

EXPLORING THE IMPACT OF DIGITAL MEDIA USE ON PRO-ENVIRONMENTAL BEHAVIOR: EVIDENCE FROM CHINA

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Abstract. Individuals' behavior is a key focus for efforts to mitigate climate change. A thorough understanding of human behavior is crucial for effective environmental conservation. Evidence suggests that media coverage has a significant predictive value for pro-environmental behavior. This study examined the link between digital media use and pro-environmental behavior, highlighting the mediating roles of environmental knowledge and environmental concern. Based on publicly available data from the China General Social Survey 2021, a positive relationship exists between digital media use and pro-environmental behavior. Both environmental knowledge and environmental concern serve as mediators, with digital media use particularly promoting pro-environmental behavior among individuals with lower educational levels, high income, and those from rural areas. The findings exhibited that digital media use may increase individuals' behavioral engagement in environmentally responsible actions within an increasingly digitalized world. Such findings benefit digital media practitioners, policymakers, and environmental organizations, all of which can enhance environmental awareness and actions in society.

Keywords: *ecological civilization, environmental knowledge, environmental concern, climate change, carbon emissions*

Introduction

Climate change is one of the many challenges the world faces nowadays (Wang et al., 2021). Greenhouse gas emissions endanger the global ecosystem and sustainable development by causing rising global temperatures, droughts, sea level rise, heatwaves, floods, and other extreme events (Mora et al., 2022). It is essential to limit the increase of global average temperature by limiting greenhouse gas emissions to no more than 1.5 to 2.0 degrees Celsius (IPCC, 2018). In response to anthropogenic climate change, humans and communities have developed various strategies to mitigate their environmental impacts. Researchers have adopted numerous approaches, including economic measures, achieving carbon neutrality, investing in new technologies, and educating individuals to change their consumption habits and daily behavior (Carrico, 2022). Consequently, reducing carbon emissions is a critical part of current efforts to combat climate change. As part of global initiatives, China has also made positive commitments by 2020 and announced to peak its carbon emissions by 2030 and achieve carbon neutrality by 2060 (McGrath, 2020). Additionally, it has actively taken measures to improve air quality as part of establishing ecological civilization, thereby advancing the goals of the “Blue Sky Protection Campaign”.

Climate change is closely associated with human activities, and individual actions play a significant role in overall emissions. Meanwhile, these actions can also support fighting against climate change (Clayton et al., 2015; Gardner and Stern, 2008). Personal pro-environmental efforts can greatly cut carbon footprints and lower CO₂ emissions when

combined with broader policies (Scannell and Gifford, 2013). Pro-environmental behavior refers to “actions contributing to environmental conservation, or human activity intended to protect natural resources, or at least reduce environmental deterioration” (Juárez-Nájera et al., 2010). It has become a crucial support in addressing environmental challenges. Individuals can lessen environmental impacts through pro-environmental actions by improving energy efficiency, reducing waste generation, and choosing low-carbon transportation methods (Liu et al., 2021a).

In China, the climate crisis has generated widespread public concern on digital media. Defined by Boulianne and Theocharis (2020), digital media encompasses digital platforms such as websites, social media, mobile applications, short-video platforms, and video games—more broadly, it refers to technologies that connect to the Internet. It is distinguished by its interactive, immediate, and decentralized information flow. This transformation has reshaped the relationship between traditional media and users, providing online spaces for public discourse on environmental issues among individuals, groups, and organizations. It has become the primary channel for disseminating environmental information (Riaz et al., 2018). And its profound influence has undeniably expanded research possibilities in specific research areas (Yang and Yu, 2019). Research indicates nuanced connections between digital media use and environmental action. Liu et al. (2021b) found that Internet use exerts a positive, albeit limited, influence on pro-environmental behavior. Other studies have explored this relationship from varied angles: Gong et al. (2020) demonstrated that online learning during leisure time substantially boosts pro-environmental engagement, while Shi et al. (2023) highlighted the positive correlation between Internet use and perceived environmental benefits/values—key motivators for conservation behavior. Lee (2015) argued that Internet use fosters citizen self-mobilization (CSM) and social movement organizations (SMO), driving participation in environmental activities. Further research examines how social media specifically facilitates environmental protection (Fernandez et al., 2017; Liao, 2024).

Despite the transformative impact of artificial intelligence, big data, cloud computing, and digital media on daily life and behavior, the specific link between digital media use and pro-environmental behavior remains under-studied. To address this gap, this article aims to: (1) systematically investigate the impact of digital media use on individual pro-environmental behavior; and (2) elucidate the mediating roles of environmental knowledge and environmental concern in this process. Utilizing the latest CGSS 2021 dataset, this paper extends beyond empirical analysis to offer comprehensive insight for both research and practice in related fields.

Consequently, the paper is structured as follows: the first section presents the introduction; the next section reviews relevant literature and develops hypotheses; the “Methodology” section details data sources, model specification, and variable definitions; the “Empirical results” section reports the findings; the subsequent section provides a discussion; and the last section outlines implications and conclusions.

Literature review and research hypotheses

Digital media use and individuals’ pro-environmental behavior (PEB)

Agenda-setting theory, a fundamental concept in communication introduced by McCombs and Shaw (1972), elucidates how the media shape the public’s awareness and perceptions regarding the salience of specific issues. McCombs et al. (1997) subsequently expanded this theory to incorporate first-level agenda-setting and second-level agenda-

setting (influencing how the public thinks about those issues, shaping their attitudes and behavior). This theory has a well-established application within environmental protection research. Studies demonstrate that green advertising can heighten individuals' sense of environmental responsibility (Fernando et al., 2014), and climate change discussions on platforms like Weibo enhance environmental awareness (Ji et al., 2024). Furthermore, Goncalves and De Santo (2022) utilized agenda-setting theory as a framework to explain the policy rationale behind Brazil's extensive marine protected areas.

The media's pivotal role in fostering environmentally friendly behavior is widely acknowledged. Media consumption indirectly affects environmental actions by shaping social norms (Chan, 1998), environmental beliefs, and self-efficacy, and generating social pressure (Huang, 2016). In the digital era, media is increasingly recognized as a central force in communicating environmental issues, particularly in driving ecological concern and perception of risks (Brulle et al., 2012; Yu et al., 2017). The influences mentioned above stem from digital media's inherent characteristics, interactivity, broad reach, and personalized information delivery. However, the digital media information ecology is highly complex, encompassing not only positive and neutral content but also negative information. To counter misinformation, the Chinese government has implemented extensive initiatives like the "Qinglang" campaign, which removed more than 22 million pieces of illegal and inappropriate information in 2021 (CCTV, 2022). Concurrently, major social platforms (WeChat, Weibo, Douyin, Xiaohongshu, Kuaishou, etc.) have strengthened content review, rumor reporting, and rumor-refutation mechanisms, fostering a more credible environment for disseminating information through digital media communication.

Consequently, the impact of digital media use on individuals' pro-environmental behavior has emerged as a significant research focus in communication and environmental psychology. As information dissemination evolves, traditional and digital media each play distinct roles in promoting environmentally responsible behavior, focusing on different mechanisms. Traditional media (TV, Newspapers, radio, and magazines) primarily guided public action, such as reducing food waste, through authoritative reporting and public discourse on environmental practices (Young et al., 2017). Zhou et al. (2019) noted that frequent exposure to public media increases the likelihood of engaging in diverse environmental behavior. In contrast, digital media leverages its dynamic and personalized nature to influence behavior through user engagement, content generation, and social interactions. Research by Ho et al. (2015) grounded in the Theory of Planned Behavior (TPB) and Media Dependency Theory (MDT) indicated that traditional media enhances green purchase intentions, while social media drives online engagement. Similarly, Liao (2024) drawing on TPB and the Social Influence Theory (SIT), highlighted social media's significant role in shaping environmental attitudes and behavioral norms. Notably, social media engagement correlates positively with promoting sustainable awareness, pro-environmental cognitions, behavioral norms, and daily eco-friendly actions among Generation Z (Balinska et al., 2021; Confetto et al., 2023; Gonzalez et al., 2023).

Additionally, news websites and video platforms are vital channels for environmental information dissemination. Individuals highly engaged with environmental news, public affairs, and nature documentaries tend to develop stronger environmental cognitions and attitudes (Holbert et al., 2003; Zhao et al., 2011). Yang and Yu (2019) reinforced this view, citing how the online documentary "Under the Dome" effectively ignited public debate on air pollution. Evidence further suggests that news media coverage enhances

pro-environmental behavior across various domains, influencing individuals' eco-anxiety (Shao and Yu, 2023), value orientations (Lee, 2011), and environmental attitudes (Awan et al., 2022; Li and Song, 2024).

The social media features like live streaming can also positively stimulate pro-environmental behavior intentions through psychological proximity (Wang and Jiao, 2024). The impacts mentioned above are likely attributable to technological advancements and the continuous evolution of digital media. As McMullan (2020) posited digital media is born from unique technological foundations, and it functions as an online platform connecting people and enabling widespread cultural dissemination. To some extent, it offers novel opportunities for addressing environmental issues. Therefore, the following hypothesis is proposed:

H1: Digital media has a positive impact on individuals' pro-environmental behavior.

The role of environmental knowledge

Environmental knowledge serves as a critical predictor of pro-environmental behavior, representing individuals' grasp of environmental concern and their understanding of "facts, concepts, and relationships concerning the natural environment and its major ecosystems" (Fryxell and Lo, 2003). This concept encompasses awareness of environmental problems and exploration of potential solutions (Zsóka et al., 2013). In the digital era, digital media fulfills multiple functions—disseminating information, monitoring public opinion, sharing knowledge, and shaping values. Both traditional and digital media must provide detailed and tangible environmental information to effectively enhance the public's environmental knowledge. Brothers et al. (1991) demonstrated that exposure to environmental news on television boosts the public's environmental knowledge. Furthermore, Holbert et al. (2003) further pointed out that watching TV news and nature documentaries increases the public's environmental knowledge and encourages their pro-environmental behavior, particularly among viewers with a pre-existing high level of environmental awareness. Zhao (2009) found that Internet use significantly improves public understanding of global warming and elevates perceived environmental knowledge. Similarly, Karahan and Roehrig (2015) showed that online information can heighten environmental awareness and knowledge, deepen comprehension, and influence attitudes. The advent of digital platforms like Google Books and Biodiversity Heritage Library has also expanded avenues for acquiring environmental knowledge (Burton and Riley, 2018). Digital media use not just facilitates public perception of environmental information but transforms this information into environmental knowledge, too.

Prior research has confirmed a strong correlation between environmental knowledge and pro-environmental behavior (Amoah and Addoah, 2021; Awan et al., 2022; Pothitou et al., 2016; Zsóka et al., 2013). For instance, Amoah and Addoah (2021) assessed the impact of environmental knowledge on PEB through a household survey. Complementing this, people use nationally representative data to explore how subjective and objective knowledge affect PEB formation (Casalo et al., 2019). Regarding green consumption, environmental knowledge significantly influences the public's behavior when purchasing green products (Choi and Johnson, 2019; Mostafa, 2007).

Building on the theory of Normative Activation Theory (NAM) and Theory of Planned Behavior (TPB), Tanwir and Hamzah (2020) employed self-organizing maps (SOM) to analyze underlying factors shaping hybrid vehicle purchasing. Their study underscored that knowledge, intention, and attitudes positively affect green purchase behavior, with

knowledge acting as a key mediator between green purchase intention and behavior. For example, Liu et al. (2021b) found that knowledge drives behavioral change when coupled with emotional engagement. Given these insights, further empirical validation of environmental knowledge's mediating role remains necessary. Consequently, we propose the following hypothesis:

H2: Environmental knowledge plays a mediating role between digital media use and pro-environmental behavior.

The role of environmental concern

Environmental concern is defined as “the degree to which people are aware of environmental problems and support efforts to solve them and/or indicate a willingness to contribute personally to their solution” (Dunlap and Jones, 2002). As a “barometer” of environmental governance, public environmental concern has increased not only thanks to the policy of energy conservation and emission reduction at the individual level, but also plays a supervisory role in mitigating urban GHGs (Wang et al., 2024). Nowadays, digital media platforms have become key channels to raise public concern about environmental protection. Publishing videos on air pollution and climate change on these platforms can draw public attention to environmental issues and trigger extensive social discussion and strengthen their support and personal willingness to act on environmental issues. Additionally, online sustainable advertising and environmental news coverage have significantly raised public awareness of ecological issues (Fernando et al., 2014; Liu and Li, 2021; Trivedi et al., 2018). Ji et al. (2024) analyzed discussions on climate change on Weibo in the period from 2010 to 2020 and found that these conversations are primarily focused on environmental effects, which indicates that digital media platforms enhance public concern regarding environmental issues.

Environmental concern is often strongly linked to pro-environmental behavior, such as purchasing products with a green label, choosing low-carbon transportation, recycling, and saving energy. Research not merely promotes green consumption behavior (Mostafa, 2009; Saari et al., 2021) and sustainable consumption behavior (Wakefield et al., 2006), but also catalyzes investment in renewable energy (Esposito and Jalal, 2025), which turns out to accelerate the circular economy and green high-quality development. Furthermore, individuals' increased environmental concern prompts them to consider environmental factors in their daily decisions, as evidenced by their willingness to pay a premium for public environmental goods and quasi-private environmental goods (Meyer and Liebe, 2010). The underlying mechanism of this behavior fosters environmental concern, stimulating individuals' pro-environmental behavior by shaping their environmental cognition and emotions. According to the theory of Value-Belief-Norm (VBN) (Stern and Dietz, 1994), a sequential psychological process shapes individuals' pro-environmental behavior. It proposes that individuals' core values shape their beliefs about environmental issues, activating moral norms and motivating environmentally responsible behavior. Individuals who have biospheric values are more likely to be exposed to the ecological pressures of climate change, thus being more active in pro-environmental behavior (Helm et al., 2018). Based on the aforementioned analysis, environmental concern plays a key role, so the following hypothesis is proposed:

H3: Environmental concern plays a mediating role between digital media use and pro-environmental behavior.

Methodology

Data source

The data for this study were from the China General Social Survey (CGSS), conducted by the National Survey Research Center of Renmin University of China. CGSS is one of the China's earliest national, comprehensive, and ongoing academic surveys. It utilizes a multi-stage stratified random sampling methodology that involves levels of individuals, households, and society. The survey targets urban and rural residents aged 18 and above, addressing topics of great scientific and practical relevance. To date, it has been widely used in research areas such as social issues, subjective well-being, education, and environmental issues in China.

The CGSS 2021 data, the latest edition, were officially released to the entire society in March 2023. They are more suitable for examining the relationship between digital media use and pro-environmental behavior. For one thing, digital media has become deeply integrated into people's lives and economic development. It is crucial to disseminate and promote environmental protection policies and concepts, encouraging people to increasingly take on the shared responsibility of caring for the ecological environment. For another thing, a beautiful ecological environment is what people aspire to, and a green, low-carbon lifestyle is steadily becoming more prevalent. The CGSS database provides comprehensive perceptions from respondents to questions about pro-environmental behavior, which we use to construct our dependent variable. Therefore, there was a significant positive relationship between them in 2021. This result indicates that the rise of environmental awareness in the digital age is closely linked to the role of digital media in promoting environmental protection.

Model setting

This paper employs an econometric model to explore the link between digital media use and individuals' pro-environmental behavior (PEB).

$$PEB_i = \beta_0 + \beta_1 \text{Digital media}_i + \beta_2 \text{Control}_i + \varepsilon_i \quad (\text{Eq.1})$$

Specifically, i represents the i -th individual; PEB is the dependent variable; digital media is the core explanatory variable; and $Control$ denotes a set of control variables. β_1 denotes the coefficient of the core explanatory variable and presents the effect of digital media use on pro-environmental behavior. β_2 denotes the coefficients of the control variables. β_0 denotes the constant term of the model, which is the baseline level of pro-environmental behavior when all explanatory variables are zero, and ε represents the error term.

The current research further validates the specific path of digital media use on pro-environmental behavior from the perspective of environmental knowledge and environmental concern. Following the approach of Baron and Kenny (1986), we construct a model for testing mediation effects with the following settings:

$$M_i = \alpha_0 + \alpha_1 \text{Digital media}_i + \alpha_2 \text{Control}_i + \varepsilon_i \quad (\text{Eq.2})$$

$$PEB_i = \gamma_0 + \gamma_1 \text{Digital media}_i + \gamma_2 M_i + \gamma_3 \text{Control}_i + \varepsilon_i \quad (\text{Eq.3})$$

In *Equations 2 and 3*, M_i represents the mediating variable of environmental knowledge and environmental concern, other conditions remaining unchanged.

Variable section

Dependent variable

The dependent variable in this study is pro-environmental behavior (PEB). Six questions relevant to PEB are selected from the CGSS2021 survey. These questions are as follows: “To what extent are you willing to make the following efforts to solve various waste disposal issues?” (1) regularly separating and disposing of the household waste produced by my family; (2) recycling and reusing the household goods; (3) willing to discuss the rubbish sorting plan with other residents; (4) willing to participate regularly as a volunteer in public service labor to maintain a clean and tidy environment; (5) willing to accept a reasonable increase in tax if it can be used to solve the problem of rubbish disposal in the city; and (6) I will take the initiative to discuss the problem of rubbish disposal with the government, environmental protection organizations, experts, rubbish disposers and other relevant departments if I have the opportunity to do so. The response options are “strongly willing, quite willing, neither willing nor unwilling, somewhat willing or strongly unwilling,” with corresponding values from 5 to 1. As the number increases, so does the individuals’ willingness to engage in pro-environmental behavior.

Explanatory variable

The explanatory variable in this study is digital media use. The questions are as follows: “How often have you used the Internet (including mobile Internet) over the past year? And how often have you used cell phone customized messaging over the past year?” Respondents answered “never, rarely, sometimes, often, or very often.” According to Gong et al. (2020), this study defines digital media use as a binary variable. In other terms, the use of digital media (including “rarely,” “sometimes,” “often,” or “very often”) is assigned a value of 1; conversely (i.e., “never”), it is assigned a value of 0.

Control variables

Control variables are also necessary to account for potential confounding factors. Therefore, the study also adds gender, age, education level, political status, marital status, personal income, and family economic status to the model to control for the possible effects of other factors on individuals’ pro-environmental behavior. Additionally, this study uses the province as a dummy variable to control for area-fixed effects.

Other variables

CGSS collected 14 questions about environmental knowledge, covering respondents’ knowledge of ecological protection and environmental policies, ecological compensation, ecological protection red line, air and water pollution, soil pollution action plan, and public participation in environmental protection. Participants rated their responses to these questions on a Likert scale (1 = not at all, 4 = very well) to assess their knowledge of environmental policies and issues.

In addition, the environmental concern consists of three questions: (1) “Generally speaking, how concerned are you about environmental issues?” (2) “We worry too much about the future of the environment and not enough about prices and jobs.” (3) “People worry too much about human progress harming the environment.” We first combine the three questions into one variable, environmental concern, ranging from 1 to 5. For the instrumental variable, the question of cell phone ownership is chosen for this study. This

instrumental variable is selected to address potential endogeneity. During the data cleaning process, all samples with answers of “not sure,” “do not know,” or missing values are excluded. As a result, this study includes 2,272 valid samples. Specific sample descriptions and detailed statistical information of the variables are shown in *Table 1*.

Table 1. Variable descriptions and descriptive statistics

Variables	Definition	Obs	Mean	SD	Min	Max
PEB	Strongly unwilling = 1, Somewhat unwilling = 2, Neither willing nor unwilling = 3, Somewhat willing = 4, Strongly willing = 5	2272	3.83	0.74	1	5
Digital media use	Using digital media = 1, else = 0	2272	0.43	0.50	0	1
Environmental knowledge	Do not know = 1, Know a little = 2, Know moderately well = 3, Know very well = 4	2272	1.29	0.38	1	3.79
Environmental concern	Not concerned at all/Strongly disagree = 1, Not very concerned/Slightly disagree = 2, Neither concerned nor unconcerned/Neither agree nor disagree = 3, Fairly concerned/Slightly agree = 4, Very concerned/Strongly agree = 5	2,272	3.10	0.61	1	5
Gender	Male = 1, female = 0	2272	0.47	0.50	0	1
Age	Age in 2021, derived by subtracting the respondent's birth year from the survey year	2272	50.33	17.56	18	94
Educational level	No formal education or primary school = 1, Junior high school or Senior high school or technical school = 2, College degree or Bachelor's degree = 3, Postgraduate degree or above = 4	2272	1.93	0.76	1	4
Marital status	Married = 1, else = 0	2272	0.68	0.46	0	1
Personal income	Personal income last year by natural logarithm value	2272	8.96	4.47	0	16.12
Family economic status	Far below average = 1, Below average = 2, Average level = 3 Above average = 4, Far above average = 5	2272	2.60	0.79	1	5
Political status	Member of the Communist Party of China (CPC) = 1; else = 0	2272	0.13	0.34	0	1
Ownership of cell phones	If own, value is 1; if not, value is 0	2272	0.95	0.21	0	1

Empirical results

Benchmark model

The ordinary least squares (OLS) method is adopted to estimate the benchmark model. The estimation results are presented in *Table 2*. Model (1) only considers the effect of digital media use on individuals' pro-environmental behavior without any control variables. Model (2) adds control variables, and Model (3) fixes the sample at the provincial level based on Model (2). The empirical evidence is presented in *Table 2*, and the R^2 values of the models increase progressively from Model (1) to Model (3), suggesting that the benchmark model specification is set up robustly. In addition, the coefficients of digital media use on individuals' pro-environmental behavior are all significant at the 1% level. It indicates that the estimation results are stable.

Robustness check

In the digital era, the widespread adoption of digital media has become an integral part of society. Thus, it is of great theoretical and practical significance to explore the impact of digital media on environmental behavior. To guarantee the credibility and strong robustness of the findings, this study carefully changes the explanatory variables

to test the robustness of the benchmark regression results in depth. First, the core explanatory variables are defined as binary variables to distinguish between digital media users and non-users. Specifically, two variables are defined as follows: digital media use1 and digital media use2. Digital media use1 operates as a binary variable: it is assigned the value of 1 when respondents use digital media sometimes, often, or very often; otherwise, it is assigned the value of 0. Digital media use2 is more narrowly defined, acting as a binary variable: when respondents use the digital media often, or very often, this variable is given the value of 1; otherwise, it is given the value of 0. Second, the study uses two measures to define the core explanatory variables. Using two measures reduces the possible bias from relying on a single measure, enhancing the credibility of the study's findings. Finally, these two methods are considered in the regression model to test the robustness. As shown in Panel A of *Table 3*, the estimation results demonstrate a positive correlation between digital media use and pro-environmental behavior regardless of the measurement method used, and it is positive and statistically significant at the 1% level.

Table 2. *Regression results of the benchmark model*

Variables	Dependent variable: PEB		
	(1)	(2)	(3)
Digital media use	0.1401*** (4.5941)	0.1019*** (3.0883)	0.0876*** (2.6668)
Gender		0.0647** (2.0672)	0.0725** (2.3391)
Age		-0.0008 (-0.7492)	-0.0017 (-1.5576)
Education level		0.0393 (1.5208)	0.0269 (1.0198)
Marital status		0.0777** (2.2658)	0.0585* (1.6958)
Personal income		0.0018 (0.5044)	0.0019 (0.5446)
Family economic status		0.0301 (1.4558)	0.0501** (2.4061)
Political status		0.2155*** (5.0009)	0.2042*** (4.7519)
Constant	3.7670*** (169.7160)	3.5435*** (33.8619)	3.9490*** (24.8057)
Province effect	NO	NO	YES
Observations	2,272	2,272	2,272
R-squared	0.0087	0.0303	0.0664
F	21.1057	9.9748	7.0634

Robust t-statistics in parentheses

*** p < 0.01, ** p < 0.05, * p < 0.1

Table 3. Robustness check

Variables	Dependent variable: PEB	
	Panel A: Changing the explanatory variables	
Digital media use 1	0.1661*** (4.4228)	
Digital media use 2		0.1342*** (4.0176)
Constant	3.9606*** (25.1215)	3.9402*** (24.8123)
Control variables	YES	YES
Observations	2,272	2,272
Variables	Panel B: Eliminate the interference of municipalities	
Digital media use	0.0917** (2.4263)	
Constant	3.8907*** (23.274)	
Control variables	YES	
Observations	1,805	
Variables	Panel C: The instrumental variable method	
	First Stage: Digital media use	Second Stage: PEB
IV	0.1893*** (6.7932)	
Digital media use		1.6152*** (3.2795)
Constant	0.3029*** (3.0004)	3.1900*** (9.7506)
Control variables	YES	YES
Observations	2,272	2,272
Kleibergen-Paap rk LM statistic	34.47	
Cragg-Donald Wald F statistic	16.59	
Kleibergen-Paap Wald rk F statistic	46.15	

Robust t-statistics in parentheses
*** p < 0.01, ** p < 0.05, * p < 0.1

Due to differences in economic and social development, digital media use and pro-environmental behavior may differ significantly between municipalities directly under the central government and other regions. This variability could introduce bias into the regression results. Therefore, this study employs the method of excluding extreme values, excluding 467 observations from municipalities directly under the central government for the robustness test. After excluding these potentially influential extreme values, this study re-estimates the model to ensure the robustness of the results. As shown in Panel B of *Table 3*, the results indicate that the positive relationship between digital media use and pro-environmental behavior remains significant at the 1% level even after excluding the data from these municipalities. This result further validates the robustness of the baseline regression results.

Discussion of endogeneity : the instrumental variable method

The above results may suffer from endogeneity issues, such as reverse causality between digital media use and pro-environmental behavior. To address these issues, the study employs the instrumental variable (IV) approach, using cell phone ownership as the instrument. In 2021, China had an Internet penetration rate of 73.0%, with 1.032 billion Internet users; notably, 1.029 billion of them were mobile users, representing 99.7% of the total. (NBS, 2022). This means that the penetration rate of smartphones in China has been sky-high. On the one hand, cell phones alone are a crucial way to use digital media, and they have a direct relationship with digital media use; on the other hand, whether an individual owns a cell phone is not directly correlated with their pro-environmental behavior. Therefore, cell phone ownership meets the requirements of an instrumental variable. As presented in Panel C of *Table 3*, the results are estimated using two-stage least squares (2SLS) to test the endogeneity issues. The coefficients remain statistically significant and positive. The Cragg-Donald Wald F and Kleibergen-Paap Wald statistics indicate that the instrumental variable is valid and has sufficient explanatory power, ruling out the possibility of a weak instrument. There is still a significant positive effect of digital media use on pro-environmental behavior, further illustrating the robustness and reliability of the results.

Mechanism analysis

The study utilizes environmental knowledge and environmental concern as mediating variables to gain more insight into the relationship between digital media use and pro-environmental behavior. Following the causal steps approach of Baron and Kenny (1986), the mediating effect is tested, and the results are presented in Panel A of *Table 4*. Column (1) examines the influence of digital media use on environmental knowledge, with the estimated coefficient for digital media use on individuals' environmental knowledge being 0.0831, which is significant at the 1% level. Meanwhile, Column (2) shows that the coefficient for digital media use remains significant even after controlling for individuals' environmental knowledge. Similarly, Column (3) shows that the estimated coefficient for digital media use on individual environmental concern is 0.0462, which is significant at the 10% level. And column (4) shows that the coefficient for digital media use remains significant after controlling for individuals' environmental concern. The results mentioned above indicate that individuals' environmental knowledge and environmental concern play a mediating role in the relationship between digital media use and pro-environmental behavior, thereby validating Hypothesis 2 and Hypothesis 3.

Heterogeneity analysis

The study explores the heterogeneity to analyze the impact of digital media use on pro-environmental behavior. It involves three aspects: educational levels, income, and urban-rural residence. In terms of educational levels, individuals are divided into two groups: those with less than a high school education and those with a high school education or more. As shown in columns (1) and (2) in Panel B of *Table 4*, the results indicate that there is a significant effect of digital media use on PEB for the group with lower education levels ($\beta = 0.0799$, $t = 2.1240$, $p < 0.05$). In comparison, there is no effect on the group with higher education levels ($\beta = 0.0712$, $t = 1.0648$, $p > 0.1$). These results suggest that individuals with lower education levels may rely more on accessible information sources, such as digital media, to gain environmental awareness.

Regarding income, the sample is divided into two groups: high-income (above average) and low-income (below average) groups. The results are presented in Panel B of *Table 4* (columns 3 and 4). Compared to individuals in low-income groups ($\beta = 0.0518$, $t = 1.1367$, $p > 0.1$), the positive effect of digital media use on pro-environmental behavior is statistically significant in high-income groups ($\beta = 0.1321$, $t = 2.7977$, $p < 0.01$). It implies that individuals with higher income levels may have more resources or opportunities to translate environmental awareness into pro-environmental behavior. Based on household registration status, individuals are classified into urban and rural groups, as shown in columns (5) and (6) in Panel B of *Table 4*. The results show that digital media use on pro-environmental behavior has an important impact on rural groups ($\beta = 0.1094$, $t = 2.3298$, $p < 0.05$) but not in urban groups ($\beta = 0.0543$, $t = 1.1674$, $p > 0.1$). The more substantial effects in rural areas may result from limited traditional media and fewer environmental education opportunities, making digital media the main information source.

Table 4. Mechanism analysis and heterogeneous effects

Variables	Panel A: Mechanism analysis			
	Environmental knowledge	PEB	Environmental concern	PEB
	(1)	(2)	(3)	(4)
Digital media use	0.0831*** (4.8615)	0.0644** (1.9765)	0.0462* (1.7050)	0.0812** (2.4861)
Environmental knowledge		0.2790*** (7.1116)		
Environmental concern				0.1381*** (5.1947)
Control variables	YES	YES	YES	YES
Constant	0.9209*** (16.2998)	3.3196*** (30.2776)	2.8812*** (32.9212)	3.1786*** (23.9410)
Observations	2,272	2,272	2,272	2,272
R-squared	0.219	0.083	0.067	0.078

Variables	Panel B: Heterogeneous effects					
	Educational level (less than high school)	Educational level (high school or more)	Low-income	High-income	Rural	Urban
	(1)	(2)	(3)	(4)	(5)	(6)
Digital media use	0.0799** (2.1240)	0.0712 (1.0648)	0.0518 (1.1367)	0.1321*** (2.7977)	0.1094** (2.3298)	0.0543 (1.1674)
Control variables	YES	YES	YES	YES	YES	YES
Constant	3.8613*** (22.1973)	4.3901*** (13.0880)	3.7174*** (18.7681)	3.8515*** (10.2810)	3.8499*** (19.6494)	4.6428*** (15.2749)
Observations	1,757	515	1,228	1,044	1,313	959
R-squared	0.0780	0.0958	0.0920	0.0868	0.0820	0.0802
F	6.4790	e(F)	5.0318	4.2372	5.3164	3.6286

Robust t-statistics in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Discussion

Based on the current research, we investigated the relationship between digital media use and pro-environmental behavior, with more emphasis placed on the mediating variables of environmental knowledge and environmental concern. The findings are consistent with our hypotheses.

Digital technology evolves rapidly, and the way people get information has become more diversified and more efficient than ever. This article offers a nuanced insight into such relationship, supporting Hypothesis 1. The result largely extends prior research, which predominantly targets the role of online activities in promoting pro-environmental behavior (Fernandez et al., 2017; Gong et al., 2020; Liao, 2024; Liu et al., 2021b). At the same time, research findings indicate that the crucial role of the visual platform lies in forming pro-environmental behavior. Individuals who actively engage with digital media content on environmental issues exhibit heightened environmental concern, awareness, and responsibility, thereby positively shaping their pro-environmental behavior (Lee, 2011; Liu and Li, 2021), which not only aligns with norm activation model theory (NAM) (Schwartz, 1973), but also further deepens its application in the digital communication context. Once individuals become aware of the long-term impact of environmental issues on society and themselves, they will develop environmental protection concern that catalyzes them to become more engaged in pro-environmental behavior. Moreover, digital media use is closely related to individuals' extensive participation on visual platforms, such as in time interactions, likes, comments, feedback, and retweets (Confetto et al., 2023; Gonzalez et al., 2023; Ho et al., 2015). Digital media enables a more interactive and interpersonal form of communication and discussion, and may be more attractive to people. Individuals' access to high-quality environmental information plays a key role in transforming sustainable behavior.

This study revealed two independent mediating pathways through which digital media use influences pro-environmental behavior, environmental knowledge and environmental concern, providing theoretical support for understanding the mechanisms of digital media use. Digital media platforms offer convenient ways for the public to obtain ecological knowledge and enhance their pro-environmental behavior. Hypothesis 2 is verified. Specifically, digital media can effectively improve individuals' knowledge visually and interactively. This innovative communication strategy inspires individuals to participate in environmental protection campaigns, reinforcing the adoption of sustainable lifestyles (Pujihartati et al., 2023). However, the environmental influence on behavior remains controversial in existing research. Some studies suggest a weak or insignificant relationship between them (Braun and Dierkes, 2019; Kollmuss and Agyeman, 2002), which may be related to differences in various knowledge types, measurement methods, or behavior types. In contrast, this study indicates that a significant positive correlation exists between environmental knowledge and environmental behavior, and it further supports the core assumption of the KAB (Knowledge–Attitude–Behavior) model, knowledge enhancement facilitates attitude transformation and drives behavior (Bettinghaus, 1986). In addition, subjective environmental knowledge has been positively correlated with pro-environmental actions (Vicente-Molina et al., 2013), further substantiating the role of knowledge in shaping pro-environmental behavior.

It is shown that environmental concern is a significant mediating variable, so that Hypothesis 3 has its scientific support. Environmental concern is also applicable to environmental issues disseminated in the context of digital media, and mainstream platforms and new technologies have increased by a wide margin public awareness of environmental issues by enhancing the accessibility and immediacy of information, strengthening the visual effects and immersion of content, and providing interactive channels. For instance, “Ant Forest” combines carbon reduction behavior and afforestation goals, getting them into intuitive and interactive processes through online game experiences. Aligning with social interaction and instant feedback to arouse more

users to pay attention to the theme of forest conservation and carbon dioxide emission reduction. “Clear Your Plate Campaign” has implanted the concept of food conservation into the public scope with the help of short videos and social media challenges, triggering widespread discussion. This environmental concern not only stays at the level of information reception but also deepens individuals’ awareness and positive attitude towards environmental issues (Li et al., 2019). It also influences individuals’ cognitive structure, emotional attitude, and social norm perception through emotional arousal and responsibility attribution, making individuals more inclined to adopt pro-environmental behavior. With the rapid development of the economy and people’s living standards, the demand of the public for a better ecological life is increasing, and much stronger yearning for a high-quality ecological environment. People recognize that a good ecological environment is a key element for a good life.

The article conducts a heterogeneity test examining variations in the effects of digital media use, yielding interesting results. First, with an educational perspective, digital media use positively influences pro-environmental behaviors (PEB) in groups with lower education levels. Prior research suggests that individuals with higher levels of education typically exhibit more positive environmental attitudes and behavior (Boeve-de Pauw and Van Petegem, 2010; Casaló and Escario, 2018). People with higher education are more likely to use their knowledge to engage in environmental behavior without getting knowledge via the Internet. In contrast, individuals in lower education groups may lack sufficient environmental knowledge thanks to limited educational opportunities (Yang et al., 2022). However, digital media allows them to overcome this gap by providing access to relevant information, which turns out to promote pro-environmental behavior. Furthermore, the high-income digital media group demonstrated a significant effect on PEB, consistent with prior findings that higher income levels are linked with a greater willingness to behave positively toward the environment (Boeve-de Pauw and Van Petegem, 2010). This view aligns with post-materialist theory, which suggests that as economic status rises, individuals become less concerned with economic constraints and pursue higher-level post-materialist goals, such as personal self-actualization and environmental protection (Inglehart, 1995). As a result, the high-income group is more likely to be concerned about environmental protection issues in digital media, thereby promoting pro-environmental behavior. For the rural area group, digital media use showed a significant effect on pro-environmental behavior, which is consistent with the finding (Bentley et al., 2019). As against the urban community, digital media has higher penetration in rural areas, and its scene-based content can effectively break through the communication bottleneck of traditional environmental publicity in rural areas. Digital media disseminates environmental information closely related to people’s daily lives, including toilet improvement technology, sewage treatment cases, garbage classification methods, and agricultural planting technology, all of which highly meets the practical needs of rural residents, and gets digital media an important channel for residents living in suburban areas to acquire environmental knowledge and raise environmental concern.

Conclusions and implications

Utilizing CGSS data, this study finds that digital media use is positively associated with pro-environmental behavior through the significant mediating roles of environmental knowledge and environmental concern. It is worth noting that the effect of digital media use on rural groups is significant. Digital media use empowers these

communities by providing effective access to environmental information and expanded social networks. These results emphasized using digital platforms to bridge knowledge gaps, promote pro-environmental behavior, and support environmental sustainability in suburban areas. Meanwhile, the study raises important theoretical and practical implications for reducing carbon emissions and dealing with climate change effectively.

However, it also has its limitations, so the authors would like to recommend several promising directions. First, this study uses regression analysis to test the predictive effect of digital media use on pro-environmental behavior. Although the results are statistically significant, it is complicated to rule out the issue of potential causality. The future study is supposed to adopt an experimental research approach to reveal the causal role of digital media use on pro-environmental behavior more transparently. Second, the focus scope on pro-environmental behavior based on our data is relatively limited, which only accounts for the behavior of waste classification and disposal and does not fully encompass the concept of pro-environmental behavior. Therefore, future studies could simultaneously examine several types of pro-environmental behavior to test whether their antecedents differ. Third, it has tested the heterogeneity of many indicators, such as education levels, income levels, and regional differences, and considered the possible role of some other socioeconomic variables in influencing pro-environmental behavior. However, certain groups (e.g., older adults or college students) may respond unpromised to digital media exposure and the stimulation of pro-environmental behavior. Thus, future studies could deep dive into different groups more comprehensively, especially into cross-cultural and regional comparative studies. Fourth, it initially explores the potential impact of digital media use on pro-environmental behavior; further studies can deep dive into the effect of different digital media platforms on pro-environmental behavior.

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