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Why Residents Don't Do What They Say: Exploring the Intention–Behavior Gap in E-Waste Online Recycling Participating

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Abstract: E-waste online recycling is a new recycling model that has received strong support from governments worldwide. It integrates multiple processes such as online inquiry and offline delivery. The complex online–offline interaction makes residents' willingness to participate susceptible to external factors, hindering their behavior. To better transform residents' recycling intentions into behavior, this paper primarily uses a questionnaire survey to explore the intention–behavior gap in e-waste online recycling participating. Our findings show that residents' e-waste online recycling intention directly predicts their behavior, but the implementation plan plays a partial mediating role between them. Additionally, perceived value and platform interactivity moderate the impact of e-waste online recycling intention towards participation behavior. Subsequent in-depth interview analysis further also confirmed these findings. The study contributes to understanding residents' online recycling behaviors and fostering the sustainable development of this model.

Keywords: intention–behavior gap; e-waste online recycling; determinants

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1. Introduction

China is pressing to recycle or properly dispose of large amounts of e-waste, as its electronic products have reached the stage of massive scrapping [1]. Particularly, the digital acceleration brought about by COVID-19 has led to a sharp increase in the amount of e-waste [2]. However, the traditional manual recycling mode of going from door to door has become increasingly challenging due to escalating labor costs [3,4]. It is estimated that the total number of old and unused smartphones in China will reach 6 billion by 2025, but the recycling rate will be less than 4% [5]. To address this social problem, the Chinese government has launched an online recycling campaign. More and more e-waste online recycling platforms, such as Aihuishou, Aibolyu, Hushanghuishou, Beijingyingchuang and Huishouge, have been established successively, contributing to the proliferation of online e-waste recycling [6,7].

Online recycling proposed a novel solution to China's growing e-waste challenges. Residents first inquire through the e-waste online recycling platform. After reaching a preliminary agreement on recycling, they complete the offline delivery based on the volume of e-waste and the convenience of offline recycling. This is done through one of three methods: scheduled doorstep collection, mail-in recycling, or drop-off at physical stores. Finally, they receive corresponding points or monetary compensation. However, in practice, residents' participation remains lackluster [8]. For instance, with mobile phones, research shows that, while residents' willingness to participate in online recycling of e-waste is pretty high, 79.3% of residents still leave their discarded mobile phones at home [9]. It is apparent that, although the majority of residents recognize the significance of e-waste online

recycling for resource preservation, environmental protection, and model innovation, their actual behavior in e-waste recycling does not align with this attitude. This suggests a certain level of inconsistency between residents' intentions and behaviors. If left unaddressed, the intention–behavior gap in e-waste online recycling participation will seriously restrict the development of China's e-waste online recycling and, even further, impede the realization of China's "Internet + Recycling" strategy.

The emergence of e-waste online recycling has gradually attracted increasing scholarly attention over time. Numerous scholars have investigated the development model, current status, and business ecosystem of e-waste online recycling [10–13]. In recent years, increasing attention has been given to studying residents' behavior in e-waste online recycling. Researchers have studied the antecedents of e-waste online recycling intentions and behavior using established theories such as the theory of planned behavior (TPB), technology acceptance model (TAM), elaboration likelihood model (ELM), innovation diffusion theory (IDT), and social cognition theory (SCT). Factors such as perceived behavioral control, subjective norms, attitudes, economic motivation, perceived convenience, and perceived innovation characteristics play crucial roles in influencing e-waste online recycling intentions. However, price disadvantage is the main obstacle for residents to participate in e-waste online recycling. Privacy concern, pricing fairness concern, environmental mental concern, and income level have different moderating effects [5,14,15]. Some scholars focus on antecedents, while others concentrate on intervention strategies for e-waste online recycling intentions. For example, Wang et al. found that providing green information and economic incentives can increase the participation intention of consumers [16,17].

Scholars generally believe that recycling intentions can predict subsequent actual participation behavior. However, unlike traditional e-waste recycling behavior, online recycling integrates online information flow, fund flow, and offline logistics. The complexity of online and offline interactions renders residents' recycling intentions more susceptible to disruption by internal psychological factors and external situational factors, hindering the transformation of intention into actual behaviors. Unfortunately, the existing research has failed to explain why residents do not do what they say in e-waste online recycling and how to promote the conversion of intention into behaviors effectively.

Taking urban residents in China as respondents, this paper uses a questionnaire survey to explore the psychological mechanism and determinants underlying the intention–behavior gap in e-waste online recycling. Semi-structured interviews were also conducted to provide additional support for our empirical findings and help us interpret results. The rest of the paper continues: First, the theoretical background and research hypotheses are presented. Then, the research method is elaborated, followed by the data analysis and results. Finally, the findings are discussed, and theoretical implications and management recommendations are proposed. In addition, the paper summarizes research limitations and points out future research directions.

2. Theoretical Background and Hypotheses Development

2.1. Theoretical Background

The extant literature on residents' online recycling behavior of e-waste has predominantly drawn upon the theory of planned behavior (TPB) proposed by Ajzen and Fishbein [18]. While this theory offers a compelling explanation for behavior based on intention, it overlooks the crucial role played by situational factors in shaping behavior. Consequently, this model has faced extensive criticism and scrutiny due to its inability to address the practical problem of the intention–behavior gap. To address this issue, Carrington et al. developed a theoretical model focused on examining the discrepancies between intention and behavior [19]. This model integrates implementation plans, behavioral control, and situational factors as intervention variables, and its efficacy and explanatory power have been validated using both large-scale and small-scale datasets [20,21].

In Carrington's model, an "implementation plan" refers to a specific plan to convert intention into behavior, mediating between consumers' pro-environmental willingness

and their behavior. Ajzen found individuals with a plan were five times more likely to act as intended [22]. The model considers two moderators: actual behavioral control and situational context. Behavioral control assesses behavior alignment and may include residents' subjective norms and perceived values. Belk defined contextual factors as those that influence consumers' current behavior within a specific period and found that contextual factors account for 18.7% of the variation in consumer behavior [23]. E-waste recycling involves online inquiry and offline delivery. A well-designed online platform enhances inquiry, while convenient offline recycling expedites delivery. Thus, platform interactivity and offline convenience are potential situational factors influencing behavior.

Drawing upon Carrington's theory model of the intentions–behavior gap [19], this study integrates the intrinsic psychological characteristics of residents with situational factors related to e-waste online recycling. The aim is to investigate the intermediate mechanism underlying the transformation from residents' e-waste online recycling intention to actual behavior. This paper identifies subjective norms and perceived value as two intrinsic psychological characteristics and online platform interactivity and offline recycling convenience as two external situational variables. The study discusses their moderating effects on the transformation of residents' intentions into actual behaviors and constructs a conceptual model as shown in Figure 1.

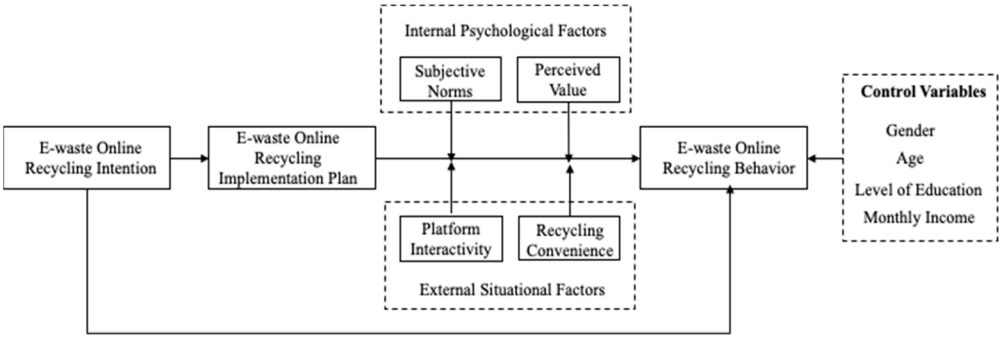

Figure 1. Research concept model.

2.2. Hypotheses Development

2.2.1. The Mediating Mechanism of "Intention–Behavior" Conversion

According to the theory of planned behavior, numerous studies have corroborated that intention strongly predicts behavior. In the context of e-waste online recycling, theoretical reasoning suggests that residents' recycling intentions should predict the recycling behavior. However, the existing literature has yet to confirm this relationship. For instance, the studies by Zhang and Wang only explored the influencing factors of recycling intentions [14,15] without examining the link between intentions and behavior. This paper argues that intention reflects the level of enthusiasm for voluntarily participating in e-waste online recycling, which has a strong correlation with the actual behavior. We thus propose:

H1. *Residents' intention of e-waste online recycling has a significant positive impact on actual behavior.*

The failure to translate intentions into corresponding behaviors results not from a lack of intention but rather from the disparity between intention and actual behavior [24]. This paper selects the implementation plan as a mediator that facilitates the residents' declared intention into actual action. The implementation plan is crucial, outlining an individual's strategy to achieve a specific objective. It details how intentions translate into actions. Dholakia et al. defined it as having two aspects: existence and reachability [25]. The former refers to plan formation, while the latter indicates its achievability. Implementation plans aid goal attainment by initiating actions, reinforcing intention–behavior links, and mitigating external influences [25]. They can also help residents transition from traditional offline to online recycling. Without a plan, willingness to participate may be hindered by

environmental factors. Effective commitments are established through implementation plans, strengthening the alignment between intentions and behavior. Thus, we hypothesize:

H2. *Residents' intention to participate in e-waste online recycling has a significant positive impact on the implementation plan.*

H3. *Residents' implementation plan of e-waste online recycling has a significant positive impact on actual participation behavior.*

H4. *Residents' implementation plan of e-waste online recycling plays a mediating role between intention and behavior.*

2.2.2. The Moderating Effect of Internal Psychological Factors

Studies have demonstrated that participants' recycling behavior is primarily influenced by individuals or groups whom they perceive as significant [26,27], aligning with the perspective of "subjective norm" in the theory of planned behavior. Subjective norm denotes the influence of other people's behavior on consumption decisions. Furthermore, the social cognitive theory posits that individuals' behavior is shaped by observing others' actions within specific social contexts, thereby emphasizing the importance of subjective norms. This paper argues that residents are susceptible to external influences under uncertain conditions. Trafimow observed that individuals' familiarity with a specific behavior weakens the connection between subjective norms and behavioral intentions [28]. This is particularly true in the early stages of new recycling models' development, as residents need time to learn and acquire knowledge about recycling programs. Russell et al. utilized an integrated model to examine the variables associated with consumer food waste behavior and found that the social environment plays an important role in the choice of food waste behavior [29]. Miliute-Plepiene et al. also longitudinally compared the early and mature stages of recycling systems and identified the greater importance of social subjective norms in the early phases [30]. These findings offer valuable insights into the e-waste online recycling platform, which is still in its infancy. Accordingly, this paper hypothesizes:

H5. *Subjective norms have a significant positive moderating effect on the conversion of the implementation plan of residents' e-waste online recycling into actual behavior.*

Residents' participation and utilization of e-waste online recycling platforms reflect their assessment of the offered products or services, driven by perceived value. This recycling model is perceived to offer greater effectiveness or value compared to traditional methods, with perceived product value central to consumer decisions. Economic incentives have a significant impact on recycling behavior, outweighing the psychological factors [31]. E-waste online recycling relies on smart terminals and mobile data networks, making information acquisition and identification efficiency crucial. The platform's resource integration and information transparency influence residents' perceived value. This model provides convenient and efficient recycling, enhancing user experience and encouraging participation. Thus, we hypothesize:

H6. *Perceived value has a significant positive moderating effect on the conversion of residents' online recycling implementation plan into behavior.*

2.2.3. The Moderating Effect of Situational Factors

Website platform professionalism fosters residents' recognition of integrity, authenticity, and professionalism. "Platform interactivity" in this paper involves resident–recycler and resident–resident interactions, empowering residents to control information. This enhances user experience and influences behavior. Teo et al. found that increased website interactivity positively affects satisfaction, effectiveness, efficiency, value, and attitude [32]. Jiang et al. showed that interactivity positively influences purchase intention through

emotional and cognitive engagement [33]. A highly interactive platform aids residents in finding products or services accurately and efficiently, impacting satisfaction, perceived value, attitudes, and intentions. Interactivity is a unique Internet advantage, likely to stimulate online recycling. Thus, we propose:

H7. *Platform interactivity has a significant positive moderating effect on the conversion of e-waste online recycling implementation plans into actual behaviors.*

Enhancing convenience significantly influences residents' recycling behavior [34]. Practical factors like cost, time, and convenience impact residents' recycling decisions [35]. Excessive time costs create perceived risks, especially in today's high-efficiency society where convenience and speed are prioritized. Failure to meet these conditions hinders residents' intention to participate in e-waste online recycling, affecting behavior [36]. To address residents' convenience needs, online recycling platforms must improve service speed, enhance experience value, and promote participation. Thus, we hypothesize:

H8. *Recycling convenience has a significant positive moderating effect on the conversion of e-waste online recycling implementation plans into actual behaviors.*

3. Research Design

3.1. Data Collection for the Questionnaire Survey

Data collection for this study was conducted through field and online surveys, adhering to academic ethical standards. The surveys were carried out from 20 November to 30 November 2023 in Changsha. Following the recommendations of Manion (1994), convenience sampling was employed [37], targeting university students and MBA (Master of Business Administration) participants in Changsha as the primary respondents for questionnaire distribution and explanation. These two groups were chosen for the offline survey for the following reasons: First, university students, as a large consumer group, frequently upgrade their electronic devices, making them more likely to need electronic product recycling. Second, students typically possess a strong sense of social responsibility, have relatively high environmental awareness, and are more receptive to new ideas, making them more likely to understand e-waste online recycling models. Third, as e-waste online recycling behavior involves the participation and influence of family members, we also aimed to include diverse backgrounds in the sample by inviting MBA students to participate. These MBA participants, who returned to study after entering the workforce, have mostly established families, and their recycling behaviors may differ from those of university students, adding greater generalizability and practical relevance to the study's conclusions. The online survey was conducted using the Wenjuanxing platform (a well-known online survey platform in China), utilizing a snowball sampling method. In total, 813 questionnaires were collected (262 offline, 551 online).

To avoid the influence of invalid questionnaires on the research findings, the study removed them according to certain standards: Firstly, those questionnaires that were less than 100 s and longer than 1 h were deleted. Secondly, questionnaires with consistently regular answers were deleted. Thirdly, a question was set to test whether the participants have visited the "Aihuishou" app (7.6.0), China's representative e-waste online recycling platform); questionnaires that failed to provide a correct response to this item were deleted. In total, 455 valid questionnaires were obtained (260 offline, 195 online), and the sample characteristics are presented in Table 1. This sample size is sufficient for regression analysis, as it far exceeds the standard proposed by Stevens [38], which suggests that the number of observations should be at least 15 times the number of variables.

Table 1. Descriptive statistics of the samples.

Item	Category	Frequency	%
Gender	Male	218	47.9
	Female	237	52.1
Age	20 or younger	26	5.7
	21–30	272	59.8
	31–40	77	16.9
	41–50	63	13.8
	51 or above	17	3.7
Level of education	Lower secondary or below	11	2.4
	High school	28	6.2
	University degree	188	41.3
	Master' s degree or above	228	50.1
Monthly income (RMB)	Below 1001	27	5.9
	1001–3000	71	15.6
	3001–6000	156	34.3
	6001–8000	73	16.0
	Above 8000	128	28.1

As variables such as gender, age, education level, and monthly income have been found to influence recycling behavior, this study specifically collected data on these variables and conducted descriptive statistics. These variables are also included as control variables in the subsequent analysis. The classification of age groups refers to the study by Li et al. [39]. In addition, considering that China typically uses 10 years to define a generation and that children under the age of 10 cannot generally independently recycle e-waste or complete the questionnaire, this study sets the starting point at 20 years of age. The collected age data are then grouped and analyzed in 10-year intervals.

The classification of household per capita monthly income mainly refers to the study by Zheng et al. [40]. Meanwhile, this study adjusts it based on the income characteristics of the primary respondents, which include university students and MBA participants.

Descriptive statistics indicate that the gender ratio of the survey population was evenly distributed, with both males and females accounting for approximately 50%, indicating a balanced representation of gender in the survey sample. In terms of education level, a relatively high proportion of respondents had attained a college degree or above, accounting for 91.4%. The majority of respondents were in their youth stage, accounting for 82.4%. In terms of monthly household income per capita, the majority fell into two categories: "3001–6001 RMB" and "8001 RMB and above", accounting for 34.3% and 28.1%, respectively (Table 1).

3.2. Variable Measurement

This paper primarily adopts Carrington et al.'s classification of factors that influence differences in intention and behavior [19]. Based on the specific context of e-waste online recycling platforms, the influencing factors are classified into five variables: implementation plan, subjective norms, perceived value, platform interactivity, and recycling convenience. The independent variable is the intention to implement e-waste online recycling, which is defined as "the specification of the expected result". Drawing upon the measurement items of Leea (2009) and Echegaray and Hansstein (2016) [41,42], a Likert five-level scale was employed to measure the independent variable. Three items were ultimately selected to measure the independent variable, such as "I will choose the e-waste online recycling." The mediation variable is the implementation plan proposed in Carrington's model, which refers to a specific implementation plan for transforming intention into behaviors. Referring to the definitions of variables by Dholakia (2007) and Carrington (2010) [19,25], this paper uses a five-level Likert scale from "1 = will not do this at all" to "2 = will not do this", "3 = will do it occasionally", "4 = do it often", and "5 = will always do it". The moderator

variables all adopt a five-level scale, and the subjective norm measurement is determined as three items based on Leea's (2009) description [39]. According to the scale proposed by Shih (2012) [43], three measurement items of perceived value were identified. Based on Park and Yang (2012) [44], the platform interactivity items were slightly modified and finally determined to be three items. According to Turel (2007) and other research, combined with the characteristics of the e-waste online recycling platform [45], three measurement items for recycling convenience were finally determined. The dependent variable is the e-waste online recycling behavior. Considering that the main purpose of this study is to verify the gap between intention and behavior, we use a dummy variable of 0–1 to measure the occurrence of actual behavior (The specific measurement items can be found in Appendix A). The control variables mainly include gender, age, education level, and monthly income [15,46]. Detailed regression analysis results can be found in Appendix B.

3.3. Interview Data Collection

Based on the quantitative research, to further clarify the internal mechanisms between variables with significant relationships and to fully explain the model testing results, semi-structured interviews were conducted between 25 August and 1 September, 2024. The interviews were conducted through casual conversations at canteens and dormitory areas in universities such as Central South University in Changsha, as well as by connecting with users who commented on related short videos under the 'Ai Hui Shou' accounts on Weibo (14.9.3) and Douyin (31.6.0). After obtaining consent, interviews were conducted with 6 female and 4 male participants (for interview samples and related information, see Appendix C). The interview questions focused on whether they had used e-waste online recycling apps, whether they were willing to use them, what factors influenced their participation in e-waste online recycling, and what measures would encourage them to actively participate in such recycling. The interview transcripts were segmented by sentences, and each sentence was coded according to the rule of 'interviewee's initials–sentence order'. The collected interview data were then analyzed.

4. Results

4.1. Common Method Bias Testing

The self-report questionnaire method used in this study has the potential to introduce common method bias. Therefore, before testing the scale's reliability, validity, and assumptions, the study employed the Harman single-factor method to test the variables for common method bias. Four factors with eigenvalues greater than 1 were obtained after exploratory factor analysis without rotation setup, and the first factor explained 36.84% of the total variance, which was less than 40% of the critical criterion, indicating that the influence of common method bias on the results of the statistical analysis in this study was not significant.

4.2. Reliability and Validity Testing

For the reliability and validity analysis of the variables involved in the integrated model, the study utilized SPSS 26.0 and AMOS24.0. The test results of each latent variable are shown in Table 2.

The internal consistency coefficient and combined reliability were used to measure the internal consistency reliability. The results show that the Cronbach's Alpha coefficient of each variable in the scale is greater than 0.7, indicating good internal consistency reliability. Additionally, the combined reliability (CR) falls between 0.7 and 0.9, which is higher than the acceptable standard of 0.7, indicating that the scale has high reliability.

Validity reflects the degree of effectiveness or accuracy of a measurement method, i.e., whether the questionnaire items are measured accurately and effectively. Conducting a validity test on the questionnaire is a fundamental prerequisite for empirical research. We examined construct validity, convergent validity, and discriminant validity separately. Since the questions of the six variables all have theoretical support and mature scales with

reference, the study deemed it appropriate to conduct confirmatory factor analysis (CFA) to verify whether the items can reflect the variables. CFA was carried out using AMOS26.0, and the factor loadings were calculated. The analysis results showed that, among the 18 observed variables, the factor load for the remaining 16 variables was all greater than 0.6, except for PV1 and IP1, which were 0.53 and 0.52, respectively. The measurement results of the model parameters (CMIN/DF = 1.819 < 2, RMSEA = 0.042 < 0.08, IFI = 0.968 > 0.9, TLI = 0.959 > 0.9, and CFI = 0.968 > 0.9) all indicate that the model has a good fit and high persuasiveness. Then, the convergent validity of the scale was evaluated by factor loading, average variance extraction (AVE), and combined reliability (CR). The results show that the lowest CR value of variables is 0.70, and the AVE value of each variable is greater than 0.45 within the allowable error range, indicating that this study has acceptable convergent validity [47]. The heterogeneity–single-trait correlation ratio (HTMT) is an effective method to evaluate the discriminant validity of variance-based structural equations [48]. This paper used the HTMT method to test the variables' discriminant validity. According to the standard of HTMT0.85, all the values contained in the table are less than 0.85, indicating no problem with discriminant validity among the variables (as shown in Table 3).

Table 2. Test of reliability and validity of the scale.

Constructs	Items	Mean	Factor Loading	CR	AVE
Intention (I)	I1	3.945	0.708	0.797	0.567
	I2	3.600	0.760		
	I3	3.670	0.789		
Implementation plan (IP)	IP1	3.560	0.516	0.754	0.514
	IP2	3.385	0.806		
	IP3	3.418	0.791		
Subjective norm (SN)	SN1	3.787	0.810	0.817	0.599
	SN2	3.802	0.830		
	SN3	3.785	0.674		
Perceived value (PV)	PV1	3.927	0.714	0.704	0.447
	PV2	3.927	0.742		
	PV3	3.585	0.529		
Platform interactivity (PI)	PI1	3.673	0.684	0.718	0.459
	PI2	3.793	0.704		
	PI3	3.793	0.642		
Recycling convenience (RC)	RC1	3.738	0.691	0.751	0.502
	RC2	3.923	0.738		
	RC3	3.932	0.696		

Table 3. HTMT results.

	RI	SN	PV	RC	PI	IP
RI	-					
SN	0.63	-				
PV	0.57	0.68	-			
RC	0.57	0.64	0.83	-		
PI	0.48	0.70	0.64	0.74	-	
IP	0.64	0.59	0.41	0.50	0.46	-

4.3. Direct Effect Testing

Based on ensuring that the indicators of the structural model meet the evaluation criteria, this study used logistic regression to test the relationship between variables. Before this, the multicollinearity test was carried out to ensure the stability of the research results. The study used the variance inflation factor (VIF) to determine whether there was a multicollinearity problem. Generally, when the VIF value is less than 5, it can be considered that

there is no multicollinearity problem. By establishing a regression model, the result shows that the maximum VIF in this paper is 1.926, which is far lower than the measurement standard of 5, so it can be considered that there is no problem of multicollinearity.

When constructing the regression model, this paper takes the residents' gender, age, education, and income as control variables. First, the actual behavior of e-waste online recycling was included as a dependent variable in the model. Then, the online recycling intention was included as an independent variable in the analysis to create a model. Next, the e-waste online recycling implementation plan is used as an independent variable to develop a new model. Finally, the intention to recycle e-waste online is taken as an independent variable, and the implementation plan of e-waste online recycling is used as a dependent variable to generate another model. By observing the regression coefficient and the significance level of the variables in the model, the study judges whether the hypothesis is supported.

The specific analysis results of the hypothesis test are presented in Figure 2. From the hypothesis verification of the direct path, it can be observed that the standardized path coefficient of residents' e-waste online recycling intention to actual behavior is 0.566 ($p < 0.001$), the standardized path coefficient of the intention to the implementation plan is 0.458 ($p < 0.001$), and the standardized path coefficient of the residents' e-waste online recycling implementation plan to the actual participation behavior is 0.656 ($p < 0.001$). All these findings reached statistical significance. According to the test results of direct effects, hypotheses H1, H2, and H3 are verified, providing hard evidence for the verification of subsequent hypotheses.

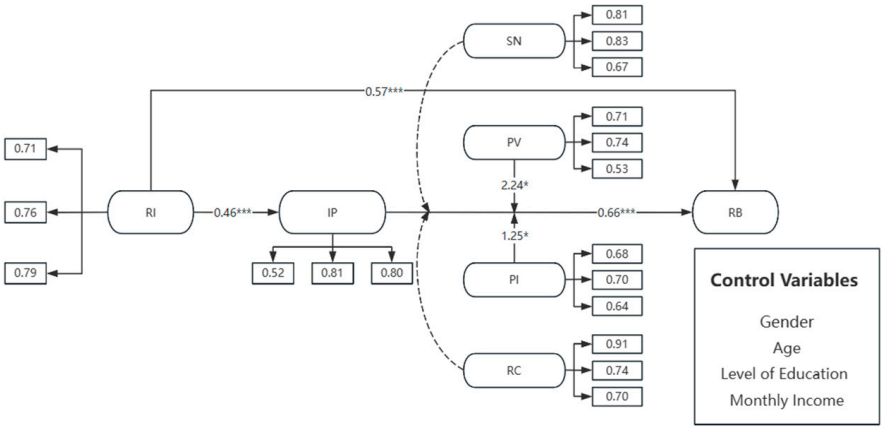

Figure 2. Hypothesis test results. Note: * and *** indicate significance at the 0.05 and 0.001 levels, respectively, in a two-tailed test.

4.4. Mediation Effect Testing

Based on proving the direct effect hypothesis, the implementation plan is included in the model as a mediator variable. The mediation effect of residents' e-waste online recycling implementation plan between intention and behavior is further tested by using the Process plug-in Model4 in SPSS 26.0. The results show that the path coefficient of the direct effect of the implementation plan is 0.352, while the path coefficient of the indirect effect is 0.214. The 95% bootstrap confidence intervals of both the direct effect and the indirect effect do not include a zero value, indicating that the mediation effect is significant. As a partial mediator, the implementation plan has a significant relationship between participation intention and actual participation, thus supporting hypothesis H4.

The analysis of the interview content further confirmed the aforementioned results. First, online recycling intention is a prerequisite for participation, as intention leads to behavior. For example, Interviewee H mentioned "When it comes to electronic products, whether buying or selling, I don't like using online methods because I feel that offline transactions offer more assurance in terms of quality or recycling prices, so I wouldn't use

an e-waste online recycling platform (H-8)". Second, once the intention to recycle is formed, residents will further develop an implementation plan based on "wish fulfillment". For instance, Interviewee C said "I think these recycling platforms are quite good. You don't even have to leave your home to sell your unused phones. The main reason I haven't used them yet is that my current phone and computer are still in good condition, and I don't have any idle devices. But when a new model I like comes out, I plan to use this method to recycle my old ones (C-12)". Third, in terms of the relationship between the implementation plan and recycling behavior, the analysis of the interview transcripts shows that residents tend to act based on "need stimulation". The implementation plan emphasizes that they already have items ready for recycling or are prepared for online recycling, which further stimulates their desire and motivation to recycle through online platforms, eventually leading to actual behavior. For example, Interviewee Y stated "I once saw a counter in a mall that was an offline display for an online electronic waste recycling platform. My friend happened to be planning to buy a new camera, so he used the screen to check the recycling price for his old camera, and he ended up recycling it there (Y-5)".

4.5. Moderating Effect Testing

The study used the binary logistic regression method to test the moderating effect of the model hierarchically. First, all variables were centralized. Second, the centralized IP was multiplied by the centralized four moderator variables, respectively, to obtain four interaction terms. Finally, regression analysis was carried out, and the control variables, centralized variables, and interaction items were incorporated into the model layer by layer for analysis. The results of the moderating effect were obtained, as shown in the simple slope analysis diagram in Figure 3.

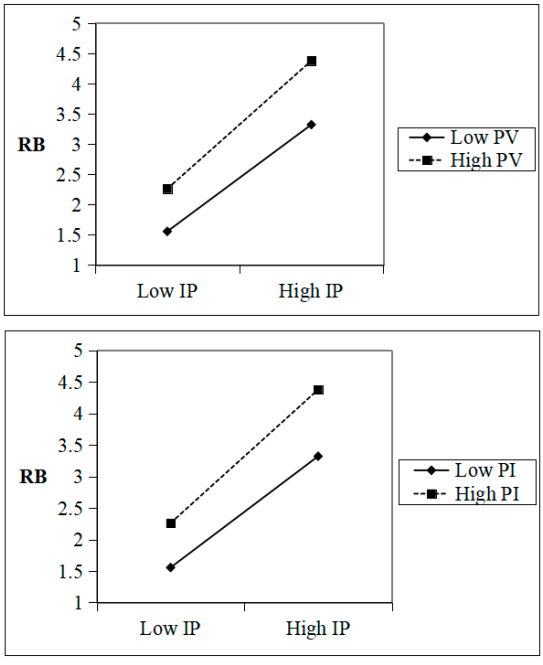

Figure 3. Moderation effect testing.

The test results of the moderating effect of subjective norms in the process of residents' e-waste online recycling implementation plan on actual participation behavior show that the correlation between the interaction term of subjective norms and implementation plan and residents' actual participation behavior is not significant. Therefore, hypothesis H5 is not supported.

The test results of the moderating effect of perceived value on the impact of residents' e-waste online recycling implementation plan on actual participation behavior show that the interaction term between perceived value and recycling implementation plan is significantly positively correlated with residents' actual participation behavior ($\beta = 2.238$, $p < 0.05$). Therefore, hypothesis H6 holds.

The test results of the moderating effect of platform interactivity on the impact of residents' e-waste online recycling implementation plan on actual participation behavior show that the interaction item of platform interactivity and implementation plan is significantly positively correlated with residents' actual participation behavior ($\beta = 1.250$, $p < 0.05$). Therefore, hypothesis H7 holds.

The test results of the moderating effect of recycling convenience on the impact of residents' e-waste online recycling implementation plan on actual participation behavior show that the interaction item of recycling convenience and the recycling implementation plan is not significantly correlated with residents' actual participation behavior. Therefore, hypothesis H8 is rejected.

The analysis of the interview transcripts further revealed two types of moderating effects. First is the reinforcing effect brought by perceived value and platform interactivity. High perceived value and platform interactivity encourage residents to complete the process to gain monetary, environmental, or smooth user experience benefits, thereby promoting actual behavior. For instance, Interviewee T mentioned "I just tried out the AiHuiShou platform, and I found the experience quite good. It's easy to use, like when a teacher highlights key points in class—you instantly know how to complete the process. Next time I need to replace an electronic device, I will use this method (T-34)". Similarly, Interviewee M stated "This method is better than the old street vendors collecting items. My old phone was just sitting at home, not being used. Through this method, I got a few hundred yuan, and it also helps protect the environment. So, considering this, I recycled my old phone through this platform (M-6)". However, for social norms and recycling convenience, the moderating effect was not significant due to a neutralizing effect. The non-exclusive nature of recycling convenience and the sporadic influence of social norms reduced the moderating impact of these variables. For example, Interviewee X said "Other recycling methods are also convenient now. For instance, when you buy a new phone, the retailer will remind you that you can trade in your old phone, and the value is directly deducted from the new one. So, I don't think convenience is a unique advantage of online recycling platforms, and it doesn't increase my willingness to use such a platform (X-52)". Interviewee W noted "Many people around me seem to give their old phones to their elders at home, rather than using these platforms to recycle them (W-26)".

5. Discussion and Conclusions

5.1. Findings and Practical Implication

This is the pioneering study to explain the influencing mechanism of why urban residents say one thing and do another when they participate in e-waste online recycling. We constructed a theory model combining the mediating factor of the implementation plan and incorporating the moderating effects of intrinsic psychological and extrinsic situational factors. Specifically, the main conclusions and practical implication of this study are as follows (as shown in Table 4).

First, residents' e-waste online recycling intention predicts subsequent actual recycling behavior. Urban residents with a stronger willingness to recycle e-waste online are more likely to use online methods to dispose of e-waste than others with no or weaker willingness to do so. Additionally, residents' e-waste online recycling intention had a significant positive effect on the implementation plan. This finding supports the results of the previous Carrington (2010) study on the difference between intention and behavior [19]. Furthermore, it provides theoretical support for the subsequent examination of the mediators and moderators that make it difficult for residents to engage in online recycling behavior. E-waste online recycling platforms should implement various strategies to enhance resi-

dents' willingness to recycle. Firstly, the platform can increase awareness of e-waste online recycling through education and promotion, emphasizing the importance of recycling for environmental protection and resource conservation. Secondly, incentives such as reward points, recycling discounts, or gamified experiences can effectively motivate residents to recycle. Additionally, the platform should leverage data analysis to understand residents' recycling habits and needs, thereby offering personalized recommendations and support to further boost recycling motivation.

Table 4. Current situations and possible solutions.

Current Situation	Research Findings	Possible Solution
Residents' participation rate in e-waste online recycling is very low	Residents' e-waste online recycling intention predicts subsequent actual recycling behavior	• Strengthen education and promotion • Provide incentives such as reward points, recycling discounts, or gamified experiences • offer personalized recommendations and support
Residents' willingness to participate in e-waste online recycling does not always translate into actual behavior	Implementation plans partially mediate the relationship between e-waste online recycling intention and actual recycling behavior	• help residents develop specific recycling implementation plans • offer personalized assistance
After residents formulate plans for e-waste online recycling, the conversion into actual behavior remains uncertain	Both perceived value and platform interactivity positively moderated the relationship between the implementation plan and e-waste online recycling behavior	• Provide more reasonable price compensation or in-kind rewards • Publicize the subsequent use of recycled electronic products • Ease information exchange and provide emotional support • Improving information presentation and user experience

Second, implementation plans partially mediate the relationship between e-waste online recycling intention and actual recycling behavior. This suggests that, while enhancing users' willingness to recycle, online recycling platforms can also enhance the predictive power of intention for subsequent actual participation behavior by prompting residents to develop a specific and detailed implementation plan. This result not only extends the application of the theoretical model proposed by Carrington (2010) but also provides a new path for existing online recycling platforms to attract residents to engage in actual recycling [19]. E-waste online recycling platforms should prioritize helping urban residents develop specific recycling implementation plans. This study confirms that such plans predict actual recycling behavior better than intentions alone. Currently, online recycling companies focus on stimulating residents' willingness to recycle, often resulting in mere downloads or registrations without action. Given the lengthy e-waste lifecycle, effective plans can clarify objectives, manage time, meet deadlines, and enhance success rates. Platforms should promote recycling's environmental significance and resource value, improve convenience, and gather insights to offer personalized assistance, boosting residents' conversion rates of recycling behavior.

Finally, both perceived value and platform interactivity positively moderated the relationship between the implementation plan and e-waste online recycling behavior. However, subjective norms and recycling convenience did not significantly moderate the path of the implementation plan in increasing participation. Based on this surprising result, this paper further tested the moderating variables and found that the positive moderating effects of certain intrinsic psychological factors and certain external situational factors were significant for both the intention-to-implement plan and intention-to-behavior paths. This suggests that, after residents establish a recycling implementation plan, convenience and subjective norms play a lesser role in actual recycling behavior but are more influential in

transitioning from intention to implementation. Electronic products' personal and emotional nature may lead residents to forgo recycling despite having a plan. Subjective social norms were more significant initially but are diminishing with the maturity of e-waste online recycling platforms [30]. Online recycling firms should enhance e-waste recycling's perceived value for residents, increasing plan translation into action. For platforms and residents, the act of recycling is not only a sustainable environmental behavior but also an economic behavior. Companies should aim to bring greater efficacy or value to residents and increase their perceived value of online recycling behaviors. On the one hand, enterprises can increase the perceived value through more reasonable price compensation or in-kind rewards to promote the conversion of intention to behavior. On the other hand, enterprises can publicize the subsequent use of recycled electronic products to visualize their environmental value, thus improving the predictive power of residents' recycling implantation plan to behavior. Lastly, recycling companies need to enhance the interactivity of online recycling platforms. Platforms should ease information exchange and provide emotional support for e-waste online recycling. Improving information presentation and user experience can leave positive impressions, encouraging ongoing participation. Accessible recycling information, connections with recyclers, and a seamless recycling process foster sustained engagement.

5.2. Theoretical Contribution

Firstly, this study contributes to the research by examining the mechanism of transforming urban residents' online recycling intention into behavior. The existing research, often based on the theory of planned behavior, assumes intention predicts recycling behavior. However, little attention is given to the gap between intention and behavior in e-waste recycling. Addressing this gap, the study constructs a theoretical model incorporating the implementation plan as a mediating variable. It explores its role in residents' e-waste online recycling behavior, filling gaps in the current research.

Secondly, while previous studies have only focused on the direct influence of intrinsic psychological factors in the process of intention and behavior, this study uncovers the moderating influence of various psychological factors on residents' online recycling participation. Building on the theoretical model of the intention–behavior gap, this study also highlights the moderating effect of perceived value between the implementation plan and online recycling behavior. It elucidates the intricate mechanism through which urban residents' e-waste online recycling intentions translate into actions.

Finally, this study elucidates how external contextual factors shape residents' online recycling participation behavior. Unlike traditional offline recycling, e-waste online recycling involves intricate online–offline interaction. However, current research has paid less attention to the unique characteristics of online recycling. This study investigates the moderating effects of recycling online platform interactivity and further clarifies the boundaries and conditions under which external contextual factors play a role.

5.3. Limitation

This study has some limitations that need to be further explored and improved. Firstly, in terms of data collection, this study primarily uses subjective evaluation methods to gather data. Although efforts were made to ensure rigor in the data collection process, such as anonymizing responses and using neutral language in the questionnaire design, issues related to social desirability bias and subjective judgments remain difficult to avoid. Additionally, data collected at a single point in time cannot dynamically reveal behavioral characteristics. Future research could consider employing experimental methods to control the research context or using reproducible data, such as app download statistics and online reviews, for variable measurement. Expanding the sample size and survey scope or conducting longitudinal tracking studies could also enhance the generalizability and dynamism of the research findings. Secondly, regarding the research content, we discussed the impact of intrinsic psychological factors and external environments on the implemen-

tation of the program and obtained some statistically significant results. However, the complexity of online and offline interactions has further dimensions that this study has not fully explored. Future research could consider factors such as switching costs and recycling habits for a more comprehensive analysis.

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Appendix A. Measurement Items

Variable	Measurement Items
Recycling behavior (RB)	How many times have you actually used Internet recycling platforms to handle e-waste?
Intention (I)	I am willing to try using online recycling platforms to handle e-waste I am willing to prioritize the use of Internet recycling platforms for the disposal of e-waste I am willing to recommend online recycling platforms to friends and family for handling e-waste
Implementation plan (Chirumalla, #18)	I will use the online recycling platform to handle e-waste in the next six months I have some old electronic products waiting to be processed using the online recycling platform My actual willingness to seek online recycling platforms to handle e-waste is very strong
Subjective norm (Parida, #1)	Important people for me (such as family, friends) will support me in using online recycling platforms to handle e-waste People who can influence my behavior (such as classmates, colleagues) will approve of my use of online recycling platforms to handle e-waste People whose opinions I value (such as media, experts) will approve of my use of online recycling platforms to handle e-waste
Perceived value (PV)	I believe online recycling platforms can provide me with more information about e-waste recycling I believe online recycling platforms can provide me with a wider range of recycling services I believe online recycling platforms can increase my expected benefits (such as economic benefits, environmental benefits, time benefits, etc.
Platform interactivity (PI)	I believe online recycling platforms can ensure timely two-way communication with recyclers I believe online recycling platforms can ensure that my recycling needs are understood by recyclers I believe online recycling platforms can effectively answer my questions
Recycling convenience (RC)	I believe online recycling platforms can allow me to obtain e-waste recycling information more quickly I believe online recycling platforms can allow me to carry out e-waste recycling activities anytime, anywhere I believe online recycling platforms can provide convenient delivery methods for e-waste recycling

Appendix B. Path Analysis Result

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Control Variables								
Gender	−0.32 *	−0.24	−0.21	−0.20	−0.18	−0.23	−0.18	−0.16 ***
Age	−0.12	−0.19	−0.14	−0.14	−0.11	−0.14	−0.13	0.13 **
Level of education	−0.23	−0.27	−0.25	−0.25	−0.20	−0.28	−0.21	0.08
Monthly income (RMB)	0.33 *	0.34 *	0.34 *	0.35 *	0.33 *	0.31 *	0.36 *	0.04
Independent Variable								
I	0.57 ***	0.35 *						0.46 ***
Moderator Variables								
SN				−0.43				
PV					−1.16			
RC						0.84		
PI							−0.52	
Interaction Terms:								
I × SN				1.07				
I × PV					2.24 *			
I × RC						−0.91		
I × PI							1.25 *	
Mediating Variable								
IP		0.21 *	0.656 ***	−0.15	−1.00	1.15	−0.32	

Note: Model 1 is the main effects model; Models 2, 3, and Model 8 are mediation effect models; and Models 4, 5, 6, and 7 are moderation effect models. *, **, and *** indicate significance at the 0.05, 0.01, and 0.001 levels, respectively, in a two-tailed test.

Appendix C. Interview Profile

Number	Name	Gender	Age	Level of Education	Interview Duration
1	H *	Female	26	Doctor's degree	44 Min
2	C **	Female	21	University degree	50 Min
3	Y **	Male	32	Master's degree	25 Min
4	T **	Male	19	University degree	32 Min
5	M *	Female	24	Master's degree	56 Min
6	W **	Female	18	University degree	43 Min
7	X **	Female	20	University degree	62 Min
8	Z **	Male	38	High school	37 Min
9	L **	Male	45	Doctor's degree	28 Min
10	D *	Female	24	Master's degree	35 Min

Note: The initial is the surname of the interviewee; to protect their privacy, their given names are replaced with * or **.

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