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Investigate the impact of social interaction on pro-environmental behavior-evidence from the Chinese general social survey

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Abstract
Given the critical role of human activities in mitigating environmental degradation and climate change, it is of great significance to identify the determinants of residents' pro-environmental behavior for sustainable development. Based on Chinese General Social Survey (CGSS) data 2021, the paper investigates the influence of social interaction on residents' pro-environmental behavior in China. Three types of pro-environmental behaviors are analyzed, including environmental payment, garbage recycling behavior, and green purchase behavior. Results show that social interaction with neighbors can encourage low-education level group to pay more money and time for environmental protection. Social interaction with friends makes residents in high-education level group more willing to pay more money and time for environmental protection. Internet usage influences environmental payment behavior the most, while life happiness affects green purchase behavior the most. Garbage recycling behavior is hardly affected by these factors. Moreover, the results show a significant difference between higher and lower education levels, low-income and high-income, party members and non-party members. These findings suggest that differentiated policies should target distinct social groups to enhance pro-environmental behavior.

Keywords Pro-environmental behavior · Social interaction · Chinese general social survey

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1 Introduction

The environmental issue is one of the most essential parts of sustainable development goals, where responsible consumption and production will provide a decisive contribution to this goal (Akinsemolu & Onyeaka, 2025). Numerous studies have found that human behavior is one of the drivers of climate change, which has led to a significant increase in the frequency and intensity of extreme weather events—such as hurricanes, heatwaves, and floods—posing severe risks to ecosystems and human societies. At the same time, growing marine pollution, including plastic waste, chemical contaminants, and oil spills, continues to degrade marine ecosystems, threaten biodiversity, and compromise the health of ocean-dependent communities (Yang et al., 2025). To cope with global warming, pro-environmental behavior is widely incentivized. In China, household emissions account for 40% of the total carbon emissions (Li et al., 2019). The proportion is growing with the repaid growth of the economy and strong demand for quality life. Solving this problem requires a fundamental shift in consumer behavior (Lange, 2023). Therefore, promoting pro-environmental behavior is an important measure to reduce carbon emissions caused by human activities.

To gain an in-depth understanding of how to encourage residents' ecological protection behaviors such as resource conservation, scholars have researched the role of various influencing factors. In this paper, pro-environmental behavior refers to human behaviors that produce environmental benefits relative to alternative behaviors (Wu et al., 2022). Existing research has demonstrated a significant association between socio-demographic factors (such as age, education level, income, place of residence, and other socio-demographic variables) and individuals' pro-environmental behavior. Generally, groups with higher educational level, younger generations, and urban residents exhibit stronger environmental awareness and behavioral tendencies, which have established these factors as widely used predictors at the individual level and have formed a stable research paradigm. In contrast, the influence of external social factors—particularly social interaction—on residents' pro-environmental behavior has not yet been systematically theorized or empirically substantiated. Although a limited number of studies suggest that changes in the frequency and quality of social interactions may significantly affect willingness to engage in environmental protection through pathways such as peer effects, norm internalization, or emotional incentives, the evidence is still very scarce. Therefore, identifying and clarifying the relationship between social interaction and pro-environmental behavior is important for addressing theoretical gaps, revealing the social dynamics of behavioral change, and informing more effective strategies to promote public participation in environmental governance (Abrahamse & Steg, 2013). The relationship between social interaction and pro-environmental behavior remains to be clarified. In this paper, we aim to address this research gap by providing an empirical study.

A questionnaire survey is one of the ways to investigate residents' pro-environmental behavior. Nonetheless, most questionnaires have fundamental flaws, such as small samples and unreasonable sampling (Wu et al., 2022). Chinese General Social Survey (CGSS) is professional and authoritative, which can overcome the above shortcomings (Yang et al., 2023a, b). In addition, the data of CGSS can reflect social, economic, and human behavior and attitude. Many researchers have used the data to study residents' behavior in China. Therefore, this paper uses the Chinese General Social Survey data from 2021 (CGSS2021) to examine the influences of social interaction on residents' pro-environmental behavior. Based on the Chinese General Social Survey, this paper explores the factors influencing

residents' pro-environmental behavior. The main contributions are reflected in the following aspects: (1) It is one of the few studies considering social interaction on residents' pro-environmental behavior. (2) Three types of pro-environmental behavior including environmental payment, garbage recycling behavior, and green purchase behavior are considered. (3) Residents' pro-environmental behavior differences between higher education level and lower education level, low-income and high-income, partisan member, and nonpartisan member are further explored.

The remainder of this paper is arranged as follows: Sect. 2 is the literature review and hypothesis. Section 3 delineates the method used in this paper. Section 4 displays and explains the results. Section 5 summarizes the conclusions.

2 Literature review and hypothesis

Increased public awareness of environmental issues and the study of the impact of human behavior on the environment have received widespread attention (Wu et al., 2022). To clarify the law of the interaction between human behavior and the environment, the study of environmental behavior began to receive attention in the mid-1960s (Lee et al., 2014). Environmental behavior research remains an active area of study (Farrow et al., 2017; Grilli & Curtis, 2021). Existing research examines human environmental behavior from psychological, sociological, anthropological, and political science perspectives (Kaida & Kaida, 2016; Yuriev et al., 2020). Among the studies related to pro-environmental behavior, the factors that motivate people to adopt pro-environmental behavior are the most studied. For example, Ateş (2020) stressed the importance of environmental education in improving residents' pro-environmental behavior. He and Zhang (2021) found that environmental regulation has a positive impact on residents' willingness to pay for environmental protection. Zhang et al. (2020) argued that internet use has a negative relationship with environmental quality evaluation in China. Wu and Zhang (2023) highlighted the role of government intervention in promoting residents' garbage recycling. However, the above studies mainly focus on individual and policy-level determinants, while ignoring external factors represented by social interactions, which may influence residents' pro-environmental behavior through mechanisms such as knowledge dissemination, social norms, peer modeling, and behavioral cascades.

Social interaction refers to the relatively stable relationship systems formed through communication and contact between members of society. Communities with closer interpersonal relationships are more cohesive, and the influence of norms, such as peer effects and norms, is more prominent (Xu et al., 2022). In particular, social interaction based on kinship and friendship plays a crucial role in economic and social life by facilitating information transmission, fostering trust, and imposing informal institutional constraints. These mechanisms inevitably shape individual behaviors, including pro-environmental actions. A growing body of literature has explored the influence of social interaction on human behavior. For example, Enssle and Kabisch (2020) pointed out that social interaction can profoundly affect human behavior and are the primary driving environmental behavior change. Martí et al. (2019) discovered that social factors have an essential influence on citizens' environmental action strategies. And the higher the social frequency and closeness with relatives, friends, and neighbors, the more positive environmental behavior residents will carry out.

Kumar et al. (2019) found that individuals with broader social networks and more frequent interactions are more politically engaged, suggesting a broader link between social capital and civic participation. The study of Hynes and Wilson (2016) argued that social interaction is not always an effective mechanism for promoting pro-environmental behavior, indicating that the effect of social relationships may vary across contexts and types of interaction. Based on these considerations, the following hypotheses are proposed:

H1a: Frequent social and recreational activities with neighbors will promote residents' pro-environmental behavior.
H1b: Frequent social and recreational activities with friends will promote residents' pro-environmental behavior.

3 Methodology

3.1 Data source

The questionnaire data used in this study comes from the Chinese General Social Survey (CGSS), which was released by Renmin University of China in 2021. The CGSS, which was first started in 2003, is China's first national, comprehensive, and ongoing academic survey project. Due to the reliability of its data, CGSS data are broadly used to analyze China's social behaviors (Liu et al., 2020, Yang & Lin, 2025). The questionnaire data are based on the theory of sampling survey, using multi-stage stratified random sampling, and the survey covers 31 provinces in China. The questionnaire provided a large amount of information on demographic characteristics, such as age, occupation, household registration, civic morality, and environmental protection. Although CGSS has conducted several surveys, each survey has a different focus. Therefore, CGSS2021 data better reflects the current state of Chinese residents' pro-environmental behaviors and meets our empirical analysis requirements. Statisticians will obtain data by conducting face-to-face interviews with households and filling out questionnaires. Before this, statisticians go through rigorous questionnaire training. After sorting out the questionnaire data, the samples with missing values are eliminated, and the effective sample number is 1820.

3.2 Dependent variables

In this study, pro-environmental behavior is operationalized through three distinct categories based on behavioral attributes: environmental payment, garbage recycling behavior, and green purchase behavior. To measure green purchase behavior, two specific variables are employed: whether respondents avoid purchasing certain products for environmental reasons (BCP) and their willingness to accept lower living standards to protect the environment (LLS). Garbage recycling behavior is assessed through the frequency of garbage recycling behavior (GCF), which serves as a practical indicator of routine participation in waste separation and recycling activities. Similarly, environmental payment behavior is evaluated through three variables: willingness to pay more money and devote more time to environmental protection (PMMT), willingness to spend more money specifically for environmental causes (PMM), and acceptance of higher taxes for environmental protection (PMT).

The pro-environmental behaviors are scored on a five-point scale of respondents' answers: 1 = totally agree, 2 = comparatively agree, 3 = neutrality, 4 = less agree, and 5 = fully disagree.

3.3 Independent variables

In this section, we first select indicators to measure the key variable social interaction. The social interaction is characterized by the frequency of contact with neighbors and friends. Given that the frequency of social interactions may influence an individual's pro-environmental behavior, we use a multidimensional scale to measure social interactions. This paper uses the closeness of interactions with others, such as neighbors and friends, to capture social interactions. The measurement of social interaction draws on previous research (Ghahtarani et al., 2020). Social interaction is the core of the social factors studied in this paper. It is mainly measured from two aspects: (1) "How often do you engage in social entertainment with your neighbors (such as hanging out with each other, watching TV together, eating, playing cards, etc.) (SFN)," using seven-point scales (1 = almost every day, 2 = once or twice a week, 3 = several times a month, 4 = once per month, 5 = several times per year, 6 = once or less per year, 7 = never); (2) "How often do you engage in social entertainment with your other friends (such as hanging out with each other, watching TV together, eating, playing cards, etc.) (SFF)," using seven-point scales (1 = almost every day, 2 = once or twice a week, 3 = several times a month, 4 = once per month, 5 = several times per year, 6 = once or less per year, 7 = never).

3.4 Control variables

We selected life happiness, social fairness, government work satisfaction, and Internet usage as control variables, which are measured by: (1) "In general, do you feel that your life is happy (LH)", which is rated on five-point scales (1 = very unhappy, 2 = a little unhappy, 3 = not happy or unhappy, 4 = a little happy, 5 = totally happy); (2) "In general, do you think today's society is fair (SF)", which is rated on five-point scales (1 = totally unfair, 2 = a little unfair, 3 = not fair or unfair, 4 = a little fair, 5 = totally fair); (3) "How do you think the central government's environmental protection work has been done in the past five years? (EPCG)", "How do you think the environmental protection work of your local government has done in the past five years (EPRG)?", which are separated into five-point scales (1 = pay one-sided attention to economic development, neglect environmental protection work, 2 = attention is not enough, insufficient investment in environmental protection, 3 = efforts were made, but the results were not satisfactory, 4 = made a lot of effort, with some success, 5 = hard to explain); (4) In the past year, your internet usage was (IU), which are separated into five-point scales (1 = never, 2 = rarely, 3 = sometimes, 4 = frequent, 5 = very frequent). In addition, we also selected four socio-demographic attribute indicators: education level, gender, age, and political affiliation.

3.5 Statistical models

Ordinary linear regression is often suitable for continuous variables and cannot satisfy the study of discrete and ordered data. Since the variables applied in this paper are ordered variables, the ordered logit/probit model is used. Specifically, this paper assumes that pro-

environmental behavior is a dependent variable with a value of 1, 2, or 3 and that the independent variables include social interactions, life well-being, social fairness, government job satisfaction, and Internet use, as well as individual sociodemographic characteristics. The model used in this paper is established as follows:

$$PEB_i = \beta_0 + \beta_1 LF_i + \beta_2 SF_i + \beta_3 EPRG_i + \beta_4 EPCG_i + \beta_5 IU_i + \beta_6 SFN_i + \beta_7 SFF_i + \sum_{n=1} \alpha_n D_{ni} + \varepsilon_i \quad (1)$$

For the respondents, where PEB_i is the degree of pro-environmental behavior. D_{ni} indicates the individual socio-demographic characteristics variables, including income, education, political status, and gender. ϵ_i and μ_i denote error terms, β_i, λ_i, α_n, $and\, \gamma_n$ are the regression coefficients to be obtained. To ensure a better goodness of fit of the model, the value of the Log Pseudolikelihood statistic, Wald Chi-square statistic, and Pseudo R-squared are provided in the results. The model fits better if these values are larger.

4 Results

4.1 Descriptive statistical analysis

Table 1 reports the proportion of pro-environmental behavior, social interaction, life happiness, social fairness, government work satisfaction, and internet usage, respectively. As displayed in Tables 1 and 43.52% of samples declared that they are sometimes willing not to buy specific products for environmental protection. Yet, around 28.68% of respondents indicated that they are never willing not to buy products for environmental protection. Regarding the measurement of social interaction with the neighborhood and friends, more than 15.27% of respondents engage in social entertainment with their neighbors once or twice a week. More than 22% of respondents engage in social entertainment with other friends several times a month. Less than 24% of respondents feel their life are totally happy. Similarly, less than 7.5% of respondents feel society is fair. As high as 51.59% of respondents think the regional government made a lot of effort, with some success in environmental protection. In the meanwhile, more than 50.66% of respondents believe the central government made a lot of effort, with some success in environmental protection. More than 75% of respondents have used the internet.

Table 2 details the descriptive statistical characteristics of the main research variables. The means of BCP, LLS, PMMT, PMM, and PMT are close to 3, indicating that the public holds a moderately positive attitude towards pro-environmental behavior. What's similar is that people often or sometimes participate in garbage recycling. The public's subjective happiness is at a high level (mean value is 3.992), and the social fairness sense is low (mean value is 3.480). Both the central government and the local government are recognized by the public, but the effect of environmental governance could be more satisfactory; the mean values are 4.051 and 3.735, respectively. The public engages in social entertainment with their neighbors and friends close to once per month and sometimes discusses environmental issues with their relatives and friends. In the sample used in this paper, about 50.6% of the respondents are female, and only 14.56% are members of the Communist Party. The average education level of the sample respondents is high school, which indicates that all respondents have completed nine years of compulsory education. The median income level is about 25,000.

Table 1 Variable description

Variable name	Definition	Variable name	Definition
Not buying certain products for environmental protection (BCP)	1 = always (12.64%) 2 = often (15.16%) 3 = sometimes (43.52%) 4 = never (28.68%)	Gender	1 = Male (49.4%) 2 = female (50.6%)
Lower living standards to protect the environment (LLS)	1 = totally agree (5.71%) 2 = comparative agree (29.84%) 3 = neutrality (18.85%) 4 = less agree (36.04%) 5 = fully agree (9.56%)	Life happy or not (LH)	1 = very unhappy (0.77%) 2 = a little unhappy (4.18%) 3 = not happy or unhappy (13.63%) 4 = a little happy (57.97%) 5 = totally happy (23.46%)
Willing to pay more money and time for environmental protection (PMMT)	1 = totally disagree (2.36%) 2 = less agree (15.11%) 3 = neutrality (20.66%) 4 = comparative agree (49.12%) 5 = fully agree (12.75%)	Society fair or not (SF)	1 = totally unfair (3.96%) 2 = a little unfair (14.07%) 3 = not fair or unfair (19.51%) 4 = a little fair (54.95%) 5 = totally fair (7.53%)
Pay more money to protect the environment (PMM)	1 = totally agree (9.78%) 2 = comparative agree (42.64%) 3 = neutrality (21.48%) 4 = less agree (20.71%) 5 = fully agree (5.38%)	Politics status (PS)	1 = the masses (78.85%) 2 = communist youth league (6.43%) 3 = democratic parties (0.11%) 4 = communist (14.56%)
Pay more taxes to protect the environment (PMT)	1 = totally agree (7.42%) 2 = comparative agree (38.79%) 3 = neutrality (20.16%) 4 = less agree (25.71%) 5 = fully agree (7.91%)	Garbage classification behavior (GCF)	1 = always (21.92%) 2 = often (25.82%) 3 = sometimes (32.53%) 4 = never (19.73%)
Social frequency with neighbors (SFN)	1 = almost every day (13.52%) 2 = once or twice a week (15.27%) 3 = several times a month (15.05%) 4 = once per month (7.03%) 5 = several times per year (13.3%) 6 = once or less per year (11.1%) 7 = never (24.73%)	Social frequency with friends (SFF)	1 = almost every day (7.58%) 2 = once or twice a week (16.1%) 3 = several times a month (22.97%) 4 = once per month (7.91%) 5 = several times per year (18.24%) 6 = once or less per year (11.04%) 7 = never (16.1%)
Internet usage (IU)	1 = never (23.96) 2 = rarely (6.7%) 3 = sometimes (7.8%) 4 = frequent (20.11%) 5 = very frequent (41.43%)	Education	1 = Without any education (8.68%) 2 = old-style private schools and literacy class (0.55%) 3 = primary school (20.05%) 4 = junior high school (29.01%) 5 = vocational high school (1.76%) 6 = general high school (12.03%) 7 = technical secondary school (5.44%) 8 = technical school (0.49%) 9 = junior college (Adult Higher Education) (3.46%) 10 = junior college (Formal Higher Education) (5.27%) 11 = undergraduate (Adult Higher Education) (2.8%) 12 = undergraduate (Formal higher education) (9.29%) 13 = Postgraduate and above (1.15%)

Table 1 (continued)

Variable name	Definition	Variable name	Definition
The environmental protection works of the regional government (EPRG)	1 = pay one-sided attention to economic development, neglect environmental protection work (2.69%) 2 = attention is not enough, insufficient investment in environmental protection (10.16%) 3 = efforts were made, but the results were not satisfactory (16.82%) 4 = made a lot of effort, with some success (51.59%) 5 = achieve great achievement (18.74%)	The environmental protection works of the central government (EPCG)	1 = pay one-sided attention to economic development, neglect environmental protection work (1.98%) 2 = attention is not enough, insufficient investment in environmental protection (5.16%) 3 = efforts were made, but the results were not satisfactory (10.44%) 4 = made a lot of effort, with some success (50.66%) 5 = achieve great achievement (31.76%)
Income		Age	2013-birth year

Number in brackets meaning proportion of each choice

Table 2 Descriptive statistics of main study variables ($N = 1820$)

Variables	Mean	Standard Deviation	Minimum	Maximum
BCP	2.882	0.965	1.000	4.000
LLS	3.139	1.119	1.000	5.000
GCF	2.501	1.041	1.000	4.000
PMM	2.693	1.071	1.000	5.000
PMT	2.879	1.115	1.000	5.000
PMMT	3.548	0.973	1.000	5.000
SFN	4.235	2.174	1.000	7.000
SFF	4.107	1.903	1.000	7.000
IU	3.484	1.628	1.000	5.000
SF	3.480	0.959	1.000	5.000
LH	3.992	0.779	1.000	5.000
EPRG	3.735	0.967	1.000	5.000
EPCG	4.051	0.897	1.000	5.000
Education	5.502	3.292	1.000	13.000
Gender	1.506	0.500	1.000	2.000
Politics status	1.505	1.063	1.000	4.000
Income	54997.954	3.37e+05	0.000	9.99e+06

4.2 Regression results of social performance and social networks on pro-environmental behavior

The main regression results are presented in Table 3. Columns (1)-(6) report the results of the six kinds of pro-environmental behavior, respectively. Comparing the results of green consumption behavior in columns (1) and (2) of Table 3 with garbage recycling behavior and environmental protection payment behavior, social interaction with neighborhoods can promote green consumption behavior, but the effect is insignificant. Similarly, social interaction with neighborhoods can promote garbage recycling behavior, and the result is insignificant. There-

Table 3 Ordered logistic regression estimates of pro-environmental behavior (total sample)

Variables	(1)	(2)	(3)	(4)	(4)	(6)
	BCP	LLS	GCF	PMM	PMT	PMMT
SFN	−0.0225	−0.00804	0.0199	0.00543	0.00535	0.0290
	(−0.90)	(−0.33)	(0.84)	(0.22)	(0.22)	(1.21)
SFF	0.0198	0.0286	−0.0346	0.00771	−0.00798	0.0486
	(0.65)	(0.99)	(−1.22)	(0.26)	(−0.27)	(1.70)
IU	−0.106**	0.0329	−0.0554	−0.00996	0.000134	−0.00210
	(−3.08)	(0.97)	(−1.64)	(−0.28)	(0.00)	(−0.06)
SF	0.0147	−0.156**	0.0848	−0.132*	−0.151**	0.00340
	(0.26)	(−2.84)	(1.57)	(−2.27)	(−2.68)	(0.06)
LH	−0.0754	−0.124	−0.0526	−0.247***	−0.257***	−0.273***
	(−1.12)	(−1.90)	(−0.83)	(−3.57)	(−3.85)	(4.09)
EPRG	−0.135*	−0.0264	−0.108	−0.124*	−0.105	0.0750
	(−2.28)	(−0.46)	(−1.81)	(−2.26)	(−1.91)	(1.25)
EPCG	0.0528	−0.187**	−0.0744	−0.0995	−0.131*	0.234***
	(0.85)	(−3.14)	(−1.22)	(−1.71)	(−2.30)	(3.76)
Education	−0.0442**	0.0257	−0.00311	0.0165	0.00586	−0.0133
	(−2.98)	(1.65)	(−0.21)	(1.11)	(0.39)	(−0.86)
Gender	−0.119	−0.0388	0.00447	0.0700	0.165	−0.0260
	(−1.34)	(−0.44)	(0.05)	(0.79)	(1.87)	(−0.29)
Politics status	−0.0549	−0.0888*	−0.0846*	−0.202***	−0.114**	0.113**
	(−1.29)	(−2.16)	(−2.07)	(−5.19)	(−2.70)	(2.76)
Income	−6.45e-08*	1.33 e-07***	2.08e-09	2.31e-08	6.32e-09	−1.56e-07*
	(−2.15)	(5.58)	(0.04)	(0.21)	(0.06)	(−2.09)
Log pseudolikelihood	−2276.3971	−2574.5062	−2476.8231	−2508.6828	−2563.0139	−2345.3154
Wald chi2	65.66	82.16	24.06	94.11	83.32	77.73
Prob > chi2	0.0000	0.0000	0.0125	0.0000	0.0000	0.0000
Pseudo R-squared	0.0134	0.0116	0.0051	0.0187	0.0174	0.0175
Observations	1820	1820	1820	1820	1820	1820

t statistics in parentheses; $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

fore, H1a and H1b are not supported. The lack of significant effects of neighborhood interactions on environmental behaviors might be attributed to several underlying reasons. First, the quality and depth of these social interactions may not be sufficient to influence significant behavior change. If interactions are superficial or infrequent, they might not provide the necessary encouragement or information to foster green behaviors. Another reason could be the level of environmental awareness and knowledge among the community members. If individuals are not well-informed about the benefits and practices of green consumption and proper garbage recycling, even positive social interactions may not translate into behavior change. Economic factors can also be significant. Individuals may face financial constraints that prevent them from engaging in green behaviors, regardless of social influence. For example, green products might be more expensive, or there might be a lack of access to proper recycling facilities. The timeframe of the study might not be adequate to capture long-term behavior changes, as social interactions might have cumulative effects that become significant over extended periods, which short-term studies might fail to capture.

It is noteworthy that social fairness and life happiness are crucial factors influencing residents' pro-environmental behavior. Results show that residents will be more willing to adopt

pro-environmental behavior in a fairer society, especially in green consumption behavior and environmental protection payment behavior. In addition, life happiness will incentivize residents to take pro-environmental behavior, particularly environmental protection payment behavior. Social equity fosters trust and cooperation among community members. When people believe that resources and opportunities are distributed fairly, they are more inclined to work together towards common goals, including environmental protection. Additionally, a fair society often cultivates a culture of inclusiveness and empowerment, where individuals feel that their contributions matter. This sense of empowerment can drive higher engagement in environmental activities, as people believe their actions will lead to meaningful change. When residents are happier, they are more likely to participate in environmental activities for several key reasons. First, happiness is often associated with a greater sense of well-being and life satisfaction. Happier individuals are more likely to feel a sense of contentment and stability in their lives, which frees up mental and emotional resources to engage in activities that extend beyond their immediate needs and concerns, such as environmental protection. Happier people also tend to have a more positive outlook on life, which includes a greater sense of personal efficacy and optimism about their ability to make a difference. This positive mindset can lead to increased motivation to participate in activities that contribute to the common good, including environmental initiatives. They are more likely to believe that their actions can have a positive impact on the environment, which encourages proactive behavior.

Internet usage has a negative coefficient in green consumption behavior in column (1), which indicates environmental protection on the internet has encouraged the green consumption behavior of residents. The reason for this regression result can be explained as the more environmental knowledge the public has, the more they understand the importance of environmental protection and are more inclined to adopt positive environmental protection actions. Apart from this, people who pay more attention to environmental information tend to magnify environmental risks. Regarding government work satisfaction, the more satisfied with government work, the more likely residents are to adopt pro-environmental behaviors. Satisfied residents typically perceive their government as competent and capable of addressing environmental issues. When the government is seen as effective, individuals are more likely to feel that their participation in environmental activities will be supported and amplified by appropriate policies and resources. They are confident that their efforts will be part of a broader, successful strategy to protect the environment, which can be highly motivating. Finally, sociodemographic factors drive residents' pro-environmental behaviors, including higher education levels, political status, and income.

4.3 Heterogeneity regression results for socio-demographic factors

Given that studies have firmly demonstrated that individual factors significantly influence the heterogeneity of residents' pro-environmental behaviors. This paper will focus on individual heterogeneity differences in this section. Specifically, the entire sample is divided into two subsamples according to education level, income level, and party affiliation, respectively, to examine whether the relationships between social factors, including social interaction, well-being in life, social fairness, government job satisfaction, and Internet usage pairs, and pro-environmental behaviors are disturbed by individual heterogeneity. Tables 4, 5 and 6 report the potential heterogeneity of the main findings.

Table 4 Ordered logistic regression estimates by education level subgroup

Variables	Lower education level						Higher education level					
	(1)	(2)	(3)	(4)	(4)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
	BCP	LLS	GCF	PMM	PMT	PMMT	BCP	LLS	GCF	PMM	PMT	PMMT
SFN	−0.0637	−0.0450	−0.00144	−0.00408	−0.0103	0.0814**	0.0461	0.0537	0.0639	0.0229	0.0360	−0.0617
	(−1.91)	(−1.41)	(−0.05)	(−0.13)	(−0.32)	(2.60)	(1.18)	(1.33)	(1.60)	(0.57)	(0.89)	(−1.65)
SFF	0.0270	0.0354	−0.0125	0.0178	0.0104	0.0000271	0.0302	0.0546	−0.0748	−0.00543	−0.0333	0.119*
	(0.73)	(1.00)	(−0.36)	(0.50)	(0.29)	(0.00)	(0.55)	(1.06)	(−1.46)	(−0.10)	(−0.62)	(2.42)
IU	−0.116**	0.0299	−0.0233	−0.00199	0.0169	−0.0144	0.0743	0.0606	−0.0956	−0.0516	−0.125	−0.0756
	(−3.09)	(0.78)	(−0.63)	(−0.05)	(0.43)	(−0.38)	(0.87)	(0.75)	(−1.20)	(−0.58)	(−1.52)	(−0.93)
SF	0.0194	−0.0852	0.119	−0.0496	−0.0604	−0.0180	0.0282	−0.308***	−0.00608	−0.338***	−0.376***	0.0335
	(0.30)	(−1.30)	(1.89)	(−0.71)	(−0.90)	(−0.27)	(0.27)	(−3.32)	(−0.06)	(−3.44)	(−3.93)	(0.37)
LH	−0.0746	−0.131	−0.0689	−0.239**	−0.242**	0.225**	−0.0976	−0.124	−0.0195	−0.248*	−0.270*	0.417***
	(−0.90)	(−1.67)	(−0.90)	(−2.95)	(−3.14)	(2.80)	(−0.87)	(−1.07)	(−0.17)	(−1.97)	(−2.19)	(3.76)
EPRG	−0.126	−0.0305	−0.0816	−0.128	−0.0701	0.0139	−0.166	−0.0352	−0.158	−0.116	−0.175*	0.191*
	(−1.65)	(−0.41)	(−1.07)	(−1.76)	(−0.97)	(0.17)	(−1.77)	(−0.41)	(−1.59)	(−1.42)	(−2.12)	(2.19)
EPCG	0.0293	−0.240**	−0.0707	−0.160*	−0.214**	0.310***	0.111	−0.0644	−0.0800	0.0549	0.0528	0.0746
	(0.39)	(−3.21)	(−0.97)	(−2.20)	(−2.94)	(3.71)	(1.00)	(−0.65)	(−0.73)	(0.57)	(0.57)	(0.80)
Education	−0.107	−0.0142	−0.0710	0.0254	0.0597	0.0738	0.0178**	0.0136	0.0507	0.0376	0.00116**	−0.0547
	(−1.79)	(−0.24)	(−1.17)	(0.44)	(1.04)	(1.30)	(0.59)	(0.47)	(1.69)	(1.25)	(0.04)	(−1.71)
Gender	−0.123	−0.0279	0.0385	0.0995	0.209	0.109	−0.274	−0.144	−0.158	−0.0389	0.0969	−0.0326
	(−1.05)	(−0.24)	(0.33)	(0.85)	(1.77)	(0.92)	(−1.93)	(−1.01)	(−1.14)	(−0.27)	(0.67)	(−0.23)
Politics status	−0.0330	−0.151*	−0.0494	−0.263***	−0.151*	0.273***	−0.0702	−0.0382	−0.123*	−0.169**	−0.0936	−0.0165
	(−0.49)	(−2.31)	(−0.75)	(−4.64)	(−2.47)	(4.61)	(−1.18)	(−0.67)	(−2.23)	(−2.82)	(−1.53)	(−0.28)
Income	−4.47e-08*	1.38e-07***	4.21e-08	3.79e-08	3.06e-08	−1.83e-07**	−9.82e-07	−1.12e-08	−1.84 e-06*	−5.18e-07	−8.42e-07	1.32e-06**
	(−2.26)	(6.85)	(1.65)	(0.42)	(0.33)	(−2.67)	(−1.54)	(−0.01)	(−2.07)	(−0.70)	(−1.02)	(2.62)
Log pseudolike-lihood	−1358.8088	−1586.2692	−1501.736	−1563.4159	−1576.5885	−1451.4474	−891.29692	−964.78988	−956.61006	−913.76584	−962.82274	−864.2528
Wald chi2	37.35	104.60	13.82	69.06	60.82	86.18	14.22	30.60	23.51	40.90	45.90	43.68
Prob > chi2	0.0001	0.0000	0.2431	0.0000	0.0000	0.0000	0.2210	0.0013	0.0150	0.0000	0.0000	0.0000
Pseudo R-squared	0.0115	0.0135	0.0043	0.0201	0.0186	0.0253	0.0080	0.0155	0.0135	0.0233	0.0257	0.0255
Observations	1093	1093	1093	1093	1093	1093	727	727	727	727	727	727

t statistics in parentheses; $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

Table 5 Ordered logistic regression estimates by income subgroup

Variables	Lower income level						Higher-income level					
	(1)	(2)	(3)	(4)	(4)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
	BCP	LLS	GCF	PMM	PMT	PMMT	BCP	LLS	GCF	PMM	PMT	PMMT
SFN	−0.0106	−0.0156	0.0248	0.00860	−0.0326	0.0334	−0.0265	−0.00249	0.0278	0.00846	0.0477	0.0222
	(−0.30)	(−0.46)	(0.74)	(0.25)	(−0.96)	(1.01)	(−0.76)	(−0.07)	(0.84)	(0.24)	(1.32)	(0.62)
SFF	0.00761	−0.00596	−0.0166	−0.0221	−0.00913	0.0484	0.0169	0.0737	−0.0735	0.0371	−0.00813	0.0461
	(0.19)	(−0.15)	(−0.43)	(−0.55)	(−0.23)	(1.24)	(0.37)	(1.70)	(−1.80)	(0.85)	(−0.18)	(1.07)
IU	−0.0689	0.0318	−0.0197	−0.0278	0.0240	0.0190	−0.107	0.0178	−0.0287	0.00607	−0.0467	−0.0218
	(−1.49)	(0.67)	(−0.43)	(−0.58)	(0.51)	(0.42)	(−1.87)	(0.33)	(−0.55)	(0.11)	(−0.79)	(−0.39)
SF	0.0354	−0.113	0.100	−0.103	−0.119	0.0139	−0.0193	−0.205**	0.0696	−0.163*	−0.185*	−0.0256
	(0.46)	(−1.47)	(1.39)	(−1.28)	(−1.57)	(0.19)	(−0.24)	(−2.59)	(0.86)	(−1.99)	(−2.19)	(−0.33)
LH	−0.00301	−0.115	0.0556	−0.226*	−0.221**	0.140	−0.145	−0.144	−0.158	−0.276**	−0.300**	0.433***
	(−0.03)	(−1.35)	(0.65)	(−2.46)	(−2.58)	(1.51)	(−1.48)	(−1.40)	(−1.62)	(−2.66)	(−2.93)	(4.52)
EPRG	−0.115	0.0454	−0.158	−0.0954	−0.0824	−0.0401	−0.172	−0.104	−0.0739	−0.170*	−0.139	0.184*
	(−1.50)	(0.59)	(−1.92)	(−1.24)	(−1.11)	(−0.47)	(−1.88)	(−1.23)	(−0.86)	(−2.20)	(−1.72)	(2.18)
EPCG	0.0342	−0.222*	0.0308	−0.0830	−0.138	0.407***	0.0601	−0.135	−0.193*	−0.0936	−0.102	0.0936
	(0.39)	(−2.48)	(0.35)	(−0.93)	(−1.62)	(4.25)	(0.66)	(−1.65)	(−2.27)	(−1.19)	(−1.26)	(1.16)
Education	−0.0743**	0.0118	−0.0117	0.00855	−0.00645	−0.0299	−0.0155	0.0255	0.0226	0.0167	0.00475	−0.00699
	(−2.92)	(0.46)	(−0.46)	(0.37)	(−0.27)	(−1.17)	(−0.81)	(1.22)	(1.14)	(0.80)	(0.24)	(−0.34)
Gender	−0.0456	0.0116	0.117	0.244	0.260	−0.116	−0.275*	−0.0711	−0.198	−0.108	0.0736	0.0733
	(−0.34)	(0.09)	(0.89)	(1.77)	(1.92)	(−0.86)	(−2.23)	(−0.58)	(−1.62)	(−0.88)	(0.60)	(0.59)
Politics status	−0.130	−0.151*	−0.0777	−0.274***	−0.172*	0.193**	−0.00780	−0.0634	−0.0637	−0.166**	−0.0780	0.0636
	(−1.65)	(−2.14)	(−1.01)	(−4.53)	(−2.54)	(2.86)	(−0.15)	(−1.20)	(−1.27)	(−3.13)	(−1.43)	(1.20)
Income	1.63 e-06	−8.90 e-06	−6.24 e-06	−1.65 e-05*	−1.27 e-05	1.14 e-05	−5.10e-08	1.09 e-07***	5.91e-08	1.05e-09	−3.52e-08	−1.53 e-07
	(0.22)	(−1.13)	(−0.83)	(−2.13)	(−1.62)	(1.46)	(−1.51)	(3.41)	(1.63)	(0.01)	(−0.32)	(−1.77)
Log pseudo-likelihood	−1096.0075	−1289.168	−1211.591	−1260.8641	−1269.1923	−1165.1356	−1170.9196	−1273.3643	−1243.4205	−1225.26	−1282.3116	−1167.1139
Wald chi2	39.93	26.11	9.98	61.27	52.05	56.82	23.35	44.62	29.64	53.28	47.88	45.53

Table 5 (continued)

Variables	Lower income level						Higher-income level					
	(1)	(2)	(3)	(4)	(4)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Prob > chi2	0.0000	0.0062	0.0000	0.0000	0.0000	0.0000	0.0158	0.0000	0.0018	0.0000	0.0000	0.0000
Pseudo R-squared	0.0151	0.0103	0.0046	0.0206	0.0194	0.0220	0.0102	0.0150	0.0112	0.0233	0.0207	0.0210
Observations	887	887	887	887	887	887	933	933	933	933	933	933

t statistics in parentheses; $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

Table 6 Ordered logistic regression estimates by party groupings subgroup

Variables	Partisan group						Nonpartisan group					
	(1)	(2)	(3)	(4)	(4)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
	BCP	LLS	GCF	PMM	PMT	PMMT	BCP	LLS	GCF	PMM	PMT	PMMT
SFN	−0.0536	−0.0663	−0.0103	−0.0747	−0.00534	−0.0226	−0.0188	0.00111	0.0170	0.0154	0.00658	0.0349
	(−0.75)	(−0.93)	(−0.16)	(−1.09)	(−0.08)	(−0.31)	(−0.70)	(0.04)	(0.66)	(0.58)	(0.24)	(1.37)
SFF	0.119	0.149	−0.0136	0.141	0.0233	0.213**	0.00647	0.0139	−0.0248	−0.00621	−0.0108	0.0284
	(1.43)	(1.87)	(−0.17)	(1.81)	(0.30)	(2.87)	(0.20)	(0.45)	(−0.80)	(−0.19)	(−0.34)	(0.91)
IU	−0.124	−0.0949	−0.341**	−0.141	−0.0488	0.0392	−0.104**	0.0523	−0.0145	0.00771	0.0116	−0.0146
	(−1.26)	(−1.05)	(−3.25)	(−1.34)	(−0.50)	(0.41)	(−2.83)	(1.41)	(−0.40)	(0.20)	(0.31)	(−0.40)
SF	−0.113	−0.167	−0.0238	−0.126	−0.316	−0.126	0.0250	−0.153**	0.106	−0.138*	−0.137*	0.0170
	(−0.70)	(−1.08)	(−0.15)	(−0.74)	(−1.79)	(−0.69)	(0.42)	(−2.61)	(1.83)	(−2.22)	(−2.30)	(0.30)
LH	−0.0267	−0.0502	0.0283	−0.226	−0.199	0.271	−0.0806	−0.142*	−0.0681	−0.255***	−0.264***	0.268***
	(−0.15)	(−0.30)	(0.15)	(−1.31)	(−1.07)	(1.57)	(−1.11)	(−1.98)	(−1.01)	(−3.36)	(−3.67)	(3.66)
EPRG	−0.142	−0.144	−0.216	−0.447**	−0.381**	0.290*	−0.137*	−0.00385	−0.0886	−0.0760	−0.0569	0.0435
	(−0.90)	(−0.92)	(−1.60)	(−3.08)	(−3.06)	(2.08)	(−2.13)	(−0.06)	(−1.32)	(−1.29)	(−0.95)	(0.66)
EPCG	−0.127	0.0297	−0.267	−0.00161	0.0968	0.330	0.0796	−0.218***	−0.0514	−0.111	−0.163**	0.215**
	(−0.58)	(0.18)	(−1.65)	(−0.01)	(0.58)	(1.94)	(1.23)	(−3.37)	(−0.78)	(−1.78)	(−2.63)	(3.17)
Education	−0.00430	0.120**	0.0456	0.156***	0.0743	−0.127**	−0.0513**	0.00474	−0.0184	−0.00706	−0.00393	0.0116
	(−0.10)	(2.85)	(1.00)	(3.38)	(1.72)	(−2.69)	(−3.10)	(0.27)	(−1.10)	(−0.44)	(−0.24)	(0.67)
Gender	−0.331	0.156	0.211	0.0769	−0.200	0.0156	−0.103	−0.0805	−0.0250	0.0480	0.199*	0.00732
	(−1.32)	(0.65)	(0.79)	(0.28)	(−0.72)	(0.06)	(−1.08)	(−0.85)	(−0.27)	(0.51)	(2.11)	(0.08)
Politics status	1.641	−2.728	14.05***	0.823	−0.588	1.100***	−0.0753	0.0372	0.253	−0.0740	−0.123	0.0214
	(1.10)	(−1.67)	(16.66)	(1.57)	(−1.11)	(4.05)	(−0.49)	(0.23)	(1.70)	(−0.50)	(−0.80)	(0.14)
Income	6.72 e-07	1.36 e-07	−1.16 e-06	−6.63 e-07	−1.38 e-07	1.28 e-07	−7.04e-08*	1.33e-07***	2.12e-08	2.79e-08	6.79e-09	−1.55 e-07*
	(0.50)	(0.08)	(−1.03)	(−0.31)	(−0.06)	(0.10)	(−2.24)	(6.03)	(0.58)	(0.25)	(0.06)	(−2.10)
Log pseudolike-lihood	−337.01001	−350.62468	−345.14817	−308.85493	−351.9561	−296.89182	−1935.4366	−2212.0874	−2116.4584	−2185.78	−2204.4155	−2031.8731
Wald chi2	11.12	22.61	318.57	35.17	29.54	59.02	54.32	77.91	13.79	44.19	56.49	49.28
Prob > chi2	0.0029	0.0201	0.0000	0.0002	0.0019	0.0000	0.0000	0.0000	0.2450	0.0000	0.0000	0.0000
Pseudo R-squared	0.0193	0.0277	0.0448	0.0497	0.0318	0.0758	0.0128	0.0115	0.0032	0.0117	0.0143	0.0129
Observations	268	268	268	268	268	268	1552	1552	1552	1552	1552	1552

t statistics in parentheses; $^{*}p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$

4.3.1 Education

Several studies have found the influence of pro-environmental behavior on differences in education levels (Gholamrezai et al., 2021). Environmental education will make the population aware of the need for environmental protection and thus more likely to adopt pro-environmental behaviors. According to the approximation of the median level of the sample's educational attainment, this paper divides the whole sample into two subgroups: the group with higher educational attainment (higher than ordinary high school) and the group with lower educational attainment (greater than or equal to ordinary high school). Table 4 displays the results for multi-group effects between higher education levels and lower education levels. As can be seen from the regression results, the coefficient on the social frequency with friends, internet usage, and satisfaction with the central government's environmental protection work is significant for lower education levels. Still, it has no significant effects on higher education levels. In contrast, the coefficient on the social frequency with friends, social fairness, and satisfaction with the regional government's environmental protection work are significant for the higher education level but have no significant effects on the lower education level. Residents with higher education levels care more about social fairness, and a more equitable society encourages them to adopt pro-environmental behaviors.

4.3.2 Income

This paper further examines income level heterogeneity by dividing the entire sample into two subgroups based on an approximation of the median income level: a lower income group (below 25,000 RMB) and a higher income group (>=25,000 RMB). As is shown in Table 5, the pro-environmental behaviors of the higher-income group are more easily affected by social fairness and satisfaction with the regional government's environmental protection work. In other aspects, the coefficients of gender are only significant in the lower-income group. It suggests that the environmental protection behavior of high-income groups will be affected by social externalities. When the external social environment sends positive signals, they are more willing to adopt pro-environmental behaviors. High-income groups are more likely to participate in environmental activities due to several factors: greater financial resources, higher education levels, better access to information, stronger social norms, greater ability to effect change, and longer-term perspectives on sustainability. These factors collectively enhance their capacity, motivation, and opportunities to engage in environmental protection.

4.3.3 Politics status

Table 6 divides the total sample into partisan and nonpartisan groups. The partial group includes party members and democratic party members. The nonpartisan group has communist youth league members and the masses. Firstly, for the partisan members, internet usage and social frequency with friends influence their pro-environmental behavior significantly. For nonpartisans, the coefficients of social fairness, life happiness, satisfaction with the central government's environmental protection work, and income are significant. For the group of party members, their sense of social responsibility may be stronger and less susceptible to the influence of social external factors. On the contrary, the public makes decisions not

only because of the situation itself but also because of the psychological state of injustice or happiness encountered in society.

4.4 Discussions

Subjective happiness is an objective reflection of an individual's living conditions, value orientation, and various needs (Wang et al., 2021). Existing studies have shown that pleasant emotions directly affect residents' pro-environmental behavior (Zelenski & Desrochers, 2021). Further, some surveys also found a positive correlation between environmental protection behavior and subjective well-being (Visser et al., 2021). Wang & Cheng (2017) and Zhang & Tu (2021) conducted an empirical test to confirm the relationship between happiness and pro-environmental behavior. Already a body of literature discussed the relationship between happiness and environment based on the theoretical foundations that access to high-quality natural or built environments may enhance happiness through biophilia. As health is an important pathway linking happiness and the environment, residents' pro-environmental behavior can be affected by their happiness (Zhang & Tu, 2021). In summary, people with a high sense of well-being tend to hold inner-oriented values and are more inclined to adopt behaviors that are beneficial to the environment (Binder & Blankenberg, 2017). People with higher levels of happiness have more positive emotions and psychological resources, and are more likely to have altruistic motivations and a sense of social responsibility, which in turn promotes them to adopt environmentally friendly behaviors.

When the public perceives the social system as fair, they develop positive feelings about society (Andrade et al., 2022). People who believe in social fairness tend to have strong moral values and view environmental protection as a social responsibility (Yan & Jia, 2021). They may believe that everyone is entitled to a clean, healthy, and beautiful environment, so they are willing to engage in pro-environmental behaviors that promote a fair and equitable distribution of the environment (Shin et al., 2022). Andrade et al. (2022) emphasized the vital role of social equity in driving residents' pro-environmental behaviors. Yan and Jia (2021) discussed the mediating role of social fairness on tourists' pro-environmental behavior. Based on previous studies, residents with higher recognition of social fairness pay more attention to collective interests, are concerned about the impact of environmental issues on the whole society, and are willing to take positive environmental protection behaviors for social well-being.

In the digital age, internet use will have a direct impact on human behavior (Beaunoyer et al., 2021). The internet is the primary channel for people to obtain information on climate change and environmental pollution. Liu et al. (2021) explored how internet use shapes pro-environmental behaviors and argued that it has a negative impact on residents' pro-environmental behavior through environmental knowledge learning and environmental pollution threat perception. Other scholars believe that the Internet provides a publicity platform for environmental agencies and an online platform for them to discuss environmental issues and generate mobilization (Diederich & Goeschl, 2017). Zhang et al. (2022) argued that internet media reports stimulate the public's enthusiasm for environmental protection and promote their pro-environmental behavior. Gong et al. (2020) confirmed that internet use encourages pro-environmental behavior and is more significant for female, educated, and urban residents.

Regardless of whether it is the local or central government when the public's evaluation of the government's environmental protection performance is low, the public's willing-

ness to protect the environment decreases. If residents are satisfied with the government's environmental governance efforts, this may inspire residents' confidence in environmental behavior. They believe that personal environmental protection efforts can have a positive impact on the environment with government support, so they are more willing to participate in environmental protection behaviors (Mohanty et al., 2021). Wu et al. (2021) pointed out that mistrust of the local government, lack of responsiveness of local government, and misbehavior of local government may be detrimental to residents' household energy-saving behavior. Yang et al. (2023a, b) empirically explored the relationship between satisfaction with local governmental air quality control and pro-environmental behavior. They found that residents with more negative sentiments or less satisfaction with the local government's air quality management will reduce the likelihood of adopting pro-environmental behavior. Therefore, the following assumptions can be made.

5 Conclusions and policy implications

Along with the improvement of citizens' environmental awareness in China, it is urgent to promote the pro-environmental behavior of the residents. This study is one of the few studies to discuss the influencing factors of pro-environmental behavior from the perspective of social interaction. It contributes to filling the relevant literature gap. Specifically, the present study assesses the impacts of social interaction on residents' green purchase behavior, garbage recycling behavior, and environmental protection payment behavior with the data from CGSS2021. The conclusions can be summarized as:

(1) Social interaction with neighbors can encourage the low-education group to invest more money and time in environmental protection. Social interaction with friends makes residents in high-education level group more willing to pay money and time for environmental protection. Frequent internet usage, life happiness, social fairness, and higher satisfaction with government environmental protection performance, and higher satisfaction with the environmental protection performance of the regional government can significantly motivate the residents to adopt pro-environmental behaviors.
(2) Moreover, the result indicates that internet usage, and satisfaction with the central government's environmental protection work have significant impacts on the lower education level population. In comparison, the higher education level residents' pro-environmental behavior is more likely affected by the social frequency with friends, social fairness, and satisfaction with the regional government's environmental protection work.
(3) Regarding the results of the subgroup analysis of income, the coefficients of social fairness, satisfaction with the regional government's environmental protection work are significant in high-income subgroup. At the same time, the coefficient of gender is only significant for the low-income group.
(4) As for the nonpartisan member, their pro-environmental behavior is more easily influenced by social fairness, life happiness, satisfaction with the central government's environmental protection work, and income. For partisan members, their environmental petition behavior is more easily affected by internet usage and social frequency with friends. The policy implications can be obtained from the above conclusions:

(1) Governments and relevant organizations should enhance the dissemination of environmental information and educational content online. Utilizing social media, official websites, and online communities can help improve public environmental awareness and knowledge.
(2) Both central and regional governments should increase transparency in environmental protection efforts and involve the public in the process. Regular updates on environmental progress and achievements can build public trust and satisfaction in government efforts.
(3) For lower education and lower income groups, emphasis should be on spreading environmental knowledge through the internet and improving satisfaction with central government environmental efforts. For higher education and higher income groups, the focus should be on social fairness and satisfaction with regional government environmental efforts.

However, the study has limitations. The data from CGSS2021, despite being representative, might contain sample bias and data limitations, potentially not fully capturing the entire Chinese population's behavior. Future research should aim to address these limitations by employing more diverse and comprehensive datasets that capture a broader spectrum of the population's behaviors and attitudes toward the environment. Additionally, incorporating qualitative methods such as interviews or focus groups could provide deeper insights into the motivations and barriers influencing individuals' environmental behaviors.

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Data availability The datasets generated during and analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethical approval This work does not require any ethical approval.

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Competing interests The authors declare no competing interests.

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