, personal norms, patience and other personal value characteristics also affect people's pro-environmental behaviors. Thirdly, human environmental knowledge has a role in promoting people's environmental behaviors, so studies show that interventions such as training, publicity and education can help promote people's environmental behaviors. At the same time, research has found that early experiences of individuals have a long-term effect on psychological and economic behaviors, but few studies have focused on the impact of past experiences on environmental behaviors. Paying attention to the mutual influence between residents and environmental improvements is necessary.

3. RESEARCH DESIGN

3.1. Data Source

Our data came from face-to-face interviews with college students. There are three reasons for choosing college students as the empirical sample. First, college students from all over the country grew up in different natural environments, so there were differences in the perception of environmental quality. Second, after taking the college entrance examination, most Chinese college students would leave their hometown cities and attend colleges and universities in other cities. The environmental quality of the college city could provide a reference for assessing the hometown environment. Moreover, when choosing a university, students mainly consider the match between their college entrance examination scores and the admission score line. Therefore, the sample of college students is suitable for the research objective of this paper.

The dataset in this paper is the Energy and Environment Cognition Survey (CSCES) of college students, conducted by a national key university in Fujian, China in 2020, which aimed to reflect the energy and environmental cognition of contemporary college students. By choosing a certain school, we can control for the congruence of the individuals' current environment and thus better compare the effects of previous environmental experiences on individual behavior. There are three main steps in the survey process. First, more than 200 questions were set up about the basic information

of individuals and families, energy cognition and energy-saving behavior, low-carbon cognition and willingness to pay. Then, the questions were revised based on the feedback from 100 respondents in the preliminary survey. After the optimization, formal survey was conducted through face-to-face interviews, combined with computer-assisted technology.

At last, there were 2987 valid samples collected, covering over 30 schools and research institutes in this university. The respondents grew up in nearly 300 cities in China, which reflect the environmental conditions of most regions in China. As shown in Figure 1, 85% of the respondents' enrollment year was the last three years at the time of the survey, which was in the "13th Five-Year Plan" period, during which China's environmental protection was highly valued, and the environmental quality continuously improved.

3.2. Variable Selection

The key explanatory variable concerned in this article is the perception of the environmental quality of the hometown. In the survey, 2987 respondents answered their perception of the air quality in their hometown. As shown in Figure 2, 34.78% of the respondents thought that the air quality in their hometown was "good", and 28.83% of the respondents thought that was "normal". The proportions who thought that was "very good" and "poor" were both close to 15%. Less than 5% thought that was "very poor".

Pro-environmental behaviors were represented by four categories: "preferred way of travel", "energy conservation", "garbage classification" and "use of plastic bags". Among the four types of PEBs, "preferred way of travel" was the most related behavior to air quality. In addition, we used other three kinds of environmental behaviors that are not directly related to air. Therefore, we could test whether the perception of air quality had spillover effects on other environmental behaviors.

According to the respondent's perception of the air quality in their hometown, they were divided into five groups, and the responses of PEBs were compared by group, as shown in Figure 3. It could be seen that the proportions of responded PEBs among groups are similar. But there was a trend in PEBs with the environmental improvement. The names and specific definitions of each variable in this paper are shown in Table 1, as the descriptive statistics of the variable characteristics are reported. The dummy variable to measure "preferred way of travel" was Green_travel, which equaled 1 if the answer was public transportation or didn't directly use polluted energy. As shown in Table 1, the

Figure 1. Distribution of enrolment years of respondents

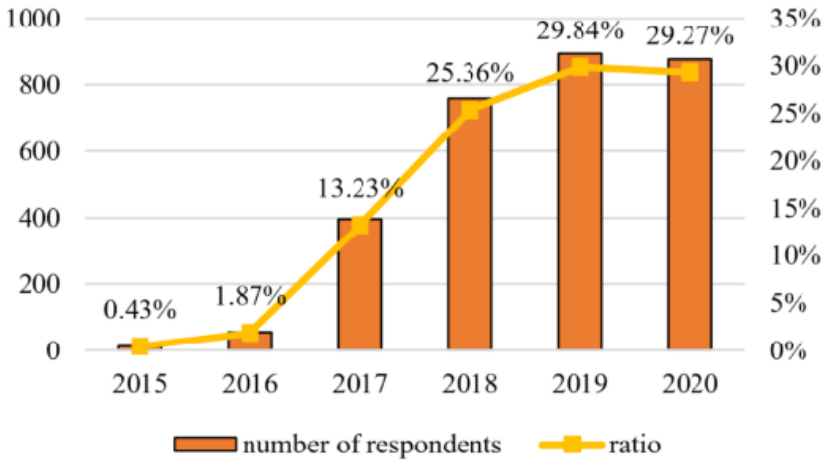
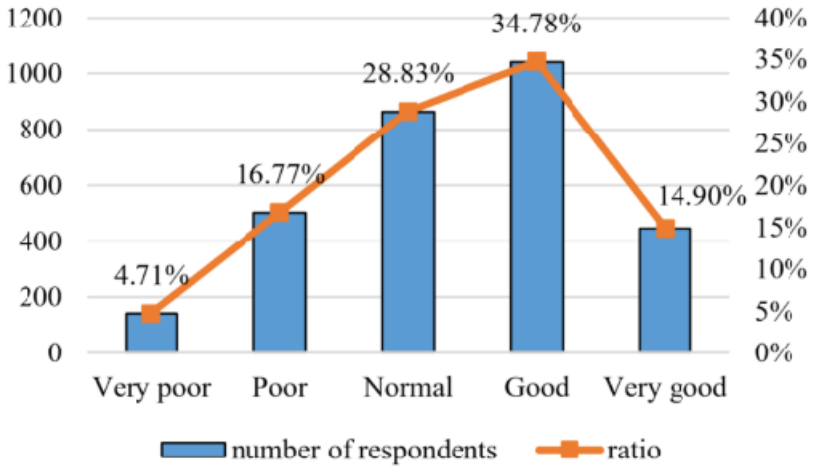


Figure 2. Perceptions of air quality in the hometown



proportion of respondents who "prefer green travel" in their daily lives was 87.5%. The variable to measure "energy conservation" was Energy_save, which was a scale measuring how often a person turn off the air conditioning and lights without use. And most people "turn off the lights" when the room is not in use. The dummy variable to measure "garbage classification" was Garbage_sort, which equaled 1 if the respondent almost followed the local waste classification standards as accurately as. The proportion of "garbage sort" is 20.6%. The variable to measure "use of plastic bags" was Plastic_bags, which was the average number of plastic bags needed for a weekly purchase, and the average weekly use of "plastic bags" is 0-5. Referring to present study (P. Zhu & Lin, 2022), we also control household income, monthly expense, gender, age, leadership experience and education background.

3.3. Model Construction

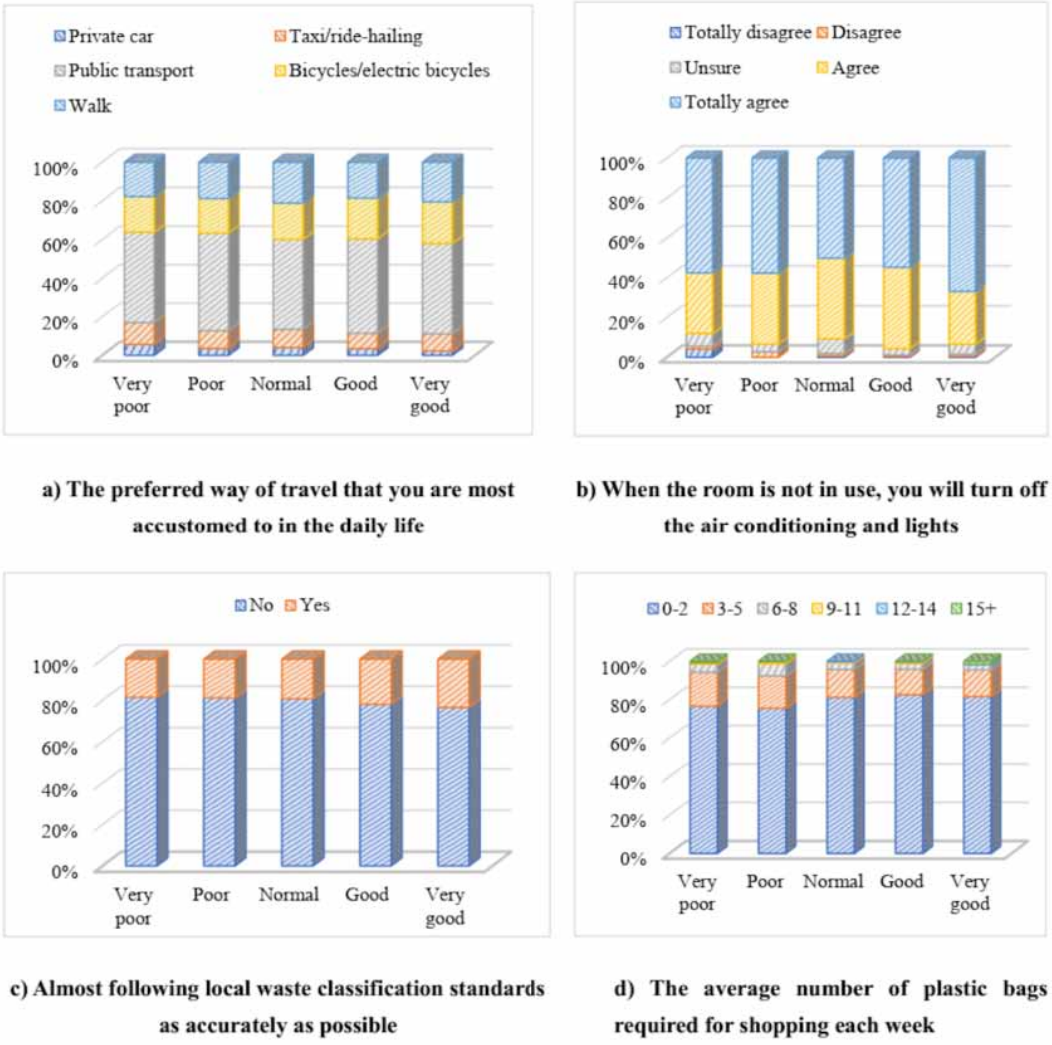
This paper mainly considered the migration group of college students, focusing on whether the environmental quality perception of their hometown had a long-term impact on present pro-environmental behaviors. Based on the existing literature above, this paper controlled for individual and family characteristics, and analyzed the influence of past environmental quality on present PEBs, environmental knowledge, environmental responsibility, and then investigated the heterogeneity under different interventions.

Based on the considerations above, this paper sets up the following Logit model:

$$Behavior_i = \alpha_0 + \alpha_1 \cdot Hometown\_air_i + \alpha_2 \cdot Controls_i + S_j + G_t + \varepsilon_i \quad (1)$$

where the definition of each variable is the same as Table 1. The dependent variable $Behavior_i$ represents the four environmental protection behaviors, including Green_travel, Energy_save, Garbage_sort and Plastic_bags. The main explanatory variable $Hometown\_air_i$ represents the perceived air quality in hometown. The most important coefficient α_1 is the influence of individual i's air quality perception on PEBs. The variable $Controls_i$ represents control variables including household income, individual consumption expenditure, gender, age, leadership and education stage.

Figure 3. Distribution of PEBs under the perception of air quality in different hometowns



a) The preferred way of travel that you are most accustomed to in the daily life

b) When the room is not in use, you will turn off the air conditioning and lights

c) Almost following local waste classification standards as accurately as possible

d) The average number of plastic bags required for shopping each week

In addition, this paper controls respondents' college S_j and grade level G_t as fixed effects, clustering robust standard errors at the city level.

The dependent variables are discrete variables obtained by questionnaire questions, as there are only two or several choices for each question. They are not continuous variables, so the ordinary least squared method (OLS) is not appropriate here (Shao et al., 2018). Green_travel and Garbage_sort are dichotomous 0-1 dummy variables whose values have no intrinsic ranking order. Energy_save and Plastic_bags are discrete ordered variables whose values have intrinsic ranking order. The Energy_save=1 indicates the least frequency of turning off the electricity with hand and Energy_save=5 indicates the most frequency of turning off the electricity with hand. Plastic_bags=1 means the least number of plastic bags used, Plastic_bags= 6 indicates the maximum number of plastic bags used.

In the Logit model, there is a latent variable Behavior* to summarize the net benefit of the behavior, which is a linear function of the vector of explanatory variables:

Table 1. Variable definitions and descriptive statistics

Variable	Definition	Measurement	N	Mean	P50	SD
Hometown_ air	Perception of air quality in your hometown	What do you think of the air quality in your hometown? 1 = very poor, 2 = poor, 3 = normal, 4 = good, 5 = very good.	2987	3.384	3	1.074
Green_ travel	Green travel	What is your preferred way of travel in your daily life? 1 = public transportation/bicycle/ electric car/shared bicycle/walking, 0 = private car/taxi/ride-hailing car.	2987	0.875	1	0.331
Energy_ save	Turn off electricity	When the room is not in use, you will turn off the air conditioning and lights? 1 = totally disagree, 2 = disagree, 3 = normal, 4 = agree, 5 = totally agree.	2987	4.449	5	0.779
Garbage_ sort	Waste Classification	Almost following the local waste classification standards as accurately as possible? 1=Yes, 0=No	2987	0.206	0	0.404
Plastic_ bags	Plastic shopping bag use	What about the average number of plastic bags needed for a weekly purchase? 1 = 0 to 2, 2 = 3 to 5, 3 = 6 to 8, 4 = 9 to 11, 5 = 12 to 14, 6 = 15 and above.	2987	1.264	1	0.633
Lincome	The logarithm of the annual household income (yuan).	Log (annual household income)	2957	11.814	11.791	0.958
Lexpense	The logarithm of the monthly expenditure (RMB) spent in school	Log (monthly expenses)	2987	7.435	7.439	0.402
Gender	Gender	0 = male, 1 = female.	2987	0.590	1	0.492
Age	Age	the interview year minus the year of birth.	2987	22.582	22	2.799
Stu_leader	Student leader	Have you served as a student leader? 0 = never served, 1 = has served / is currently serving.	2987	0.785	1	0.411
Home_city	Growing place	The city where the family is located.	2987			
School	School	The school which you are in.	2987			
Stage	Academic stage	0 = undergraduate, 1 = master's student, 2 = Ph.D. student.	2987	1.605	2	0.658
Grade	Grade	Current grade.	2987	2.299	2	1.107

$$Bahavior^{*} = x'\beta + \varepsilon \tag{2}$$

where x' represents all explantory variables above, β is the corresponding coefficients to be estimated. Behavior* is unobservable, then we can observe the Behavior of respondents while Behavior* attains certain threshold value z_k.

(a) For Green_travel and Garbage_sort:

Behavior=1, if *Behavior**>0
Behavior=0, if *Behavior** ≤ 0 (3)

Thus, the probability in (a) that respondents choose 1 is expressed as:

$$P\left(Behavior = 1|x\right) = P\left(Bahavior^{*} > 0|x\right) = P\left(x'\beta + \varepsilon > 0|x\right)$$
$$= P\left(\varepsilon > -x'\beta|x\right) = F_{\varepsilon}(-x'\beta \mid x) \tag{4}$$

(b) For Energy_save and Plastic_bags (R. Wu & Lin, 2022):

$$Behavior = \begin{cases} 1, & if\, Bahavior^{*} \le z_1 \\ 2, & if\, z_1 < Bahavior^{*} \le z_2 \\ & \cdots \\ & \cdots \\ M, & if\, Bahavior^{*} \le z_M \end{cases} \tag{5}$$

Thus, in (b), the probability that respondents choose k is expressed as:

$$P\left(Behavior = k|x\right) = P\left(z_{k-1} < Bahavior^{*} \le z_k|x\right) = P\left(Bahavior^{*} \le z_k|x\right) - P\left(Bahavior^{*} < z_{k-1}|x\right) = P\left(x'\beta + \varepsilon \le z_k|x\right) - P\left(x'\beta + \varepsilon < z_{k-1}|x\right) = F_{\varepsilon}\left(z_k - x'\beta|x\right) - F_{\varepsilon}\left(z_{k-1} - x'\beta|x\right) \tag{6}$$

If ε follows logistic distribution, we can use maximum likelihood estimation method (MLE) to estimate equation (1).

4. RESULTS AND DISCUSSION

4.1. Benchmark Regression Result Analysis

Baseline regression uses the perception of air quality in the hometown as an explanatory variable and controls individual characteristic variables such as household income, personal consumption expenditure, gender, age, student cadre, and education background (Hua et al., 2021). In university life, many courses and extracurricular activities are school-based with different characteristics. In addition, students in the same entrance year receive the same first-year entrance education. Therefore, the school and grade are fixed effects. The clustering robustness error is set at the level of the prefecture city. The benchmark regression results are shown in Table 2.

In Table 2, each variable's coefficients and odds ratios are reported separately for each type of environmental behavior. The minimum change in the key explanatory variables is at least 1 unit. Given the other variables, the coefficient of 1.102 for Hometown_air in column (2) indicated that when the perception of home air quality rose by 1 unit (e.g., the perception of home air quality rises from "normal" to "good"), the odds ratio of an individual preferring green travel increased by 10.2%. In columns (4) and (6), if the coefficients of Hometown_air were 1 unit higher, the odds of garbage classification and turning off the lights would increase by 9.7% and 12.2%, respectively. In column (8), the coefficient of Hometown_air 0.859 indicated that when the home air quality perception rose by 1 unit, the odds of individuals choosing more plastic bags would reduce by about 14.1%. On the whole, the perceived hometown air quality would motivate respondents' current environmentally friendly behaviors, which was reflected in the preferred green travel way such as bus, walking, and bicycle; increasing the frequency of turning off air conditioners and lights when no one was there; carrying out accurate garbage classification as much as possible; and reducing the use of plastic bags for shopping. This results were similar to the existing study (X. Liu et al.,

2021; Ming et al., 2022), indicating that public concern for pro-environmental behaviors had a significant negative correlation with air quality. The results of this paper, from the perspective of long-term experience, showed that after experiencing better air quality in their hometown, there were still more positive environmental behaviors.

In addition, gender coefficients were positive at a significant level of 1% for green travel and turning off electricity, indicating that females were more likely to exhibit more environmentally friendly behaviors than males (Ankrah Twumasi et al., 2021; McCright et al., 2014). The coefficients of household income and consumption expenditure had different effects on different PEBs, but both inhibit green travel patterns; that is, individuals with higher household income and consumption expenditure prefer taxis and private cars to public transportation. The leadership experience, usually associated with responsibility, had positive effect on green travel, energy saving, and garbage classification.

4.2. Potential Mechanism Analysis

Residents who grew up in areas with good air quality had a good environmental experience. The mediation effects of expectation, attitude and responsibility were examined. Environmental awareness was an important factor in environmental behaviors (Bamberg & Möser, 2007). Besides, when people gained accurate knowledge about environmental issues, they were more likely to act

Table 2. Benchmark regression of environmental quality on PEBs

Variable	Green_travel		Energy_save		Garbage_sort		Plastic_bags	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Logit	Logit (Odds Ratio)	Ologit	Ologit (Odds Ratio)	Logit	Logit (Odds Ratio)	Ologit	Ologit (Odds Ratio)
Hometown_air	0.097*	1.102*	0.093***	1.097***	0.115*	1.122*	-0.152***	0.859***
	(0.054)	(0.060)	(0.036)	(0.039)	(0.065)	(0.073)	(0.050)	(0.043)
Lincomeyuan	-0.320***	0.726***	0.040	1.041	0.111*	1.118*	0.040	1.041
	(0.076)	(0.055)	(0.042)	(0.044)	(0.062)	(0.070)	(0.050)	(0.052)
Gender	0.552***	1.737***	0.405***	1.499***	0.008	1.008	-0.025	0.975
	(0.123)	(0.214)	(0.077)	(0.116)	(0.108)	(0.108)	(0.111)	(0.108)
Lexpense	-0.847***	0.429***	-0.166*	0.847*	-0.252**	0.777**	0.616***	1.851***
	(0.163)	(0.070)	(0.096)	(0.081)	(0.119)	(0.093)	(0.131)	(0.243)
Stu_leader	0.266*	1.304*	0.435***	1.544***	0.327***	1.386***	-0.077	0.926
	(0.145)	(0.189)	(0.079)	(0.122)	(0.123)	(0.170)	(0.115)	(0.106)
Age	-0.136	0.872	0.041	1.042	-0.438*	0.645*	-0.069	0.933
	(0.327)	(0.285)	(0.218)	(0.227)	(0.264)	(0.170)	(0.284)	(0.265)
Age2	0.000	1.000	-0.003	0.997	0.011**	1.011**	0.001	1.001
	(0.006)	(0.006)	(0.004)	(0.004)	(0.005)	(0.005)	(0.006)	(0.006)
School	Yes		Yes		Yes		Yes	
Stage	Yes		Yes		Yes		Yes	
Grade	Yes		Yes		Yes		Yes	
Cluster	Yes		Yes		Yes		Yes	
Observations	2912		2943		2941		2943	

Note: Standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01. Cluster in hometown city level

pro-environmentally (Soares et al., 2021). When people understood the responsibility for protecting the environment, the likelihood of pro-environmental behaviors increased (Soares et al., 2021). Expectation, attitude and responsibility are measured using relevant questions in the questionnaire: Expectation is measured by the question "Is air quality an important factor in choosing a city after you graduate"; Attitude to energy saving is measured by "Rational use of energy is conducive to environmental protection"; Attitude to garbage sorting is measured by "Garbage sorting and recycling is conducive to protecting the environment"; Responsibility to energy saving is measured by "Rational use of energy is the right thing to do"; Responsibility to garbage sorting is measured by "I have an obligation to sort the garbage".

The empirical results are shown in Table 3. It showed that better the perception of air quality in the hometown was along with the higher the individual's expectation of air quality, more positive the attitude towards energy conservation and garbage recycling, and the stronger sense of responsibility for energy conservation and garbage recycling. It demonstrated that expectation, attitude and responsibility played a mediating role between experience and behavior.

4.3. Heterogeneity Analysis

The perception of the environmental quality of the hometown was an experience, and its impact on the current environmental protection behavior was also regulated by the current external publicity, education, surrounding atmosphere and other factors. Therefore, the overall sample was divided into different groups according to environmental protection activities, environmental protection publicity awareness, and family atmosphere. And we did the Logit and ordered Logit regressions in two subsamples of each panel separately. The results of three panels are shown in Table 4.

In Panel A of Table 4, respondents were divided into two groups based on whether they have participated in environmentally-related activities. The results showed that in terms of green travel, turning off of electricity, and the use of shopping plastic bags, the impact of environmental quality perception was significant in the groups who engaged in environmental protection activities. In contrast, the groups that hadn't participated in environmental protection activities might not pay much attention to the environment, so the perception did not have a significant impact on it.

In Panel B of Table 4, the students were divided into two groups according to their understanding of the school's environmental protection publicity. Advocacy helped to increase students' environmental awareness (Bamberg & Möser, 2007; P. Liu et al., 2020). The effectiveness of the advocacy depended heavily on whether the student understood the content of the environmental advocacy (Gu et al., 2020; Y. Zhang et al., 2022). As seen from Panel B of Table 4, when students understood the school's environmental protection advocacy, hometown air quality perception has a role in promoting pro-environmental behaviors.

Table 3. Analysis of potential mechanisms

Variable	(1)	(2)	(3)	(4)	(5)
	Expectation	Attitude_ saving	Attitude_ garbage	Responsibility_ saving	Responsibility_ garbage
Hometown_air	0.218***	0.081**	0.130***	0.102***	0.134***
	(0.042)	(0.035)	(0.041)	(0.035)	(0.042)
Fixed effect	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes
Observations	2943	2943	2943	2943	2943

Note: Standard errors are in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01. Cluster in hometown city level

Table 4. Whether to have participated in environmental protection-related activities

	Green_travel		Energy_save		Garbage_sort		Plastic_bags	
Panel A: Whether to have participated in environmental protection-related activities?								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Yes	No	Yes	No	Yes	No	Yes	No
Hometown_air	0.217***	0.028	0.198***	0.040	0.145	0.108*	-0.242***	-0.089
	(0.083)	(0.067)	(0.068)	(0.041)	(0.095)	(0.063)	(0.079)	(0.058)
Observations	1016	1854	1036	1907	1025	1896	1036	1907
Panel B: Whether to know about environmental advocacy in schools?								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Yes	No	Yes	No	Yes	No	Yes	No
Hometown_air	0.112*	0.024	0.071*	0.160*	0.126*	0.043	-0.143***	-0.163
	(0.066)	(0.114)	(0.039)	(0.092)	(0.066)	(0.114)	(0.051)	(0.103)
Observations	2228	655	2254	689	2253	672	2254	689
Panel C: Whether your family agrees with an environmentally friendly lifestyle?								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Yes	No	Yes	No	Yes	No	Yes	No
Hometown_air	0.173**	-0.055	0.126***	0.041	0.060	0.229**	-0.166***	-0.124*
	(0.073)	(0.084)	(0.046)	(0.061)	(0.067)	(0.091)	(0.061)	(0.073)
Observations	1736	1135	1754	1189	1754	1165	1754	1189
Fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Standard errors are in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01. Cluster at the hometown city level.

In Panel C of Table 4, the overall sample was divided into two groups according to whether the family agreed with the environmentally friendly lifestyle. Environmental protection behaviors were influenced by surrounding social relations, especially the family (Grønhøj & Thøgersen, 2017; Jia & Yu, 2021). The result in Part C of Table 4 showed that when there was a consensus on environmental protection in the family, the individual's improved environmental experience was more likely to promote their environmental protection behavior.

5. ROBUSTNESS TEST

5.1. Other Environmental Protection Behaviors

The environmental protection behaviors selected above in this paper include green travel, energy conservation, garbage classification, and plastic bag use. To enhance the robustness of the conclusions of this paper, other pro-environmental protection behaviors were selected here for analysis to check whether there is the same effect. Other behaviors include "Littering", "Sort recyclable waste", "Sort hazardous waste", and "Open the refrigerator less". In Table 5, the results of each column showed that the better people perceived the quality of their home environment, the less likely they were to litter, the more likely they were to sort recyclable and hazardous waste, and the more likely they were to minimize the number of times they opened and closed the refrigerator door.

Table 5. Influence of home environmental quality perception on other PEBs

Variable	(1)	(2)	(3)	(4)
	Littering	Recycle sort	Hazardous sort	Refrigerator
Hometown_air	-0.117**	0.079**	0.104***	0.119***
	(0.057)	(0.033)	(0.038)	(0.035)
School	Yes	Yes	Yes	Yes
Grade	Yes	Yes	Yes	Yes
Cluster	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	2926	2943	2943	2943

Note: Standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01. Cluster in hometown city level.

5.2. Threshold Effect of Objective Environmental Quality

The explanatory variable used above was the individual's perception of the air quality in his hometown. However, personal perception was subjective, and the comparability among cities was not enough. Therefore, the objective indicator PM2.5, which measured environmental quality, was used next as the main explanatory variable. When PM2.5 was within different threshold ranges, the effects might differ. Therefore, a threshold regression model was used (Fan et al., 2021):

$$\begin{aligned} Behavior_i &= \alpha_0 + \alpha_1 * Log\left(PM2.5\right)_i * I\left(PM2.5 \le \eta_1\right) \\ &+\alpha_2 * Log\left(PM2.5\right)_i * I\left(\eta_1 < PM2.5 \le \eta_2\right) \\ &+\alpha_3 * Log\left(PM2.5\right)_i * I\left(PM2.5 > \eta_2\right) \\ &+\alpha_4 * X_i + \varepsilon_i \end{aligned} \tag{7}$$

where $Log\left(PM2.5\right)_i$ was the logarithm of the annual average PM2.5 in individual i's hometown in the year of enrollment. The index functions $I\left(PM2.5 \le \eta_1\right)$, $I\left(\eta_1 < PM2.5 \le \eta_2\right)$, $I\left(PM2.5 > \eta_2\right)$ were used to indicate the threshold interval in which PM2.5 should be. Based on the F-statistic of the threshold values, the most suitable threshold models were selected.

Table 5 showed the regression results of the threshold model for objective environmental quality PM2.5 influencing PEBs. In column (1), the annual average of PM2.5 on green travel was significant at 1%; the smaller the PM2.5 value (the better the air quality) and the greater the probability of green travel. In the double threshold model for green travel, the PM2.5 threshold values are 26.045 and 40.867, respectively. According to the classification of the Ministry of Ecology and Environment of China, the air quality is classified as "excellent" when the PM2.5 value is less than 35 and "Good" when PM2.5 is in the range of 35-75. Based on the empirical results of Table 6, when PM2.5 is within the first threshold value in the "excellent" air quality range, its impact is the largest. The results show that in cities with better environmental quality, the greater the incentive effect of environmental quality on PEBs.

5.3. Adjust the Sample and Method

In this section, the samples and methods are adjusted to further test the robustness of the above conclusions. Firstly, only the undergraduate sample is retained for regression, and Panel A in Table

Table 6. Threshold regression results of objective environmental quality affecting PEBs

Variable	(1)	(2)	(3)	(4)
	Green_travel	Energy_save	Garbage_sort	Plastic_bags
lnPM2.5_1	-0.149***	-0.221**	-0.155***	0.162***
	(-3.06)	(-2.30)	(-3.63)	(3.04)
lnPM2.5_2	-0.129***	-0.167*	-0.131***	0.138***
	(-2.96)	(-1.96)	(-3.62)	(3.05)
lnPM2.5_3	-0.110***	-0.141*		
	(-2.84)	(-1.94)		
Fixed effect	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	2893	2893	2893	2893

Note: T statistics in parentheses * p < 0.1, ** p < 0.05, *** p < 0.01. Cluster at the hometown city level.

7 shows that the empirical results are consistent. Undergraduate and graduate students have many differences in choosing a university. On the one hand, when applying for admission, undergraduate students get published examination scores firstly and then apply for admission, mainly according to score requirements. While graduate students firstly choose one university, then take exams and get scores. On the other hand, undergraduate enrollment is based on the National College Entrance Examination, and there is a prescribed proportion of enrollment in each province, so the hometowns of undergraduate students are all over the country. However, the proportion does not limit the graduate enrollment, and individuals may consider more regional-related factors. Therefore, the home of the undergraduate students is more random and diverse. Secondly, the Probit method is used instead of Logit model, assuming that the dependent variable is normally distributed. Panel B in Table 7 lists Probit results. Thirdly, the main life in university is based on the school as a unit. The curriculum of each school, the usual publicity, and the attention to the environment is different. Moreover, the students in the same school have mutual influence. So, the clustering robust standard error level is adjusted to the school level, and the results are shown in Panel C in Table 7.

The above robustness tests all support the conclusions of the benchmark regression in this paper; that is, the better the perception of the environmental quality of the hometown, the more positive people's environmental protection behavior.

6. CONCLUSION

This paper illustrated a virtuous circle between environmental improvement and human pro-environmental behaviors. Current pro-environmental behaviors positively correlated with perceptions of past environmental quality, based on a survey of college students who grew up in nearly 300 prefecture-level cities in China. The higher the perceived environmental quality of one's hometown, the more likely people were to engage in pro-environmental behaviors now. This was primarily reflected in the fact that people who lived in areas with higher environmental quality were more likely to choose green travel, use fewer plastic shopping bags, sort their garbage as accurately as possible, and turn off lights and air conditioners when the room is empty. Individuals with better environmental quality in their hometowns were also more environmentally conscious. People who grew up in a better environment had higher environmental expectations of their future workplace, were better able to understand the benefits of environmentally friendly behaviors, and were more environmentally responsible. This effect's heterogeneity across different types of groups was investigated further.

Table 7 Results of adjustment of the sample and method

	Green_travel	Plastic_bags	Garbage_sort	Energy_save
Panel A: Reserved for undergraduate students only				
	(1)	(2)	(3)	(4)
Hometown_air	0.130*	0.136***	0.104*	-0.149*
	(0.077)	(0.046)	(0.061)	(0.080)
Observations	1410	1439	1437	1439
Panel B: Probit method				
	(1)	(2)	(3)	(4)
Hometown_air	0.050*	0.060***	0.066*	-0.082***
	(0.029)	(0.021)	(0.036)	(0.028)
Observations	2912	2943	2941	2943
Panel C: Adjust the level of clustering standard error				
	(1)	(2)	(3)	(4)
Hometown_air	0.097*	0.093**	0.115**	-0.152***
	(0.051)	(0.046)	(0.045)	(0.046)
Observations	2912	2943	2941	2943
Fixed effect	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

Note: Standard errors in parentheses. * p < 0.1, ** p < 0.05, *** p < 0.01. Cluster in hometown city level for Panel A and B, and cluster in school level for Panel C.

When there had been participation in environmental-related activities, knowledge of environmental advocacy, and environmental consensus in the family, the influence of environmental quality on individual environmental behaviors was more pronounced. Robustness tests were performed, and the results were consistent.

These findings strongly suggested that environmental quality's long-term effect on PEBs should be highlighted for environmental sustainability. People who grew up in better-quality environments had more positive environmental behaviors and were more environmentally conscious. As a result, current environmental protection construction could improve current environmental quality and create a virtuous circle. People who had experienced a high-quality environment were more willing to preserve the environment by engaging in more environmental protection behaviors. Second, garbage classification PEBs needed to be improved. With the growing volume of household garbage and its importance in environmental sustainability, garbage classification deserved more attention and advocacy.

Finally, this work has some limitations that could be addressed in future research. First, respondents in our survey reported a general perception of the environmental quality of their hometowns, but we were unable to measure the effect of environmental quality improvement accurately. Second, even though respondents came from all over the country and were exposed to various environmental conditions, there were constraints in collecting representative respondents. Future research could also examine the economic benefits of previous environmental experiences, such as willingness to pay, investment in sustainability programs, and environmental donations.

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