

Article

Consumer's Waste Classification Intention in China: An Extended Theory of Planned Behavior Model

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Abstract: Although there have been a variety of studies on waste classification management, there are few studies on how governments can effectively publicize waste classification knowledge in order to enhance citizen participation. Government publicity may be the key to the effective implementation of waste classification management in China. The purpose of this study is to examine the effects of government publicity, consumer attitudes, subjective norms, perceived behavioral control and consumer knowledge on consumers' willingness to classify waste in the process of waste management in China. The methodology used for the study included data collected from a survey conducted among citizens from four cities in China, the extended theory of planned behavior model and a moderating effect analyses using the statistical software Amos17.0 and SPSS 22.0, utilizing structural equation modeling, hierarchical regression, and the interpretation of the results. The results show that government publicity has a significant positive impact on consumer attitudes, subjective norms, and perceived behavioral control. The positive effect of consumer attitudes and perceived behavioral control on waste classification intentions are significant. Consumer knowledge plays a significant role in moderating the effect of perceived behavioral control on waste classification intentions. The findings of this study are of great significance to government and public decision-making. The results strongly suggest that the government should vigorously publicize the knowledge of waste classification at the initial stage of implementation of waste classification. Furthermore, a detailed distinction between types of consumers and the role of personal values in the implementation of waste classification is considered as a direction of future research.

Keywords: municipal solid wastes; waste classification; government publicity; consumer knowledge; extended theory of planned behavior model; structural equation model

1. Introduction

Environmental problems have become problems on a global scale and a focus of research and policy in many countries [1,2]. According to a report released by the World Bank in September 2018, the world will produce 3.4 billion tons of garbage a year by 2050, up from 2.01 billion tons in 2018 [1]. East Asia and the Pacific are the areas that produce the most municipal waste. By 2050, the fastest growth in municipal waste will be three times that of Sub-Saharan Africa. Southern Asia will have twice as much waste as it has now. The same is true of the Middle East and northern Africa [1]. In these areas, more than half of the waste is dumped openly, and the rapid growth of waste will lead to environmental, health, economic, and other problems, so there is an urgent need for action. The problems associated with waste polluting the environment have become a global crisis. With the process of industrialization and urbanization, many environmental problems have been caused by solid waste pollution [2]. In particular, pollution by plastic waste is very serious. It is estimated that

4.8–12.7 million tons of plastic have entered the ocean [3]. Although the problem of environmental pollution is global, the degree of attention it receives varies between different countries [4]. In developed countries, environmental quality is an important factor in assessing policy and decision-making [5], while in some developing countries, the problem of environmental pollution has not attracted enough attention [2]. With the rapid development of the world economy, more and more countries have begun to pay attention to environmental pollution and take various measures to protect the environment and realize sustainable development goals within cities [6,7]. How to deal with solid waste effectively is an important aspect of solving the problem of environmental pollution. Waste collection, specifically, is a key step in solving waste problems. According to the statistics of the World Bank, waste collection is widely implemented in high-income countries. Forty-eight percent of waste is collected in cities, but only 26% of garbage is collected outside the city in low-income countries [1]. One of the problems related to the bad waste collection is the overload of landfill sites, which can lead to environmental problems. For example, a lot of landfill waste from industrial, commercial, agricultural, and other applications pollute groundwater resources, posing a significant threat to people's health and the environment [8]. Air pollution is caused by odorous emission due to delayed or incomplete landfill [9]. Moreover, existing landfills have been unable to meet the growth of municipal solid waste and most landfills lack the configuration facilities [10]. Relying on the waste collection system alone will not solve the problems associated with the significant amount of waste generated. A large amount of municipal waste is sent to the suburbs for landfill, so cities are surrounded by waste [11,12]. There is no doubt that the classification of municipal solid waste is an effective means for solving this problem, and it has been adopted by many countries [13]. Effective waste management can turn waste into a useful source of raw materials and energy [14].

Being the largest developing country in the world, the process of urbanization in China is developing rapidly, and the urban population is increasing rapidly. China's population rose from 540 million in 1949 to nearly 1.4 billion in 2018, and the average annual growth rate is 1.4%. Within this, the urban population accounted for 59.58% in 2018 [15]. With the surge in urban population, waste management has become a significant problem for sustainable urban development [16]. As early as 2000, China selected eight cities to host pilot projects to implement waste classification management [17]. In 2015, China gradually expanded the management of classified waste, selecting 26 cities as the first pilot cities for domestic waste classification. Since July 2019, China began to implement waste classification in 46 cities, which was subsequently extended to the whole country. Although waste classification management has been implemented, the effect is not satisfactory. The first problem is that residents are less willing to classify waste because of their established habits [16]. Secondly, the facilities for waste classification are not perfect. For example, the classification of the trash cannot be clearly marked, and garbage transport vehicles are not classified and managed. Therefore, there is an urgent need to find effective methods and measures to improve the implementation of waste classification so as to make urban residents actively classify household waste. In existing research, much attention has been paid to the technology of waste classification [18–20]. In the latest research in the field of social science, some scholars have studied why individuals are willing or unwilling to participate in waste classification management [21,22], while few studies have focused on how to effectively use government publicity in the implementation of waste classification [15,16,22]. Waste classification management has just begun to be implemented on a large scale in China. Waste classification can be effectively implemented only with the participation of the whole of society. The government has launched a wide range of publicity strategies, but the effectiveness of the publicity is unknown [15]. In this process of implementation, knowledge of how publicity can be improved to make individuals take the initiative and voluntarily carry out waste classification, and how to enhance the effectiveness of policies, is relatively lacking in the existing research [16]. The difference between this study and existing research is that, combined with studies of real situations, this study looks at the influence of government publicity on consumers' behavior towards waste classification.

The research purpose of this paper is to explore the influence of government publicity on consumers' willingness to participate in waste classification. The extended theory of planned behavior model is used to analyze the impact of government publicity on consumer attitudes, subjective norms and perceived behavioral control [23,24], as well as the impact on consumer waste classification intentions. In this study, combined with analysis of the actual situation, it is found that consumers' waste classification knowledge is very important in the process of implementation [25–27]. Therefore, this study puts forward the variable of consumer knowledge and brings it into the model, including an in-depth analysis of its regulatory effect on consumers' willingness to participate. The aim of this study is to have a clearer understanding of consumers' psychology around participating in waste classification and to help China and other countries improve the effectiveness of waste classification implementation. The findings of this study are of great significance to the governmental and public decision-making. This study is expected to put forward suggestions and countermeasures for the effective implementation of waste classification. The aim of this study is to help improve the efficiency of the use of government public resources and enhance the willingness of the whole of society to participate in waste classification.

2. Relevant Literature and Hypotheses Development

2.1. The Theory of Planned Behavior Model

Based on an analysis of the factors that affect the behavioral intentions of individuals towards waste classification, this study focuses on the effect government publicity has on these factors. The theory of planned behavior (TPB) model is most commonly used in the study of factors that influence behavioral intention [22]. The TPB was proposed by Ajzen [28]. It was an extension of the theory of reasoned action [29], which connects attitudes and behaviors. In the TPB model, consumers' willingness to act is determined by three factors: Attitude toward the behavior, subjective norms, and perceived behavioral control [28]. Attitude is defined as a person's general feeling, either favorable or unfavorable, towards the behavior [30]. Attitude is a positive or negative belief in a behavior [28]. Attitude is determined by an individual's belief in the results or by the attributes of behavioral performance [31]. Subjective norms are a social factor, and it is assumed to be the function of a specific belief that someone agrees or disagrees to display a behavior [32]. That is to say, the subjective norms refer to the perceived external social pressure on whether or not to do a certain behavior [28]. A person's subjective norms are determined by her or his normative belief, that is, whether it is important for her or him to approve or disapprove of a certain behavior [31]. Perceived behavioral control was introduced into the theory of planned behavior to predict an individual's behavioral intentions and subsequent behavior. It refers to the perception of how easy it is to get something done. Therefore, perceived behavioral control evaluates controlling factors that may facilitate or hinder a specific behavior [33]. Perceived behavioral control may directly predict behavior and behavioral intentions. Therefore, when the behavior is more controllable, the relationship is stronger [34]. It is worth noting that perceived behavioral control is different from actual behavioral control. It is based on personal perception, rather than assuming that the real occurrence of behavior affects the consumers' intentions [23].

The theory of planned behavior model (TPB model) has been applied in many fields. Recently, it has been widely used in the fields of green consumption, sustainable consumption, environmental protection, and moral behavior. An extended TPB model was used to analyze the impact of the Double-11 shopping festival atmosphere on Chinese consumers' sustainable consumption. It found that the atmosphere had a negative effect on the sustainable consumption purchase intentions of consumers [35]. Other studies used the TPB model to explore the decision-making process for farmers in considering low-carbon products and put forward suggestions for supporting policies for low-carbon agriculture [36]. In predicting an individual's immoral behavior, the study found that the theory of planned behavior is superior to the theory of reasoned action. The results show that the predictive effect of perceived behavioral control is better than attitude in predicting behavioral intentions [37].

The TPB model has also been applied to the green lodging industry to predict the continued intention of consumers to use and recommend green hotels [38]. With the development of environmental deterioration caused by human beings, an extended environmental TPB model has been used to analyze many variables around green purchase intentions [39].

Although the TPB model has been widely used in the field of environmental protection and green consumption [40], there is still a lack of related research in the field of waste classification.

2.2. Waste Classification

The classification of municipal solid waste includes throwing, collecting, transporting, and disposing [41]. Waste classification is one of the most important means by which all citizens can participate in the protection of the environment. Different countries have different types of waste classification [13]. There have been many successful programs for waste classification in different countries and cities. In Japan, waste is divided into industrial type and municipal type waste. Within these, there are three kinds of municipal waste categories: Combustible waste, incombustible waste, and bulk waste [42]. Combustible waste includes paper, kitchen garbage, textiles, wood and bamboo, as well as plastics and rubber. Incombustible waste includes metals, glass, pottery, and adulterated matters. Bulk waste includes furniture, bicycles, tatami mats, and kitchen appliances. Local municipal governments in Japan implement waste management and enforce the laws and rules [43]. In the United States, on average, about 8% of municipal waste is converted into renewable energy, 25% of waste is recycled, and the rest is landfill. Each state has its own waste management system (WMS), so the waste management level is not the same. In Connecticut and Maine, 50% of waste is converted into energy, 30% is used for composting or recycling, and only 10%–15% of waste is landfill [44]. In the United States, municipal waste is divided into four types, containers and packaging such as boxes and beverage bottles, durable goods such as electrical appliances and furniture, non-durable goods such as clothes and newspapers, and other rubbish, such as kitchen waste and yard trimmings [45]. In the EU, municipal waste includes household and similar wastes, and household waste is divided into very detailed categories. It is divided into nearly ten types according to the material of the garbage to be disposed of, such as paper, glass, metal, etc. [46].

In China, the development strategy has changed from rapid development to high-quality development. Environmental protection is an important part of a high-quality development strategy. In the 2017 Chinese Government report, Premier Li Keqiang proposed that China should begin to implement waste classification. In China, there are four types of municipal waste: Kitchen waste, hazardous waste, recyclable waste, and other waste. Kitchen waste includes leftover food, bones, vegetable roots and leaves, pericarp, and other food waste. Hazardous waste contains heavy metals, toxic substances that are harmful to human health, or wastes that cause realistic or potential harm to the environment, including batteries, fluorescent tubes, light bulbs, expired drugs, etc. Recyclable waste mainly includes five categories: Waste paper, plastic, glass, metal, and cloth. The other waste category includes toilet paper, brick and tile ceramics, dregs, tissue and other wastes that are difficult to recycle, such as dust, food bags, etc.

2.3. Government Publicity

Waste classification is a new policy, and if citizens do not understand it, they will encounter great difficulties in implementing it. Therefore, before implementation, the government needs to carry out vigorous publicity to let citizens gain knowledge on waste classification, so they can take the initiative in implementing waste classification. The publicity of waste classification by the government plays an important role in promoting the implementation of waste classification by citizens, just as the government encourages people to eat healthy food [47]. For some public welfare programs, the publicity effect of the government will be far greater than that of non-profit organizations [48]. First of all, the scope of government publicity is very extensive. Through administrative instructions, publicity on waste classification can be heard and seen almost daily in various communities in the pilot cities for

waste classification. Promotional information about waste classification can be seen everywhere in newspapers, television, radio, and on the internet. Each community distributes publicity materials on waste classification to its citizens [49]. Secondly, the government has taken measures to promote the separation and disposal of waste by citizens and has widely publicized the policy. These measures include incentives and penalties and the waste sorting system has been included in legal documents [50]. Thirdly, the government conducts publicity to build knowledge on waste classification. Before the implementation of the policy, the citizens had little knowledge of waste classification and were used to a mixed garbage system. The implementation of this policy needs to change the ideology of citizens by vigorously publicizing the relevant knowledge on waste classification, to help effective implementation of the policy. Therefore, the promotion of waste classification knowledge is everywhere, in communities, enterprises, schools, and a variety of public places [51].

There is evidence that publicity plays an important role in enterprise reputation and brand building [52,53]. Publicity and advertising are two important marketing communication mechanisms. Advertising can be controlled by the enterprise [54]. Publicity is a broader form of communication that is beyond the control of the enterprise. Some studies have suggested that publicity can help shareholders judge if a business is a legitimate entity and that it builds long-term reputations [55]. Positive publicity can effectively enhance the attitude of shareholders towards the brand of the company [56]. Compared with the publicity of enterprises, the publicity of waste classification by the government is stronger and wider, so it has a greater impact on citizens. Therefore, the hypothesis1 is put forward.:

Hypothesis 1. *Government publicity is positively affecting consumers' attitudes towards waste classification.*

In China, the publicity of waste classification is very extensive, from the elderly to children, almost everyone is affected. Children are educated at school, where they learn about waste classification, and throw away rubbish according to the rules [49]. Students are asked to teach their parents what they have learned at school about waste classification [25]. This publicity builds social norms from within the family. Through publicity, citizens have recognized that they need to comply with and implement waste classification, which is protected by law [50].

Hypothesis 2. *Government publicity is positively affecting subjective norms of waste classification.*

Perceived behavioral control refers to whether consumers feel it is difficult or easy to do a specific behavior [28]. Government publicity enables citizens to gain relevant knowledge about waste classification, which makes behaviors for waste classification operable. At the same time, the publicity of waste classification facilitates this process, providing a convenient and easy format for citizens to perceive waste classification behaviors [49].

Hypothesis 3. *Government publicity is positively affecting perceived behavioral control of waste classification.*

According to the TPB model, consumer attitudes play an important role in behavior. The relationship between attitude and behavior has been mentioned in many studies. For example, attitudes towards green policies refer to consumers' thoughts, feelings, and interests regarding what they like or do not like about green consumption [57]. Attitude is an important psychological emotion that can predict consumers' behavioral intentions [58]. Green attitude positively affects the green purchase intentions of consumers [39]. Therefore, consumer attitudes toward waste classification will also affect consumer behavioral intentions.

Hypothesis 4. *Attitude towards waste classification is positively affecting behavioral intention.*

Subjective norms are a kind of group pressure on individual perception, opinion, attitude and behavior. In accordance with the norms activation theory [59], the consumer's subjective norms will

suggest that it is reasonable and useful to perform waste classification because it is consistent with the behavioral patterns of his or her family, friends and other important people around him. Some studies have shown that subjective norms have an effect on the willingness of people to choose green hotels [33], their intention to buy organic food [60], and green purchase intentions [39]. Therefore, on the basis of previous studies, this study attempts to prove the relationship between consumers' subjective norms and their behavioral intentions to classify waste.

Hypothesis 5. *Subjective norms are positively affecting behavioral intention.*

Perceived behavioral control affects people's behavior in two ways. One is to affect people's behavioral intentions, the other is to directly affect people's behavior [61]. Some scholars have researched how perceptual behavior control affects people's intentions to display certain behaviors, through empirical research [62]. For example, some scholars found that influencing tourists' perceived behavioral control has a positive effect on their intention to perform environmentally responsible behaviors [63]. Therefore, this study examines the effect of perceived behavioral control on consumers' willingness to classify waste.

Hypothesis 6. *Perceived behavioral control is positively affecting behavioral intention.*

2.4. Consumer Knowledge

Consumer knowledge is a key factor affecting consumer behavior [26]. In particular, understanding a consumer's knowledge base can help enterprises understand the information search and information processing behavior of consumers [27]. Consumer knowledge includes objective knowledge, subjective knowledge, and previous use experience [64]. Objective knowledge reflects the relevant information about the product that is stored in the long-term memory of consumers. Subjective knowledge reflects what consumers think they know or how much they actually know about the product. Use experience reflects some of the previous experiences that consumers had in buying or using the products [65]. These three kinds of consumer knowledge are related, and they have different influences on consumers' information searches and decision-making [65]. Consumer subjective knowledge may be the result of objective knowledge and previous use experience. Studies have shown that consumer subjective knowledge has a greater impact on consumer behavior and decision-making [66]. Therefore, consumer subjective knowledge can represent consumer knowledge.

Government publicity is an external factor used to encourage consumers to classify waste, and consumer knowledge is a very important internal factor that encourages consumers to carry out waste classification behaviors. Studies have found that when consumers have more knowledge of organic food, they become more dependent on themselves in forming their attitudes, and subsequently making decisions. In other words, consumer knowledge has a moderating effect on the impact that attitudes have on organic food purchase decisions [67]. The higher the level of knowledge of consumers, the more confident they are in their behavior [65]. This also lessens the impact of external pressures on consumer behavior. In other words, the higher the consumer knowledge, the less subjective norms influence consumer behavioral intentions. An increased level of consumer knowledge can help them to make more efficient and accurate decisions and reduce the difficulty of perceived behavioral control [68]. Therefore, consumer knowledge plays a negative moderating role in the impact of perceived behavioral control on behavioral intentions.

Hypothesis 7. *The effect of consumer attitude on waste classification intentions will be greater when consumers have a high level of waste classification knowledge than when they have a low level of waste classification knowledge.*

Hypothesis 8. *The effect of subjective norms on waste classification intentions will be greater when consumers have a low level of waste classification knowledge than when they have a high level of waste classification knowledge.*

Hypothesis 9. *The effect of perceived behavioral control on waste classification intentions will be greater when consumers have a low level of waste classification knowledge than when they have a high level of waste classification knowledge.*

According to the literature review and all the hypotheses, the conceptual model of this research is shown in Figure 1.

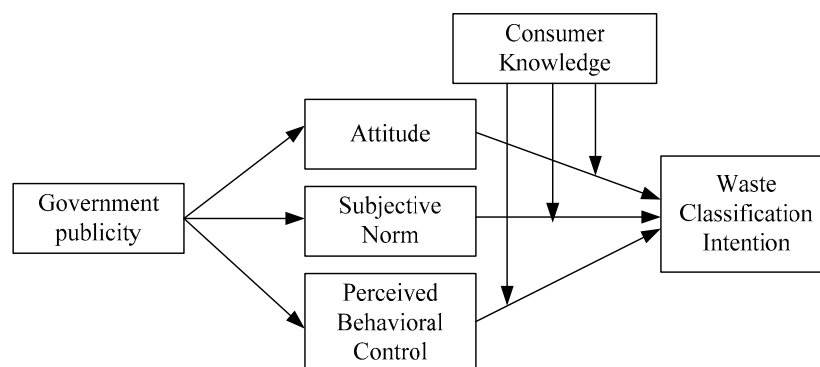


Figure 1. Conceptual model.

3. Methodology

3.1. Sample and Data Collection

Data were collected from four different cities in China: Shanghai, Xi'an, Mianyang, and Shenyang. Among the four cities, Shanghai was the earliest city to implement waste classification, which was enforced in July 2019. Xi'an was enforced in September 2019 and Shenyang will begin to enforce it in December 2019. Mianyang City has not been enforced at present but will be a provincial demonstration city for waste classification. These four cities represent various situations of waste classification in China and the samples from these four cities are very representative. The sample data were collected by random street interception. In order to obtain accurate data, the survey used manual data collection. A total of 12 people participated in the process, three in each city. Investigators in each city took 65 samples, which were completed in three days. In order to ensure the comprehensiveness of the sample, the interception time was divided into three periods, namely, from 9 a.m. to 11:00 a.m., from 3 p.m. to 5 p.m., and from 7:30 p.m. to 9:30 p.m. The survey of each time period selects different locations of the city and selects people of different ages to ensure the representativeness of sampling. The samples in this study are consistent with a large sample survey in statistics [69] and can represent the population who carry out waste classification. The study uses a random sample selection. The sample subjects answered the questionnaire face-to-face with the investigators. All the items in the questionnaire come from existing literature, requiring that the questionnaire be translated into Chinese and then translated back into English to maintain consistency. A total of 260 questionnaires were collected in the four regions, 236 of which were valid, with an effectiveness rate of 90.7%. Among them, 59 were in Shanghai, 59 in Xi'an, 57 in Mianyang and 61 in Shenyang. Overall, 51.3% of the participants in the survey were women and 48.7% of them were men. Among them, one was under 18 years old (0.3%), 117 were 19–30 years old (37.8%), 125 were 31–40 years old (40.3%), 42 were 41–50 years old (13.5%), and 25 were over 50 years old (8.1%). The demographic variables of the sample are shown in Table 1.

Table 1. Demographic characteristics of the sample.

Characteristics	Categories	Frequency	%
Gender	Male	115	48.7
	Female	121	51.3
Age	under 18 or 18	1	0.4
	19–30	89	37.7
	31–40	98	41.5
	41–50	28	11.9
	Over 50	20	8.5
Family structure	Single	50	21.2
	Husband and wife	26	11.0
	Three-member-family	97	41.1
	Family of four	31	13.1
	Three Generations under One Roof	32	13.6
Education	High school and below	89	37.7
	College or university	72	30.5
	University graduate	64	27.1
	Postgraduate and above	11	4.7
Annual household income (CNY)	Under 100,000	128	54.2
	100,000–200,000	68	28.8
	200,000–300,000	23	9.8
	Above 300,000	17	7.2

3.2. Measures

Six constructs were measured in the questionnaire. All constructed measurement items have been used in previous literature, though some items were revised according to the content of this study. All items were measured using the seven-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree).

The six constructs in the questionnaire included government publicity, consumer attitudes, subjective norms, perceived behavioral control, consumer knowledge, and waste classification behavioral intention. Government publicity was measured based on three items modified from previous studies [70]. Attitude toward waste classification behavior was measured by five items used in the TPB literature about consumers' sustainable consumption and tourists' responsible environmental behaviors [35,63]. Subjective norms were measured using four items based on previous studies on the extended TPB [23,35,63]. Perceived behavioral control was measured by three items used in previous literature [23,35,63]. The measurement of consumer knowledge used four items, which were revised in accordance with the requirements of this study [71–73]. Waste classification behavioral intention included six items in the extended TPB study, which were modified to suit the content of this study [23,35,63]. The descriptive statistics of all the items are shown in Table 2, including their mean and standard deviation.

Table 2. Descriptive statistics of questionnaire items.

Questionnaire Items	Mean	Standard Deviation
Government publicity		
GP1: I see the government publicity of waste classification every day	3.661	1.246
GP2: I see the publicity of waste classification in public places	3.610	1.214
GP3: I think the government has done a lot to publicize the waste classification.	4.996	1.466
Attitude: I think waste classification in household		
ATT1: Is wise.	5.614	1.224
ATT2: Is a good idea.	5.763	1.172
ATT3: Is positive behavior.	5.703	1.140
ATT4: Is worthwhile.	5.581	1.166
ATT5: Is beneficial.	5.653	1.121

Table 2. Cont.

Questionnaire Items	Mean	Standard Deviation
Subjective norms		
SN1: Most people who are important to me think we should carry out waste classification	5.267	1.255
SN2: People in my organization (school, university, company) want to carry out waste classification	5.182	1.280
SN3: Most people who are important to me think waste classification is a good thing	5.521	1.215
SN4: Most people who I am familiar with think it is useful to carry out waste classification	5.479	1.169
Perceived behavioral control		
PBC1: It's easy for me to carry out waste classification.	4.907	1.438
PBC2: Carrying out waste classification is a decision that is only up to me.	4.678	1.576
PBC3: I am confident that if I want, I can carry out waste classification.	5.640	1.119
Consumer knowledge		
CK1: Compare to others, I know a lot of about waste classification.	4.564	1.252
CK2: I don't feel very knowledgeable about waste classification.	3.839	1.444
CK3: Compare to my friends, I am one of the experts on waste classification.	3.886	1.343
CK4: I know pretty much about waste classification.	4.373	1.342
Waste classification intention		
WCI1: I am willing to classify the waste.	5.593	1.326
WCI2: I will suggest others to classify the waste.	5.415	1.329
WCI3: I will spend little time in classify the waste.	2.856	1.280
WCI4: I think it is troublesome to classify the waste.	3.360	1.539
WCI5: When dealing with waste, I am willing to classify according to the rules.	5.513	1.246
WCI6: I definitely want to classify the waste in the near future.	5.597	1.179

4. Results

4.1. Testing of Reliability and Validity of the Measurement Model

In order to ensure the validity of the questionnaire data, statistical tests were used to ascertain the reliability and validity of the questionnaire.

Firstly, Cronbach's α and composite reliability (CR) scores are indicators used to evaluate the reliability of how multiple items scale for each construct. The Cronbach's α of all variables were as follows: Government publicity (0.803), attitude (0.880), subjective norms (0.865), perceived behavioral control (0.742), consumer knowledge (0.797), and waste classification intention (0.901). As can be seen from Table 3, all of Cronbach's alpha coefficients were greater than the threshold value of 0.7 [74]. This shows that each construct had a high level of internal consistency. The composite reliability (CR) of the six constructs were as follows: Government publicity (0.822), attitude (0.886), subjective norms (0.861), perceived behavioral control (0.746), consumer knowledge (0.792), and waste classification intention (0.906). All composite reliabilities were greater than the threshold value of 0.7 [74].

Table 3. Items, reliability, coefficient, and AVE of variables.

Variables	Items	Cronbach's α	CR ¹	AVE ²
Government publicity	3	0.803	0.822	0.610
Attitude	5	0.880	0.886	0.612
Subjective norms	4	0.865	0.861	0.608
Perceived behavioral control	3	0.742	0.746	0.500
Consumer knowledge	4	0.797	0.792	0.505
Waste classification intention	6	0.901	0.906	0.620

Note: CR = composite reliability, AVE = average variance extracted.

Secondly, the validity of the scale is measured by convergent validity and discriminant validity. The average variance extracted (AVE) of each construct is listed in Table 3, which shows that the AVE exceeded the recommended level of 0.5 in all cases [75]. The results of the model fitted based on

confirmatory factor analysis (CFA) show an acceptable fit (χ^2 (176) = 450.453, χ^2/df = 2.559, $p < 0.001$, normed fit index (NFI) = 0.880, confirmatory fit index (CFI) = 0.922, Tucker–Lewis index (TLI) = 0.907, and root mean square error of approximation (RMSEA) = 0.08. Thus, all constructs had adequate reliability and convergent validity levels.

4.2. Testing of the Structural Equation Model

In order to test the hypothesis proposed in this paper, structural equation modeling was used to analyze the variable relationship and path proposed in the research model using the program AMOS17.0. The result showed that the structural model fit was acceptable: $\chi^2/\text{degree of freedom}$ (df) = 2.559 < 3, GFI = 0.831 > 0.8, CFI = 0.922, IFI = 0.923, TLI = 0.907, RMSEA = 0.08. Most of the goodness-of-fit indicators exceeded the threshold values and the model was accepted.

Table 4 shows the test results for each hypothesis. Overall, five of the six hypotheses in the structural equation model were supported. First, government publicity has positive and very significant effect on attitude ($\beta = 1.127$, $p < 0.001$), subjective norms ($\beta = 1.155$, $p < 0.001$), and perceived behavioral control ($\beta = 1.453$, $p < 0.001$). Therefore, Hypothesis 1, Hypothesis 2, and Hypothesis 3 are supported. Second, the effects of attitude, subjective norms, and perceived behavioral control on waste classification intention were examined. The attitude has a significant and positive effect on waste classification intention ($\beta = 0.478$, $p = 0.049 < 0.05$), and perceived behavioral control also has a positive and significant effect on waste classification intention ($\beta = 1.105$, $p = 0.012 < 0.05$). Thus, Hypothesis 4 and Hypothesis 6 are supported. However, the path from subjective norms to waste classification intention was not significant ($\beta = -0.786$, $p = 0.152 > 0.05$). Hence, Hypothesis 5 is not supported.

Table 4. Results for path analysis.

Hypotheses	Estimate	t-Value	Hypothesis
Hypothesis 1: Government publicity→attitude	1.127	6.621 ***	Supported
Hypothesis 2: Government publicity→subjective norms	1.155	6.534 ***	Supported
Hypothesis 3: Government publicity→perceived behavioral control	1.453	6.855 ***	Supported
Hypothesis 4: Attitude→waste classification intention	0.478	1.972 *	Supported
Hypothesis 5: Subjective norms→waste classification intention	−0.786	−1.431	Not supported
Hypothesis 6: Perceived behavioral control→waste classification intention	1.105	2.504 *	Supported

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

4.3. Moderating Effects of Consumer Knowledge

In this part, the moderating effect of consumer knowledge was examined. Parameters were estimated in SPSS 20.0 using the hierarchical regression technique. The moderating role of consumer knowledge in the formation of attitudes, subjective norms and perceived behavioral control on waste classification intention were examined separately. Before the hierarchical regression, all data were centrally processed. The data in Table 5 reflect the results for the moderating effect of consumer knowledge.

Table 5. Moderating Effects of Consumer Knowledge.

	Estimate	S.E.	t-Value	p
Constant	0.000	0.037	0.000	1.000
Attitude	0.848	0.125	6.794	0.000 ***
Consumer knowledge	0.528	0.190	2.771	0.006 **
Attitude*Consumer Knowledge	−0.356	0.257	−1.382	0.168
Constant	0.000	0.041	0.000	1.000
Subjective norms	0.810	0.131	6.181	0.000 ***
Consumer knowledge	0.457	0.178	2.570	0.011 *
Subjective norms*Consumer knowledge	−0.348	0.256	−1.359	0.176
Constant	0.000	0.043	0.000	1.000
Perceived behavioral control	1.006	0.151	6.647	0.000 ***
Consumer knowledge	0.639	0.189	3.388	0.001 **
Perceived behavioral control *Consumer knowledge	−0.757	0.289	−2.615	0.010 *

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 5 shows the results of adding interaction terms to the hierarchical regression model. From the regression results with the interaction terms, the moderating role of consumer knowledge in the effect of attitudes on waste classification intention is not significant. The coefficient of ‘Attitude*Consumer knowledge’ was -0.356 , and the p -value was 0.168 ($\beta = -0.356$, t -value = -1.382 , $p = 0.168 > 0.05$). Therefore, Hypothesis 7 is not supported. It was found that the moderating role of consumer knowledge in the effect of subjective norms on waste classification intention was not significant. The coefficient of ‘Subjective norms*Consumer knowledge’ was -0.348 , and the p -value was 0.176 ($\beta = -0.348$, t -value = -1.359 , $p = 0.176 > 0.05$). Therefore, Hypothesis 8 is not supported. Finally, the moderating role of perceived behavioral control was analyzed. The results showed that the moderating role of consumer knowledge in the effect of perceived behavioral control on waste classification intention was significant. The coefficient of ‘Perceived behavioral control*Consumer knowledge’ was -0.757 , and the p -value was 0.010 ($\beta = -0.757$, t -value = -2.615 , $p = 0.010 < 0.05$). Hence, Hypothesis 9 is supported.

5. Discussion

Municipal waste management has become an important issue affecting global sustainable development [1]. China recently incorporated municipal waste classification into law enforcement documents. However, the effect of waste classification did not meet the expectations [76]. In existing research, there is a lack of quantitative analyses on how to effectively improve waste classification management. Therefore, this study starts by focusing on the publicity of waste classification by the government and uses the extended theory of planned behavior model to analyze the influences working on consumers’ willingness to classify waste by considering three aspects: Attitude, subjective norms and perceived behavioral control. The samples collected in the study were from four Chinese cities with different degrees of waste classification. Different times and locations were used when carrying out the survey, selecting samples of different ages to ensure the sample is representative [68]. The aim of this study is to have a clearer understanding of consumers’ psychology regarding participating in waste classification in order to make up for the shortcomings of the existing research. At the same time, this study is expected to help improve the effectiveness of waste classification in China and other countries, allowing the authors to put forward suggestions for the government on public resources decision-making in order to make more effective use of public resources.

5.1. Contributions to Theory and Research

This article has made several contributions to the existing literature. First of all, this article considers government publicity as an important factor in the implementation of waste classification. In the existing related research, most research on waste classification behavior from the perspective

of consumers and technology lacks research on government guidance [45,57]. In this study, with the help of the impact of advertising in the field of marketing research on consumer decision-making and behavior, government publicity is regarded as an important driving variable affecting consumers' waste classification behavior. This study provides an in-depth analysis of the impact of government publicity on consumer attitudes, subjective norms, and perceived behavioral control, and how these affect the willingness of consumers to classify waste [56]. Our conclusion is that government publicity plays a very important role in consumers' waste classification attitude, subjective norms, and perceived behavioral control. This conclusion shows that the government's publicity of waste classification is relatively effective, with a positive attitude towards consumers which affects consumers' willingness to classify waste. Similarly, government publicity has a positive impact on perceived behavioral control, which, in turn, has a positive impact on consumers' willingness to classify waste. The results show that government publicity affects consumers' willingness to classify waste through consumers' attitudes and their perception of the difficulty of waste classification. Interestingly, although government publicity affects subjective norms, subjective norms do not affect the willingness of consumers. This shows, that in the implementation process of waste classification, the behavior of others has no impact on consumers. In other words, waste classification behavior is determined more by the subjective will of consumers. This effect is inconsistent with the conclusions about subjective norms in other recent literature [38–40]. This discrepancy may be due to the particularity of the behavior of waste classification.

Secondly, this study contributes an extension to the TPB model. The TPB model is often used to analyze consumers' sustainable consumption [35], 'green' consumption [49], and organic food consumption [67], but it is rarely used to study the waste classification behavior of consumers. In particular, waste classification has been widely implemented in China, and the extended TPB model helps in the in-depth study of the behavioral mechanisms around waste classification. It broadens the application field for the TPB model. In this study, two variables are added to the TPB model, government publicity and consumer knowledge, to form an extended TPB model. These two variables have an indirect effect on consumer waste classification intentions. At the same time, our results also show that the TPB model is suitable for the study of behavioral intention towards waste classification. The uniqueness of this study lies in taking the variable of government publicity as the antecedent variable that affects consumers' attitudes, subjective norms and perceived behavioral control [38,39]. The reason for constructing the extended theory of planned behavior model lies in the realistic background of the implementation of waste classification in China [15,41,50,51]. The government leads the implementation of waste classification and, in the initial stage of implementation, the government spends a significant amount of public resources on publicity. Therefore, this study investigates the effect of government publicity of waste classification to help the government allocate resources more effectively.

Thirdly, this study considers the moderating effect of consumer knowledge, which is lacking from the existing waste classification research [46,49]. The implementation of waste classification is closely related to the waste classification knowledge of consumers. In previous studies, consumer knowledge was often used to study consumer decision-making and purchasing behavior [65,66]. However, the difficulty in performing waste classification felt by consumers is affected by consumers' waste classification knowledge. Therefore, combined with the relevant literature on consumer knowledge, in this study, the variable of consumer knowledge was added to the analysis of consumer waste classification intentions, which expands the research field of consumer knowledge. It also makes a useful supplement to the related research on waste classification. Looking at government publicity of waste classification in China, a lot of the publicity content is about the relevant knowledge of waste classification [41,51]. Therefore, it is necessary to explore the impact of consumer knowledge of waste classification on their behavior intentions. Interestingly, consumer knowledge does not moderate consumer attitudes and subjective norms, but only significantly moderates the impact of perceived behavioral control on waste classification intention. When consumers have more knowledge of waste

classification, the influence of perceived behavioral control on waste classification will be reduced. The result presents ideas for effective government publicity.

5.2. Managerial Implications

As mentioned earlier, the model proposed by this study also has insights for management. This study provides empirical evidence on consumers' intentions to classify waste. This study provides methods and pathways towards the sustainable implementation of waste classification. First of all, this study provides the government with recommendations for effectively managing the implementation of waste classification. The implementation of waste classification needs to be vigorously publicized by the government. Because waste classification is a behavior asked of every citizen in society, publicity by the government should be spread throughout society as a whole. (1) The conclusion of this study provides ideas for effective government publicity. Government publicity has a significant positive impact on consumer attitudes, subjective norms, and perceived behavioral control. Among these three factors, only consumer attitude and perceived behavioral control have a positive impact on consumers' willingness to classify waste. Therefore, at the beginning of the implementation of waste classification, people need to change their living habits and the government should increase publicity efforts to help people accept this new policy ideology and form new habits. The government's promotion of waste classification should pay more attention to the fact that waste classification is beneficial to environmental protection, which can effectively enhance consumers' attitudes. (2) This study also found that the impact of perceived behavioral control on consumers' willingness to classify waste is moderated by consumer knowledge. The higher the level of consumer knowledge, the lower the influence of perceived behavioral control factors on their willingness. In other words, when consumers have more knowledge of waste classification, even if the classification is very troublesome, consumers are still willing to classify waste. Therefore, it is suggested that when the government publicizes, it uses knowledge of waste classification as its key content and carries out a wide range of publicity methods to make consumers more familiar with this knowledge, so they can effectively enhance consumers' willingness for waste classification.

Secondly, the study provides management suggestions for enterprises in two key areas. The sustainable development of enterprises and the environment are inseparable. All enterprises should implement waste classification from a managerial level. On the other hand, the implementation of waste classification also brings opportunities for sustainable development within enterprises that manufacture waste sorting equipment. These enterprises need to keep up with national policies and provide materials for the effective implementation of waste sorting policies. On the basis of supporting the sustainable development of the environment, enterprises can also benefit from developing sustainable solutions.

5.3. Limitations and Recommendations

There were also some limitations in our research. First of all, in this study, four cities with different degrees of waste classification in China were considered and 65 samples were randomly selected from each city. Although these data collection methods and quantities meet the statistical requirements of large sample data [68], compared with the population of Chinese cities, as well as the sample sizes in other studies [35,36], the sample size of this study is not large enough. If the sample size can be effectively expanded, the degree of support for the research results will be higher. Secondly, there is no detailed classification of the publicity methods used by the government in this study. This study only discusses the scope and frequency of publicity as a whole. In future research, the effects of various publicity methods used by the government should be compared. For example, public service television advertising, paper material publicity, advertising screens in public places etc. Thirdly, in this study, there was no consideration made of subgroups among the consumers in the study when looking at consumer attitudes, subjective norms, and perceived behavioral control. In reality, consumer heterogeneity has an impact on consumer behavior [67]. In future research, the acceptance

of government publicity by different types of consumers should be considered, as well as the impact this has on their behavioral intentions towards waste classification. Future studies should also classify the personal values of consumers and analyze how these influence their willingness to participate in waste classification, based on the existing literature [77].

6. Conclusions

Waste classification has been widely enforced in China and its implementation effects will play a vital role in the sustainable development of the natural environment. This study focuses on waste classification, combining data on the actual situation in China with in-depth analyses of the impact of government publicity on consumers' willingness to classify waste. The variability of consumer knowledge is added to the study to analyze its moderating role. The conclusion of the study provides management suggestions for the government to publicize effectively.

First of all, some theoretical conclusions are obtained in this study. (1) The government's publicity of waste classification significantly and positively affected consumers' attitudes, subjective norms, and perceived behavioral control. Therefore, the government's publicity plays a very important role in the implementation of waste classification. Waste classification has just begun to be implemented in China, so, in the early days of waste classification, government publicity is highly important. (2) According to the analysis with the extended TPB model, the consumers' attitude towards waste classification has a significant positive impact on the consumers' intentions towards waste classification. Perceived behavioral control also has a significant positive effect on waste classification intention. However, the positive impact of subjective norms on waste classification intention was not significant. In other words, consumers' own attitudes and the degree of difficulty in performing these behaviors have a greater impact on consumers' willingness to classify waste than the behavior of others, which had little impact on consumers. Therefore, in the implementation of waste classification, people pay more attention to their own attitudes and feelings and are less affected by others. (3) Consumer knowledge plays a very significant role in moderating the effect of perceived behavioral control on waste classification intention. However, the moderating role of consumer knowledge in the impact of consumer attitudes and subjective norms on waste classification intention was not significant. In other words, consumers' mastery of waste classification knowledge will promote the impact of perceived behavioral control on waste classification intention.

Secondly, according to the conclusion of the theoretical research, this study puts forward some management suggestions for the government's publicity. The government should publicize the benefits of waste classification to the natural environment and human life more, so as to improve people's attitudes towards waste classification. It is also suggested that the government should publicize more knowledge about waste classification. These suggestions may help to improve consumers' willingness to classify waste.

In summary, waste classification has begun to be enforced on a large scale in China and effective implementation will be of great benefit to the natural environment upon which human beings depend. Improving the participation of the whole of society in waste classification is the key to effective implementation. Based on this point, this study analyzes the mechanism of the influence of government publicity on consumers' willingness to classify waste, finally providing effective management suggestions for the government.

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