Exploring Households' Recycling Behaviour in a World Heritage City, Melaka

(Meneroka Kelakuan Kitar Semula Isi Rumah di Bandar Warisan Dunia, Melaka)

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ABSTRACT

The aim of this study is to examine the determinants of household recycling behaviour from the perspective of the Theory of Planned Behaviour (TPB). Attitudes towards recycling, subjective norms, perceived behavioural control, commitment to the environment and intention to recycle were hypothesised to explain recycling behaviour. Data was collected using stratified sampling via a questionnaire survey involving 444 households from Melaka. The model was validated and tested using structural equation modelling. The findings confirmed that all the hypotheses developed were supported, with an R^2 value of 66.7%. This study contributes to the field by introducing a new perspective on research into recycling behaviour, incorporating an additional variable, commitment to the environment, in the TPB model. It provides new empirical findings for government policy makers and other agencies to help develop policies and regulations in relation to the sustainability of household recycling behaviour. It is recommended that other variables be included and a longitudinal research design adopted to overcome the limitations of this study in future research.

Keywords: Theory of planned behaviour; attitude towards recycling; subjective norms; perceived behavioural control; commitment to the environment

ABSTRAK

Tujuan kajian ini adalah untuk mengkaji penentu tingkah laku kitar semula isi rumah dari perspektif Teori Tingkahlaku Dirancang (TPB). Sikap terhadap kitar semula, norma subjektif, kawalan tingkah laku yang dilihat, komitmen terhadap alam sekitar dan niat untuk mengitar semula adalah hipotesis untuk menjelaskan tingkah laku kitar semula. Data dikumpul menggunakan persampelan berstrata melalui kaji selidik kuesioner yang melibatkan 444 isi rumah dari Melaka. Model ini telah disahkan dan diuji menggunakan pemodelan persamaan struktur. Penemuan ini mengesahkan bahawa semua hipotesis yang dibangunkan disokong, dengan nilai R^2 66.7%. Kajian ini menyumbang kepada bidang ini dengan memperkenalkan perspektif baru mengenai penyelidikan ke dalam tingkah laku kitar semula, memasukkan pembolehubah tambahan, komitmen terhadap alam sekitar, dalam model TPB. Ia memberikan penemuan empirikal baru bagi pembuat dasar kerajaan dan agensi lain untuk membantu membangunkan dasar dan peraturan berkaitan dengan kelestarian tingkah laku kitar semula isi rumah. Adalah disyorkan bahawa pembolehubah lain dimasukkan dan reka bentuk penyelidikan membujur yang digunakan untuk mengatasi batasan kajian ini dalam penyelidikan masa depan.

Kata kunci: Teori tingkah laku dirancang; sikap terhadap kitar semula; norma subjektif; kawalan gelagat ditanggap; komitmen terhadap alam sekitar

INTRODUCTION

Rapid economic growth and urbanisation have increased our general standard of living, which has also contributed to an increase in the generation of solid waste. Malaysia, which has a population of 31.7 million (Department of Statistics 2017) is estimated to dispose of around 30,000 to 33,000 tonnes of solid waste per day (The Malaysia Insider 2014). Melaka, a small state, generated 711 tons per day in 2009; an increase of 38% relative to 2000 (Johari et al. 2014). Solid waste reduction has thus become one of the main challenges in Malaysia, and especially in Melaka. Melaka is the third smallest state, with a population of 820,000 (Department of Statistics 2010). Melaka was declared a World Heritage Site in 2008, and relies heavily on tourism. It is a small state with limited space for the mounting volume of waste, which will definitely have a negative impact on its tourism industry. This has led to our interest in studying household recycling behaviour in Melaka, with the aim of investigating its determinants. This research is also in line with the 'Go Green' vision adopted by the Melaka government, which is set to be achieved in 2020.

Households in Malaysia are currently still not actively involved in recycling programmes, although the separation of solid waste at household level is the most efficient method of recovery and reuse of materials (Hassan et al. 2000). The existing 2 + 1 programme for rubbish collection, which allocates two days for rubbish collection and one day for recyclables collection, has had a very low response rate and attracted little attention from households in Melaka (Sin Chew 2015). Recyclables are

still not being separated from rubbish due to a lack of awareness, structured recycling programme and facilities for household recycling initiatives (Zaini 2011). Public awareness of household recycling opportunities and the role recycling can play in the reduction of waste in Malaysia is still very undeveloped (Hezri 2009); it has bluntly been reported that it is inadequate (Samsudin & Don 2013).

The first national recycling programme was launched by the Ministry of Urban Wellbeing, Housing and Local Government under the ABC plan in 1993. It was not successful due to poor collection services, and a lack of public awareness, promotion and a master plan for recycling (Abdelnaser et al. 2009). A more aggressive national recycling campaign was launched again in 2001 with an emphasis on publicity and public education. The government also designated 11 November as the annual National Recycling Day of Malaysia. Recycling still failed to improve at the household level, however.

The overall recycling rate remained at 5% of total waste as reported in the Ninth Malaysia Plan (2006). The absence of concrete policy, laws and regulations has also contributed to the ineffectiveness of waste minimisation initiatives such as recycling (Agamuthu et al. 2011). Since 2010, more activities and programmes have been initiated, including recycling banks in kindergartens, schools, residential areas, government offices etc. These efforts have improved the recycling rate to 10.5% (National Solid Waste Management Department 2012), but this is still low, given that the target for 2020 is 22% (Ninth Malaysia Plan 2006). More extensive action plans and enhancement of the existing programmes are required to drive further improvement in Malaysia's recycling rate according to Dr. Mohd Pauze Mohamad Taha, the Deputy Chief Executive Officer (Technical) of the Solid Waste Management and Public Cleansing Corporation (The Star Online 2017).

Landfill is one of the main methods of solid waste disposal in Malaysia (Zaini 2011). As a result of the limited lifespan of landfill sites and the scarcity of new sites, Malaysia is switching from landfill to incineration (Zaini 2011), however, the capital cost of constructing incinerators is high. The high moisture content of solid waste in Malaysia and the humid weather also cause problems with incineration (Johari et al. 2014). Chenayah and Takeda (2005) claimed that recycling is inexpensive in the long run compared with maintaining landfill sites and other ways of reducing solid waste; it also reduces the need for landfill and dumpsites. Recycling can also minimise the negative impact of solid waste on the environment, such as pollution, and conserves natural resources, among other advantages.

Household recycling is very dependent on household members for the sorting of materials (Sidique, Lupi & Joshi 2010) and that willingness of households to undertake sorting is critical (Stoeva & Alriksson 2017; Martin, Williams & Clark 2006). Households must be committed to sorting recyclables and be more involved in recycling activities if household recycling programmes are to be a success; this will require behavioural change (Ittiravivongs 2012).

On the basis of these issues, the Theory of Planned Behaviour (TPB) was used to frame our investigation of factors influencing the recycling behaviour of households in Melaka. The TPB model was extended by integrating a variable representing the interdependence between humans and their environment, namely commitment to the environment, to explain household recycling behaviour in Melaka. Davis, Green and Reed (2009) reported that there has been a dearth of empirical research on the relationship between perceptions of the interdependence of humans and their environment and environmental behaviour. They have argued that humanity and the natural world are closely connected.

TPB has been extensively used in research into household recycling in the context of Western countries (Carrus et al. 2009; Davis & Morgan 2008; Mannetti, Pierro & Livi 2004; White et al. 2009) but there has been very limited research in Asian countries (Chan & Bishop 2013; Ittiravivongs 2012; Niaura 2013). Research applying the TPB Model in the Malaysian setting is also scant (Abdelnaser & Abdelsalam 2011; Abdelnaser et al. 2009; Murad & Siwar 2007). With the limited research and low recycling rate reported, it is therefore essential to research household recycling behaviour in a Malaysian context.

This study addresses the gap in the literature by extending the original version of the TPB (Ajzen 1985, 1991) to include a new variable that captures perceptions of the interdependence of humans and their environment. The findings of this study could provide useful information for the government and local authorities which could be used to develop policies, strategies and a regulatory framework in relation to waste management and household recycling for encouraging greater participation in household recycling.

LITERATURE REVIEW

THEORY OF PLANNED BEHAVIOUR

The TPB (Ajzen 1985, 1991) is an extension of the Theory of Reasoned Action (Ajzen & Fishbein 1980). This theory assumes that human beings are rational, and usually base behavioural decisions on the available information. According to the TPB model, the intention of an individual is the central factor in determining whether a given behaviour is performed. Intentions (behaviours) are a function of attitudes to a given behaviour, subjective norms and perceived behavioural control (PBC).

Intentions are pivotal to the TPB (Ajzen 1991, 2005). Intentions have been defined as a "person's subjective probability that he/she will perform the behaviour in question" (Fishbein & Ajzen 1975: 12). Intentions are the immediate factor of behaviour in the TPB; they represent motivational factors which affect behaviour in that they

reflect an individual's willingness to try (Ajzen 1991). It is assumed that stronger intentions indicate a greater willingness to engage in a given behaviour (Ajzen 1991). Boldero (1995) studied household newspaper recycling, and concluded that respondents who have strong intentions would be more willing to involve in their newspapers recycling. Many previous studies have identified intention to recycle as having a positive effect on the behaviour of recycling (Chan & Bishop 2013; Chu & Chiu 2003; Niaura 2013; Pakpour et al. 2014; White et al. 2009).

Attitude is one of the immediate determinants of intention according to TPB (Ajzen 1985), and is indirectly related to behaviour. An individual's attitude to a behaviour is his or her evaluation – positive or negative – of that behaviour. Bagum et al. (2009) defined attitude as a person's feelings toward specific objects that will affect behaviour. Many previous studies have shown that attitude is an important predictor of recycling intention or recycling behaviour (Apinhapath et al. 2015; Carrus et al. 2009; Gadiraju 2016; Meinhold & Malkus 2005; Nameghi & Shadi 2013; Pakpour et al. 2014; White et al. 2009). In some studies attitude was the strongest factor in recycling behaviour (Lee & Paik 2011; Mosler et al. 2008; Vicente & Reis 2008), but Davies, Foxall and Pallister (2002) found that attitude had only a moderate effect on intention to recycle; this result was in line with their qualitative finding in which recyclers are more emotive about ecology concern.

Subjective norms in TPB (Ajzen 1985, 1991) are defined as the pressure that significant others put on an individual to perform a given behaviour. In the context of recycling, subjective norms represent the influence of family members, friends and neighbours on recycling intention or behaviour. Some might feel that their reputation will be affected if they do not recycle. Barr and Gilg (2005) also showed that individuals were more likely to recycle if their neighbours and friends did so. Diyana and Osman (2010) argued that subjective norms were the second most important determinant of intention to recycle, because recycling is a public behaviour. Many previous studies have found that subjective norms were a factor in intention to recycle or recycling behaviour (Apinhapath et al. 2015; Chan & Bishop 2013; Gadiraju 2016; Mannetti et al. 2004; Pakpour et al. 2014).

PBC is defined as "beliefs about the presence of the factors that may further or hinder performance of the behaviour that was termed as control belief" (Ajzen 2002: 665), a reference to self-efficacy with respect to the behaviour in question or one's ability to perform that behaviour. The TPB (Ajzen 2005) assumes that PBC has motivational implications for intentions. A person who feels that they have a high degree of control over a given behaviour will have a stronger intention to perform it (Ajzen 2002). Diyana and Osman (2010) found that PBC was a stronger predictor of recycling intention than subjective norms. Other studies also showed that PBC was positively associated with intention to recycle or recycling behaviour (Stoeva & Alriksson 2017; Botetzagias, Dima &

Malesios 2015; Carrus et al. 2009; Chan & Bishop 2013; Gadiraju 2016; Pakpour et al. 2014; Taylor & Todd 1995; White et al. 2009). Tong et al. (2018) found that PBC was an important predictor of recycling intention, however Boldero (1995) found that PBC did not predict intention to recycle or recycling behaviour; Boldero gave no clear argument for the lack of association between PBC and recycling behaviour.

PREVIOUS RESEARCH APPLYING TPB IN A RECYCLING CONTEXT

The TPB (Ajzen, 1991) was developed based on the assumption that behaviour is explained by behavioural intentions, and that intentions are explained by attitudes to behaviour, subjective norms and PBC. The TPB model has been used extensively in the context of recycling, (Apinhapath 2014; Chan & Bishop 2013; Chu & Chiu 2003; Davis & Morgan 2008; Davis et al. 2006; Ittirvivongs 2012; Pakpour et al. 2014; Stoeva & Alriksson 2017; Taylor & Todd 1995; White et al. 2009). Many of these studies have broadened the TPB to include new variables, as this increases the overall percentage of variance in recycling behaviour explained by the models (Carrus et al. 2009; Cheung et al. 1999; Gadiraju 2016; Knussen et al. 2004; Mannetti et al. 2004; Pakpour et al. 2014; Tonglet et al. 2004). Ajzen (1991) suggested that in principle the TPB model could be extended to include variables which would increase the explanatory power of the model.

The most recent studies to apply the TPB to recycling behaviour include a study of behaviour with respect to household waste in Iran (Pakpour et al. 2014) and studies that emphasised the moral basis of an extended TPB model (Botetzagias et al. 2015; Chan & Bishop 2013). Pakpour et al. (2014) have extended the TPB model to include past behaviour, moral obligations, self-identity and action planning, as well as age, gender and education, and overall their model accounted for 47% of the variance in recycling behaviour in their study. In the study by Chan and Bishop (2013) a multicollinearity problem affecting attitude and moral norms caused problems with model fit which were resolved by replacing attitudes with moral norms in the theoretical framework, with all the variables significant.

Davies et al. (2002) found that the predictability of intention to recycle improved after including additional predictors such as affective evaluation and personal norms in the TPB model. This percentage of explained variance increased from 9% in the original model to 19% in the extended model. Similarly, the TPB model explained 29% of the variance in intentions when hierarchical multiple regression was used to control for the effects of variance in demographic variables (Knussen et al. 2004), but including past behaviour and perceived habits of recycling increased the percentage variance explained to 55%; all the variables except subjective norms were predictors of intention to recycle.

Tonglet et al. (2004) showed that the percentage of variance in recycling intention explained by their model increased from 26.1% to 33.3% when additional variables were included. Davies and Morgan (2008) also produced a model with similar predictive power (30.9% of variance explained) in a case study conducted in Bristol, UK, in which the objective was to determine the factors affecting recycling and waste minimisation behaviours. They found that PBC and attitude, but not subjective norms, were strong determinants of intention to recycle. These finding conflict with the results of Tonglet et al. (2004), who found that attitude was the strongest determinant of intention to recycle, followed by PBC and subjective norms.

On the other hand, Taylor and Todd (1995) integrated a TPB model which employed beliefs based on relative advantages, complexity and compatibility, from the innovations literature. 99% of the variance explained revealed in intention to recycle by the model with all the variables significant except complexity and compatibility. Chu and Chiu (2003) adapted a similar approach to that of Taylor and Todd (1995), who modelled personal relative benefits and social relative benefits to explain attitudes; primary normative beliefs and secondary normative beliefs to explain subjective norms and self-efficacy; and facilitating conditions to explain PBC. An external factor, perceived moral obligation, was also incorporated in the TPB model.

Despite limited research in the application of TPB, some significant findings have been made in a Malaysian recycling context. Studies conducted to investigate recycling behaviour among university students (Diyana & Osman 2010; Ramayah, Lee & Lim 2012) showed that all three original variables in TPB were found to have a significant effect on recycling behaviour. Jekria and Daud (2016) carried out study in Selangor, and found that recycling behaviour was affected by the attitude of householders, and attitude in turn was predicted by environmental concerns. This is congruent with findings by Ramayah, Lee and Lim (2012) which showed that environmental-related knowledge and awareness were showed to have a significant impact on attitude on recycling.

COMMITMENT TO THE ENVIRONMENT

Human activities and the environment are very closely related; in fact they are interdependent. Most environmental problems are caused by human activity, and have a negative impact on human wellbeing. Leopard (1949) suggested that humans depend on nature, and that human behaviour has a big impact on nature. Davis et al. (2009) also argued that humans and nature are closely connected. To have a sustainable lifestyle, households must have a clean and healthy environment, and this in turn depends on how well the environment is being protected. The balance between these two factors is very important in having a sustainable environment.

Commitment to the environment was defined as a "psychological attachment and long-term orientation to the natural world" (Davis, Le & Coy 2011: 261). Schultz (2002) argued that a person who perceived themselves to be part of nature would act in the best interests of nature. This in turn will cultivate their commitment towards nature, which will strengthen their intention to keep this relationship. This implies that people who commit themselves to the environment are more likely to recycle their household waste.

Davis et al. (2009) argued that there is a positive association between human dependence on nature and commitment, such that people who perceive the relationship between humanity and the environment to be one of interdependence are more willing to act to preserve the environment. They also opined that commitment to the environment was a useful concept for descriptions of person-environment relationships. Their empirical data indicated a positive association between commitment to the environment and environment-related behavioural intentions. This means commitment to the environment also predicted pro-environment behaviour at an individual level. It thus confirmed that an individual's self-commitment to the environment also plays a vital role in influencing environmental behaviour. In view of this, it was integrated into the TPB model to examine Melaka's household recycling behaviour.

Davis et al. (2011) model, in which commitment to the environment and willingness to make sacrifices for the environment predicted ecological behaviour, also indicated that commitment to the environment predicted willingness to make sacrifices for the environment. The variance in willingness to sacrifice increased by 5% after commitment was added to the regression analysis. This finding is consistent with research by Van Lange et al. (1997) showing that willingness to make sacrifices for the environment was positively associated with commitment to the environment. These results imply that households that are highly committed to the environment will be more willing to recycle.

Based on the above discussion, the following hypotheses were established, and their relationships are presented in Figure 1.

H_1 Attitude towards recycling has a positive effect on household intentions to recycle

H_2 Subjective norms have a positive effect on household intentions to recycle

H_3 Perceived behavioural control has a positive effect on household intentions to recycle

H_4 Commitment to the environment has a positive effect on household intentions to recycle

H_5 Household intentions to recycle have a positive effect on recycling behaviour
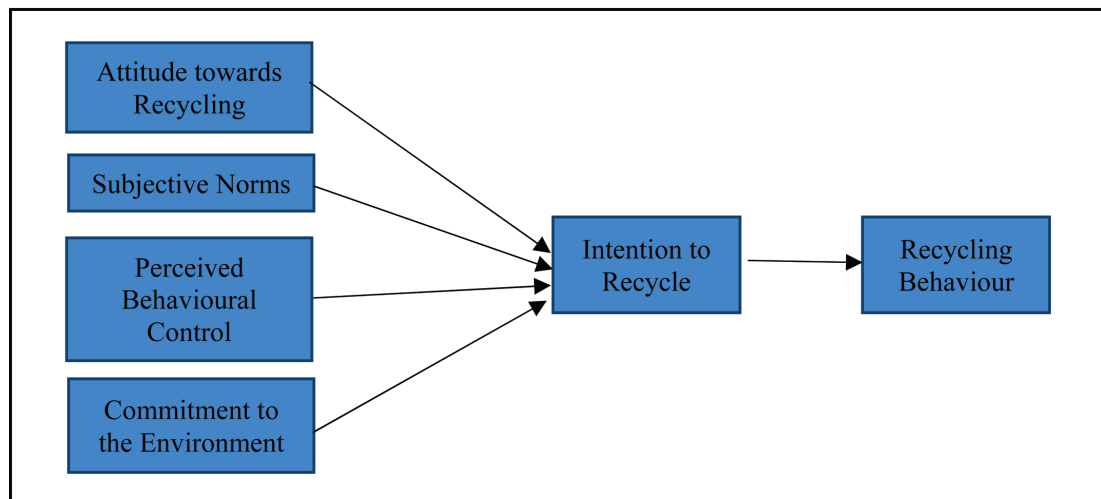
FIGURE 1. Research framework for this study

RESEARCH METHODOLOGY

This research was carried out in Melaka, a world site Heritage city in Malaysia. The unit of study was an individual in a household. Proportionate stratified sampling was used to select the households in Melaka. Samplings were taken by statisticians from the Department of Statistics, Putrajaya, because the department has access to information on all the households in Melaka from their censorship survey. Households in Melaka were segmented into strata, the urban and rural areas; almost 86.5% of the population lives in urban areas (Department of Statistics 2010). The use of sampling method ensured that the sample was reflected proportionately in the urban areas. Observations were drawn from the strata using systematic sampling generated by the computer. The samples, which are the households selected, were presented as maps and plans. A total of 55 maps were bought from the Department of Statistics, each representing an area containing ten selected households. G*Power was used to determine the minimum sample size, with a value of 85 obtained. The survey was based on the maps and plans provided. Data collection took place between August and December 2012. Because some of the households were not available during the data collection period, a total of 505 respondents were recruited for this study. Of these, 61 respondents did not complete the questionnaire and were excluded from analysis. The remaining 444 completed questionnaires that were analysed using SmartPLS software, version 3.

The questionnaire was designed in the self-administered format and distributed by hand to each household, which had been sampled earlier. The questionnaire has three parts: Parts I and II captured socio-demographic data and data on recycling practices respectively, and Part III was designed to measure the constructs. It consisted of recycling behaviour (5 items), intention to recycle (4 items), attitude towards recycling (5 items), subjective norms (4 items), PBC (4 items), and commitment to the environment (6 items). These variables used a seven-point Likert scales, from 1 = strongly disagree to 7 = strongly agree. These measurements were adapted from previous studies, as they had been validated and tested (Chu & Chiu 2003; Davies et al. 2002; Davis et al. 2009; Knussen et al. 2004; Mannetti et al. 2004; Oskamp et al. 1991; Rusbult, Martz & Agnew 1998; Saphore et al. 2006; Taylor & Todd 1995; Tonglet et al. 2004).

DATA ANALYSIS AND FINDINGS

Out of 444 respondents, 38.3% were male and 61.7% were female. The highest age group 46-55 (29.5%), followed by 36-45 (25.5%) and 55+ (16.7%). The smallest category was that between 16 and 20 (4.7%). More than half the respondents were Malay (58.5%). 39.2% of the respondents were Chinese, followed by Indian respondents at 2.3%. Interestingly, 42.6% who answered the questionnaires were in the housewives or homemakers group (see Table 1).

Structural Equation Modelling (SEM) was used to examine the five hypotheses established. The data was analysed in two stages using the Smart-PLS. First, the measurement model was tested for its convergent validity and discriminant validity. This is to ensure that the measured variables in the model are valid and reliable. In the second stage, the model was assessed to identify how well the variables were associated with one another.

MEASUREMENT MODEL

The convergent validity of the model was verified by the factor loadings with a minimum value of 0.7, average variance extracted (AVE), 0.5, and construct reliability (CR), 0.7 (Hair et al. 2017). As shown in Table 2, all the standardised factor loadings are greater than 0.7 except PBC1 with a value of 0.508. The item was retained because

TABLE 1. Profile of respondents

Variable	Frequency	Percentage (%)
Gender		
Male	170	38.3
Female	274	61.7
Age		
16-20	21	4.7
21-25	32	7.2
26-35	73	16.4
36-45	113	25.5
46-55	131	29.5
Above 55	74	16.7
Ethnic/Race		
Malay	260	58.5
Chinese	174	39.2
Indian	10	2.3
Education Level		
Primary School	79	17.8
Secondary School	271	61.0
Diploma	41	9.2
Graduate	31	7.0
Postgraduate Degree	13	2.9
Others	9	2.0
Occupation		
Professional	9	2.0
Manager/Senior Manager	9	2.0
Executive Officer	28	6.3
Non-executive	57	12.8
Entrepreneur/Self-employed	79	17.8
Housewife/Homemaker	189	42.6
Retiree	39	8.8
Students	29	6.5
Others	5	1.1

Sample Size = 444

of its contribution to content validity (Hair, Ringle & Sarstedt 2011). Four items with a standardised factor loading less than 0.5 were deleted, namely AT1, CE1, IR4 and SN1. The AVE obtained were in the range of 0.646 to 0.922. Similarly, the CR items were within a range of 0.901 to 0.973 (Hair et al. 2017). The convergent validity of these constructs is thus deemed adequate. Discriminant validity was assessed using the Fornell-Larcker (1981) criterion and Heterotrait-monotrait (HTMT) criterion (Henseler, Ringle & Sarstedt 2015). The Fornell-Larcker (1981) criterion was examined by comparing the square root of the AVE with the correlations between the constructs. Table 3 shows that all the square roots of AVE (diagonal values) are more than the correlation coefficients between the constructs (off- diagonal values), indicating discriminant validity is adequate. HTMT can be assessed by comparing the HTMT values obtained with the required threshold of $HTMT_{.85}$ (Kline, 2011) or $HTMT_{.90}$ (Gold, Malhotra & Segars 2001) and $HTMT_{inference}$ does not contain value 1. As shown in Table 4, all the values passed $HTMT_{.90}$ and the $HTMT_{inference}$ did not show a value of 1, indicating that discriminant validity is established. All the VIF values for independent variables are less than 5 as shown in Table 5, showing no collinearity problem (Hair et al. 2017).

STRUCTURAL MODEL

A bootstrapping procedure with a resample of 5000, as suggested by Hair et al. (2017), was used to test the hypotheses developed for this study, as shown in Figure 2. The results obtained are presented in Table 5.

TABLE 2. Measurement model

Construct	Items	Loadings	CR	AVE
Attitude towards Recycling	AT2	0.866	0.952	0.833
	AT3	0.944		
	AT4	0.907		
	AT5	0.932		
Commitment to the Environment	CE2	0.85	0.938	0.752
	CE3	0.884		
	CE4	0.815		
	CE5	0.893		
	CE6	0.891		
Intention to Recycle	IR1	0.957	0.973	0.922
	IR2	0.973		
	IR3	0.951		
Perceived Behavioural Control	PBC1	0.508	0.916	0.742
	PBC2	0.95		
	PBC3	0.954		
	PBC4	0.946		
Recycling Behaviour	RB1	0.812	0.901	0.646
	RB2	0.901		
	RB3	0.792		
	RB4	0.776		
	RB5	0.726		
Subjective Norms	SN2	0.877	0.954	0.873
	SN3	0.968		
	SN4	0.955		

TABLE 3. Discriminant validity using Fornell-Larcker criterion

	1	2	3	4	5	6
1. Attitude towards Recycling	0.913					
2. Recycling Behaviour	0.636	0.803				
3. Commitment to the Environment	0.635	0.497	0.867			
4. Intention to Recycle	0.704	0.817	0.603	0.960		
5. Perceived Behavioural Control	0.382	0.433	0.348	0.491	0.861	
6. Subjective Norms	0.620	0.656	0.556	0.658	0.350	0.934

Note: Values on the diagonal (bolded) represent the square root of the AVE, while the off-diagonals represent correlations

TABLE 4. Discriminant validity using HTMT criterion

|	1	2	3	4	5	6
1. Attitude towards Recycling						
2. Recycling Behaviour	0.692 $CI_{90}(0.633, 0.743)$					
3. Commitment to the Environment	0.683 $CI_{90}(0.623, 0.733)$	0.539 $CI_{90}(0.475, 0.600)$				
4. Intention to Recycle	0.745 $CI_{90}(0.700, 0.782)$	0.89 $CI_{90}(0.856, 0.917)$	0.639 $CI_{90}(0.579, 0.691)$			
5. Perceived Behavioural Control	0.415 $CI_{90}(0.338, 0.494)$	0.515 $CI_{90}(0.442, 0.589)$	0.378 $CI_{90}(0.292, 0.455)$	0.534 $CI_{90}(0.456, 0.610)$		
6. Subjective Norms	0.662 $CI_{90}(0.596, 0.717)$	0.721 $CI_{90}(0.661, 0.774)$	0.596 $CI_{90}(0.527, 0.656)$	0.693 $CI_{90}(0.632, 0.748)$	0.394 $CI_{90}(0.310, 0.475)$	
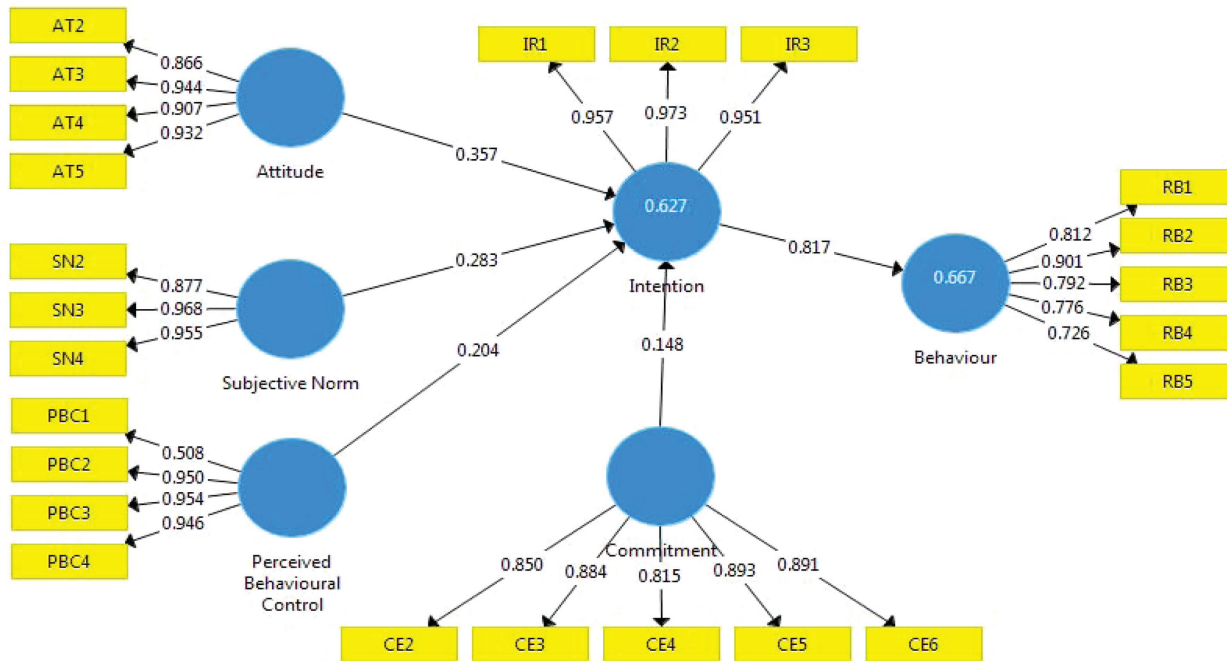
FIGURE 2. Structural model for this study

TABLE 5. Results of partial least square

Hypothesis	Relationship	Std. Beta	Std. Error	t-value	Decision	R2	Q2	f2	VIF
H_1	Attitude – > Intention	0.357	0.046	7.752**	Supported	0.627	0.544	0.164	2.076
H_2	Subjective Norms – > Intention	0.283	0.048	5.959**	Supported			0.121	1.777
H_3	Perceived Behavioural Control – > Intention	0.204	0.044	4.637**	Supported			0.092	1.215
H_4	Commitment – > Intention	0.148	0.04	3.714**	Supported			0.032	1.827
H_5	Intention – > Behaviour	0.817	0.02	40.745**	Supported	0.667	0.401	2.002	1

** Significant at p-value < 0.01

Chin (1998) suggested that R^2 values of 0.67 were substantial, a value of 0.33 moderate, and 0.19 weak. The R^2 value obtained for intention to recycle was 0.627, and was 0.667 for recycling behaviour. The value of 0.667 met Chin's (1998) guideline for a model. All the paths tested in the structural model are significant with all the t-values greater than critical value of 2.3263. The results also indicate that attitude towards recycling (β = 0.357), subjective norms (β = 0.283), perceived behavioural control (β = 0.204) and commitment to the environment (β = 0.148) have a positive effect on intention to recycle. Intention to recycle was also found to have a predictor effect on recycling behaviour with a beta value of 0.817.

Cohen (1988) suggested testing the model for effect size (f^2) to quantify the means of two groups. All effect sizes were greater than 0.02 in this study. A blindfolding procedure was used to assess the predictive relevance. The model has predictive relevance for a particular endogenous construct when Q^2 is greater than 0 (Hair et al. 2017). The Q^2 values obtained were 0.544 and 0.401, which suggests the model has predictive relevance.

DISCUSSION

The substantial R^2 value indicates that the TPB model has a good predictive ability to determine household recycling behaviour. The findings for Melaka household recycling are congruent with those of previous studies using the TPB in different settings (Boldero 1995; Cheung et al. 1999; Chu & Chiu 2003; Knussen et al. 2004; Mosler et al. 2007; Tonglet et al. 2004).

This study revealed that attitude towards recycling (β = 0.357) has positive effect on intention to recycle, and thus, H_1 is supported. This is in line with previous studies (Lee & Paik 2011; Nameghi & Shadi 2013; Pakpour et al. 2014) which found that attitude towards recycling is an important predictor of recycling intention. This finding implies that Melaka households perceived a positive attitude towards household recycling, however they did not turn it into actual recycling behaviour. This could be due to low awareness and limited knowledge of the adverse effect to the human and environment of not recycling.

The study also revealed that subjective norms (β = 0.283) have a positive effect on intention to recycle, and

hence H_2 is supported. This corroborates other studies suggesting that subjective norms have a positive effect on recycling intention (Chan & Bishop 2013; Chu & Chiu 2003; Mannetti et al. 2004; Pakpour et al. 2014). Bruvoll, Halvorsen and Nyborg (2002) noted that people tend to be very concerned about the potential damage to their reputation if it becomes known that they do not recycle. The results have revealed that Melaka households reacted positively towards pressure to recycle from other people, including relatives, neighbours and friends. Despite this, insufficient and not well-established recycling activities in residential areas could be the root cause of low participation in recycling their household waste.

PBC (β = 0.204) was also found to have a positive effect on intention to recycle, and thus, H_3 is supported. Similar findings were also reported by other studies (Carrus et al. 2009; Chan & Bishop 2013; Pakpour et al. 2014; White et al. 2009). This implies that Melaka householders who perceive themselves as having more control over their recycling activity are likely to have a stronger intention to recycle. Having insufficient practical knowledge and improved facilitating of recycling could have prevented them from practising recycling, however.

Commitment to the environment (β = 0.148), which was intended to capture householder commitment to recycling household waste in this study, showed that it had a positive effect on intention to recycle, and so H_4 is supported. This finding is in line with other research suggesting that the concept of commitment to the environment is useful in understanding the person-environment relationship (Davis et al. 2009), and that individual commitment was the strongest predictor of recycling (Aini et al. 2002). This finding shows that Melaka households who are committed to the environment in general will also be more willing to recycle. A lack of knowledge and the promotion of recycling program initiatives could be barriers to their greater involvement.

Meanwhile, the findings in this study also confirmed that intention to recycle (β = 0.817) has a positive effect on the recycling behaviour of households, and thus, H_5 is supported. Similar findings were also made by previous studies (Chan & Bishop 2013; Niaura 2013; Pakpour et al. 2014; White et al. 2009). The results thus indicate that the more willing Melaka households are to recycle their household waste, the higher their engagement in recycling activities. It is therefore essential for the local authorities to

focus on mechanisms to turn their willingness into actual recycling behaviour.

CONCLUSION AND IMPLICATIONS

This study was triggered and driven by the low recycling rate in Malaysia and critical reviews in previous research of recycling in a Malaysian context. At the time of writing the national recycling rate in Malaysia remains low by international standards. It was therefore important to investigate household recycling behaviour determinants in Melaka. The TPB model was used as the foundation for this study, and the starting point for the hypotheses formulated. This study confirmed that all hypotheses developed were supported by empirical findings. The extended TPB model demonstrated a relatively good proportion of variance explained in recycling behaviour.

This study has made a noteworthy contribution to the existing literature. It has examined household recycling behaviour in Melaka using an extended TPB framework that includes a new variable related to individuals' senses of the interdependence of humans and their environment, namely, commitment to the environment. It has consequently contributed to the existing literature and introduced a new perspective through which to research recycling behaviour by incorporating commitment to the environment into the TPB model. The Recycling Act should be enforced at a household level to achieve a higher national recycling rate and ensure the long-term success of recycling programmes. Consistent, reliable and systematic classification in a waste generation database should also be established as an indispensable government tool to improve reporting on solid waste; information about the generation of solid waste could be used to develop, enact and enforce laws on household recycling in order to ensure the success of household recycling initiatives.

The findings of this study will enable us to formulate several strategies and policy recommendations for achieving sustained and successful household waste recycling behaviour. It is imperative for the local authorities to increase public awareness of households in Melaka towards the negative impact on social and environmental of not recycling their household waste. This can be achieved through more awareness-raising campaigns, holding more seminars and providing more publicity for household recycling, educating Melaka householders about the potential benefits of recycling household waste and the harmful impact of the mounting waste generated especially in the residential areas. These activities must be intensified and should be ongoing if they are to have a significant impact on household recycling behaviour. Local authorities could also make a concerted effort to improve knowledge about the practicalities of household recycling, such as what can be recycled, ways to separate recyclables and methods of disposing of them to recycling schemes. These could be done by introducing a public education programme through the formal or informal educational system or distributing booklets to the households. Local authorities could also embark on an intensive advertising campaign across different mass media – social media, television, radio, newspapers, magazines etc. Public access to the recycling facilities in residential areas needs to be improved in order to ease the inconvenience of recycling. Kerbside and drop-off recycling schemes could also be implemented in the non-landed housing areas.

LIMITATIONS AND FUTURE STUDY

Several limitations in relation to this study must be addressed, and avenues for future investigation have thus been suggested. The study considered only a limited set of potential determinants of recycling behaviour, namely attitude towards recycling, subjective norms, PBC and commitment to the environment, neglecting other potentially relevant factors such as perceived moral obligation, monetary incentives and intrinsic satisfaction, as these variables were found to have significant effects on household recycling behaviour in the studies undertaken by Aini et al. (2002); Chan and Bishop (2013); and Murad and Siwar (2007). It is recommended that the model used in this study should be extended to investigate the role of these variables.

This study also relied on the self-reports of household recycling behaviour which may have overstated involvement in household recycling, thus biasing the results and presenting an unrepresentative picture of recycling behaviour in the study area. Self-reports should be supplemented with observational data or follow-up phone calls in future studies.

Finally, the study used a cross-sectional design which might not capture the precise situation corresponding to the study. The differences in results may be gathered using longitudinal study. A longitudinal study allows recycling behaviour to be measured at more than one point in time in a given sample element, and thus looks at changes over time. Future studies should employ longitudinal research. These methodological changes would reduce or eliminate the biases associated with cross-sectional research and thus produce more reliable results.

RUJUKAN

Abdelnaser O. & Abdelsalam O. Gebril. 2011. Study of household attitude toward recycling of solid wastes: A case study. *ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering* Tome IV: 79-82.

Abdelnaser O., Mahmood, A., Aziz, H.A. & Robbison, G.M. 2009. Investigating households' attitude toward recycling of solid waste in Malaysia: A case study. *International Journal of Environmental Research* 3(2): 275-288.

Agamuthu, P., Chenayah, S., Hamid, F.S. & Victor, D. 2011. 3R related policies for sustainable waste management in Malaysia. *Conference Proceedings of Innovation and Sustainability Transition in Asia*, Kuala Lumpur, Malaysia, Paper 135.

Aini, M. S., Fakhru'l-Razi, A., Lad, S.M. & Hashim, A.H. 2002. Practices, attitudes and motives for domestic waste recycling. *International Journal of Sustainable Development and World Ecology* 9(3): 232-238.

Ajzen, I. 1985. From intentions to actions: A theory of planned behaviour. In *Action-Control: From Cognition to Behaviour*, edited by J. Kuhl & J. Beckman, 11-39 Herdelberg: Springer.

Ajzen, I. 1991. The theory of planned behaviour. *Organization Behaviour and Human Decision Processes* 50: 179-211.

Ajzen, I. 2002. Perceived behavioural control, self-efficacy, locus of control, and the theory of planned behaviour. *Journal of Applied Social Psychology* 32(4): 665-683.

Ajzen, I. 2005. *Attitudes, Personality and Behaviour*. 2nd edition. Milton. Keynes, England: Open University Press (McGraw-Hill).

Ajzen. I. & Fsihbein, M. 1980. *Understanding Attitudes and Predicting Social Behaviour*. Englewood Cliffs, NJ.: Prentice Hall.

Apinhapath, C. 2014. Community mapping and Theory of Planned Behaviour as study tools for solid waste management. *Journal of Waste Management*: 1-7.

Apinhapath, C., Tanasugam, C., Chansatiporn, N. & Stecker, A. 2015. Determinants protecting intention to properly dispose of used batteries. *Kasetsart Journal-Social Sceince* 36: 173-182.

Barr, S. & Gilg, A.W. 2005. Conceptualising and analysing household attitudes and actions to a growing environmental problem: Development and application of a framework to guide local waste policy. *Applied Geography* 25: 226-247.

Begum, R.A., Siwar, W., Pereira, J.J. & Jaafar, A.H. 2009. Attitude and behavioural factors in waste management in the construction industry in Malaysia. *Resources, Conservation and Recycling* 53: 321-328.

Botetzagias, I., Dima, A-F. & Malesios, C. 2015. Extending the Theory of Planned Behaviour in the context of recycling: The role of moral norms and of demographic predictors. *Resources, Conservation and Recycling* 95: 58-67.

Boldero J. 1995. The prediction of household recycling of newspapers: The role of attitudes, intentions and situational factors. *Journal of Applied Social Psychology* 25: 440-462.

Bruvoll A., Halvorsen B. & Nyborg K. 2002. Households' recycling efforts. *Resources, Conservation and recycling* 36: 337-354.

Carrus, G., Bonnes, M., Passafaro, P., Tronu, G. & Fornara, F. 2009. Planned behaviour and "local" norms: An analysis of the space-based aspects of normative ecological behaviour. *4th International Conference on Spatial Cognition, Rome,* 10: 198-200.

Chan, L. & Bishop, B. 2013. A moral basis for recycling: Extending the Theory of Planned Behaviour. *Journal of Environmental Psychology* 36: 96-102.

Chenayah, S. & Takeda, E. 2005. PROMETHEE multicriteria analysis for evaluation of recycling strategies in Malaysia. Discussion paper in Economics and Business, Graduate School of Economics and Osaka School of International Public Policy (OSIPP), February, 2005, Osaka University, Japan.

Cheung S.F., Chan D.K.-S. & Wong Zoe S.-Y. 1999. Re-examining the Theory of Planned Behaviour in understanding wastepaper recycling. *Environment and Behaviour* 31(5): 587-612.

Chin, W.W. 1998. The partial least squares approach for structural equation modeling. In *Modern Methods for Business Research*, edited by G.A. Marcoulides, 295-336. Mahwah, NJ Lawrence Erlbaum Associates, Publisher.

Chu Pin-Yu & Chiu Ja-Fun. 2003. Factors influencing household waste recycling behaviour: Test of an Integrated Model. *Journal of Applied Social Psychology* 33: 604-626.

Cohen, J. 1988. *Statistical Power Analysis for the Behavioural Sciences*. 2nd edition. Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Davies, J., Foxall, G.R. & Pallister, J. 2002. Beyond the intention – behaviour mythology: An integrated model of recycling. *Marketing Theory* 2: 29-113.

Davis, G., Phillips, P.S., Read, A.D. & Iida, Y. 2006. Demonstrating the need for the development of internal research capacity: Understanding recycling participation using Theory of Planned Behaviour in West Oxfordshire, UK. *Resources, Conservation & Recycling* 46: 115-127.

Davis, G. & Morgan, S. 2008. Using the Theory of Planned Behaviour to determine recycling and waste minimization behaviours: A case study of Bristol City, UK. *The American Community Psychologist* 20: 105-116.

Davis, J.L., Green, J.D. & Reed, A. 2009. Interdependence with the environment: Commitment, interconnectedness, and environment behaviour. *Journal of Environmental Psychology* 29: 173-180.

Davis, J.L., Le, B. & Coy, A. E. 2011. Building a model of commitment to the natural environment to predict ecological behaviour and willingness to sacrifice. *Journal of Environmental Psychology* 31: 257-265.

Department of Statistics, Malaysia. 2010. Population distribution and basic demographic characteristics 2010. *Population and Housing Census of Malaysia*.

Department of Statistics, Malaysia. 2017. *Current Population Estimates, Malaysia, 2014-2016*.

Diyana, M.S.N. & Osman, K. 2010. The determinants of recycling intention behaviour among the Malaysian school students: An application of Theory of Planned Behaviour. *Procedia Social and Behavioural Sciences* 9: 119-124.

Fishbein, M. & Ajzen, I. 1975. *Belief, Attitude, Intention and Behaviour: An Introduction to the Theory and Research*. Addison-Wesley.

Fornell, C., & Larcker, D.F. 1981. Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research* 18(1): 39-50.

Gadiraju, Tejaswini. 2016. Investigating the determinants of recycling behavior in youth by using Theory of Planned Behaviour. Graduate Theses and Dissertations. University of South Florida.

Gold, A.H., Malhotra, A. & Segars, A.H. 2001. Knowledge management: An organisational capabilities perspective. *Journal of Management* 18(1): 185-214.

Hair, J.F., Hult, G., Tomas, M., Ringle, C.M. & Sarstedt, M. 2017. *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. SAGE Publications, Incorporated.

Hair, J.F., Ringle, C.M. & Sarstedt, M. 2011. PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice* 19(2): 139-151.

Hassan, N.M., Midzanur, M.R., Chong T.L. & Awang, M. 2000. *Malaysia: Economics and environmental needs*. Paper presented at "Recycling as a Socio-Economic Activity in the New Millennium", Southern Waste Management Sdn. Bhd., 5 June, Johor Bahru,

Henseler, J., Ringle, C.M. & Sarstedt, M. 2015. A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science* 43(1): 115-135.

Hezri, A. A. 2009. Toward 3R-based waste management: Policy change in japan, Malaysia and the Philippines. Available at www.eria.org/pdf/research/y2009/no10/ch11_3R.pdf.

Ittiravivongs, A. 2012. Household waste recycling behaviour in Thailand: The role of responsibility. *International Conference on Future Environment and Energy* 28, Singapore, 21-25.

Jekria, N. & Daud, S. 2016. Environmental concern and recycling behaviour. *Procedia Economics and Finance* 35: 667-673.

Johari, A., Alkali, H., Hashim, H. & Mat., R. 2014. Municipal solid waste management and potential revenue from recycling in Malaysia. *Modern Applied Science* 8(4): 37-49.

Kline, R.B. 2011. *Principles and Practice of Structural Equation Modeling*. New York: Guilford Press.

Knussen, C., Yule, F., MacKenzie, J. & Wells, M. 2004. An analysis of intentions to recycle household waste: The roles of past behaviour, perceived habit, and perceived lack of facilities. *Journal of Environmental Psychology* 24: 237-246.

Lee, S. & Paik, H.S. 2011. Korean household waste management and recycling. *Building and Environment* 46: 1159-1166.

Leopold, A. 1949. *A Sand Country Almanac and Sketches Here and There*. New York, NY: Oxford University Press.

Mannetti, L., Pierro, A. & Livi, S. 2004. Recycling: Planned and self-expressive behaviour. *Journal of Environmental Psychology* 24: 227-236.

Martin, M., Williams, I.D. & Clark, M. 2006. Social, cultural and structural influences on household waste recycling: A case study. *Resources, Conservation and Recycling* 48: 357-395.

Meinhold, J.L. & Malkus, A.J. 2005. Adolescent environmental behaviours: Can knowledge, attitudes, and self-efficacy make a difference? *Environmental and Behaviour* 37(4): 511-532.

Mosler H-J., Tamas A. Tobias R., Rodriguez T.C. & Miranda O.G. 2008. Deriving interventions on the basis of factors influencing behavioural intentions for waste recycling, composting, and reuse in Cuba. *Environment and Behaviour* 40(4): 522-544.

Murad, W. & Siwar, C. 2007. Waste management and recycling practices of the urban poor: A case study in Kuala Lumpur city, Malaysia. *Waste Management & Research* 25: 3-13.

Nameghi, E.N.M. & Shadi, M.A. 2013. Affective and cognitive: Consumer attitude towards practicing green (Reducing, Recycling & Reusing). *International Journal of Marketing Studies* 5(1): 157-164.

National Solid Waste Management Department. 2012. Ministry of Urban Wellbeing, Housing and Local Government, Malaysia.

Niaura, A. 2013. Using the Theory of Planned Behaviour to investigate the determinants of environmental behaviour among youth. *Environmental Research, Engineering and Management* 1(63): 74-81.

Ninth Malaysia Plan. 2006. Promoting environmental Stewardship, Kuala Lumpur: *The Economic Unit Planning* 22: 453-463.

Oskamp, S., Harrington, M.J., Edwards, T.C., Sherwood, D.L., Okuda, S.M. & Swanson, D.C. 1991. Factors influencing household recycling behaviour. *Environment and Behaviour* 23: 494-519.

Pakpour, A.H., Zeidi, I.M., Emamjomeh, M.M. & Asefzadeh, S. 2014. Household waste behaviour among a community sample in Iran: An application of the theory of planned behaviour. *Waste Management* 34: 980-986.

Ramayah, T., Lee, W.C. & Lim, S. 2012. Sustaining the environment through recycling: An empirical study. *Journal of Environmental Management* 102: 141-147.

Rusbult, C.E., Martz, J.M. & Agnew, C.R. 1998. The investment model scale: Measuring commitment level, satisfaction level, quality of alternatives, and investment size. *Personal Relationship* 5: 357-391.

Samsudin, M.D.M. & Don, M.M. 2013. Municipal solid waste management in Malaysia: Current practices, challenges and prospect. *Journal of Technology* 62(1): 95-101.

Saphores, J.M., Nixon, H., Ogunseitan O.A. & Shapiro, A.A. 2006. Household willingness to recycle electronic waste: An application to California. *Environmnet and Behaviour* 38: 183-208.

Schultz, P.W. 2002. Inclusion with nature: the psychology of human-nature relations. In *Psychology of Sustainable Development*, edited by P. Schmuck & P.W. Schultz, 61-78. Dordrecht, Netherlands: Kluwer Academic Publishers.

Sidique, S.F., Lupi, F. & Joshi, S.V. 2010. The effects of behaviour and attitudes on drop-off recycling activities. *Resources, Conservation and Recycling* 54: 163-170.

Sin Chew. 2015. Compulsory to Separate Rubbish in September, 2015. February 25.

Stoeva, K. & Alriksson, S. 2017. Influence of recycling programmes on waste separation behaviour. *Waste Management* 68: 732-741.

Taylor, S. & Todd, P. 1995. An integrated model of waste management behaviour: A test of household recycling and composting intentions. *Environment and Behaviour* 27: 603-630.

The Malaysians Insider. 2014. Compulsory for Malaysians to separate rubbish from next year, Available at www.themalaysianinsider.com.

The Star Online. 2017. Low awareness on recycling among Malaysians, August 20. Available at www.thestar.com.my.

Tong, X., Nikolic, I., Dijkhuizen, B., Hoven, M.V.D., Minderhoud, M., Wackerlin, N., Wand, T. & Tao, D. 2018. Behvaiour change in post-consumer recycling: Applying agent-based modelling in social experiment. *Journal of Cleaner Production* 187: 1006-1013.

Tonglet, M., Phillips, P.S. & Read, A.D. 2004. Using the Theory of Planned Behaviour to investigate the determinants of recycling behaviour: A case study from Brixworth, UK. *Resources, Conservation & Recycling* 41: 191-214.

Van Lange, P.A.M., Rusbult, C.E., Drigotas, S.M., Arriaga, X.B., Witcher, B.S. & Cox, C.L. 1997. Willingness to sacrifice in close relationship. *Journal of Personality and Social Psychology* 72(6): 1373-1395.

Vicente, P. & Reis, E. 2008. Factors influencing households' participation in recycling. *Waste Management & Research* 26: 140-146.

White, K.M., Smith, J.R., Terry, D.J., Greebslade, J.H. & McKimmie, B.M. 2009. Social influence in the Theory

of Planned Behaviour: The role of descriptive, injunctive, and in-group norms. *British Journal of Social Psychology* 48: 135-158.

Zaini Sakawi. 2011. Municipal solid waste management in Malaysia: Solution for sustainable waste management. *Journal of Applied Sciences in Environmental Sanitation* 6(1): 29-38.

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