Research on the Public's Intention of Garbage Sorting and Recycling: An Integrative Model of Theory of Planned Behavior and Norm Activation Theory

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Abstract: In recent years, the continuous improvement of people's living standards has made the garbage increase exponentially, and the pressure of environmental governance is increasing, and the problem of garbage classification and recycling governance is imminent. Based on the comprehensive analysis framework of planned behavior theory and normative activation theory, this study uses structural equation model and 525 questionnaires to empirically test the influencing factors and mechanism of public garbage sorting and recycling intention. The results show that: (1) Public garbage sorting and recycling intention is the result of the interaction of rationality and morality, rather than pure rationality or pure morality driven behavior. (2) Behavioral attitudes, perceived behavioral control, subjective norms, and personal norms all have a positive impact on the public's behavioral intention of garbage classification and recycling. (3) Results consciousness and responsibility ownership have positive effects on personal norms. (4) The reward and punishment system from the external situation is one of the measures to effectively improve the public's willingness to recycle garbage. Finally, according to the research conclusions, corresponding countermeasures and suggestions are put forward to improve the public's willingness and behavior in the process of garbage classification and recycling.

1. Introduction

According to the statistics of the Ministry of Ecology and Environment over the years, since the 18th National Congress of the Communist Party of China, with the continuous development of China's social economy and the acceleration of the pace of people's life, the production of domestic waste in large and medium cities has continued to rise, the pollution problem has become increasingly serious, and the phenomenon of "garbage encircling the city" has become increasingly serious[1]. Affected by the imperfect statistical data, as of 2019, the annual domestic waste production has reached 235.605 million tons, with a cumulative growth rate of 45.9% in seven years. However, the rate of household garbage disposal has increased year by year, which greatly reduces the impact on environmental pollution. However, it is undeniable that the garbage classification and recycling work still faces certain problems and challenges (Table 1). The Party and the state are deeply aware of the

urgency and importance of solving the problem of garbage classification and recycling, and speed up the promulgation and implementation of relevant systems[2]. Over the years, the national garbage classification work has gradually been launched from the point to the surface, and initial results have been achieved. The public, as the main producer of domestic waste, is the key to the good operation of the garbage sorting and recycling system. However, the public's awareness of garbage classification and recycling behavior is weak, and the governance in most areas only stays on the surface, the enforcement is poor, and there is a large "know-doing" gap at the individual level of the public[3]. In the long run, government guidance, market operation and public participation are the inevitable trends of urban solid waste classification and recycling governance in the future. However, due to the large number of subjects involved, how to encourage, supervise and design efficient guidance measures to enhance the public's willingness to classify and recycle solid waste has become an urgent problem to be solved in the current society. In the process of transformation from high-speed development to high-quality development in the new era, the policies and guidance measures proposed by the government and society can only be accepted and recognized by the public and actively participate in them, which can greatly improve the governance capacity and modernization of the urban solid waste classification and recycling governance system, and keep up with the development pace of environmental governance in developed countries.

Table 1: Statistical data of domestic waste in large and medium cities from 2013 to 2019

Year	Production capacity (tons)	Capacity (tons)	Processing rate (%)	Annual production increase (tons)	Annual production growth rate (%)
2013	16148.8	15730.65	97.41	/	/
2014	16816.1	16445.2	97.8	667.3	4.1
2015	18564.0	18069.5	97.3	1747.9	10.4
2016	18850.5	18684.4	99.1	286.5	1.6
2017	20194.4	20084.3	99.5	1343.9	7.1
2018	21147.3	21028.9	99.4	952.9	4.7
2019	23560.2	23487.2	99.7	2412.9	11.4
2020	/	/	99.3	/	/
2021	/	/	99.9	/	/
2022	/	25767.22	99.9	/	/

China is one of the first countries in the world to propose garbage sorting and recycling, which can be traced back to the concept of "urban garbage sorting and collection" proposed by Beijing in 1957. With the development of China's economy and modernization construction, the problem of garbage difficult to effectively deal with comes along, and gradually attracts the attention of the academic community[4]. The public's garbage sorting and recycling behavior is essentially to emphasize the positive impact of individual activities on the environment and help improve environmental conditions at the individual level. The influencing factors of public garbage sorting and recycling behavior are complex and diverse. According to existing literature studies, they can be divided into internal factors and external factors. The internal factors include individual differences, emotional factors and motivation factors, and the external factors include situational factors[5]. Individual difference refers to the difference of individual's cultural and educational level, income level, age, household registration, personal experience, etc. Emotional factors are divided into four aspects: presentation form, experience structure, time dimension and responsibility. Motivation factors include cost and benefit, ethics and norms, etc. Situational factors include the division of many different dimensions, such as the home scene and the out scene, the public sphere and the private

sphere. Among the situational factors, many scholars believe that the lack of necessary infrastructure is one of the important factors that hinder the public's practice of garbage classification and recycling[6]. On the whole, the exploration of factors affecting public garbage classification and recycling behavior is becoming more and more complete. However, in general, the research focuses more on individual psychological factors, that is, the influence of internal driving force on garbage classification and recycling behavior, while the interaction of internal and external factors is relatively rare, and the combination of external guidance measures is lacking. Based on this, this study introduced the external reward and punishment system on the basis of the comprehensive analysis framework of planned behavior theory and normative activation theory, and conducted a questionnaire survey to study the internal and external driving factors and action mechanisms of public garbage classification and recycling behavior, so as to further explore the relationship between them.

2. Theoretical analysis and research hypothesis

The theory of planned behavior, proposed by Ajzen, is one of the classical theories in the study of individual behavior, and a large number of relevant studies on this theory have fully demonstrated its explanatory power in the aspect of pro-environmental behavior[7]. According to this theory, individual behaviors are not all out of absolute willingness, but are displayed under control. Although absolute will can control behavior, non-individual will can completely control behavior through some internal and external comprehensive cognitive factors. According to TPB, an individual's behavioral intention is the most direct factor to determine his behavior, and behavioral intention is mainly affected by three factors: behavioral attitude, subjective norms and perceived behavioral control[8]. In this study, behavioral attitude refers to the public's evaluation of garbage sorting and recycling. According to planning theory, attitude is an important determinant of behavioral intention, and the more positive the attitude evaluation, the more likely the behavior will be implemented. Subjective norms refer to the individual morality perceived by the public in the practice of garbage classification and recycling and the constraints of people around them on their own behavior choices. It includes the restriction and control of public individual morality on garbage classification and recycling behavior, as well as the restriction and promotion of surrounding groups and social organizations on individuals' practice of garbage classification and recycling behavior. When relatives, friends and community organizations around the public support the garbage sorting and recycling behavior, and individuals realize that the practice of garbage sorting and recycling is in line with the group moral norms, their own tendency to practice this behavior will increase. And when the public believes that the practice of garbage sorting and recycling is fully in line with their own moral values, their willingness to increase. Perceptual behavior control means that the public can perceive the difficulty of garbage classification and recycling by evaluating the existing resource capacity conditions. When the public believes that the smaller the obstacle to the expected occurrence of the garbage sorting and recycling behavior, the stronger the perceived control of the behavior, the more likely it is to trigger the behavior[9]. In theory, when the public believes that it has sufficient time cost and economic strength through the assessment of relevant resource conditions, the more confident the public is in the ability to practice garbage classification and recycling, the smaller the perceived behavioral barriers, thus enhancing the willingness to do so. Accordingly, the following hypothesis is proposed:

H1: The attitude towards garbage sorting and recycling positively drives the public's willingness to practice this behavior.

H2: The perceived behavior control of garbage sorting and recycling positively drives the public's willingness to practice the behavior

H3: The subjective norm of garbage classification and recycling positively drives the public's

willingness to practice this behavior.

Because the choice of individual behavior under the framework of TPB needs to fully consider the pros and cons of behavior execution, execution pressure and execution difficulty, it is considered to be a partial rational choice behavior based on "cost-benefit"[10]. Garbage classification and recycling is a pro-environment behavior. In the selection of pro-environment behavior, besides rational factors, irrational factors also have an important impact on the occurrence of this behavior. Norm-activation theory was first proposed by Schwartz, and NAM has been used to explain and predict pro-environmental behavior since the end of the 20th century. This theory holds that only when social norms are internalized into personal norms can they affect the pro-environmental behavior of individuals[11]. According to Schwartz, two conditions are required for the activation of personal norms. One is that the individual must be aware of the possible consequences of his or her actions (i.e., consequence consciousness), and the other is that the individual must be aware of his or her responsibility to act (i.e., responsibility ownership)[12]. According to previous studies by scholars, the public's practice of garbage classification and recycling is not only an irrational behavior driven by personal morality, nor a pure rational behavior motivated by "cost-benefit", but the result of the joint action of rationality and morality, that is, on the basis of rational drive of interests, individuals with a high level of environmental morality are more willing to implement garbage classification and recycling[13]. Accordingly, the following hypothesis is proposed:

H4: The personal norms of garbage classification and recycling are positively driving the public to practice this behavior.

H5: The responsibility of garbage classification and recycling is positively driven by the public's personal norms.

H6: Awareness of the results of garbage classification and recycling is driving the public's personal norms.

H7: The personal norms of garbage sorting and recycling are positively driving the public's willingness to practice this behavior.

H8: The intention of garbage sorting and recycling is positively driving the public to practice this behavior.

The formation of public garbage sorting and recycling behavior is a gradual process. In this process, the guidance measures from the external environment are essential for the cultivation and restraint of public behavior. At present, in the face of environmental pollution and resource consumption dilemma, the government, enterprises and other social forces are taking a variety of measures to guide the public to actively practice garbage classification and recycling behavior, and then have a subtle impact on the awareness and behavior of the public[14]. Therefore, if the external environment has clear guidance measures, then the public may be more willing to try or continue to implement the garbage sorting and recycling behavior. On the contrary, the enthusiasm of the public to carry out this behavior may not be high. Based on the review of predecessors, this study starts with the reward and punishment system to judge its impact on the public's intention of garbage classification and recycling, and puts forward the following hypotheses:

H9: The reward and punishment system of garbage classification and recycling is positively driving the public to practice this behavior.

This study tries to explain the driving factors and mechanism of public garbage sorting and recycling behavior from three aspects: rationality, morality and reward and punishment system in external context, so as to enhance the explanatory power of individual pro-environmental behaviors. To sum up, this study built a theoretical model of the behavioral intention and influence relationship of public garbage sorting and recycling (Figure 1).
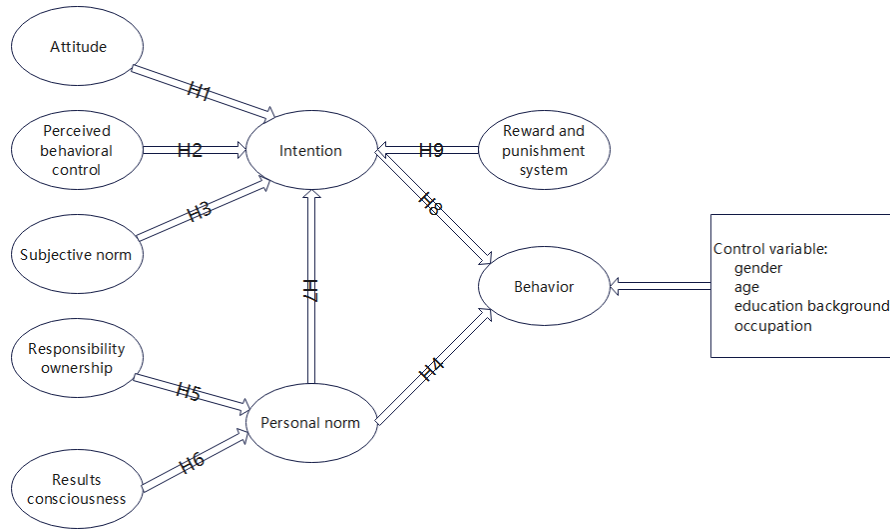
Figure 1: Theoretical model of public garbage sorting and recycling behavior

3. Research design

3.1 Research Methods

In this study, structural equation model is used to analyze the relationship between variables. It has been shown that structural equation model can better capture the specific influence relationship and action path of each factor in the case of multiple observed variables. Compared with traditional econometric regression models such as Logit and Probit, this method has the following advantages: first, it can effectively deal with the problems of variables (latent variables) that cannot be directly measured, such as attitude and perception norms; Second, the influence relationship and action path between observed variables and latent variables as well as between latent variables can be obtained. Third, the measurement error of latent variables can be fully considered, which makes the model estimate results more accurate. The structural equation model includes two parts: measurement model and structure model. Among them, the measurement model is used to test the relationship between the latent variable and its observation index. The equation is expressed as follows:

$$x = \wedge x\xi + \delta \tag{1}$$

$$y = \wedge y\eta + \varepsilon \tag{2}$$

The structural model reflects the causal relationship path between each latent variable, and the equation is expressed as follows:

$$\eta = B\eta + \Gamma\xi + \xi \tag{3}$$

η is the endogenous latent variable. ξ is exogenous latent variable; B is the influence coefficient between endogenous latent variables; Γ is the influence coefficient of exogenous latent variable on endogenous latent variable, also known as the path coefficient of exogenous latent variable on endogenous latent variable. x is the observed variable of exogenous latent variable; y is the observed variable of endogenous latent variable; $\wedge$x and $\wedge$y are the factor loads of observed variables x and y, reflecting the relationship between latent variables and observed variables.

3.2 Data Sources

According to the model of public garbage sorting and recycling intention, the questionnaire was used to measure the intention, and the questionnaire scale was designed by combing literature and combining regional characteristics. Four descriptive variables were set, including gender, age, education background, occupation (Table 2). 9 latent variables are set, including 27 observed variables. This questionnaire adopts a mixed online and offline collection mode. Xiamen City, Fujian Province, China is the main collection point, and a total of 525 questionnaires are collected.

Table 2: Basic characteristics of descriptive variables

Variable	Classification standard	Quantity	Proportion (%)
Gender	Male	281	53.5
	Female	244	46.5
Age	Under 18 years old	35	6.7
	18 to 30 years old	167	31.8
	31 to 40 years old	189	36.0
	41~50 years old	86	16.4
	Over 50 years old	48	9.1
Educational background	Below undergraduate level	217	41.3
	Undergraduate	176	33.5
	Postgraduate and above	132	25.2
Occupation	Government personnel	62	11.8
	Enterprise personnel	80	15.2
	Self-employed person	35	6.7
	Student	126	24.0
	Retiree	169	32.2
	Freelance work	53	10.1

4. Results and analysis

4.1 Reliability and validity test

In order to ensure the stability, consistency and reliability of the measured results of the scale, Spss21.0 and Amos26.0 software were used in this study to test the reliability and validity of the questionnaire data (Table 3). Reliability testing methods usually use Cronbach's α coefficient and Composite Reliability, whose coefficient ranges from 0 to 1. The greater the value, the higher the reliability. According to the test results, Cronbach's α coefficient and combination reliability of the items are above 0.7, which fully indicates that the overall reliability of the research scale is high.

The commonly used indexes in convergent validity test are AVE and factor load variables, and the value range of the above indexes is 0-1. Generally, the AVE value and factor load are required to be at least 0.4. According to the test results, the AVE value and factor load of each variable meet the

basic test standards. In summary, the measurement model in this study has good reliability and validity, and can be further analyzed.

Finally, Amos26.0 software is used to fit the model with the maximum likelihood estimation method, and the fitting index value is obtained. The results show that CEI>0.9, RMSEA<0.05, 1<CMIN/DF<3. Compared with the evaluation criteria of fitting degree of structural equation model, all fitting values of the research model meet the fitting standards, indicating that there is a good matching relationship between the model of public garbage classification and recycling intention and the obtained data, and the model has a good fitting effect.

Table 3: Reliability and validity test table

Variable	Observation index	Factor loading	AVE	CR	Cronbach's α coefficient
Attitude(ATT)	ATT1	0.846	0.585	0.807	0.819
	ATT2	0.796			
	ATT3	0.637			
Perceived behavioral control(PBC)	PBC1	0.869	0.546	0.777	0.760
	PBC2	0.772			
	PBC3	0.536			
Subjective norm(SN)	SN1	0.852	0.663	0.821	0.818
	SN2	0.773			
	SN3	0.704			
Responsibility ownership(RO)	RO1	0.767	0.706	0.878	0.875
	RO2	0.871			
	RO3	0.878			
Results consciousness(RC)	RC1	0.827	0.587	0.890	0.804
	RC2	0.681			
	RC3	0.783			
Personal norm(PN)	PN1	0.774	0.573	0.798	0.791
	PN2	0.866			
	PN3	0.609			
Reward and punishment system(RPS)	RPS1	0.864	0.694	0.872	0.873
	RPS2	0.831			
	RPS3	0.803			
Intention(INT)	INT1	0.829	0.697	0.873	0.872
	INT2	0.885			
	INT3	0.788			
Behavior(BE)	XW1	0.842	0.734	0.892	0.890
	XW2	0.883			
	XW3	0.844			

4.2 Analysis of model results

Amos26.0 software was used to estimate the structural model, and the standardized estimation results of the model were obtained (Table 4). Where, "***" means that the p value is less than 0.001, "**" means that the p value is less than 0.01, and "*" means that the p value is less than 0.05.

First of all, behavioral attitude and perceived behavioral control of garbage sorting and recycling have a positive impact on behavioral intention, and the significance test is passed, indicating that the

two have a positive driving effect on garbage sorting and recycling intention, and the research hypothesis H1 and H2 are verified. The path coefficient between the subjective norm and the behavioral intention of garbage sorting and recycling is 0.556, and the p value is significant below the level of 0.01. Hypothesis H3 is verified. So when relatives and friends around the public are practicing garbage sorting and recycling, they will encourage themselves to implement this behavior. Personal norms and garbage sorting and recycling intentions have a good predictive effect on behavior practice, and the path coefficients are 0.432 and 0.222, respectively, and the P-value is significant at the level of 0.001. The research hypothesis H4 and H8 are verified. The above results are consistent with the planned behavior theory, which further validates the explanatory power of the theory to the garbage sorting and recycling behavior. Secondly, in the normative activation theory, responsibility attribution and result consciousness jointly activate the personal norms of garbage classification and recycling, and the path coefficients are 0.457 and 0.166, respectively, and the P-value is significant at the level of 0.01. The research hypothesis H5 and H6 are verified. The path coefficient between individual norms and behavioral intentions for garbage sorting and recycling is 0.643, and the P-value is below 0.005, indicating that the behavioral intentions for garbage sorting and recycling are positively driving behaviors, and the research hypothesis H7 is verified. Finally, in the relationship between the reward and punishment system and garbage sorting and recycling behavior, the standardized path coefficient is 0.242, and the P-value is below 0.001, indicating that the reward and punishment system is positively driving the public garbage sorting and recycling behavior, and the research hypothesis H9 is verified. Then, in the process of daily garbage classification and recycling, the government, communities and other restrictive organizations can formulate and resolutely implement a clear reward and punishment system, and the probability of the public practicing garbage classification and recycling is greater.

Table 4: Results of standardized estimation and hypothesis testing

Action path	S.E.	CR	P-value	Normalized regression coefficient	Hypothetical result
ATT→INT	0.063	7.762	***	0.378	H1 Support
PBC→INT	0.051	5.431	***	0.270	H2 Support
SN→INT	0.045	9.703	**	0.556	H3 Support
PN→BE	0.055	7.724	***	0.432	H4 Support
RO→PN	0.071	6.820	**	0.457	H5 Support
RC→PN	0.043	3.819	**	0.166	H6 Support
PN→INT	0.052	14.096	***	0.643	H7 Support
INT→BE	0.067	4.087	***	0.222	H8 Support
RPS→INT	0.043	2.872	***	0.242	H9 Support

5. Conclusions and Suggestions

5.1 Conclusion

In this study, planned behavior theory and normative activation theory were integrated and expanded to build a theoretical model of public garbage sorting and recycling behavioral willingness, and 525 questionnaire survey data were empirically tested by structural equation, so as to identify the influencing factors and action paths of public garbage sorting and recycling behavioral willingness. The main conclusions are as follows: (1) Public garbage sorting and recycling willingness is the result of the interaction between rationality and morality, rather than purely rational or purely moral driven

behavior. (2) Behavioral attitudes, perceived behavioral control, subjective norms, and personal norms all have a positive impact on the public's behavioral intention of garbage classification and recycling. (3) Results Consciousness and responsibility ownership had positive effects on individual norms of garbage sorting and recycling. (4) The reward and punishment system from the external context is one of the measures to effectively promote the public's practice of garbage classification and recycling.

5.2 Suggestions

The improvement of public garbage sorting and recycling behavior is a systematic project, which needs the joint efforts of the government, enterprises, the public and other participants. Based on the above research conclusions, this study puts forward the following suggestions:

(1)Relevant regional environmental protection and management units should integrate current resources, and regularly carry out garbage classification and recycling publicity, education and training activities with units such as residents' living systems and local education systems as the starting point, so that the general public can deeply understand the benefits of garbage classification and recycling behavior for solving the current environmental pollution and resource constraints. Improve the public awareness level and the cognition of the results of garbage classification and recycling behavior, so as to develop good behavior attitudes and personal norms.

(2)Strengthen the construction of infrastructure and clear the behavioral barriers of garbage classification and recycling. The construction of garbage sorting and recycling infrastructure is a key part of raising the public's willingness to act. The government should increase investment, combine the actual situation of residents and local characteristics, and improve the construction of garbage sorting and recycling infrastructure. The market should actively participate in the construction of garbage classification and recycling system, design and develop advanced recycling devices and systems, enhance the convenience of public behavior perception, stimulate the power of garbage classification and recycling, indirectly improve the operating efficiency of enterprises, and create a green ecological image of enterprises.

(3) Improve the reward and punishment system for garbage classification and recycling. To consider the different types of groups of garbage classification and recycling, middle-aged and elderly people can start from the material reward, and young people can start from the spiritual reward. At the same time, attention should be paid to the implementation of punitive measures, otherwise it will reduce the public's willingness to practice. Only when the reward and punishment mechanism is clear, the public can actively implement the garbage classification and recycling policy.

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