

## Article

# Factors Influencing Urban Residents' Intention of Garbage Sorting in China: An Extended TPB by Integrating Expectancy Theory and Norm Activation Model

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**Abstract:** With the deepening of the garbage classification policy strength, making urban household garbage sorting mandatory in China, it is imperative to clarify the key factors affecting the urban residents' intention to behave in garbage classification. Though it has attracted the attention of researchers, there are still several aspects that need to be supplemented and improved. Thus, this study aims to investigate the critical factors affecting the urban residents' intention of garbage sorting and develop an extended model of planned behavior by integrating expectancy theory (ET) and norm activation model (NAM). Given the positive externalities of urban residents' garbage sorting behaviors, awareness of consequences and attribution of responsibility are correspondingly interpreted as environmental benefits (EB) and environmental concerns (EC). The sample data of 668 urban residents who lived in four pilot cities of garbage classification in China were collected and adopted to the structural equation modeling (SEM) with bootstrapping estimation method to assess the causal relationship between variables. The results indicated that the expectation (Exp) was a significant positive predictor of garbage sorting intention. Attitude (AT), perceived behavior control (PBC) and subjective norm (SN) positively affected urban residents' expectation of garbage sorting, with SN having the most significant direct impact. The results also found that the EB has significant influences EC, which strongly influences urban residents' expectation of garbage sorting. Furthermore, the total effect of EC on Exp is higher than other paths, and the mediating effect of SN on Exp by AT and PBC is greater than other indirect paths, which accounted for about 27.1% of the total effect. Finally, we discuss both theoretical and practical implications, along with recommendations for future research.

**Keywords:** garbage classification intention; theory of planned behavior; expectancy theory; environmental benefits; environmental concerns

## 1. Introduction

The increasing population size and sustained economic growth have resulted in annual increases in domestic garbage in China. Based on the China Statistical Yearbook, during the 13th Five-Year Plan period, the amount of China's domestic garbage has risen from 204 million tons in 2016 to 242 million tons in 2019, with an average annual growth rate of about 6%. This amount is expected to exceed 270 million tons by 2021. Current disposal methods include mixed landfill (about 45.59% in 2019) and mixed incineration (approximately 50.69% in 2019), intensifying the demand for landfill land and greenhouse gas emissions during incineration. These problems will ultimately lead to tension in the

human–environment relationship and a significant increase in environmental pollution [1]. Garbage has been referred to as an “urban mineral”, a concept that has been validated in the literature [2,3].

In March 2017, the National Development and Reform Commission of the People’s Republic of China and the Ministry of Housing and Urban–Rural Development of the People’s Republic of China jointly issued *The Implementation Plan for the Household Garbage Classification System*, marking urban household garbage sorting mandatory in China. In June 2019, the *Notice on the Comprehensive Implementation of Domestic Waste Classification in Cities at the Prefectural Level and Above* was issued by the Ministry of Housing and Urban–Rural Development of the People’s Republic of China. In the start-up and pilot phases, garbage classification and processing systems will be established in 46 key cities at the prefectural level and above. In 2020, the second revision of the Law of the People’s Republic of China on the Prevention and Control of Environmental Pollution by Solid Waste was completed, and garbage classification was upgraded to an independent section, which is an integral part of the law. Therefore, the garbage classification policy has been refined, and the implementation regulations are more specific, making garbage sorting in urban households mandatory. The subsequent promulgation and formulation of policies and systems at the macro level promote top-level design and the formation of a system for garbage classification. Therefore, the degree of participation of urban residents in garbage classification determines the practical operation and long-term success of policies and systems. Previous studies found that the results of urban residents’ garbage sorting were unsatisfactory, and variable results were observed for different cities [1,4–6]. Thus, it is imperative to identify the main influencing factors affecting urban residents’ behavioral intention of garbage sorting.

Few studies have focused on urban residents’ behavioral intention of garbage sorting and the influencing factors. However, several aspects need to be discussed. First, due to the popularity of the policy of mandatory garbage classification, the logical relationship between the main predictive variables affecting urban residents’ behavioral intention/behavior may need to be adjusted. Several studies have shown that urban residents’ intention and behavior of garbage sorting were always positively related. However, the causal relationship between the determinants and the intention is not consistent. Zhang et al. [7] found that the attitude (AT), perceived behavioral control (PBC) and classification knowledge (CK) were positively related to Chengdu residents’ intention of garbage sorting, and the attitude had the most significant impact. However, the subjective norm (SN) and infrastructure had no significant effect on intention, and incentive measures failed to strengthen the intent.

In contrast, Wang et al. [8] showed that attitude, subjective norm, perceived behavioral control, moral norm and classification knowledge about garbage sorting positively affected Heifei residents’ intention, and the classification knowledge had the most significant impact. Meanwhile, incentive measures strengthened the relationship between intention and behavior. In addition, Zhang et al. [9] found that attitude had the greatest impact on Tai’an residents’ intention of garbage sorting. However, the subjective norm and perceived behavioral control had no significant effect on the residents’ intention, and facility accessibility failed to moderate the relationship between intention and behavior. Wang et al. [10] analyzed the antecedent variables of garbage sorting intention using the extended theory of planned behavior (TPB). The results showed that the residents’ garbage sorting intentions were significantly correlated with the behavior, facility accessibility and moral norm. In contrast, the perceived behavioral control and policy factors did not significantly affect residents’ garbage sorting intention. The second aspect that requires additional research is that differences in the results of existing studies may imply that additional variables need to be integrated to strengthen the relationship between the independent and dependent variables based on the TPB framework. The reviewed literature indicates that the relationship between subjective norm, perceived behavioral control and classification intention is uncertain. Incentive measures and facility accessibility do not

always strengthen the relationship between behavioral intentions and behavior. Therefore, the extended model TPB adjusts the relationship between variables to provide a better explanation of the residents' intention to sorting. Third, more comprehensive information can be obtained by increasing the number of survey regions. The homogeneity of residents from a single region may affect the results due to similarities in the knowledge structure, subjective norm and attitude.

It is undeniable that the extended TPB model has higher robustness for interpreting and predicting behavioral intentions by integrating other variables. Therefore, in this study, the extension of the TPB model is based on the following two aspects. First, we utilize Vroom's expectancy theory (ET) since the expectation (Exp) is an essential source of driving an individuals' behavioral intention. Second, we incorporate the norm activation model (NAM) because moral norm are critical predictors of an individual's positive attitude. In addition, the awareness of consequences (ACs) and attribution of responsibility are correspondingly interpreted as environmental benefits (EB) and environmental concerns (EC) and as antecedent variables of subjective norm (SN) and moral norm (MN), respectively. The objectives of this research are to:

- (1) Use Vroom's expectancy theory (ET) to examine the effect of individual's expectation (Exp) on urban residents' intention to garbage sorting.
- (2) Use the NAM to analyze the effect of environmental benefits and concerns on subjective norms and moral norms, respectively.
- (3) Assess the mediating effect of environmental concerns on expectation (EC→Exp) relationship based on the attitude, moral norm and perceived behavioral control and the mediating effect of subjective norm on expectation (SN→Exp) relationship base on the attitude and perceived behavioral control.

Thus, this paper provides significant information for researchers and decisionmakers to understand urban residents' intention to garbage sorting and develop suitable plans to guide garbage classification using a science-based method.

The remainder of this paper is organized as follows: Section 2 explains the conceptual framework and hypothesis. Section 3 presents the methodology, including the measurements, sample collection and profile and data analysis. Section 4 describes the results, including the analyses of the model and the mediating effects. Section 5 discusses the results from theoretical and practical aspects. The final section provides the conclusion.

## 2. Conceptual Framework and Hypothesis

### 2.1. Theory of Planned Behavior and Its Extended Model

The theory of reasoned action (TRA) and the TPB have been widely used in a multitude of behavioral domains to explain an individual's behavioral intention and behavior in the decision-making process [11–17]. The TRA model holds that subjective norm and attitude toward behavior are the driving factors affecting behavioral intention [18]. Subsequently, Ajzen [19] incorporated perceived behavioral control into the TRA model, substantially improving the predictive ability of this model and extending the TPB. A favorable attitude, supportive subjective norm and sufficiently strong perceived behavioral control are the determinants of an optimistic behavioral intention. Behavioral intention results in behavior, and perceived behavioral control affects this behavior [20–22]. Intention reflects the degree of effort to implement a particular behavior and can also be understood as the individual's subjective possibility or intention to behave in a specific manner in the future [19]. Some empirical studies have confirmed that intention is a significant indicator of actual behavior; thus, it is feasible for intention to replace real action as a dependent variable [15,23–26].

Since garbage sorting by urban residents falls into the pro-environmental domain, it is reasonable for this study to use the TPB model as the basic framework. Nevertheless, as Ajzen [22] said, "the TPB is, in principle, open to the inclusion of additional predictors". Therefore, additional variables are required to analyze individual behavior decisions in specific context. The criteria for adding variables to the TPB model are as follows [22]:

- (1) Compatibility. The added variables meet the criteria for defining and measuring specific behaviors in the same manner as the theory's existing variables.
- (2) Causality. The added variables meet the criteria of being causal factors that determine intention or behavior.
- (3) Independence. The added variables should not be the same as the theory's existing variables.
- (4) Versatility. The added variables are suitable for a multitude of behavioral domains.

## 2.2. The Extended TPB Model Based on Expectation (Exp)

The well-respected expectancy theory (ET) was proposed by Vroom [27] to explain the decision-making process of individuals who have various behavioral alternatives [28–32]. Traditionally, the framework states that an individual's desire for a performance target (defined as valence) increases their level of effort (defined as instrumentality) to achieve expected outcomes (defined as expectation), i.e., the higher the efforts, the higher the likelihood of achieving the performance target [31,32]. Vroom's expectancy theory emphasizes how to promote the formation of individual motivational forces, thus facilitating the creation of appropriate incentive plans in the workplace. The theory is also referred to as the process theory of motivation. The higher the individual's cognition of self-competence, the more likely they are to form the behavioral intention or implement the behavior. Researchers have found that individual expectation was the determinant of behavioral choice and had a significant positive effect on pro-environment behavioral intention [24,29]. In the current study context, the expectation factors of expectancy theory include knowledge, skills, confidence and being a role model for other people, denoting an individual's cognition of self-competence. These indicators are consistent with the internal factors of the perceived behavioral control proposed by Kraft et al. [33], reflecting the rationality of expectation as an additional construct based on the TPB. The following hypothesis is developed:

**Hypothesis 1. (H1.)** *Expectation (Exp) significantly affects urban residents' intention to garbage sorting (Int).*

Attitude (AT) as an accessible behavioral belief in the TPB model is based on a rational evaluation of an individual's behavioral intention/behavior. In performing a specific behavior, a favorable attitude can increase an individual's desire for knowledge, skills and confidence, resulting in expectation that generates behavioral intentions/behavior [8,34,35]. As a result, we believe that the urban residents' attitudes are positively associated with the expectation of garbage sorting.

Subjective norms (SN) refer to the social pressure that individuals perceive coming from important people around them (e.g., families, friends or neighbors, etc.) when making decisions about whether to perform an action or not. When a person believes that people around them support or affirm their behavior and have a positive attitude toward the behavior, positive perception expectations are formed, resulting in behavioral intention/behavior. Studies have found that subjective norm had the most significant effect or no effect among all antecedent variables [7,16,23,36,37]. The main reason for this difference lies in the cultural differences between countries, namely collectivism and individualism, whereas the effect from the actual behavior is minor. Previous studies have observed positive relationships between subjective norms, attitude and perceived behavioral control [38–40]. Therefore, subjective norms are crucial to the attitudes, perceived behavioral control and expectation of urban residents' regarding garbage sorting.

Perceived behavioral control (PBC) is regarded as the degree of perceived difficulty to enact a behavior according to one's abilities or experiences. It reflects the individual's perceived ability to overcome barriers to perform a behavior [22]. In addition, Kraft, Rise, Sutton and Røysamb [33] proposed that perceived behavioral control includes both internal and external perception factors. Internal factors mainly refer to skills, knowledge, information identification and confidence, whereas external perception factors include time,

energy, cost and other aspects. In this study, the internal factors of perceived behavioral control are equivalent to the expectation factors of the expectancy theory. Typically, direct or indirect effects impact the perceived behavioral control in the relationship with intention, and indirect effects account for about 20% to 60% of the total effects [23,41,42].

In view of this, the following hypotheses are proposed:

**Hypothesis 2. (H2.)** *Attitude (AT) positively affects urban residents' expectation of garbage sorting (Exp).*

**Hypothesis 3. (H3.)** *Subjective norms (SN) positively affect urban residents' expectation of garbage sorting (Exp).*

**Hypothesis 4. (H4.)** *Perceived behavioral control (PBC) positively affects urban residents' expectation of garbage sorting (Exp).*

**Hypothesis 5. (H5.)** *Subjective norm (SN) positively affects urban residents' attitude of garbage sorting (AT).*

**Hypothesis 6. (H6.)** *Subjective norms (SN) positively affect urban residents' perceived behavioral control (PBC) of garbage sorting.*

### 2.3. The Extended TPB Model Based on Environmental Benefit (EB) and Environmental Concerns (EC)

The decision-making process of an individual is driven by multiple motivations and is not necessarily caused only by a rational person's assumptions. Therefore, the urban residents' garbage-sorting behavior is regarded as a mixture of self-interest and altruism. Norm activation theory (NAM), which aims to provide a reasonable explanation for pro-social intentions/behaviors, states that people exhibit altruism and helpfulness in daily life [43,44]. Studies have reported that supportive moral norm will lead to an individual's favorable attitude toward forming intentions and enacting a behavior [23,45,46]. Thus, the decision-making process of urban residents' for sorting garbage falls into the moral domain and is defined as moral norm (MN) in this study. Awareness of consequence is another variable in the NAM model. It indicates that environmental quality is directly related to population health, social development and the natural environment [47]. Not performing a pro-social behavior will have adverse awareness consequences [11]. Similarly, individuals are more inclined to be aware of positive consequences by participating in garbage sorting. Thus, awareness of consequence is the antecedent variable for subjective and moral norms since they improve the environmental quality, promote resource recovery and reduce human health risks. The awareness of positive consequences leading to environmental well-being is an environmental benefit (EB). Cudjoe, Yuan and Han [6] utilized the TRA and found a positive relationship between residents' awareness of environmental benefit (EB) and their garbage sorting intention. Therefore, environmental benefits of garbage sorting may be positively related to an individual's subjective and moral norm.

The attribution of responsibility is the last variable in the NAM framework. It refers to individual behavior that can prevent or aggravate potential adverse consequences [48] of not performing a pro-socially behavior [11]. Likewise, individuals are more inclined to take responsibility for positive consequences by participating in garbage sorting, thus enhancing the individuals' perceived behavioral control and moral norm, which is conducive to environmental protection, the balance of nature and humans living in harmony with the environment [49,50]. Environmental concern (EC), which refers to an individual's concern level regarding environmental issues, is a valid predictor of environmentally conscious behavior [51]. We established the following hypotheses:

**Hypothesis 7. (H7.)** *Moral norm (MN) significantly influences urban residents' attitude of garbage sorting (AT).*

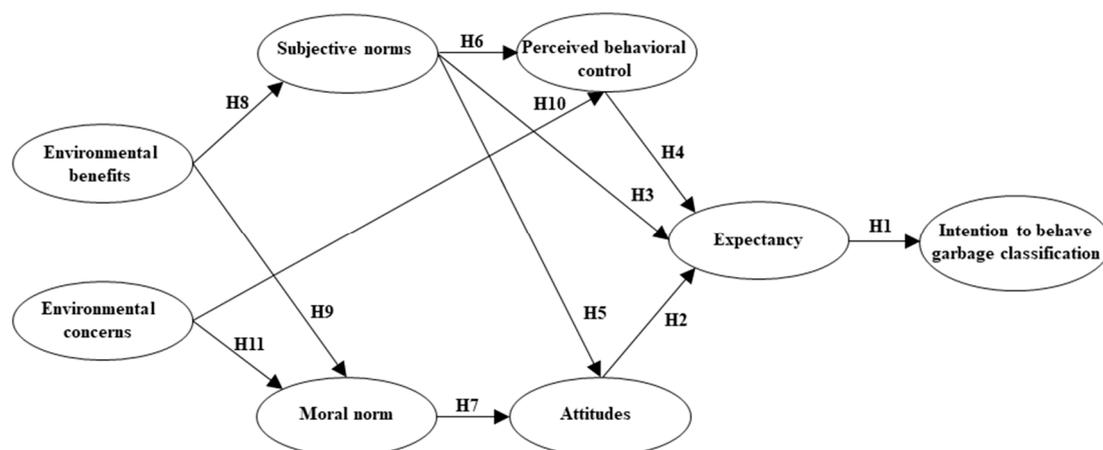
**Hypothesis 8. (H8.)** Environmental benefits (EB) significantly influence urban residents' subjective norm (SN).

**Hypothesis 9. (H9.)** Environmental benefits (EB) significantly influence urban residents' moral norm (MN).

**Hypothesis 10. (H10.)** Environmental concerns (EC) significantly influence urban residents' perceived behavioral control (PBC).

**Hypothesis 11. (H11.)** Environmental concerns (EC) significantly influence urban residents' moral norm (MN).

Therefore, the proposed conceptual model of the hypothesis is shown in Figure 1.



**Figure 1.** The conceptual model framework of hypothesis.

### 3. Methodology

#### 3.1. Questionnaire Design

The measurement scale was developed based on the proposed conceptual model (Figure 1), which included 37 measurement items from previous literature (see Table S1 for details) [11,28,52–58]. These observed variables were appropriate amendments developed to fit this study's settings. Then, we improved the precision of the measurement from the following three aspects. First, the linguistic description of each observation variable was consistent with the background of garbage classification in China. Second was a pre-test and reviews by professors, experts and urban residents from the pilot city of garbage classification. According to their opinions and suggestions, each item was improved to be best read and understood. Third, this study conducted a pilot with 30 participants as samples to guarantee content validity. The questionnaire adopted a 5-point Likert scale (from 1 = strongly disagree/extremely unimportant to 5 = strongly agree/extremely important).

#### 3.2. Data Collection

Questionnaires were conducted in four pilot cities in the eastern region (Beijing and Shanghai), the central region (Hefei) and the southwest region (Chongqing) of China. These cities were identified as urban garbage classification pilot cities by the Chinese government. The urban residents' intention to garbage sorting in these cities would represent of citizens in other Chinese cities facing similar problems. To make respondents more aware of a policy document issued by the Ministry of Housing and Urban–Rural Development of the People's Republic of China, essential background information about the *Notice on the Comprehensive Implementation of Domestic Waste Classification in Cities at the Prefectural Level and Above* (in

June 2019) was introduced to respondents in the first part of the questionnaire, namely by the three-step strategy: In the start-up and pilot phases (from 2019 to 2020), garbage classification and processing system would be established in the 46 pilot cities. From 2021 to 2022, at least one district of each prefecture-level city is been fully covered by domestic garbage classification, and a street of the rest districts is set up as a demonstration site for domestic garbage classification; by 2025, a garbage classification system will be built in China. The survey was conducted from January to March of 2021. The questionnaire survey was conducted using an online. The invitation cards with the URL of the questionnaire web page were sent to a residential property in the target cities (<http://www.sojump.com>, accessed on 18 March 2021). After the completion, small incentives (i.e., red envelopes) were randomly assigned to the participants to appreciate their contribution. Adopting a convenience sampling method, questionnaires were distributed among urban residents, mostly young people. Previous studies have confirmed that samples of young people were reliable by the convenience sampling method [59,60]. About 80% of responses were from young people aged below 45 years old in this study. A total of 1000 invitation cards were sent out, and 758 online replies were received. Ninety questionnaires were removed based on logic errors and the same options. Ultimately, 668 valid responses were received, for a response rate of 66.8%.

One-factor analysis of variance (ANOVA) was used to check significant differences between the four pilot cities. No significant difference was found in all the constructs among the four pilot cities ( $p < 0.05$ ). Thus, it was feasible to combine the samples of the four pilot cities into a complete sample for data analysis. The chi-square test showed no problem in the non-response bias assessment of the data ( $p > 0.05$ ). Common Method Bias (CMB) might have influenced the observed strength among the study variables [61]. On the one hand, CMB might have mitigated by collecting data from multiple sources [62]. As can be seen from the occupational distribution of the sample, the different sources mainly include self-employment, corporate employees and civil servants/public institution staff. On the other hand, Harman's one-factor method was employed to check the CMB. Firstly, exploratory factor analysis found that the variance interpretation rate of the first factor was only 9.965% (less than 50%) before no rotation. The results indicated that the CMB was acceptable. Moreover, the maximum correlation coefficient of all variables in the scale is 0.427 (less than 0.9), which also indicates that the CMB of the data is not a problem.

### 3.3. Data Analysis Method

Statistical analysis and structural equation modeling (SEM) employed SPSS 25.0 and AMOS 24.0. SEM calculated the simultaneous assessment of the general relationships between various independent and dependent variables [63–65]. We followed Anderson and Gerbing [66] recommendations to employ a two-step process in the current study. Accordingly, we first performed confirmatory factor analysis (CFA). Following a satisfactory fitting result, the structural model was further evaluated. The path coefficients of each hypothetical relationship were measured, and the extent of model fit was often focused on these indices such as CFI, TLI, RMSEA and so on.

## 4. Data Analysis and Results

### 4.1. Sample Profile

The survey was conducted in four pilot cities in China, whose population accounts for 6.25% of the total population. Based on the results of China's 7th National Population Census, 17.9% of people are aged 0–14, 63.4% are aged 15–59, and 18.7% are aged 60 and above. A total of 51.2% of residents were male. These percentages were consistent with those listed in Table 1. As can be seen from Table 1, 52.5% of responses were male. About 79% of the respondents were aged 26–45. Most respondents had an educational level of bachelor's degree or higher (66%), and only 16.3% had a senior high school education or below. In comparison, the average education level in literature [7–9,12,15,23,67] was: 21.4% senior high school or below, 24.7% junior college, 34.5% bachelor's degree, 21.6% master's

degree or Ph.D., which is similar to the survey result of this study. The respondents included self-employed people, corporate employees and civil servants/public institution staff, accounting for 18%, 32.6% and 46.4%, respectively. The monthly income level was predominantly RMB 5001 to 10,000, accounting for about 35% of the total sample.

**Table 1.** The demographic composition of the samples (N = 668).

Variable	Category	Frequency	Percent (%)	Variable	Category	Frequency	Percent (%)
Gender	Male	351	52.5	Occupational	Master's degree or Ph.D.	172	25.7
	Female	317	47.5		Self-employment	120	18.0
Age	Under 25	11	1.6	Corporate employees	217	32.6	
	26–35	224	33.5	Civil servants/Public Institution staff	309	46.4	
	36–45	300	44.9	Retirees	20	3.0	
	46–55	112	16.8	Under 3000	54	8.1	
	Over 56	21	3.1	3001–5000	131	19.6	
Educational level	Senior high school or below	109	16.3	Income/month (RMB)	5001–10,000	231	34.6
	Junior college	124	18.6		10,001–15,000	104	15.6
	Bachelor's degree	263	39.4		Over 15,000	148	22.2

#### 4.2. Establishment of the Model and Measurements

Before the confirmatory factor analysis (CFA), the skewness and kurtosis of each variable were examined (skewness =  $-0.099$  to  $0.458$  and kurtosis =  $-0.775$  to  $0.448$ ), and their absolute values were all within 1. Therefore, the sample data met the normal distribution assumption. CFA was used to check the reliability and validity of each construct using the maximum likelihood [24,68]. A satisfactory fitting result was obtained with the following parameters: chi-square/degree of freedom =  $1.907$ , RMSEA =  $0.037$ , CFI =  $0.952$ , TLI =  $0.946$ , IFI =  $0.953$ , SRMR =  $0.059$ .

As shown in Table 2, the lowest values of Cronbach's alpha and the composite reliability were  $0.773$  and  $0.832$ , respectively; both values were above the recommended benchmark value of  $0.70$  [69,70], thus confirming the consistency and reliability. The loadings of all observed variables were within  $0.703$ – $0.913$  (Table 2), and all were higher than the standard value of  $0.70$  [15,71,72]. The average variance extracted (AVE) was in the range of  $0.555$ – $0.669$ , which exceeded  $0.5$ , thus supporting convergent validity. Table 3 shows that the minimum value of  $\sqrt{AVE}$  was  $0.745$  among the latent constructs, the maximum value of the correlation coefficient between two different latent constructs was  $0.427$  and  $ASV < AVE$ , thus also supporting discriminant validity [15,69]. These results indicate that the proposed model has adequate reliability and good validity.

**Table 2.** Results of reliability and validity analysis.

Construct and Measurement Items	Loadings	Cronbach's Alpha	CR	AVE
Environmental concerns (EC)				
EC1	0.767	0.902	0.909	0.669
EC2	0.743			
EC3	0.764			
EC4	0.913			
EC5	0.888			

Table 2. Cont.

Construct and Measurement Items	Loadings	Cronbach's Alpha	CR	AVE
Moral norm (MN)				
MN1	0.785			
MN2	0.789			
MN3	0.744	0.791	0.847	0.58
MN4	0.727			
Attitudes of garbage sorting (AT)				
AT1	0.763			
AT2	0.718	0.79	0.841	0.57
AT3	0.796			
AT4	0.743			
Environmental benefits (EB)				
EB1	0.755			
EB2	0.747			
EB3	0.799	0.833	0.866	0.563
EB4	0.723			
EB5	0.725			
Subjective norm (SN)				
SN1	0.799			
SN2	0.710			
SN3	0.718	0.773	0.832	0.555
SN4	0.748			
Perceived behavioral control (PBC)				
PBC1	0.707			
PBC2	0.784			
PBC3	0.785	0.791	0.839	0.567
PBC4	0.733			
Expectation of garbage sorting (Exp)				
Exp1	0.791			
Exp2	0.749			
Exp3	0.804	0.854	0.86	0.606
Exp4	0.768			
Intention to garbage sorting (Int)				
Int1	0.703			
Int2	0.814			
Int3	0.796			
Int4	0.758	0.840	0.918	0.616
Int5	0.793			
Int6	0.819			
Int7	0.806			

Table 3. Descriptive statistics, convergent and discriminant validity.

Construct	EC	MN	AT	EB	SN	PBC	Exp	Int	ASV
EC	<b>0.818</b>	0.114	0.117	0.077	0.099	0.065	0.139	0.136	0.107
MN	0.337 ***	<b>0.762</b>	0.128	0.061	0.061	0.066	0.099	0.076	0.086
AT	0.341 ***	0.357 ***	<b>0.755</b>	0.057	0.063	0.048	0.096	0.083	0.084
EB	0.277 **	0.247 **	0.239 **	<b>0.751</b>	0.136	0.183	0.109	0.122	0.106
SN	0.315 ***	0.246 **	0.250 ***	0.369 ***	<b>0.745</b>	0.122	0.096	0.115	0.099
PBC	0.255 ***	0.257 ***	0.220 ***	0.428 ***	0.349 ***	<b>0.753</b>	0.130	0.126	0.106
Exp	0.373 ***	0.314 ***	0.310 ***	0.329 ***	0.310 ***	0.361 ***	<b>0.778</b>	0.183	0.122
Int	0.369 ***	0.276 ***	0.288 ***	0.349 ***	0.339 ***	0.355 ***	0.427 ***	<b>0.785</b>	0.120

Note: The numbers in the diagonal row (bold) are the values of  $\sqrt{AVE}$ ; The numbers above diagonal are the squared correlation coefficients between the constructs; the numbers below the diagonal are the correlation coefficients between the constructs. ASV is Average Shared Variance; \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

### 4.3. Structural Model Analysis

AMOS 24.0 was used to analyze the hypothesis model. The model fit showed a satisfactory goodness-of-fit (chi-square/degree of freedom = 2.235, RMSEA = 0.043, CFI = 0.933, TLI = 0.927, IFI = 0.934) [72]. The results indicated a good fit of the hypothesis model. The path coefficients obtained from the AMOS results are listed in Table 4. The results supported all the hypothetical paths, and the modification indices suggested potential improvements to the hypothesis model. After adding two newly discovered paths from environmental concerns to expectation (D1) and environmental benefits to environmental concerns (D2), the goodness-of-fit improved significantly. The results of the final model fit were as follows: chi-square/degree of freedom = 2.112, RMSEA = 0.041, CFI = 0.940, TLI = 0.934, IFI = 0.940, SRMR = 0.076. A comparison of the fit index results between the final model and the original TPB model (chi-square/degree of freedom = 2.294, RMSEA = 0.044, CFI = 0.949, TLI = 0.941, IFI = 0.949) confirmed that the final model was reasonable ( $\Delta$ RMSEA = 0.003 < 0.015 and  $\Delta$ CFI = 0.009 < 0.01) [73]. Therefore, the final model includes two new significant paths (D1 and D2); all paths are summarized in Table 4.

**Table 4.** Summary of hypotheses testing results.

Path	Path Coefficient	t-Value	Results
H1: Exp→Int	0.564	9.895 ***	Supported
H2: AT→Exp	0.190	2.836 ***	Supported
H3: SN→Exp	0.205	4.271 ***	Supported
H4: PBC→Exp	0.156	3.000 **	Supported
H5: SN→AT	0.178	7.417 ***	Supported
H6: SN→PBC	0.349	7.271 ***	Supported
H7: MN→AT	0.232	8.593 ***	Supported
H8: EB→SN	0.303	6.733 ***	Supported
H9: EB→MN	0.172	4.300 ***	Supported
H10: EC→PBC	0.132	3.882 ***	Supported
H11: EC→MN	0.245	7.000 ***	Supported
D1: EC→Exp	0.316	9.294 ***	Supported
D2: EB→EC	0.227	4.830 ***	Supported

Note: \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

We found that H1 (Exp→Int) had the highest path coefficient (See Table 4). The expectation of garbage sorting was a significant positive predictor of garbage sorting behavioral intention ( $\beta = 0.564$ ,  $t = 9.895$  \*\*). D1 (EC→Exp) posited that the environmental concerns positively influenced expectation of garbage sorting, which was confirmed ( $\beta = 0.316$ ,  $t = 9.294$  \*\*). These results indicate that the higher the environmental concern regarding garbage sorting, the higher the personal expectation is, and the more likely it is that the person will perform garbage sorting. Second, personal expectations were positively influenced by attitude (H2), subjective norm (H3) and perceived behavioral control (H4). The links were all significant ( $\beta$ H2 = 0.190,  $t = 2.836$  \*\*;  $\beta$ H3 = 0.205,  $t = 4.271$  \*\*\*;  $\beta$ H4 = 0.156,  $t = 3.000$  \*\*), thus confirming H2, H3 and H4. In addition, the remaining path coefficients were H6 ( $\beta = 0.349$ ,  $t = 7.271$  \*\*\*), H8 ( $\beta = 0.303$ ,  $t = 6.733$  \*\*\*), H11 ( $\beta = 0.245$ ,  $t = 7.000$  \*\*\*), H7 ( $\beta = 0.232$ ,  $t = 8.593$  \*\*\*), D2 ( $\beta = 0.227$ ,  $t = 4.830$  \*\*\*), H9 ( $\beta = 0.172$ ,  $t = 4.300$  \*\*\*), H5 ( $\beta = 0.178$ ,  $t = 7.417$  \*\*\*) and H10 ( $\beta = 0.132$ ,  $t = 3.882$  \*\*), and all links were significant. The effect of the subjective norm on perceived behavioral control was more dominant than the effect of environmental concern. The environmental concern had a more dominant influence on moral norm than environmental benefit, and the moral norm had a larger effect on attitude than subjective norm.

In the original TPB model, the path coefficients were 0.178 (SN→AT), 0.355 (SN→PBC), 0.216 (MN→AT), 0.126 (PBC→Int), 0.106 (SN→Int) and 0.196 (AT→Int). In the hypothesis model, the path coefficients were 0.559 (Exp→Int), 0.196 (AT→Exp), 0.240 (SN→Exp), 0.200 (PBC→Exp), 0.176 (SN→AT), 0.138 (EC→PBC), 0.346 (SN→PBC), 0.234 (MN→AT), 0.176 (EB→MN), 0.298 (EB→SN) and 0.249 (EC→MN).

#### 4.4. Mediating Effect Analysis

We used the bootstrapping method of MacKinnon et al. [74] and Williams and MacKinnon [75] to test the effect of the moderating variables. Unlike the Sobel test, the bootstrap method does not assume a normal distribution of the indirect influence and does not require a large sample size [76,77]. In addition, no standard error is needed to estimate the interval of the mediating effect. If the 95% confidence interval does not contain zero (95% C.I.  $\not\subset 0$ ), the mediating effect holds. Therefore, the bootstrap method is more accurate and reliable for analyzing multiple mediating effects.

Table 5 presents the results of the direct, indirect and total effects analysis. The 95% confidence interval, positive asymptotic critical ratio (Z-values > 0) and significant *p*-values of the test indicated that all mediating effects were positive and significant.

**Table 5.** The results of direct, indirect and total effects analysis.

Effect Source	Point Estimate	Product of Coefficients		Bias-Corrected 95% C.I.		Percentile 95% C.I.	
		SE	Z-Value	Lower	Upper	Lower	Upper
Indirect Effects							
EC→ PBC→ Exp (EE1)	0.020	0.009	2.222 ***	0.006	0.044	0.005	0.042
EC→ MN→ AT→ Exp (EE2)	0.007	0.004	1.750 **	0.002	0.017	0.001	0.016
Total EE1 and EE2	0.028	0.010	2.800 ***	0.011	0.053	0.010	0.051
SN→ AT→ Exp (SE1)	0.022	0.011	2.000 **	0.006	0.051	0.004	0.048
SN→ PBC→ Exp (SE2)	0.054	0.019	2.842 ***	0.022	0.097	0.019	0.093
Total SE1 and SE2	0.076	0.022	3.455 ***	0.039	0.125	0.037	0.121
EB→ EC→ MN (EM1)	0.055	0.014	3.929 ***	0.032	0.087	0.030	0.084
Direct Effects							
EC→ Exp (EE)	0.316	0.046	6.870 ***	0.220	0.405	0.222	0.406
SN→ Exp (SE)	0.205	0.057	3.596 ***	0.089	0.314	0.091	0.315
EB→ MN (EM)	0.172	0.046	3.739 ***	0.084	0.261	0.085	0.263
Total Effects							
Total EE and EE1 and EE2	0.344	0.045	7.644 ***	0.248	0.430	0.250	0.432
Total SE and SE1 and SE2	0.281	0.052	5.404 ***	0.173	0.379	0.175	0.379
Total EM and EM1	0.228	0.045	5.067 ***	0.140	0.314	0.142	0.316
Contrasts							
SE2 vs. EE1	0.034	0.016	2.125 **	0.011	0.075	0.008	0.068

Note: 5000 bootstrap samples; \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

The total indirect effects of the environmental concerns on expectation through attitude, moral norm and perceived behavioral control were positive and significant (Z-value = 2.800 > 1.96, 95% C.I.  $\not\subset 0$ ,  $p < 0.001$ ). Subsequently, we analyzed specific indirect effects of the EC→Exp relationship. As shown in Table 5, the specific indirect effects were EE1 0.020 (through the perceived behavioral control), EE2 0.007 (through the attitude and moral norm). After the examining the potential mediators, we found that the perceived behavioral control was a significant mediator of the EC→Exp relationship (Z-value = 2.222 > 1.96, 95% C.I.  $\not\subset 0$ ,  $p < 0.001$ ), and the attitude and moral norm were mediators of the EC→Exp relationship (Z-value = 1.750, 95% C.I.  $\not\subset 0$ ,  $p < 0.01$ ). Meanwhile, environmental concerns were also significant mediators of the EB→MN relationship (Z-value = 3.929 > 1.96, 95% C.I.  $\not\subset 0$ ,  $p < 0.001$ ).

The SN→Exp relationship was mediated by attitude and perceived behavioral control, and the total indirect impacts were positive and significant (Z-value = 3.455 > 1.96, 95% C.I.  $\not\subset 0$ ,  $p < 0.001$ ). Two specific indirect effects were SE1 0.020 (through attitude) and SE2 0.054 (through perceived behavioral control), and both attitude and perceived behavioral control were significant mediators of the SN→Exp relationship, as shown in Table 5. However, the difference between SE1 and SE2 was not significant (the data are not shown). The total indirect effect on expectation from subjective norm 0.076 (through attitude and perceived behavioral control), which was higher than that from environmental concerns

0.028 (through perceived behavioral control, moral norm and attitude). The significant difference occurred due to the SE2 and EE1 ( $Z$ -value = 2.125 > 1.96, 95% C.I.  $\not\subset 0$ ,  $p < 0.01$ ). In contrast, the direct and total effects on expectation from environmental concerns were 0.316 and 0.344, respectively (EE and Total EE and EE1 and EE2), which was greater than that from subjective norm (SE and Total SE and SE1 and SE2). The indirect effect of the subjective norm on expectation was 27.1% of the total effect.

## 5. Discussion

### 5.1. Theoretical and Practical Implications

This study investigated whether a mandatory garbage classification policy improved the intention of urban residents to sorting garbage in pilot cities and the influencing factors. The results are vital for follow-up policies and to determine the effectiveness of policy implementation. We established an extended TPB model that integrates the planned behavior, norm activation and expectation. The study provides new information on the relationship between expectation and intention of garbage sorting based on the extended TPB model. The integration deepens the current understanding of the expectation mechanism affecting garbage sorting and the resulting behavioral intent. Empirically, the study verified that the extended TPB model provided a valid framework for identifying the primary determinants influencing the intent of garbage sorting and the relationship between the determinants. Similar to previous studies, we added new variables into to improve the explanatory power of the extended TPB model [15,16,49,71,78].

The empirical results of our study showed that expectation of garbage sorting as an antecedent variable of the intention (H1: Exp→IB) had significant positive effects. This result implies that the extended TPB has an excellent explanatory ability for the intention of garbage sorting after adding the expectation variable. This approach improves our understanding of how expectation affects the intention to garbage sorting and has crucial theoretical value. The intention to sorting garbage is positively affected when urban residents expect that their actions will eventually significantly improve the environment quality. This finding conforms to that of Kiatkawsin and Han [24] and Tang, Liu and Long [29], who reported evidence that individuals with higher expectation were more likely to form an intention to behave pro-environmentally. This result provides a strategy for boosting residents' intention to garbage sorting and detailed guidance on garbage classification, saving residents' time and energy and reducing confusion about garbage sorting methods in daily life. Moreover, the importance of garbage sorting for improving environmental quality and promoting resource recovery needs to be constantly strengthened. This information increases positive expectations, resulting in the intention to garbage sorting.

Our results showed that three variables in the original TPB model (attitude (H2), subjective norm (H3) and perceived behavioral control (H4)) were positively and significantly associated with the expectation of garbage sorting. The results suggest that urban residents' perceived expectations of garbage sorting are higher when they have favorable attitude toward garbage sorting and experience social pressure to the garbage sorting in daily life. Notably, the path coefficient of D1 (0.316) in the final TPB model was much higher than that of the other three antecedents associated with expectation of garbage sorting (see Table 4). The above results indicate that the level of residents' environmental concern is the primary determinant of the expectation of garbage sorting, and that the total impact of the EC→Exp relationship on the expectations is 0.344 (see Table 5). In other words, the higher the environmental concern, the more likely it is that the residents' have a high expectation of garbage sorting. Therefore, in the era of mandatory garbage classification, the government should take measures to enhance the urban residents' environmental concerns to strengthen the synergies between the various measures [79]. The current study suggests a potential strategy for raising the level of the environmental concerns of urban residents. The higher the cognition of urban residents' environmental benefits, the more likely they are to have higher environmental concerns. If the implementation of a policy

can significantly improve environmental quality, it will significantly enhance the residents' responsiveness to environmental benefits. Thus, the government should carefully analyze the measures of garbage classification through various channels (such as schools, communities and public places), so that the measures do not represent a punishment, which would weaken the positive aspects of the policy.

As an essential antecedent variable of an individual's participation in pro-environmental behavior, the moral norm is often added to TPB models to improve the predictive ability of extended TPB models [23,25,37,49,67,80]. Therefore, we attempted to add moral norm to the TPB model and found that this variable indirectly affected expectation of garbage sorting through attitude. This finding verifies the theoretical contribution of the moral norm to the extended TPB model [9]. It is worth noting that the direct influence of the EB/EC→MN relationship is significant and positive. This result is in line with the argument by Shi, Fan and Zhao [67] that people who have higher environmental concern are more likely to have higher moral norm. In addition, environmental benefits can also indirectly affect moral norms through environmental concerns; the indirect effect of the EB→MN relationship was 24.1% of the total impact. The present study found that the extended TPB that included environmental benefits and concerns as new variables was a useful framework for describing the impact of moral norms and attitude on expectation of garbage sorting. The magnitude of the total effect of EC→Exp was 1.2 times greater than SN→Exp.

In summary, enhancing urban residents' expectation of garbage sorting could be an alternative guiding principle in follow-up policy supplements. If the government adopts this principle and uses other variables in the TPB model, the intention to garbage sorting can be improved. In addition, the results of this study suggest that the follow-up policy supplements should be improved by considering environmental benefits and concerns. The results showed that environmental benefits and concerns should be taken into account in policy measures to strengthen urban residents' attitude, moral norm, subjective norm and perceived behavioral control.

## 5.2. Limitations and Future Research

Several limitations of this study have to be considered in the future. First, this study used a specific context (i.e., the era of mandatory garbage classification) and expanded the TPB by integration with the NAM and ET. Thus, the sample dataset may not be representative. A replication of this study in different scenarios and with different behaviors will improve the generalization ability of the proposed method and the integrity of the findings. Second, due to the nature of online data collection, the actual behavior of urban residents regarding garbage sorting cannot be tracked. Since the actual behavior is highly variable, we replaced behavior with intention. Finally, an assessment of the implementation results of the mandatory garbage classification policy is critical to ensure effective policy implementation. The assessment results can influence follow-up policies and multi-path interventions regarding the behavior of urban residents' related to garbage sorting.

## 6. Conclusions

This study developed an extended TPB model that integrated the TPB, the NAM and Vroom's ET. We analyzed the influences of social-psychological factors on urban residents' intention to garbage sorting in pilot cities in China. The main conclusions were as follows. First, the explanatory ability of the extended TPB for garbage sorting intention was 31.9%. Second, new insights were found and confirmed regarding the relationship between expectation and intention to garbage sorting. The expectation significantly positively affected the intention to garbage sorting. Third, our research highlights the importance of environmental benefits and concerns as antecedents affecting subjective norms, moral norms, perceived behavioral control and expectation by empirically demonstrating that urban residents deriving higher environmental benefits and having greater environmental concerns have higher expectations and intentions to garbage sorting.

Based on these results, it is suggested that governments and decisionmakers should consider increasing urban residents' environmental benefits and concerns related to garbage sorting to promote their expectation of this activity. The government should gradually implement a legal system for managing garbage to maintain moderate social pressure. Finally, it is necessary to achieve a better understanding of the social-psychological factors affecting urban residents in practical applications and develop a more detailed and scientific approach to guide garbage sorting.

**Supplementary Materials:** The following are available online at <https://www.mdpi.com/article/10.3390/su132312985/s1>, Table S1. Construct and measurement items.

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