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Extended Household Waste Separation Model (HWSM) within the scope of moral norms, environmental values and facilitating conditions

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ABSTRACT

In this study, attitudes and behaviors towards the separation of household waste were investigated with the help of a model proposed within the scope of moral norm, environmental benefit, facilitating conditions, existing infrastructure adequacy added to the Theory of Planned Behavior (TPB). In the proposed Extended Household Waste Separation Model (HWSM), the exogenous latent variable of moral norm is designed as an estimator of the variables of attitude, subjective norm and perceived behavior, control which are the antecedents of the TPB model. In the model, the environmental benefit of waste separation, conditions that facilitate waste separation, and existing infrastructure adequacy are included as predictors of behavior towards waste separation. The sample consisted of 350 units and the data were collected through an online questionnaire. It was determined that 40.7% of the participants in the sample resided in Eskişehir, 8.7% in Istanbul, 8.2% in Bursa, 7.4% in Antalya, 6.5% in Ankara and 5.6% in Izmir. The fit of the proposed model and the hypothesis testing of the structural relationships were performed using partial least squares structural equation modeling (PLS-SEM). As a result of the path analysis, the effect of only environmental benefit on behavior was not found to be significant and it was determined that only one of the 13 hypotheses was not supported. When the PLS-SEM compliance criteria related to the suitability of the proposed HWSM were examined, it was evaluated that the model was compatible. One of the remarkable results of the study is that the direct effect of environmental benefit on waste behavior is not significant, but the relationship is determined as positive and significant thanks to the full mediation of the intention variable. In addition, perceived behavioral control appeared to play a moderator role in the relationship between moral norm and waste sorting behavior. In addition, it was determined that a one-unit increase in facilitating conditions and existing infrastructure adequacy would cause an increase of 0.328 and 0.234 units, respectively, in household waste separation behavior.

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Ahlaki normlar, çevresel değerler ve kolaylaştırıcı koşullar kapsamında Genişletilmiş Evsel Atık Ayrıştırma Modeli (EAAM)

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ÖZ

Bu çalışmada, Planlı Davranış Teorisine (TPB) eklenen ahlaki norm, çevresel fayda, kolaylaştırıcı koşullar, mevcut altyapı yeterliliği kapsamında önerilen bir model yardımıyla evsel atıkların ayrıştırılmasına yönelik tutum ve davranışlar araştırılmıştır. Önerilen Genişletilmiş Evsel Atık Ayrıştırma Modelinde (HWSM), ahlaki normun dışsal gizli değişkeni, TPB modelinin öncülleri olan tutum, öznel norm ve algılanan davranış, kontrol değişkenlerinin bir tahmincisi olarak tasarlanmıştır. Modelde, atık ayırmanın çevresel faydası, atık ayırmayı kolaylaştıran koşullar ve mevcut altyapı yeterliliği, atık ayırmaya yönelik davranışın öngörücüleri olarak dahil edilmiştir. Örneklem 350 birimden oluşmuş ve veriler online anket yoluyla toplanmıştır. Örneklemdeki katılımcıların %40,7'sinin Eskişehir, %8,7'sinin İstanbul, %8,2'sinin Bursa, %7,4'ünün Antalya, %6,5'inin Ankara ve %5,6'sının İzmir'de ikamet ettiği belirlenmiştir. Önerilen modelin uyumu ve yapısal ilişkilerin hipotez testi, kısmi en küçük kareler yapısal eşitlik modellemesi (PLS-SEM) kullanılarak gerçekleştirilmiştir. Yol analizi sonucunda, yalnızca Çevresel faydanın Davranış üzerindeki etkisi anlamlı bulunmamış ve 13 hipotezden sadece birinin desteklenmediği belirlenmiştir. Önerilen HWSM'NİN uygunluğu ile ilgili PLS-SEM uyum kriterleri incelendiğinde, modelin uyumlu olduğu değerlendirilmiştir. Araştırmanın dikkat çekici sonuçlarından biri, çevresel faydanın atık davranışı üzerindeki doğrudan etkisinin anlamlı olmaması, ancak niyet değişkeninin tam aracılığı sayesinde ilişkinin pozitif ve anlamlı olarak belirlenmesidir. Ayrıca, algılanan davranışsal kontrolün, ahlaki norm ve atık ayırma davranışı arasındaki ilişkide düzenleyici bir rol oynadığı görülmüştür. Ayrıca kolaylaştırıcı koşullarda ve mevcut altyapı yeterliliğinde bir birimlik artışın evsel atık ayırma davranışında sırasıyla 0,328 ve 0,234 birim artışa neden olacağı belirlenmiştir.

1. Introduction

Rapid urbanization and population growth, along with technological developments and industrialization, increase the negative impact of human behavior on the environment day by day all over the world. While the rapid growth in production and marketing causes excessive depletion of natural resources, the resulting wastes threaten the environmental structure and human health negatively. For all these reasons, it is very important to separate waste sources in households and to recycle them. In addition, it is an indisputable fact that it is important for municipalities to effectively manage household waste by solving the problem of waste storage and resource saving.

In general, people's attitudes and behaviors towards household waste management can be affected by a country's socioeconomic conditions, development and education level, income sources, lifestyle and culture. In recent years, interest in household waste sorting and recycling has been increasing in Turkey (Yılmaz and Arı, 2019). According to the research report of the Turkish Statistical Institute, a total of 104.8 million tons of waste, 30.9 million tons of which is hazardous, was generated in manufacturing industry workplaces, mining enterprises, thermal power plants, organized industrial zones (OIZ), health institutions and households in Turkey in 2020. The total amount of waste increased by 10.5% compared to 2018. While the amount of household waste generated in households was 28 099 214 million tons in 2018, it was calculated as 28 635 018 million tons in 2020. The average daily amount of waste per person collected in municipalities was calculated as 1.13 kg. It was

determined that 1387 of 1389 municipalities in Turkey provided waste services. While 69.4% of the 32.3 million tons of waste collected in municipalities where waste service is provided is sent to landfills, 17% to municipal dumps and 13.2% to recycling facilities, 0.4% is burned in the open and buried. It was determined that the waste was disposed of by pouring into a stream or land (TUIK, Waste Separation, 2020).

Household wastes are wastes that can be collected from garbage bins in front of the houses by the municipal service, disposed of in landfills, recycled by separation, composted or incinerated. These are food scraps, kitchen garbage, packaging waste, paper, glass, metal, etc. there may be waste. Household solid wastes cause air, water and soil pollution when they are not disposed of in accordance with the technical and health conditions. In particular, soil-filled household food waste can produce methane gas, which has a 21 times greater impact on global warming than carbon dioxide. In addition, the moist nature of food waste is also a major contributor to landfill leachate generation, and their presence in the waste stream can contaminate and complicate the recovery process of other recyclables. For these reasons, it is necessary to use methods that will ensure the disposal of solid wastes in a way that causes the least damage to the environment (Karim Ghani, Rusli, Biak, Idris, 2013).

The aim of this study is to investigate and measure the factors affecting the household waste separation behavior of individuals. Household waste separation behavior; In addition to environmental benefits, it is also a new source creation method. Although Household waste separation behavior is quite common in many countries, it is not very common in Turkey. For a clean and livable world and for our benefit to the nature and environment we live in, it is very important to investigate the factors that lead individuals to household waste separation behavior. For this reason, in this study, it will be discussed what can affect the household waste separation behavior of individuals and what can be done to increase this behavior. Thanks to the study, while a structural model was proposed to the household waste separation literature, on the other hand, it was tried to expand the TPB with the variables added in the study.

2. Literature review and hypothesis development

When the literature is reviewed, some socio-psycho research has been carried out in order to elucidate why households might or might not comply with waste management policies such as waste reduction, resource allocation and garbage disposal. Ajzen (1991) brought forward TPB on the basis of the theory of reasoned action, which highlights that an individual's behavior is affected by attitude, subjective norm, and perceived behavioral control. Many scholars have investigated waste categorisation and recycling behaviors via TPB theory. For example, Nguyen et al. (2015) revealed that personal ethics is an important influencing factor in promoting waste classification and behavioral intention of residents. Park and Ha (2014) found out that habitants are motivated and impressed upon witnessing their neighbors or companions sorting and recycling household waste. Yılmaz and Arı (2019) investigated the household waste separation behavior of university students in Eskişehir with the TPB model and determined that the household waste separation intention, attitude, and subjective norm variables had a statistically positive effect. Karim Ghani et al. (2013) determined that the only predictor of the intention to classify food waste is attitude, as well as pointing out that subjective norm, perceived behavioral control, and local facilities are negligible variables in an area where food waste separation establishments were poor. Chu and Chiu (2003) showed that, in addition to TPB variables, perceived moral responsibility further improves the prediction of intention to recycle household waste. Corsini et al. (2018), in their study to explore waste prevention behavior, revealed that there is a positive relationship between attitudes and perceived behavioral control. Liao et al. (2018) showed that there is a significant relationship between waste separation behavior and perceived behavioral control and waste separation intention of facilities. The relationship between time pressure and intention is significantly negative. It also supported the feasibility of incorporating additional constructs into the theory of planned behavior. Bortoleto et al. (2012) stated that household waste prevention behavior in households stems from perceptions of moral obligation and discomfort, as well as a concern for the environment and society.

Although the TPB model tries to explain the recycling and waste separation behavior of residents, there appear some limitations of the model. The TPB fundamentally studies internal variables; nevertheless, other factors may interefere in the transformation of intentions into behavior as well (Boldero, 1995). Stern and Oskamp (1987) formed a multifaceted model of environmental behavior, arguing that environmental behavior consists of relevant external and internal factors acting cooperatively. On the grounds of this finding, Guagnano et al. (1995) established the Attitude-Behavior-Condition theory, which proposes that the behavior of individuals arises from the united impact of people's attitudes and external factors, and revealed that external factors are pivotal to detecting whether residents execute household waste recycling behavior. Attitude-Behavior-Condition theory was enhanced by Tucker et al. (1998) and they propounded a research model where residents' household solid waste disposal behavior (HSW) is represented by attitudes, subjective norms, social norms, and external conditions.

When the literature is examined, so far most of the research have separately examined individuals' waste reduction behavior (Bortoleto et al., 2012), the behavior of waste source categorisation (Zhang and Wen, 2014), household recycling behavior of recyclable resource (Fei et al., 2016). Systematic and comprehensive studies to investigate household waste separation behaviors simultaneoulsy are rare (Meng et al, 2019). Among the studies presented, there are very few studies that consider both internal (subjective) factors and external (i.e. situational) factors affecting the waste management behaviors of individuals. The study contributes to the literature with its HWSM.

In this study, in order to understand the household solid waste separation behavior of residents, both internal and external factors are comprehensively addressed, and a structural research model that reveals causal relationships is proposed. Moral norm, environmental benefit, existing infrastructure adequacy, and facilitating conditions were added as exogenous variables to the Extended Household Waste Separation Model (HWSM), which was put forward on the basis of TPB. When the literature is examined, it has been evaluated that it may be appropriate to include existing infrastructure adequacy, moral responsibility, environmental benefit and facilitating conditions as an independent variable in the traditional model of Theory of Planned Behavior. In the construction of the model, studies by Chu and Chui (2003), Karim et al. (2013), Corsini et al. (2018), Meng et al. (2019), have been used.

2.1. Moral norm

Moral norm can be defined as a person's concern with the level of responsibility to act morally or immorally when faced with an ethical situation that is better defined than the personal norm and attributed responsibility (Kaiser & Shimoda, 1999). It is a moral responsibility for people to conscientiously feel guilty towards other people and nature when they do not separate household waste, and to feel a duty towards other living things and nature to separate waste in order to protect natural resources.

Chan and Bishop (2013) extended the TPB model with moral norms and proposed it as a strong basis for explaining household waste separation behavior. Chen (2016) stated that the moral norm has the greatest impact on attitudes towards energy conservation and carbon reduction. Wang et al. (2021) revealed that moral norm has a positive effect on household waste separation intentions and behaviors. In the light of the studies revealed, the following hypotheses have been proposed:

H1: As the moral norm level increases, the positive attitude towards household waste separation also increases.

H2: The moral norm positively affects the subjective norm for household waste sorting.

H3: Moral norm positively affects the perceived behavioral control of household waste sorting.

2.2. Environmental benefit

Value-base theory (Stern & Dietz, 1994) emphasized that attitude towards environmental issues is more generally based on core values. It has been confirmed that environmental benefit is assumed to be an important environmental basis. According to Begum et al. (2009) determined that the attitudes and behaviors of contractors related to waste management differ according to their knowledge.

Similarly, Janmaimool (2017), in his study of 193 public and private office workers residing in the city of Bangkok, revealed that environmental benefit is not a significant predictor of attitude in waste prevention behaviors. In general, the literature has shown that there is a significant and positive relationship between environmental benefit and attitude and intention and behavior (Diamantopoulos, et al., 2003; Ramayah et al., 2012). Using the literature on the subject, the following hypotheses have been proposed to test the relationships between environmental benefit and attitude, intention and behavior towards household waste separation behavior:

H4: There is a positive and significant relationship between environmental benefit and the attitude towards household waste separation.

H5: There is a positive and significant relationship between environmental benefit and intention to separate household waste.

H6: There is a positive and significant relationship between environmental benefit and household waste separation behavior.

2.3. The Relationship Between Attitude-Subjective Norm-Perceived Behavioral Control and Intention

Attitude appears as one of the three important predictors of intention in TPB. Attitude towards behavior expresses the degree to which a person evaluates the behavior in question positively or negatively (Ajzen, 1991). In studies that reveal the attitudes and behaviors of household waste, Tutum says, "Separating household waste helps to protect nature.", "I feel better when I separate household waste." It has been evaluated from a utilitarian perspective with items such as (Liao et al., 2018; Karim Ghani et al., 2013). In many studies revealing the household waste attitude and behavior, it has been determined that the attitude affects the household waste intention positively (Yılmaz and Arı, 2019; Arı and Yılmaz, 2016; Liao et al., 2018; Corsini et al., 2018). In the light of the information revealed, the following hypothesis has been proposed to reveal the relationship between attitude and intention:

H7: As the attitude towards household waste separation increases, so does the intention to separate household waste.

In TPB, social influence is represented by the concept of subjective norm. (White et al., 2009). Subjective norm; It has been defined as social pressure from significant others that has an impact on individuals' behavioral intentions (Ajzen, 1991). The main source of social influence is the individual's immediate environment, such as family members, friends and neighbors. However, laws and regulations can also be effective in this regard. As the individual considers the social pressure from other people, the subjective norm either encourages or inhibits how the individual behaves (López-Mosquera et al., 2014). People act in response to social norms because they seek the approval of their immediate environment and avoid blaming others (Comber and Thieme, 2013; Wan et al., 2017). Subjective norm is the social pressure applied on individuals to perform more household waste separation in studies investigating household waste behaviors (Thomas and Sarp, 2013). When the literature is examined, positive studies on the subjective norm's intention to separate household waste have been revealed in various studies (Park and Ha, 2012; Chu et al., 2013; Karim Ghani et al., 2013). Park and Ha (2012) revealed that when residents recognize their neighbors or peer groups sorting and recycling waste, they are generally guided and impressed. In the light of the studies revealed, the H8 hypothesis has been proposed in order to reveal the relationship between the subjective norm and the intention to separate household waste:

H8: Subjective norm affects intention to separate household waste.

Perceived behavioral control (PBC) is defined as an individual's perceived ease or difficulty in performing a certain behavior (Ajzen, 1991). Some studies have revealed that high levels of perceived control should positively affect pro-environmental behavior intention (Bortoleto et al., 2012; Karim Ghani et al., 2013). However, some of the results from the literature are still contradictory. For example, Davies et al. (2002) suggested that perceived behavioral control does not have a direct effect on pro-environmental behavior. Considering these mixed results, the effect of perceived behavioral

control was investigated more extensively for the purpose of the study and the following hypotheses were proposed:

H9: Perceived behavioral control for household waste sorting affects intention to sort household waste.

H10: Perceived behavioral control for household waste sorting affects behavior for household waste sorting.

Ajzen (1991) defines intention as an individual's level of desire to perform a behavior and the intensity of the effort he plans to put forth. When the literature is examined, it is seen that the intention is important before the behavior occurs in household waste separation studies (Liao et al., 2018; Yılmaz and Arı, 2019; Karim Ghani et al., 2013). Because in TPB, intention is used to predict whether a behavior will occur or not. For example, Yılmaz and Arı (2019) concluded that university students' intentions regarding household waste separation affect behavior. Research shows that intention in TPB helps to predict whether a behavior will occur or not. In the study, the following hypothesis was proposed to test the relationship between intention and behavior regarding household waste:

H11: As the intention to separate the household waste increases, the behavior towards the separation of household waste also increases.

2.4. Facilitating Conditions

The stronger the behavioral intentions in TPB, the more likely people will be to act on those intentions. Some researchers have suggested that additional variables such as facilitating conditions should be added to the model to increase the explanatory power of TPB (Davis et al., 2006). A review of the literature has confirmed that time, home space, and convenience-enhancing external conditions of recycling channels have a significant impact on preventing or promoting residential solid waste recycling behaviors of residents (Chu and Chiu, 2003; Matsumoto, 2014; Wu et al., 2017). Abbott et al. (2011) found that building more recycling zones near residential areas in the United Kingdom has resulted in an increase in the frequency of residents sorting household waste. This study also found that when the government does not pay residents adequate disposal fees, residents neither actively reduce the waste produced not make an effort to participate in the sorting and recycling of household waste. The study stated that economic factors play an important role in the garbage disposal behavior of residents. Meng et al. (2019) revealed that the time spent on the classification and recycling of household waste and the landfill used for the storage of solid wastes at home affect the behaviors regarding the classification and recycling of household waste. Providing food waste bins to households and collecting food waste more frequently and separately from other wastes are seen by respondents as the most encouraging approaches for separating food waste at home. In addition, the presence of household waste bins in homes can help increase household perception of their neighbors' involvement, which in turn may encourage their participation (Karim Ghani et al., 2013). In the light of the studies revealed, the following hypothesis has been proposed as it is thought that the facilitating conditions affect the household waste separation behavior:

H12: Facilitating conditions positively affect the behavior towards household waste sorting.

2.5. Existing infrastructure adequacy

The management of urban solid waste is an important problem for developing countries. Leaving waste in open areas haphazardly is still the best solution found for some countries. However, this “solution” causes soil pollution, groundwater pollution, garbage explosions, collapses and slides and epidemics, and these areas are rarely scientifically selected, well planned and managed appropriately (Diaz and Savage, 2002). While the responsibility of removing the wastes generated in the environment from the settlements or disposing them in a way that does not harm the nature belongs to many institutions, the municipalities have the most responsibility, and the municipalities have to reflect the waste management in their local policies (Koçak et al., 2016).

If the local governments, especially the municipalities, do a good job in collecting and recycling household waste in the region where people live, and the waste collection activities are well organized, it will have a positive effect on people's household waste separation intentions and behaviors. In the light of all this information, the following hypotheses have been proposed:

H13: Existing infrastructure adequacy affects behavior towards household waste sorting.

3. Method

3.1. Research design

The data in the study were obtained by online survey method in April-May-June 2021, since face-to-face surveys could not be conducted due to the Covid-19 epidemic. In the study, first of all, a pilot study was conducted by applying a questionnaire to 106 people in order to determine the reliability of the questionnaire questions and whether the questions were understandable. In regard to the results and feedback received, some questions have been corrected or altered. Afterwards, the questionnaires were filled by 350 people who were able to access online and voluntarily participate. It was determined that 40.7% of the participants resided in Eskişehir, 8.7% in Istanbul, 8.2% in Bursa, 7.4% in Antalya, 6.5% in Ankara and 5.6 in İzmir. These cities are located in different geographical regions of the country and are among the most populated provinces of the country. After the control question analysis was done, it was determined that 29 questionnaires were not reliable and these answers were removed from the data and the analyzes were based on 321 data. The questionnaire consists of items measuring environmental benefit, enabling conditions, attitude, subjective norm, perceived behavioral control, intention, moral norm, existing infrastructure adequacy, and behavior. In the first part, there are demographic questions, while in the second part, the attitude items are "I do not agree at all - I completely agree" and the items of behavior are "Never-Always" with 11 likerts. The Cronbach's Alpha value of the measurement tool, which consists of Likert items, was obtained as 0.93 and was evaluated as highly reliable.

Items from the survey questions in the study to environmental benefit (7,15,23) Tonglet et al. (2004); facilitating conditions (9,14,27) Chu and Chiu (2003), Matsumoto (2014) and Meng et al. (2019); Attitude 11.17 Liao et al. (2018) and Karim Ghani et al. (2013), subjective norm (12,21,24) Park and Ha (2012); perceived behavioral control (13,30) Borteloto et al. (2012) and Davies et al (2002); intention (8-22-29) Yılmaz and Arı (2019); moral norm (10,16,28) Chan and Bishop (2013) and Wang et al (2021); to existing infrastructure capability (19,25,31), Abbott et al (2011), Guagnona et al. (1995); behavior (32.33.34) items were written using the studies of Arı and Yılmaz (2106).

Demographic characteristics of the participants participating in the survey are given in Table 1. It consists of 321 participants, 61.4% of the participants are women and 38.6% are men. 52.6% of the participants are 18-22 years old; 21.5% are 23-27 years old; 6.9% are 28-33 years old; 7.2% are 34-40 years old; 7.5% are 41-48 years old; 4.4% are between the ages of 49-56. 28.7% of the participants are married and 71.3% are single. 0.5% of the participants are primary education; 8% are secondary education; 24.3% are high school; 41.4% of them are university graduates; 9% are graduate students and 16.8% are university students. 29.6% of the participants were graduate students, 11.8% were civil servants; 2.8% are workers; 2.2% are housewives; 1.6% are tradesmen-traders; 5% are retired; 3.7% are self-employed; 4.0% are unemployed and 39.3% are from other occupational groups.

Table 1

Demographic statistics participants

Measure	Item	Frequency	%
Gender	Male	124	38.6
	Female	197	61.4
Marital status	Married	92	28.7
	Single	229	71.3
Education status	Primary school	2	0.5
	Middle school	25	8.0
	High school	78	24.3
	University	133	41.4
	Graduate	29	9.0
	College student	54	16.8
Job	Graduate Student	95	29.6
	Official	38	11.8
	Employee	9	2.8
	Housewife	7	2.2
	Merchant	5	1.6
	Retired	16	5.0
	Self employment	12	3.7
	Unemployed	13	4.0
	Other job	126	39.3

4. Results

4.1. Construct Reliability and Validity

The analysis of the data was carried out using Partial Least Squares Structural Equation Modeling (PLS-SEM) and SmartPls software, which did not require the assumption of multivariate normal distribution and was successfully applied in small-volume samples. Table 2 shows that the AVE values of the factors are higher than 0.50, and the CR and CA values of the factors are higher than 0.70. The obtained results show that the convergent validity of the model is provided. CR, CA, AVE Values for Factors are given in Table 2.

Table 2

CR, CA and AVE Values for Factors

	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
A	0.825	0.896	0.741
B	0.598	0.832	0.713
C	0.748	0.856	0.666
D	0.681	0.862	0.758
E	0.739	0.852	0.658
F	0.744	0.854	0.661
G	0.911	0.944	0.848
H	0.802	0.881	0.716
K	0.781	0.874	0.698

A: Moral norm; B: Attitude C: Subjective norm; D: Perceived behavioral control; E: Environmental benefit; F: Intent; G: Behavior; H: Existing infrastructure adequacy; K: Facilitating conditions

When the structural reliability of the study was checked in Table 3, the CR values were A=0.89, B=0.83; It was observed that C= 0.85, D=0.86, E= 0.85, F= 0.85, G=0.94, H=0.88, K=0.87 and AVE values were greater than 0.65.

The discriminant validity of the measurement model is checked by comparing the square root of the AVE value of each construct and the correlation between that construct and the other constructs. As a result of these comparisons, discriminant validity is ensured if the square root values of the AVE are larger (Fornell & Larcker, 1981). In Table 3, the root square of AVE is greater than the correlation coefficients between all constructs. Therefore, it can be stated that discriminant validity is provided.

Table 3

Discriminant validity (Fornell-Larcker Criterion)

	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**K**
A	0.861								
B	0.685	0.844							
C	0.517	0.362	0.816						
D	0.606	0.506	0.597	0,871					
E	0.689	0.741	0.359	0.454	0.811				
F	0.730	0.568	0.642	0.702	0.563	0.813			
G	0.545	0.376	0.614	0.653	0.346	0.650	0.921		
H	0.254	0.154	0.533	0.399	0.190	0.396	0.539	0.846	
K	0.488	0.364	0.566	0.743	0.372	0.615	0.693	0.448	0.836

As a result of the validity and reliability analysis of the measurement model, any variables were not removed from the model.

4.2. Compliance Criteria

The size of the R^2 values is important in determining the accuracy of the predictive values. Moral norm is effective at the level of 61%, 27% and 37%, respectively, in not explaining the variables of attitude, subjective norm and perceived behavioral control. It can be said that these calculated R2 values represent significant quantities. In the study, it was evaluated that the inclusion of moral norm as an exogenous latent variable in the model is beneficial and increases the level of explanation of the model. Intention and waste separation behavior were explained by other variables in the model as 64% and 61%, respectively.

The Q^2 measure is an indicator of the validity of the model's prediction. The fact that the Q^2 value of the structural model is greater than zero indicates that it provides predictive validity (Chin, 1998). Q^2 values B=0.417; C=0.173; D=0.274; F=0.408; G=0.509. Model validity was provided according to the Q^2 values obtained as a result of the analysis. That is, the model in question predicts the original observed variables well.

f^2 (effect size) is used to evaluate the change in R^2 value when a particular exogenous latent variable is removed from the model. The effect measure f^2 estimator states that a latent variable has a weak ($0.02< f^2<0.14$), moderate ($0.15< f^2<0.34$), or high ($f^2>0.34$) effect at the structural level. (Cohen, 1988). According to thef^2 values obtained as a result of the analysis: A, C(0.364) has a high effect, and D(0.574) has a high effect. B, F(0.02) fairly weak, C, F(0.165) moderate; D affects the latent variable F(0.199) moderately, G(0.016) weakly. E affects B(0.351) at a high level, F(0.043) weakly, and G(0.003) at a weak level. H variable G(0.109) moderate; K has a weak effect on the latent variable G(0.113).

The SRMR value for the model was calculated as 0.074. NFI value is required to take values between 0 and 1. A value close to 1 for NFI indicates that the model has a good fit. For the model in the study, SRMR was calculated as 0.074<0.10 and NFI as 0.804. These results show that the model has good fit.

Finally, in the evaluation of the model, it should be determined whether there is a multicollinearity between the latent variables. For this, VIF (variance inflation factor) values are examined. A VIF value less than 5 indicates that there is no collinearity between the variables (Hair et al., 2011). VIF values among latent variables obtained from SmartPLS software are in the range of 1.39<VIF<4.32. When the calculated VIF values are examined, it is seen that all values are less than 5. Accordingly, it can be said that there is no multicollinearity problem between latent variables.

4.3. Path coefficients and hypothesis test results

As a result of the PLS-SEM analysis, the model in Figure 1 was obtained. According to the results of the analysis, a statistically positive and significant relationship was found between moral norm and attitude, subjective norm and perceived behavioral control. A one-point increase in the moral norm is 0.332 in the attitude towards household waste sorting; will result in an increase of 0.517 points in the subjective norm and 0.606 points in perceived behavioral control.

A significant and positive relationship was found between attitude and intention. A one-unit increase in the attitude towards household waste separation will increase the waste separation intention by 0.132 units. In addition, a statistically significant relationship was found between subjective norm and perceived behavioral control and intention. A one-point increase in the subjective norm and perceived behavioral control variables will increase the household waste separation intention by 0.308 and 0.365 points, respectively. Oneunit increase in perceived behavioral control will increase household waste sorting behavior by 0.136 units. From this, it has been revealed that TPB can be used successfully in waste separation behavior and moral norm has significant effects on the antecedent variables of TPB.

A one-point increase in the environmental benefit perception of household waste sorting increases the attitude by 0.562 points. This coefficient shows the importance of environmental benefit perception in the formation of positive attitudes towards waste separation. A positive and significant relationship was found between intention and behavior. This value indicates that a one-point increase in intention will result in a 0.284-point increase in household waste sorting behavior. There was no significant relationship between environmental benefit and waste separation behavior. However, it has been evaluated that intention may have a mediating role in the relationship between these two variables.

A statistically significant positive correlation was found between facilitating conditions and household waste sorting behavior. This value shows that a one-point increase in facilitating conditions will cause an increase of 0.234 points in household waste sorting behavior. A statistically significant positive correlation was also found between existing infrastructure competence and behavior. It states that a one-point increase in existing infrastructure adequacy will result in a 0.328-point increase in behavior towards household waste sorting.

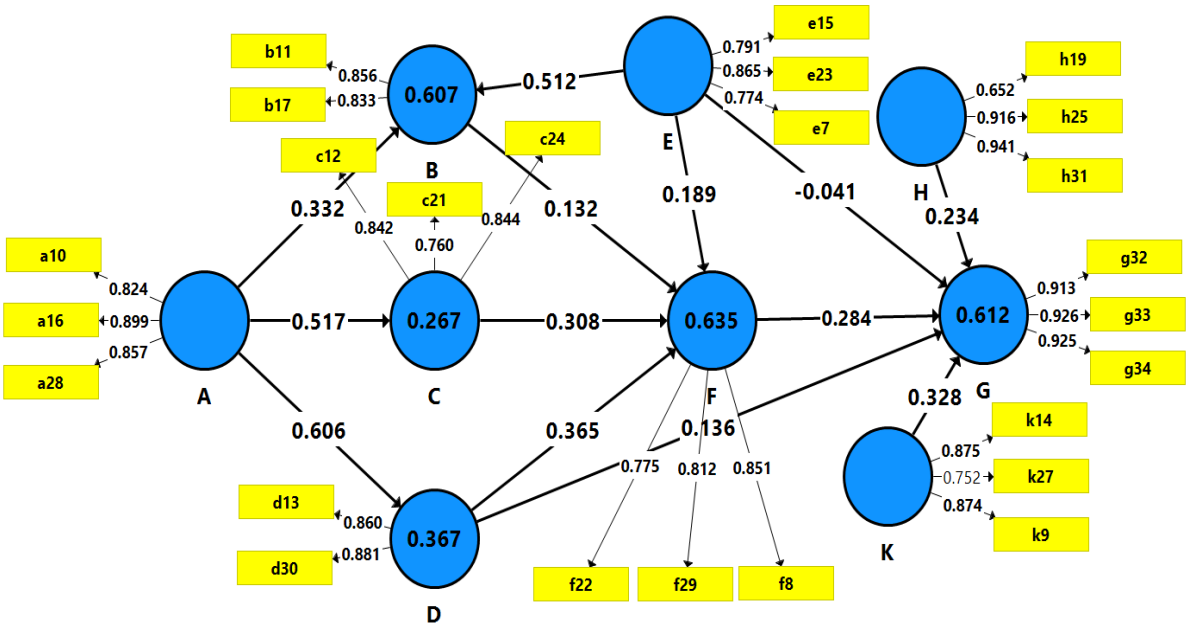

Fig.1. Extended Household Waste Separation Model (HWSM)

A: Moral norm; B: Attitude C: Subjective norm; D: Perceived behavioral control; E: Environmental benefit; F: Intent; G: Behavior; H: Existing infrastructure adequacy; K: Facilitating conditions

The results of hypothesis testing, correlation coefficients and t and p values regarding the structural model are given in Table 4. When table 4 was examined, it was seen that all hypotheses were supported except for the E→G hypothesis.

Table 4

Hypothesis testing results

Hipotezler	**Path coeff.**	**Std. dev.**	**t-Values**	**P-Values**	**Results**
H_1:A→B	0.332	0.074	4.507	P<0.01	Retained
H_2:A→C	0.517	0.045	11.589	P<0.01	Retained
H_3:A→D	0.606	0.043	14.072	P<0.01	Retained
H_7:B→F	0.132	0.062	2.124	P<0.05	Retained
H_8:C→F	0.308	0.049	6.315	P<0.01	Retained
H_9:D→F	0.365	0.058	6.329	P<0.01	Retained
H_{10}:D→G	0.136	0.068	2.000	P<0.05	Retained
H_4:E→B	0.512	0.074	6.940	P<0.01	Retained
H_5:E→F	0.189	0.064	2.963	P<0.01	Retained
H_6:E→G	-0.041	0.045	0.932	0.352	Rejected
H_{11}:F→G	0.284	0.071	3.969	P<0.01	Retained
H_{13}:H→G	0.234	0.043	5.387	P<0.01	Retained
H_{12}:K→G	0.328	0.059	5.539	P<0.01	Retianed

4.4. Mediation effect of intention (F) on the relationship between environmental benefit (E) and waste behavior (E→F→G)

When the hypothesis test results in Figure 1 and Table 4 are examined, it is seen that the relationship between environmental benefit and waste behavior is not statistically significant at 0.041 (*t=0.323; p=0.352*). This result is not expected. For this reason, it was thought that intention might have a mediating effect in this relationship. First, the direct relationship between environmental benefit and waste behavior was investigated and it was found to be significant as 0.371 (*t=8.293; p<0.01*) (figure 2).

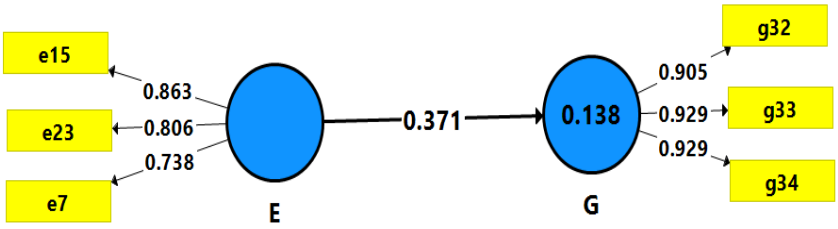

Fig. 2. Direct relationship between environmental benefit and waste behavior

Then, the relationship between E→G was investigated by adding intention to the relationship model between environmental benefit and waste behavior (Figure 3). When F is added to the relationship model, the relationship becomes -0.017 (*t=0.307; p=0.759*) and E→F: 0.570 (*t=10.356; p<0.01*) and F→G: 0.657 (*t=12.292; p <0.01*) relations were found to be significant.

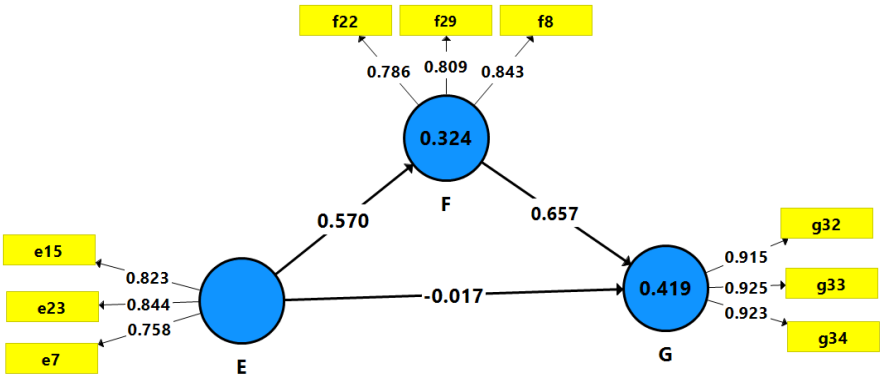

Fig. 3. The mediating effect of intention on the relationship between environmental benefit and waste behavior

4.5. Total effects vs specific indirect effects

In the study, total effects and specific indirect effects are given in Table 5-6. When Table 5 is examined, it has been determined that all total indirect effects are significant. It is seen that the effect coefficients of the moral norm on the solid waste separation intention and behavior are 0.424 and 0.202, respectively. These positive and significant values show that moral norm has a strong positive effect not only on the external latent variables (B, C, and D) but also on the internal latent variables (F and G) of TPB. Specific indirect effects are given in Table 6. When Table 6 shows that the moral norm indirectly affects the intention and behavior of recycling (A→C→F, A→D→F, A→C→F→G and A→D→F→G) through subjective norm and perceived behavior control. It has been evaluated that individuals with high moral norms will have high waste separation intentions and behaviors thanks to the social environment effect and their perceived behavioral control towards household waste sorting.

Table 5

Total indirect effects

Direction of relationship	Original Sample	Std.dev.	t-Values	P-Values
A →F	0.424	0.045	9.401	P<0.01
A →G	0.202	0.042	4.789	P<0.01
B →G	0.038	0.021	1.747	P<0.10
C →G	0.087	0.026	3.373	P<0.01
D →G	0.104	0.033	3.106	P<0.01
E →F	0.068	0.030	2.251	P<0.05
E →G	0.073	0.023	3.120	P<0.01

Table 6

Spesific indirect effects

Direction of relationship	Original Sample	Std. dev.	t-Values	P-Values
A→ B→ F	0.044	0.027	1.622	NS
E→ B→ F	0.068	0.030	2.251	P<0.01
A→C→F	0.159	0.031	5.214	P<0.01
A→D→F	0.221	0.041	5.342	P<0.01
A→D→ G	0.082	0.043	1.911	P<0.10
A →B→ F→G	0.012	0.009	1.402	NS
B →F →G	0.038	0.021	1.747	P<0.10
E → B→F →G	0.019	0.011	1.816	P<0.10
C→F →G	0.087	0.026	3.373	P<0.01
A→C →F→ G	0.045	0.015	3.083	P<0.01
D→F→G	0.104	0.033	3.106	P<0.01
A →D→F →G	0.063	0.021	2.943	P<0.01
E→ F→G	0.054	0.022	2.440	P<0.05

NS: Not significant

4.6. Multi group analysis (MGA) for gender

Multi group analysis (MGA) was performed for gender in the study and the results are given in Table 7. When table 7 is examined, it is seen that the highest correlation coefficients for both genders are between moral norm→subjective norm and moral norm→perceived behavioral control. While the B→F relationship was significant for men, it was not significant for women. In E→F, on the other hand, while it is significant in women, it is not significant in men. The reason why the E→ G direct relationship could not be found significant for both genders is due to the mediating effect of intention between these two variables.

Welch-Satterthwait Test was used to test the significance of the gender difference for all hypotheses. Gender difference was found to be significant in the relationship between environmental benefit and waste separation intention (*E→F: -0.232, t=2.021, p<0.05).* The relationship between environmental benefit and intention is higher in women than in men. In addition, in C→F (*0.155, t=1.664, p<0.10) and F→G (0.232, t=1.665, p<0.10)* relationships, the gender difference could only be determined at 10% significance level. The first of these values shows that men exhibit household waste sorting behavior by being more affected by the social environment effect than women. Similarly, the relationship between intention and behavior was found to be stronger in males.

Table 7

MGA-Bootstrapping results

Hypotheses	Path Coeff. Male	Path Coeff. Female	t-Value Male	t-Value Female	p-Value Male	p-Value Female
H1:A→B	0.333	0.383	3.116	3.420	P<0.01	P<0.01
H2:A→C	0.581	0.468	8.335	9.073	P<0.01	P<0.01
H3:A→D	0.617	0.588	8.071	12.003	P<0.01	P<0.01
H7:B→F	0.186	0.081	2.310	1.103	P<0.05	NS
H8:C→F	0.398	0.243	6.642	3.384	P<0.01	P<0.01
H9:D→F	0.389	0.331	5.275	4.592	P<0.01	P<0.01
H10:D→G	0.066	0.160	0.573	1.915	NS	P<0.10
H4:E→B	*0.578*	0.395	5.729	3.305	P<0.01	P<0.01
H5:E→F	0.069	0.302	0.829	3.772	NS	P<0.01
H6:E→G	-0.046	-0.025	0.763	0.408	NS	NS
H11:F→G	0.395	0.163	3.563	1.927	P<0.01	P<0.10
H13:H→G	0.297	0.207	3.357	3.800	P<0.01	P<0.01
H12:K→G	0.235	0.423	2.291	5.385	P<0.05	P<0.01

NS: Not significant

5. Conclusion and discussion

In this study, attitudes and behaviors towards the sorting of household wastes were investigated with the help of the HWSM, which was proposed within the scope of moral norm, environmental benefit, facilitating conditions, existing infrastructure adequacy added to the TPB. In the HWSM, the external latent variable of moral norm is designed as an estimator of the variables of attitude, subjective norm and perceived behavior, which are the antecedents of the TPB model. Thanks to the study, while HWSM was recommended to the household waste separation literature, on the other hand, it was tried to expand the TPB with the variables added in the study.

85.8% of individuals fully agree with the statement "Separating household waste creates a better environment for future generations. 73.7% of the participants completely agree with the statement "It is my moral responsibility (to people and nature) to recycle my household waste". In the results of the study, it was determined that the subjective norm (0.307) and perceived behavioral control (0.368) variables statistically positively affected the household waste separation intention.

Karim Ghani et al. (2013) investigated the factors affecting the intention to segregate food waste at homes with TPB and found that subjective norm and perceived behavioral control variables positively affected household waste sorting intention. Liao et al. (2018) investigated the factors affecting the staff's intention to segregate food package waste with extended TPB. In the study, no significant relationship was found between subjective norm and food package waste separation intention, but it was determined that perceived behavioral control positively affected package separation intention. In this study, however, these relationships were found to be significant.

According to Begum et al. (2009) revealed that environmental benefit positively affects attitudes and behaviors related to waste management, contrary to the result obtained, Janmaimool (2017) revealed that environmental benefit is not an important predictor of attitude in waste prevention behaviors. In this study, however, a direct relationship could not be determined between environmental benefit and waste behavior, but significant relationships emerged through the intention variable. The results revealed that intention plays a full mediating role in the relationship between environmental benefit and waste behavior. It has been evaluated that the effect of environmental benefit perception of household waste sorting on behavior can only be realized if individuals have a strong waste sorting intention.

According to the results of the study, it was found that moral norm has a positive effect on attitude, subjective norm and perceived behavioral control. In support of the study, Chu and Chiu

(2003) concluded that moral responsibility has a positive effect on attitude (0.17). Wang et al. (2021) stated that moral norms have a positive effect on household waste separation attitudes and behaviors. In the study, it was determined that the perceived control variable had a moderator role between moral norm and behavior. (*0.149, t=2.509, p<0.05*). It has been determined that the moderating effect is positive, and the level of ease perceived by people in sorting household waste, increases/reduces the moral norm and waste sorting behavior.

Household solid waste classification and planning of recycling facilities are extremely important in cities. According to the results of the research, "environmental facilities and services" have the most comprehensive impact on the behavior of residents. In particular, accessibility to recycling facilities, facilitating factors of existing infrastructure adequacy are key factors influencing the household waste sorting behavior of residents (Meng et al., 2019). In the study, the existing infrastructure adequacy factor and facilitating conditions positively affected the household waste separation behavior. Similar to the results of the study, Steova and Alriksson (2017), in their study investigating the household waste sorting behaviors of university students in Sweden and Bulgaria on the basis of TPB, added the variable of satisfaction with local facilities to the TPB model and stated that this factor positively affected the household waste sorting behavior of students.

When waste collection becomes easier and residents are pleased with the local circumstances of waste categorisation, their behavior and attitudes towards recycling are positive. Having satisfactory facilities for household waste separation has been a necessary requirement for households to participate in waste categorisation / recycling (Meng et al., 2019; Corsini et al., 2018; Karim Ghani et al. 2013; Bortoleto et al., 2012). The fact that people have enough recycling bins near their homes, that the waste collection works are well organized in the place where they live, that there are sufficient resources to collect household waste separately, affect the waste sorting behavior positively. It coincides with the idea that the absence of external factors that may prevent a person from performing the intended behavior in accordance with the planned behavior rules will positively affect the realization of that behavior (Ajzen, 1991). Providing satisfactory conditions for recycling in the living area is one of the most effective ways to separate and recycle household waste, and to increase the rate of collected materials (Yılmaz and Arı, 2019).

It was investigated whether the mean of variables in the HWSM differed in terms of gender. It was determined that there was a statistically significant difference between the mean response scores of men and women for attitude (t = 3.022; p<0.01). The mean score of women is higher than the mean score of men. Men's mean score ($\bar{x}$= *8.64*); the mean score of women is ($\bar{x}$= *9.27*). It can be said that women's attitudes towards household waste sorting behaviors are higher than men's. Similarly, a statistically significant difference was found between the perceived behavioral control mean scores of men and women ($t = 1.988; p < 0.05$). The average score of women is higher than that of men. Men's mean score ($\bar{x}$= *7.33*); the mean score of women is ($\bar{x}$= *7.97*). It can be said that women know better than men about the separation of waste at home and which of the household wastes will be recycled. In addition, it can be stated that the separation of household waste for women is easier than for men. There was no statistically significant difference between the mean scores of the answers given by men and women to the questions of environmental benefit, intention, facilitating conditions, subjective norm, moral responsibility, existing infrastructure adequacy and behavior ($p>0.05$).

Waste sorting is an event that requires individual effort. It is very important to provide the necessary conditions for the separation of household waste and to increase the participation of individuals in household waste sorting. Local authorities, municipalities and recycling organizations should first facilitate the separate collection of household waste. Underground container systems and recycling containers to be placed on streets, in front of apartments by local governments will give positive results in terms of recycling and regular waste collection as they are easily accessible to the people of the region. These containers, which will be placed underground, will not only prevent the formation of bad odors, but also prevent the mixing of this household waste and the wastes to be recycled with each other and the soil. Thus, they can achieve a higher participation rate. Municipalities can establish waste programs in order to recycle household waste and should constantly measure the satisfaction of local facilities and take the results into account.

The results of the study may be useful for policy makers. Implementing any campaign targeting to increase their participation in wastecategorisation can be a loss of time and money. It also has little or no impact on individuals who find the recycling facilities inadequate or who are dissatisfied with waste collection programs in the area they live. Therefore, the development of efficient and satisfactory waste collection for city dwellers is essential to achieve high reuse and recycling rates.

With quantitative research and observation of real behavior in future research, it can provide a more comprehensive data output. Features of recycling programs, such as giving bonuses to sorted household waste according to their quantity, creating a new law on waste sorting, requests or information campaigns, may also play a role in predicting waste sorting behavior. A few more variables can be added to the HWSM suggested in future studies and researches covering different countries can be carried out. "Environmental Awareness", "Relevance and Awareness Regarding Household Waste Segregation", "Perceived Political Activity", "Demographic Factors" etc. that affect waste sorting behaviors are included in the model. Comprehensive models can be reached by adding other factors.

Author statement

Research and publication ethics statement

This study has been prepared in accordance with the ethical principles of scientific research and publication.

Approval of ethics board

Ethics Committee Approval has been obtained for this research with the 11.03.2022 dated and E.94522 numbered decision of Kütahya Dumlupınar University.

Author contribution

All authors have contributed the study equally.

Conflict of interest

There is no conflict of interest arising from the study for the authors or third parties.

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Reference

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