

Integrating Theory of Planned Behavior and Value-Belief-Norm Theory to Explain Residents' Intention on Garbage Classification

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Abstract. Guiding residents' garbage classification behavior is one of the important ways to alleviate urban environmental pollution. Based on the theory of planned behavior (TPB) and the theory of value-belief-norm (VBN), 440 questionnaires were analyzed by using partial least squares structural equation modeling (PLS-SEM) to study the factors affecting residents' intention (I) of garbage classification. The results show that the integrated TPB and VBN model developed in this study has a stronger ability to predict and explain the Intention (I) of residents' garbage classification. The residents' Perceived Behavioral Norms (PBN), Subjective Norms (SN), and Personal Norms (PN) directly affect the behavioral intention (I) of residents' garbage classification, and Perceived Behavioral Control (PBC) is the biggest factor affecting the Intention (I) of residents' garbage classification. Besides, Residents' Subjective Norm (SN), Awareness of Consequences (AC), and Ascribed Responsibility (AR) explain residents' Personal Norms (PN), among which Subjective Norm (SN) have the most significant impact on Personal Norms (PN). Personal norm is a mediator between social norms and Intention (I) on garbage classification. The study further enriches the research on residents' garbage classification intention (I) and inspires for enhancing residents' garbage classification intention (I).

Keywords: TPB model, VBN theory, Garbage Classification, Intention.

1. Introduction

Classified recycling is a modern domestic waste treatment method that can recycle domestic waste. However, in the promotion process, classification and recycling frequently face numerous practical difficulties. Exploring the influencing factors of household garbage classification behavior, which can provide theoretical support for the field of household garbage treatment, solve the dilemma of household garbage treatment, and contribute to the construction of ecological civilization, is thus of great practical significance and value.

Many researchers have made significant improvements in the study of household garbage classification behavioral intention(I) to date, focusing primarily on macro aspects such as policy system, community type, publicity, and education [1-2]. At the micro level, research into household garbage classification behavioral intention(I) is still in its early stages. In this regard, the theory of planned behavior (TPB) is primarily used to analyze the factors influencing residents' garbage classification behavior intention(I) [3].

However, many scholars found that TPB theory only discussed the behavior decision-making mode from the perspective of personal factors, and did not take into account the impact of moral obligations, social norms, and other altruistic factors on garbage classification behavior intention (I), which is one-sided for the study of garbage classification. To solve this problem, Xu, L. et al. introduced perceived moral obligation and perceived policy effectiveness into the TPB to study household garbage classification behavior [4-5]. Shen, L et al. incorporated personal moral obligation into the TPB to study the factors affecting teenagers' willingness to classify urban solid waste [6]. However, these studies only introduced individual altruistic factors based on the TPB and did not integrate other models to study the residents' garbage classification behavior intention (I), so the interpretation is still relatively simple.

The value-belief-norm theory (VBN) is a new model built based on the norm activation model (NAM) intermediary model by integrating value theory and New Ecological Paradigm (NEP) theory. Previously, some researchers used NAM, the predecessor of VBN, to study garbage classification behavior [7]. The model integrated NAM and TPB, considering both self-interest and altruistic factors that influence human behavioral intentions (I), shifts the study of residents' behavioral intentions (I) to classify garbage from a single theory of planned behavior to the integration of two complementary models to better predict and explain garbage classification behavior intention (I). VBN not only includes the self-interest and altruism factors that affect human behavior intention (I) but also includes the impact of values and New Ecological Paradigms (NEP) on individual behavior [8-10]. The integrated model of VBN and TPB has been successfully applied to explain other behavioral intentions (I) [11]. Compared with two separate TPB and VBN models, the combined model of TPB and VBN has more advantages in explanation. However, there are still few further studies using VBN.

Therefore, in an attempt to study the influencing factors of residents' garbage classification behavior intention (I) further, this paper will study the influencing factors of residents' garbage classification behavior intention (I) by building an integrated model of TPB and VBN using partial least squares structural equation modeling (PLS-SEM) and compare the explanatory power of models constructed by the theory of planned behavior alone and the normative theory of value beliefs alone with the integrated model. The research results provide for the development of policies to promote residential waste sorting behavior.

2. Research Design

2.1. Research hypothesis

2.1.1 Theory of Planned Behavior (TPB)

For a long time, the theory of planned behavior (TPB) has been widely used in the study of environmentally friendly behavior [12-13]. Garbage classification has been extensively studied by scholars using the TPB model as an important component of environmentally friendly behavior [4, 14]. The TPB model variables used in our proposed integrated model contain four variables: Attitude (A), Subjective Norm (SN), Perceived Behavioral Control (PBC) and Intention (I). They have been proven to have significant positive effects on residents' intention(I) to garbage classification [15]. Moreover, Attitude (A), Subjective Norm (SN), and Perceived Behavioral Control (PBC) act together to influence Intention (I).

Attitude (A) is the positive or negative evaluations that individuals have when they perform a particular behavior [16]. Subjective Norm (SN) refers to the social pressure that individuals feel when deciding whether to perform a particular behavior, and it reflects the influence of significant figures or groups on individuals' behavioral decisions. Perceived Behavioral Control (PBC) is the degree to which an individual perceives that it is easy or difficult to perform a particular behavior, and it reflects the individual's perception of factors that facilitate or hinder the performance of the behavior intention (I) refers to taking some kind of action. Therefore, this study puts forward the following hypotheses:

Hypothesis 1 (H1). Attitude (A) towards garbage classification positively influences their Intention (I) on garbage classification.

Hypothesis 2 (H2). Subjective Norm (SN) positively influences their behavior intention (I) towards garbage classification.

Hypothesis 3 (H3). Perceived Behavioral Control (PBC) positively influences their Intention (I) on garbage classification.

2.1.2 Value-Belief-Norm Theory (VBN)

The value theory and the New Ecological Paradigm (NEP) theory in VBN are complementary to the NAM. The VBN model variables used in our proposed integrated model consist of six variables: Egoistic Values (EV), Biospheric Values (BV), New Ecological Paradigm (NEP), Awareness of Consequences (AC), Ascribed Responsibility (AR) and Personal Norms (PN). The Egoistic Values

(EV) and Biospheric Values (BV) influences the New Ecological Paradigm (NEP), the New Ecological Paradigm (NEP) influences the Awareness of Consequences (AC), the Awareness of Consequences (AC) triggers the Ascribed Responsibility (AR), and the Awareness of Consequences (AC) and the Ascribed Responsibility (AR) activates Personal Norms (PN). Among these, Awareness of Consequences (AC) refers to the individual's perception of the negative consequences of not performing the targeted behavior on others or other things. Ascribed Responsibility (AR) refers to an individual's sense of responsibility for the negative consequences of not performing the targeted behavior. Personal Norms (PN) refer to an individual's sense of moral obligation to perform a particular act, internalized by social norms. It is expressed in the individual's moral perception that he or she has a responsibility and obligation to separate waste. Residents will engage in the act of waste segregation if they believe it is their moral obligation to do so. A positive relationship between Personal Norms (PN) and behavior exists only when individuals acknowledge that they are responsible for their actions, which is an important influencing factor in the implementation of particular behaviors. To activate Personal Norms (PN), residents must be aware of the negative consequences of their failure to segregate waste and further recognize their responsibility to do so to protect the environment. Values reflect beliefs about people's behavioral preferences and are the guiding criteria by which people choose their behavior and evaluate it. Some studies have shown that Awareness of Consequences (AC) positively influences Personal Norms (PN) for waste segregation attribution. However, many studies ignore their mutual influence relationship, therefore, this study will also examine whether there is a mutual influence relationship between Awareness of Consequences (AC) and Ascribed Responsibility (AR). Therefore, from the discussed arguments, the following hypothesis was proposed:

Hypothesis 4 (H4). Awareness of Consequences (AC) positively influences Ascribed Responsibility (AR).

Hypothesis 5 (H5). Ascribed Responsibility (AR) positively influences Personal Norms (PN).

Hypothesis 6 (H6). Awareness of Consequences (AC) positively influences Personal Norms (PN).

Hypothesis 7 (H7). Personal Norms (PN) positively influence the Intention (I) of garbage classification.

The Egoistic Values (EV) refer to acting for maximizing individual outcomes to self-matter, focusing on personal costs and benefits when making choices. The Biospheric Values (BV), on the other hand, consider both the welfare of human groups and non-human species. The New Ecological Paradigm (NEP) is rooted in the intrinsic values of individuals [17]. Whereas many scholars have verified that environmental beliefs have a positive impact on residents' intentions (I) to sort waste as a major predictor of the New Ecological Paradigm (NEP), few studies have examined whether values primarily influence the New Ecological Paradigm (NEP) and thus behavioral intentions (I) to sort waste, and therefore this will be further investigated in this paper. Based on the above analysis, the following hypothesis was proposed:

Hypothesis 8a (H8a). The Egoistic Values (EV) positively influence the New Ecological Paradigm (NEP).

Hypothesis 8b (H8b). The Biospheric Values (BV) positively influence the New Ecological Paradigm (NEP).

The New Ecological Paradigm (NEP) is a measure of environmental beliefs that emphasizes the influence and constraints of environmental factors on human society, arguing that social life is composed of many interdependent biomes and that human behavior has caused persistent adverse effects on fragile ecological environments [17-18]. Awareness of Consequences (AC) refers to the individual's perception of the negative consequences of not performing the targeted behavior. Based on the VBN theory, residents with good environmental beliefs are more likely to be aware of the negative environmental consequences of not performing garbage classification behavior. Hence, the following hypothesis was proposed:

Hypothesis 9 (H9). The New Ecological Paradigm (NEP) positively influences the Awareness of Consequences (AC).

2.1.3 Integrating TPB and VBN models

TPB chooses reasonable interests from the perspective of self-interest to conduct self-interest behavior, but it does not include moral obligations, social norms, and other altruistic factors. On the contrary, VBN focuses on the influence of social ethics and incorporates altruistic factors, but lacks the process of cognition, interpretation, and reasoning from the subjective perspective of people. Although these two models are usually used separately, some researchers try to combine them to explain that people are specifically affected by altruistic factors when making behavioral decisions [19]. Since waste classification behavior is the one of pro-environmental behaviors, combining the TPB and VBN to study waste classification behavior can better take into account the social role of people and their responsibility for protecting the environment. According to the existing studies integrating TPB and VBN models, the Subjective Norm (SN) may be the basis for the formation of the personal norm, and it is proved that the Subjective Norm (SN) has a positive effect on the personal norm [19]. Therefore, the following hypothesis was proposed:

Hypothesis 10 (H10). Subjective Norm (SN) (TPB) positively influences Personal Norms (PN) (VBN)

Some scholars used the TPB and VBN integrated model in studying other pro-environmental behaviors and found that Awareness of Consequences (AC) also positively influences Attitude (A) [20]. Based on this, the following hypothesis was suggested:

Hypothesis 11 (H11). Awareness of Consequence (TPB) positively influences Attitude (VBN).

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

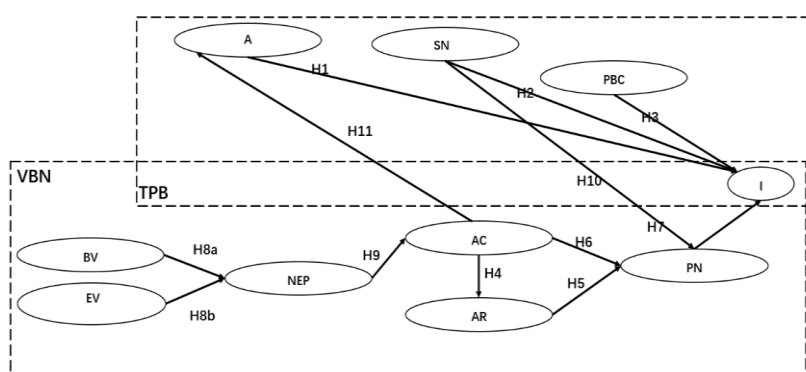


Figure 1. The conceptual model framework of hypothesis

2.2. Scale design and description

The questionnaire was designed according to the previous references and considering the situation of this study. It consisted of three parts. Through the questionnaire, we measured TPB variables (I, PBC, SN, A), VBN variables (EV, BV, NEP, AC, AR, PN), and the basic information of the respondents including gender, age, education level, and monthly income. Each of the scales is assessed on a 7-point Likert scale, ranging from ‘completely disagree’ (1) to ‘completely agree’ (7).

In the TPB model, Perceived Behavioral Control (PBC), Subjective Norm (SN)s, Attitude(A), and residents' intentions (I) to sort garbage were measured using three question items [21]. In the VBN model, three Egoistic Values (authority, social power, wealth) and three Biospheric Values (prevention of pollution, protection of the environment, unity with nature) were selected for measurement. The New Ecological Paradigm (NEP) is measured by selecting 3 items from the NEP scale, and consequence awareness, Ascribed Responsibility (AR), and Personal Norms (PN) are measured using 3 items [22].

2.3. Data sources and sample characteristics

2.3.1 Data collection

The questionnaire survey in this study was conducted through the Internet, using a convenience sampling method. We collected a total of 468 questionnaires from March 22 to April 23,2022, and

the target respondents were the residents in Guangdong Province. A total of 440 valid questionnaires were obtained for analysis, and the valid response rate was 94.09%.

2.3.2 Respondents

As can be seen from Table 1, the main area of respondents was in the Pearl River Delta, accounting for 93.64%. Females accounted for 281 and the female ratio of the respondents involved in this study was 63.86%, slightly more than males. 89.09% of the respondents' age varied between 18 and 25 years. They were highly educated (92.73% had a College or above education). Besides, most of the respondents have a monthly income below the level of 2000 RMB (59.08%), or a medium monthly income, ranging from 2001 and 4000 RMB per month (28.86%). The majority of groups were covered, ensuring the validity of this study. The sample data characteristics are shown in Table 1.

Table 1. Demographics characteristics of respondents

Demographic Variables	Categories	Frequency	Percentage (%)
Location	Guangzhou	156	35.45%
	Shenzhen	143	32.50%
	Other parts of the Pearl River Delta	113	25.68%
	Other regions	28	6.36%
Gender	Male	159	36.14%
	Female	281	63.86%
Age	Under 18 years old	13	2.95%
	18-25 years old	392	89.09%
	Over 25 years old	35	7.95%
Educational level	Lower secondary or below	12	2.73%
	Senior high school or Technical school	20	4.55%
	Junior college or university degree	390	88.64%
	Postgraduate and above	18	4.09%
Monthly income	2000 yuan or less	260	59.09%
	2001-4000 yuan	127	28.86%
	4001-6000 yuan	28	6.36%
	6001-8000 yuan	7	1.59%
	8001 yuan and above	18	4.09%

Notes: RMB is the abbreviation of the Renminbi, the monetary unit of China.

3. Results

3.1. Reliability and validity analysis

This paper assesses the reliability and validity of the questionnaire by calculating the standardized factor loadings, Cronbach's alpha, Composite Reliability (CR), and Average Variance Extracted (AVE). The values of these four indicators range from 0 to 1, with higher values indicating higher reliability and validity of the questionnaire. It is generally accepted that when the standardized loadings are greater than 0.7, the questionnaire variables meet the factor requirements. When the value of Cronbach's alpha is greater than 0.7, the reliability of the questionnaire is acceptable, and when the value of Cronbach's alpha is greater than 0.8, the reliability of the questionnaire is good. The internal consistency of the questionnaire is good when the CR value is greater than 0.7, and the reliability of the questionnaire is good when the AVE value is greater than 0.5. In the measurement model, all factor loadings >0.7 and within an acceptable range indicated that the model fitted the data adequately. All CR values were >0.8, indicating good reliability of the current data. AVE values in the study were all >0.60, indicating good convergent validity of the corresponding constructs. The overall content Cronbach's alpha value of 0.921 is greater than 0.8 and the Cronbach's alpha values for each construct are greater than 0.70, which can be interpreted to mean that these questionnaires

reflect the objectives effectively and that the results of these questionnaires have good reliability and stability. The measurement results are shown in Table 2.

Table 2. Results of the measurement model

constructs	items	Standardized factor loadings	Cronbach's Alpha	CR	AVE
A	A1	0.920	0.906	0.941	0.841
	A2	0.926			
	A3	0.906			
AC	AC1	0.875	0.871	0.921	0.795
	AC2	0.901			
	AC3	0.899			
AR	AR1	0.948	0.932	0.956	0.880
	AR2	0.940			
	AR3	0.926			
BV	BV1	0.923	0.891	0.932	0.820
	BV2	0.920			
	BV3	0.874			
EV	EV1	0.871	0.872	0.918	0.789
	EV2	0.880			
	EV3	0.912			
I	I1	0.914	0.879	0.925	0.805
	I2	0.909			
	I3	0.868			
NEP	NEP1	0.906	0.776	0.865	0.682
	NEP2	0.802			
	NEP3	0.762			
PBC	PBC1	0.890	0.816	0.889	0.729
	PBC2	0.872			
	PBC3	0.796			
PN	PN1	0.926	0.892	0.933	0.823
	PN2	0.913			
	PN3	0.882			
SN	SN1	0.909	0.900	0.938	0.833
	SN2	0.919			
	SN3	0.911			

Next, Confirmatory Factor Analysis (CFA) was used to assess the discriminant validity of the proposed integrated model, generally using the root value of the AVE and the results of correlation analysis to compare the questionnaire with good discriminant validity when the root value of the AVE for each factor was greater than the maximum value of the correlation coefficient between that factor and the other factors. In this study, the square root of the AVE of each factor was higher than the corresponding correlation value of that variable, which had good discriminant validity and ensured the discriminant validity. The measurement results are shown in Table 3.

Table 3. Convergent and discriminant validity analysis

constructs	CR	AVE	A	AC	AR	BV	EV	I	NEP	PBC	PN	SN
A	0.941	0.841	0.917									
AC	0.921	0.795	0.618	0.892								
AR	0.956	0.880	0.470	0.555	0.938							
AV	0.932	0.820	0.543	0.464	0.337	0.906						
EV	0.918	0.789	0.192	0.142	0.170	0.251	0.888					
I	0.925	0.805	0.497	0.437	0.346	0.316	0.116	0.897				
NEP	0.865	0.682	0.276	0.240	0.109	0.278	0.247	0.230	0.826			
PBC	0.889	0.729	0.318	0.292	0.255	0.140	0.092	0.612	0.129	0.854		
PN	0.933	0.823	0.785	0.642	0.544	0.499	0.139	0.542	0.300	0.354	0.907	
SN	0.938	0.833	0.745	0.577	0.447	0.487	0.196	0.614	0.300	0.466	0.756	0.913

Note: Diagonal elements represent the square root of AVE values.

3.2. Results of hypotheses test

After the reliability and validity analyses of the measurement model were conducted, the proposed structural model was evaluated with PLS-SEM. R^2 is a commonly used indicator in statistics to measure how well a model fits the data. Its value ranges from 0 to 1, and the closer it is to 1, the better the model fits the data. The statistical inference method of extrapolating from a sample to the overall population based on certain hypotheses is usually expressed as a p-value (P-Value, Probability), where the sample is statistically significantly different when $p < 0.01$. The fitting effects are shown in Table 4 and the testing of hypotheses are shown in Table 5. Figure 2 is the structure model outcome for the integrated model.

The integrated model explained Intention(I) better ($R^2=0.523$) than the other tested models (Intention (I) R^2 : TPB Model=0.516; VBN Model=0.297). The integrated model also explained personal norm better ($R^2=0.653$), than VBN models ($R^2=0.461$). For all these reasons, we accepted the integrated model as a better model to explain residents' intentions(I) to sort waste (Table 4).

Table 4. The fitting effect of each model

	R^2		
	TPB	VBN	TPB-VBN
I	0.516	0.297	0.523
PN	-	0.461	0.653

Table 5 shows the hypotheses testing results. First of all, Perceived Behavioral Control (PBC), Subjective Norm (SN) and personal norm explain a high Intention (I) on garbage classification, while this is not the case for the Attitude (A). These findings confirm our H2, H3, and H7 but reject H1. According to the results, the most powerful predictor of Intention (I) to engage in garbage classification was Perceived Behavioral Control (PBC), followed by the Subjective Norm (SN).

We found that Egoistic Values (EV) and Biospheric Values (BV) had a significant impact on the New Ecological Paradigm (NEP). The New Ecological Paradigm (NEP) significantly affected Awareness of Consequences (AC) that in turn influenced Ascribed Responsibility (AR). Ascribed Responsibility (AR) had a positive and significant impact on Personal Norms (PN) and Personal Norms (PN) on Intention (I). Therefore, H4-6, H8a and H8b, H9 were supported.

As regards the integration of the two models, the Awareness of Consequences (AC) has a significant impact on residents' attitudes(A) towards garbage classification, Subjective Norm (SN) significantly affected the personal norm. The independent variables Subjective Norm (SN)s, Awareness of Consequences (AC), and Ascribed Responsibility (AR) accounted for 65.3% of the variance in the personal norm. The most powerful predictor of the personal norm was the Subjective Norm (SN), followed by the Awareness of Consequences (AC) and Ascribed Responsibility (AR). These findings supported H9 and H10.

Table 5. Structural relationships and hypotheses testing

Parameter	Estimate	C.R.	P-value	Decision
A -> I	0.038	0.611	0.541	Non-supported
AC -> A	0.618	13.729	0.000	Supported
AC -> AR	0.555	12.775	0.000	Supported
AC -> PN	0.231	4.831	0.000	Supported
AR -> PN	0.171	4.611	0.000	Supported
BV -> NEP	0.231	4.704	0.000	Supported
EV -> NEP	0.189	3.405	0.001	Supported
NEP -> AC	0.240	5.345	0.000	Supported
PBC -> I	0.418	10.468	0.000	Supported
PN -> I	0.161	2.873	0.004	Supported
SN -> I	0.269	4.210	0.000	Supported
SN -> PN	0.546	11.692	0.000	Supported

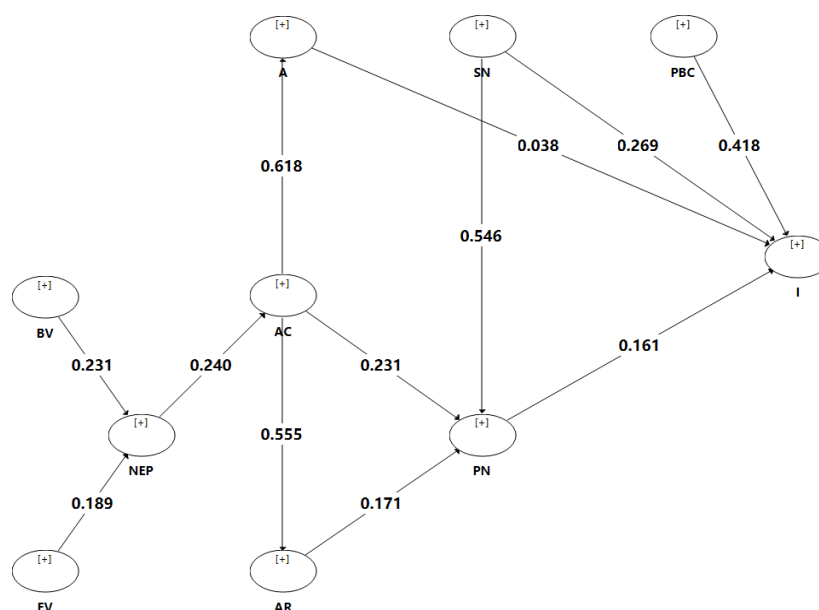


Figure 2. The structural model outcomes for the integrated model

4. Conclusions

This study integrated the TPB and VBN into a comprehensive theoretical framework. The results indicated that TPB had more influence than VBN for predicting residents' intention (I) towards garbage classification, and the proposed framework is more suitable for predicting residents' garbage classification intention (I) than TPB or VBN, because the TPB and VBN are designed to capture different aspects of a person's intention (I).

Secondly, the residents' Perceived Behavioral Norms (PBN), Subjective Norm (SN)s, and Personal Norms (PN) positively and directly influenced residents' behavioral intention (I) to classify garbage. Among them, Perceived Behavioral Control (PBC) was the largest factor influencing residents' behavioral intention (I) to classify garbage, but the effect of Attitude (A) on residents' behavioral intention (I) to sort garbage was not significant in the integrated model, which indicates that although residents recognize the importance of garbage classification, their Intention (I) has not significantly improved. This is probably because the standards of classification make respondents confused and unaware of how to classify garbage and the implementation remains vague due to unclear legal responsibilities [6]. This result confirms the existence of the "attitude-behavior gap," the same as previous studies [7]. Meanwhile, the Subjective Norm (SN) can influence the residents' waste classification intention (I). If people around are actively practicing waste separation, residents are more likely to have an Intention (I) toward waste classification, which is consistent with the previous studies [15, 23]. Thirdly, the results suggest that activation of personal norm is a composite procedure that entails the influence of Ascribed Responsibility (AR), Awareness of Consequences (AC) and Subjective Norm (SN), among which Subjective Norm (SN)s have the most significant impact on Personal Norms (PN), and Ascribed Responsibility (AR) has the least impact on Personal Norms (PN) [19].

5. Limitations and prospects

Although this research has several significant contributions, it also has some limitations that. First of all, we used convenience samples, and thus, generalizability to the entire population is questionable. And the survey is restricted to the areas in the province of Guangdong with a sample of 440 residents. Residents' intention (I) of garbage classification varies due to the regional differences and unbalanced economic development around the country, so the results and application made in this paper are not universal. Future studies should try to collect data from more provinces around China. Further, the

effects of socio-demographic features should be further studied. Numerous other background factors, such as education, income, and the area of residence (town or rural), could also be associated with the constructs and relationships considered in our studies. Moreover, the current research focuses on Intention (I) instead of the behavior. Since a gap between the Intention (I) and behavior exists, in further study, more methods measuring the actual behavior should be used to investigate the policy effectiveness on actual behavior.

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