Proceedings of the International Conference on Social Psychology and Humanity Studies
DOI: 10.54254/2753-7048/10/20230215

# *Analysis of the Influencing Factors of the Garbage Sorting Behavior on Campus in the Post-Epidemic Period*

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***Abstract:*** With the rapid development of the economy and the rise of people's con-sumption level, the problem of garbage is becoming a more and more severe challenge. Meanwhile, colleges, as a place with a high concentration of stu-dents, have also more serious garbage sorting problems. Therefore, this paper will be devoted to analyzing the factors that influence college students' gar-bage sorting behavior in the post-epidemic period. To start with, a question-naire based on the Theory of Planned Behavior (TPB) model was made to collect students' data. Then the KMO tests and AMOS Structural Equation Fitting were conducted to verify the validity of the data and structure. After confirming that the data is effective, the data will be analyzed by building models including the Measurement Model of Empirical Analysis Framework, Overall model fitting, Theory of Reasoned Action (TRA) model and original Model. Lastly, with the optimization of the mediation effect and confirmatory factor analysis, the conclusion can be drawn that the student participants tend to adopt garbage-sorting behavior in both willingness and action. And the results show that they also have a positive attitude, good subjective norms, and strong perceived behavior control for the garbage sorting behavior on campus.

***Keywords:*** empirical analysis framework, garbage sorting behavior, questionnaire testing

## 1. Introduction

### 1.1. Background

Where there are people, there is garbage. With economic growth and the continuous expansion of urban scale, the production of municipal solid waste is increasing. At the same time, the improvement of science and technology also led to a variety of polymer synthetic materials being widely used. The composition of waste and garbage is becoming more and more complex, and the harm is also more serious [1]. Colleges and universities, as places where the population is relatively concentrated, consume huge amounts of goods and produce a very large amount of garbage. Universities in the United States have a serious waste problem. College student produces about 640 pounds of waste per year on average [2]. Therefore, the study of factors affecting campus garbage sorting behavior in the post-epidemic period is of great significance for the construction of a conservation-oriented campus and ecological society.

DOI: 10.54254/2753-7048/10/20230215

## 1.2. Related Research

Garbage sorting behavior refers to the process of separating different types of waste materials such as organic, recyclable, and non-recyclable items. Garbage sorting behavior has been identified as a critical factor in reducing waste and promoting environmental sustainability [3].

Several factors have been identified as important in shaping garbage sorting behavior. These factors can be broadly categorized as individual-level, social, and structural [4].

Individual-level factors include knowledge, attitudes, and values. People who have a greater understanding of the benefits of garbage sorting are more likely to sort their garbage. Similarly, people who place a high value on environmental sustainability are more likely to do so.

Social factors include social norms, peer influence, and social support. It has been found that people are more likely to sort their garbage when they perceive that it is a normative behavior among their social group. Peer influence and social support also play a role in shaping garbage-sorting behavior.

Structural factors include access to facilities, convenience, and economic incentives. People are more likely to sort their garbage when they have access to convenient facilities such as recycling bins and composting facilities. Economic incentives such as financial rewards for sorting garbage can also be effective in promoting the behavior.

The effects of garbage sorting behavior can be seen at both individual and societal levels [5]. At the individual level, garbage sorting behavior can contribute to a sense of personal responsibility for the environment and can increase environmental awareness. At the societal level, garbage sorting behavior can lead to reduced waste and reduced environmental impact.

Generally, literature has pointed out that garbage sorting behavior is a comprehensive and complex behavior that is affected by a range of individual-level, social, and structural factors. Effective interventions to promote garbage sorting behavior need to address these different factors. The effects of garbage sorting behavior can be seen at both individual and societal levels and can contribute to increased environmental awareness and reduced environmental impact.

However, current research has tended to focus on how academics evaluated the impacts, with little attention paid to undergraduate viewpoints and the detailed reasons for these impacts. Thus, this paper is aimed at discussing the mechanism of influencing factors in garbage sorting. Most scholars, based on the theory of planned behavior (TPB) model, have studied the influence mechanism of attitude (ATT), subjective norm (SN), perceived behavioral control (PBC), and personal moral norm (PMN) on garbage sorting behavior as shown in Fig. 1 [6]. And this paper will continue to explore the garbage-sorting behavior of college students based on this model.

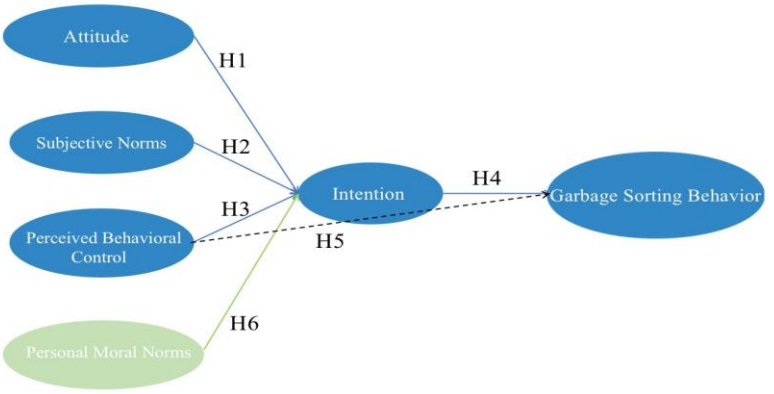


Figure 1: The Theoretical Framework of Garbage Sorting Behavior.
(Photo Credit: Original)

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### 1.3. Objection

To figure out the specific influencing factors, firstly, by combining a literature review and in-depth field investigation, relevant factors affecting students' garbage sorting behavior are identified, and a theoretical framework model of influencing factors of garbage sorting behavior is proposed. Secondly, based on referring to the theoretical framework of conclusion behavior and field research, questionnaires were conducted on the influencing factors of students' garbage sorting and throwing behavior, and the reliability and validity of 216 questionnaires effectively recovered were tested. Finally, the differences in students' characteristics are tested based on SPSS statistical analysis, and the mechanism of influencing factors of students' garbage sorting behavior is empirically analyzed by building a structural model.

## 2. Methodology

Aiming at the research on the garbage classification literacy of college students, this paper elaborated with a questionnaire on the influencing factors of the garbage classification behavior of students at Sichuan University during the post-epidemic period. Based on the reliability and validity of the data collected, the structural equation fitting test would be carried out to verify the effectiveness of the questionnaire and later research, including data collection, data verification, and model building.

### 2.1. Data Collection

The questionnaire was designed based on the theory of planned behavior. The theory explains how beliefs influence human behavior. According to the theory, three fundamental factors including attitude (ATT), subjective norms (SN), and perceived behavioral control (PBC) will work together to shape a person's behavioral intentions (INT). Moreover, personal moral norms (PMN) will also have a potential impact on the intentions [7].

After accomplished the questionnaire and surveying students in the Jiangan Campus, Wangjiang Campus, and Huaxi Campus of Sichuan University, 2160 valid data were collected. Detailed sample distribution and representative questionnaire content are in Table 1- 2.

Table 1: Sample Distribution in the Questionnaire.

| Variables | Options | Frequency | Percentage |
|---|---|---|---|
| Gender | Male | 580 | 26.9% |
| | Female | 1580 | 73.1% |
| Age | <=20 | 1410 | 65.3% |
| | 21~25 | 720 | 33.3% |
| | 26~30 | 20 | 0.9% |
| | >30 | 10 | 0.5% |
| | Total | 2160 | 100.0% |

Table 2: Questionnaire Structure and Representative Content.

| Construct | Sub-concept | ID | Description |
|---|---|---|---|
| Attitude | Behavioral Belief Strength | ATT1 | Sorting garbage at school will reduce my comfort of life in school. |
| Subjective Norms | | SN1 | Others will expect me to sort the garbage. |

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Table 2: (contituned).

| | | | |
|---|---|---|---|
| Perceived Behavioral Control | The strength of control belief | PBC1 | I know I can sort the garbage at school. |
| Intention | | INT1 | I'm going to sort the garbage. |
| Actual Behavior | | AB1 | I would sort the renewable waste from the non-renewable waste |
| Personal Moral Norms | | PMN1 | I will feel compunctious if I don't practice garbage sorting. |

## 2.2. Questionnaire Testing Method

To test the effectiveness of the questionnaire setting and the validity of the questionnaire data, the KMO tests and AMOS structure equation fitting will be carried out, with detailed contents as follows.

### 2.2.1. KMO Tests

To compare the simple correlation coefficient and partial correlation coefficient between variables, the KMO (Kaiser-Meyer-Olkin) test statistic is utilized. It is primarily utilized in multivariate factor analyses. Before factor analysis, it is necessary to perform the KMO test. The questionnaire has structural validity only when the KMO test coefficient is bigger than 0.5 and the P value was smaller than 0.05 [8]. Otherwise, it may be considered as designed unreasonably. Based on this, the subsequent analysis of influencing factors of garbage sorting behavior can be carried out.

$$KMO = \frac{\sum\sum_{i\neq j} r_{ij}^2}{\sum\sum_{i\neq j} r_{ij}^2 + \sum\sum_{i\neq j} r_{ij\cdot 1,2\cdots k}^2} \tag{1}$$

### 2.2.2. AMOS Structural Equation Fitting

To verify the rationality of the questionnaire structure, the Principal Component Analysis (PCA) as a statistical method will be first conducted. A set of variables that might be correlated are transformed into a set of linearly unrelated variables, known as principal components, through orthogonal transformation. Although orthogonal transformation can easily explain and represent the results of factor analysis, the results of transformation often do not accord with reality because of the uncorrelation between the specified factors. Therefore, the Kaiser normal maximum variance method will be used in this paper.

In principal component analysis or factor analysis, the Kaiser normal maximum variance method is used to maximize the sum of variances of the different factor loads by coordinate transformation. It can easily explain the factors, but also ensure a simple structure between the factors. More importantly, correlations between allowable factors are also more realistic.

$$R_{\text{VARIMAX}} = \text{argmax}_R\left(\sum_{j=1}^{k} \times \sum_{i=1}^{p} - \frac{\gamma}{p}\sum_{j=1}^{k} \times \left(\sum_{i=1}^{p} \ (\Lambda R)_{ij}^2\right)^2\right) \tag{2}$$

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## 2.3. Models

### 2.3.1. Measurement Model of Empirical Analysis Framework

After the initial processing of the questionnaire data conducted in 2.2, the proposed framework will first be tested. The target model is redesigned as a Confirmatory Factor Analysis (CFA) model. By doing the analysis, the convergence validity and combination reliability of each dimension of the scale are tested [9].

### 2.3.2. Overall Model Fitting

The best-fitting models H1-H4 and H6 (see Figure 1) were used for hypothesis testing. Overall model fitting was measured by Chi-square (CMIN), Degree of Freedom (DF), Root Mean Square Error Approximation (RMSEA), Tucker and Lewis Index (TLI), Comparative Fitting Index (CFI), and Goodness of Fitting Index (GFI).

### 2.3.3. TRA Model and Original TPB Model

Also, an additional construct, personal moral norm (PMN) H6, was added to the original model. Based on the Theory of Reasoned Action (TRA) model, specific behaviors exhibited by individuals are influenced by their behavioral intentions (INT), which are jointly determined by their attitude (ATT) and subjective norm (SN) for behaviors. Meanwhile, studies indicate that attitudes and subjective norms also affect each other [10]. Because TRA assumes that individuals have complete voluntary control over whether to engage in a particular behavior, it ignores the ethical and moral decisions made by core users, especially when individual characteristics are ignored [11]. Therefore, an additional construct, personal moral norm (PMN) H6, was added to the original model.

### 2.3.4. Mediation Effect Model

The mediating effect was examined by the bootstrap-up method (H5). The mediator is an important statistical concept in the mediation effect. By analyzing the mediation effect, it can be seen whether there is a mediator M that has a potential effect on the variables.

## 3. Results and Discussion

## 3.1. Data Verification

The KMO value is range from 0 to 1. As it approaches 1, indicating a stronger correlation between the variables and greater suitability of the original variables for factor analysis. SPSS22.0 was used for the reliability analysis of questionnaire sample data, and the value of KMO was 0.868 (see Table 3), indicating a strong correlation between variables. After the correlation between variables was determined, principal component analysis was carried out (see Table.3).

Table 3: Common Factor Variance.

| ID | Initial | Extracted | ID | Initial | Extracted |
|---|---|---|---|---|---|
| **ATT1** | 1.000 | 0.760 | **INT1** | 1.000 | 0.696 |
| **ATT2** | 1.000 | 0.822 | **INT2** | 1.000 | 0.770 |
| **ATT3** | 1.000 | 0.766 | **INT3** | 1.000 | 0.598 |
| **ATT4** | 1.000 | 0.630 | **INT4** | 1.000 | 0.715 |
| **SN1** | 1.000 | 0.657 | **GCB1** | 1.000 | 0.533 |

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Table 3: (contituned).

| | | | | | |
|---|---|---|---|---|---|
| **SN2** | 1.000 | 0.812 | **GCB2** | 1.000 | 0.672 |
| **SN3** | 1.000 | 0.723 | **GCB3** | 1.000 | 0.673 |
| **SN4** | 1.000 | 0.626 | **GCB4** | 1.000 | 0.711 |
| **PBC1** | 1.000 | 0.576 | **PMN1** | 1.000 | 0.640 |
| **PBC2** | 1.000 | 0.562 | **PMN2** | 1.000 | 0.699 |
| **PBC3** | 1.000 | 0.560 | **PMN3** | 1.000 | 0.729 |
| **PBC4** | 1.000 | 0.677 | **PMN4** | 1.000 | 0.644 |

Given the disadvantages of principal component analysis method may have, Caesar Normal Variance Method is used to optimize. From the samples represented by this set of variables, each sample can be represented by a linear combination of functions of a few variables, and the rotation has converged after eight iterations. After component transformation, the result is shown in Table 4.

Table 4: Component Transformation.

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| ATT1 | -.175 | .849 | -.059 | -.045 | -.016 | .053 |
| ATT2 | -.052 | .880 | -.119 | -.080 | -.018 | -.157 |
| ATT3 | .007 | .858 | .008 | -.057 | -.038 | -.156 |
| ATT4 | -.272 | .662 | -.159 | .010 | -.130 | .274 |
| SN1 | .145 | -.082 | .213 | .137 | .682 | .316 |
| SN2 | .155 | .023 | .013 | .075 | .874 | .130 |
| SN3 | -.045 | .019 | .120 | .207 | .151 | .800 |
| SN4 | .401 | -.144 | .400 | .206 | .476 | -.124 |
| PBC1 | .206 | -.097 | .655 | .089 | .267 | .123 |
| PBC2 | .255 | -.117 | .383 | .203 | .235 | .490 |
| PBC3 | .299 | -.092 | .377 | .199 | .046 | .528 |
| PBC4 | .055 | -.019 | .796 | .124 | -.014 | .159 |
| INT1 | .332 | -.233 | .544 | .206 | .177 | .402 |
| INT2 | .558 | -.296 | .330 | .216 | .464 | .004 |
| INT3 | .425 | -.247 | .406 | .324 | .284 | .078 |
| INT4 | .613 | -.224 | .326 | .191 | .361 | -.124 |
| GCB1 | .180 | -.102 | .355 | .604 | .118 | .076 |
| GCB2 | .193 | -.032 | .061 | .776 | .072 | .151 |
| GCB3 | .308 | -.046 | .357 | .619 | -.063 | .248 |
| GCB4 | .124 | -.033 | .003 | .800 | .189 | .141 |
| PMN1 | .596 | .051 | .039 | .161 | .158 | .480 |
| PMN2 | .772 | -.137 | .126 | .134 | .137 | .177 |
| PMN3 | .760 | -.141 | .225 | .225 | .136 | -.108 |
| PMN4 | .775 | -.056 | .049 | .153 | .025 | .186 |

According to the above calculation, it can be found that KMO is ideal, and the common factor variance from the principal component analysis is successful. In the data analysis, the data and the model can be well-fitted. The design of this questionnaire is reasonable and can provide theoretical support for the investigation of garbage sorting behavior in colleges during the post-epidemic period.

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## 3.2. Model Analysis

### 3.2.1. Measurement Model of Empirical Analysis Framework

After the initial verification of the questionnaire processing, the suggested framework is first tested. The target model is reclassified as a confirmatory factor analysis (CFA) model. After doing the analysis, each scale dimension's convergence validity and combination reliability were evaluated (see Table 5).

Table 5: Test of Convergence Validity and Combination Reliability of Each Dimension.

| Path Relationship | | | Estimate | AVE | CR |
|---|---|---|---|---|---|
| ATT1 | <--- | Attitude | 0.82 | 2.494 | 1.151 |
| ATT2 | <--- | Attitude | 0.879 | | |
| ATT3 | <--- | Attitude | 0.78 | | |
| ATT4 | <--- | Attitude | 0.611 | | |
| SN1 | <--- | Subjective Norms | 0.673 | 3.491 | 1.082 |
| SN2 | <--- | Subjective Norms | 0.606 | | |
| SN3 | <--- | Subjective Norms | 0.361 | | |
| SN4 | <--- | Subjective Norms | 0.705 | | |
| PBC1 | <--- | Perceived Behavioral Control | 0.665 | 3.447 | 0.973 |
| PBC2 | <--- | Perceived Behavioral Control | 0.727 | | |
| PBC3 | <--- | Perceived Behavioral Control | 0.663 | | |
| PBC4 | <--- | Perceived Behavioral Control | 0.54 | | |
| INT1 | <--- | Intention | 0.705 | 3.758 | 0.875 |
| INT2 | <--- | Intention | 0.903 | | |
| INT3 | <--- | Intention | 0.809 | | |
| INT4 | <--- | Intention | 0.826 | | |
| GSB1 | <--- | Garbage Sorting Behavior | 0.666 | 3.6 | 0.964 |
| GSB2 | <--- | Garbage Sorting Behavior | 0.676 | | |
| GSB3 | <--- | Garbage Sorting Behavior | 0.775 | | |
| GSB4 | <--- | Garbage Sorting Behavior | 0.646 | | |
| PMN1 | <--- | Personal Moral Norms | 0.618 | 3.721 | 0.911 |
| PMN2 | <--- | Personal Moral Norms | 0.802 | | |
| PMN3 | <--- | Personal Moral Norms | 0.791 | | |
| PMN4 | <--- | Personal Moral Norms | 0.699 | | |

There are six indexes in the extended model: ATT, SN, PBC, INT, GSB, and PMN, each of which is measured by four items, as shown in Table 5. And attitude item ATT 1-4 is anti-coding; thus, a high score indicates a positive attitude towards garbage classification. All these structures provide acceptable consistency and reliability within the data.

### 3.2.2. Overall Model Fitting

The fitting statistics of the model are given in the third column of Table 6, in which the chi-square value CMIN is 1044.102 and the degree of freedom is 249. CMIN/DF = 1.38, RMSEA = 0.04, IFI = 0.97, TLI = 0.96, CFI = 0.97, GFI = 0.89 The reference standards were excellent except that GFI was good.

In the model fitting, each index has at least 3 measurements, so it is suitable for structural regression models. When the standardized load was greater than 0.40, AVE values reached a

DOI: 10.54254/2753-7048/10/20230215

minimum of 0.5, and CR values reached a minimum of 0.7. All measurements were significantly correlated with the specified structure, and principal component analysis also showed good construct validity.

Table 6: Model Fitness Test.

| Index | Criteria | Result |
|---|---|---|
| CMIN | / | 1044.102 |
| DF | / | 249 |
| CMIN/DF | Excellent:1-3, Good:3-5 | 1.38 |
| RMSEA | Excellent:<0.05，Good:<0.08 | 0.04 |
| IFI | Excellent:>0.9，Good:>0.8 | 0.97 |
| TLI | Excellent:>0.9，Good:>0.8 | 0.96 |
| CFI | Excellent:>0.9，Good:>0.8 | 0.97 |
| GFI | Excellent:>0.9，Good:>0.85 | 0.89 |

### 3.2.3. TRA Model and TPB Model

According to the results of the model comparison, as shown in Table 7, significant differences are between the two models (P<0.001). Another analysis parameter, the multiple correlations of squares (R2), which represents the proportion of the total deviation, also demonstrates this difference. Compared with the consequences of the original TPB model, the garbage sorting intention $R^2$ of the extended TPB model increases from 0.594 to 0.664, and the garbage sorting behavior $R^2$ increases from 0.398 to 0.41.

Table 7: Comparison of the Two Models.

| Structural Weight | TPB | TPB+PMN |
|---|---|---|
| INT<---ATT | -0.21 | -0.19 |
| INT<---SN | 0.81 | 0.67 |
| INT<---PBC | 0.56 | 0.46 |
| INT<---PMN | / | 0.56 |
| GSB<---INT | 0.577 | 0.577 |
| INT($R^2$) | 0.594 | 0.664 |
| GSB($R^2$) | 0.398 | 0.41 |

It can be found from the comparison that the relationship between garbage sorting intention and behavior is enhanced, and R2 is improved at the same time. It can be concluded that the additional construction of personal moral norms enhances the explanatory power of the model.

### 3.2.4. Mediation Effect Model

As shown in Table 8, perceived behavioral control (PBC) has significant direct and indirect effects on garbage sorting behavior through willingness (β = 0.313). Although it cannot achieve a complete mediating effect, conscious control still plays a partial mediating effect between perceptual behavior control and energy-saving behavior.

DOI: 10.54254/2753-7048/10/20230215

Table 8: Mediation Effect Analysis.

| Independent Variable | Mediator | Dependent Variable | Path Coefficient | Indirect Influence | Direct Influence |
|---|---|---|---|---|---|
| X | M | Y | X-->M | X-->Y | X-->Y |
| PBC | INT | CGB | 0.623 | 0.3595 | 0.313 |

According to Table 7, except for the negative correlation between attitude and garbage sorting behavior (INT<-- --ATT: -0.19) because of the anti-coding, all other constructs in the model are positively correlated with intention of garbage sorting behavior. The summaries of hypothesis testing results are listed in Table 9 below.

Table 9: Summary of Hypothesis Testing Results.

| Order | Hypothesis | Solution |
|---|---|---|
| 1 | ATT is positively correlated with intention of GSB. | NO |
| 2 | SN is positively correlated with the intention of GSB. | YES |
| 3 | PBC is positively correlated with intention of GSB. | YES |
| 4 | INT is positively correlated with GSB. | YES |
| 5 | PBC is mediated by the intention of GSB. | YES |
| 6 | PMN is positively correlated with the intention of GSB. | YES |

### 3.3. Results of Confirmatory Factor Analysis

With the correction and optimization of the extended TPB model and mediation effect model, the final consequence of the CFA can be obtained. Assuming a regression weight of 1.000 for ATT1, SN1, PBC1, INT1, GSB1, and PMN1, $\alpha$ of the subjective norm is effective because of the broad conceptual structure and because each construct represents only one sub-concept (see Table 10). By testing the subjective norm of observed variables and the convergence validity and combination reliability of each dimension, the comprehensive measure of each construction is obtained.

If Cronbach's alpha score is larger than 0.50 it means a middle level or excellent level of reliability. Except for the SN3 coefficient, which had a significant difference from the other group coefficients of 0.361, all structures above demonstrated middle or high internal reliability (see Table 5).

Table 10: Confirmatory Factor Analysis Result.

| Structure | Measures | Standardized Regression Weighting |
|---|---|---|
| Attitude($\alpha$=0.854) | ATT1 | 0.817 |
| | ATT2 | 0.878 |
| | ATT3 | 0.783 |
| | ATT4 | 0.625 |
| Subjective Norm ($\alpha$=0.0.669) | SN1 | 0.615 |
| | SN2 | 0.567 |
| | SN3 | / |
| | SN4 | 0.71 |
| Perceived Behavioral Control ($\alpha$=0.743) | PBC1 | 0.649 |
| | PBC2 | 0.725 |

DOI: 10.54254/2753-7048/10/20230215

Table 10: (contituned).

| | | |
|---|---|---|
| | PBC3 | 0.655 |
| | PBC4 | 0.586 |
| Intention($\alpha$=0.883) | INT1 | 0.61 |
| | INT2 | 0.751 |
| | INT3 | 0.656 |
| | INT4 | 0.655 |
| Garbage Sorting Behavior ($\alpha$=0.787) | GSB1 | 0.471 |
| | GSB2 | 0.391 |
| | GSB3 | 0.499 |
| | GSB4 | 0.357 |
| Personal Moral Norms ($\alpha$=0.812) | PMN1 | 0.57 |
| | PMN2 | 0.834 |
| | PMN3 | 0.851 |
| | PMN4 | 0.723 |

## 4. Conclusion

The results of this paper show that the student participants have a positive attitude, good subjective norms, and strong perceived behavior control for the garbage sorting behavior on campus and tend to adopt garbage sorting behavior in both willingness and action in the post-epidemic period. To get the conclusion of the analysis, a questionnaire that has been tested for rationality is first published in the school. Then, based on the data obtained, this paper establishes the TPB model and analyzes it by principal component analysis. Finally, the intermediary effect model is optimized to get the result. Garbage sorting behavior is an important issue for sustainable waste management. College students represent an influential group of potential change agents who can help promote environmentally friendly behaviors. Therefore, understanding the factors that influence their garbage sorting behavior is crucial for developing effective strategies to promote sustainable waste management and environmental enhancement in the future. It is undeniable that the research data collected in this paper is insufficient, and the models can be further optimized. However, in future research on the influencing factors of garbage sorting behavior, there must be much more breakthroughs and progresses.

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