Knowledge Level, Attitude and Practices of Malaysian towards Urban Littering: A Theory of Planned Behaviour Approach

Chan Kah Sin

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Department of Biological Sciences School of Medical and Life Sciences

Sunway University

Primary Supervisor: Dr Ooi Pei Boon

Secondary Supervisor: Dr Jane Gew Lai Ti

I declare that the work presented in this written report is my own and all other published work has been acknowledged.

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Abstract

In Malaysia, urban littering has raised concerns over the past few decades due to its devastating impacts across various domains. This unresolved issue has severely compromised the life quality of countless living organisms, urging a comprehensive solution. This paper aimed to propose and validate a model based on the Theory of Planned Behaviour (TPB) to gain deeper insights into the behavioural patterns of Malaysians concerning urban littering. The model is constructed by incorporating the fundamental five variables of TPB (attitude, subjective norm, perceived behavioural control, intention, and behaviour) along with environmental theory knowledge and incentive measures. A 2-week survey was conducted via online forms, and the collected data was subjected to analysis using structural equation modelling (SEM). The initial data analysis confirmed that all constructs exhibited commendable levels of reliability, internal consistency, and validity. The proposed model exhibited a high degree of fitness, successfully validating all eight hypotheses based on the data collected from 351 participants. Notably, attitude emerged as the most potent predictor of perceived behavioural control and behavioural intention, while perceived behavioural control showcased a mediating role in the relationships between attitude and subjective norm with behavioural intention. The proposed model also demonstrated considerable predictive power to capture the association between behavioural intention and responsible environmental behaviours. The issue of demographic bias in this study should be overcome with more diverse recruitment. Ultimately, the proposed model provides related organisations and companies with an invaluable tool for policymaking and targeted marketing when tackling environmental issues.

Keywords: knowledge, attitude, practices, urban, littering, environment, Theory of Planned Behaviour

Introduction

Urban littering is a pressing environmental problem that has persisted worldwide for several decades. Every year, approximately 2.01 billion tonnes of urban solid waste are generated worldwide with about one-third of them being mismanaged (World Bank, 2018). Marine debris, which includes plastic, paper, metal, textile, glass, and rubber, is the most common type of urban litter, accounting for around half of the total waste production (United Nations, 2021; Agamuthu et al., 2019). Plastics, in particular, dominates that marine debris, accounting for approximately 50% to 90% of the overall marine debris discovered worldwide. Beyond the ecological consequences, urban littering has health, environmental, and economic impacts.

The impact of marine debris on wildlife is significant, with approximately 1 million seabirds estimated to die annually due to marine plastic pollution (WWF-Australia, 2018). The ingestion of plastics can have toxic effects and physical harms on seabirds' internal organs, as well as may lead to starvation due to the fullness feeling after consuming plastic. Floating plastics can also carry invasive species, chemicals, and pollutants to the marine ecosystem, posing risks to both marine life and human health (Agamuthu et al., 2019). Microplastics can also be unintentionally consumed by humans and animals through contaminated water sources and marine food, resulting in potential toxicity (Agamuthu et al., 2019; Ojedokun et al., 2022). The accumulation of litter can degrade landscapes, negatively impacting tourism and income (Agamuthu et al., 2019). Litter accumulation can also destroy animal habitats and contribute to flooding disasters by blocking the river flow and drainage systems (Department of Irrigation and Drainage, 2017; Ojedokun et al., 2022).

According to OECD (2014), approximately 13 million tonnes of urban solid waste are produced from Malaysia annually, and one-fifth of this waste consists of plastic. By 2021, Malaysia accounts for the top 3 ranking in marine plastic waste generation worldwide (World Population Review, 2021). Urban littering is a persistent issue in Malaysia. In 2015, Cameron Highland's Mossy Forest in Pahang had to close for 6 months to allow the recovery of local fauna due to uncontrolled littering by Malaysian tourists (Clean Malaysia, 2016; Fong, 2016). The Covid-19 pandemic also worsened the situation from 2020 to 2022, with an alarming amount of used personal protective equipment (PPE), such as face masks, irresponsibly disposed daily in Malaysia. (The Star, 2020; Malay Mail, 2021; New Straits Times, 2022). During this period, about 7 million used face masks were disposed irresponsibly in Malaysia daily (Lim, 2021). In September 2020, flash flood in Kuala Lumpur revealed waste retention, primarily plastics, at Batu flood retention pond, which reflected the littering attitude of Malaysians (M & Ravindran, 2020). In May 2023, the accumulation of rubbish around the low-cost flats at Skudai had brought a challenge to the state government at Johor (Mahpar, 2023; Malay Mail, 2023). Approximate 18000 kilogrammes of garbage are required to be collected daily for cleanliness restoration of these flats (Malay Mail, 2023). Despite various attempts, including warnings, fines, and camera monitoring, the issue of littering in Malaysia persists without a satisfactory solution.

To tackle urban littering effectively, it is crucial to assess the contributing factors and understand Malaysian attitudes toward urban littering. The Theory of Planned Behaviour (TPB), initially known as the Theory of Reasoned Action (TRA) in 1980, was developed to predict an individual's intention to engage in a specific behaviour at a particular time and location (LaMorte, 2022). This theory was designed to encompass behaviours where individuals can exercise self-control. TPB has proven effective in predicting and understanding various health-related behaviours and intentions, such as smoking, drinking, healthcare utilization, breastfeeding, substance use, energy consumption, and political engagement (LaMorte, 2022; Bosnjak et al., 2020). In recent years, the TPB has gained traction in the field of environmental science, with extensive research focusing on waste management, green consumption, climate and environment, conservation, and sustainable transportation (Si et al., 2019).

Moreover, TPB has been employed to study litter prevention and explore individuals' intentions and behaviours related to anti-littering in various locations including Nigeria, India, and Mount Merapi National Park in Indonesia (Ojedokun, 2022; Singh & Kaur, 2021; Fenitra, 2023). Building on the insights from these environmental studies, my research aims to assess Malaysians' knowledge, attitudes, and behaviors concerning urban littering using the TPB methodology. By obtaining a comprehensive understanding on waste management strategies and urban littering trends in Malaysia, it is anticipated that the initiative execution and effectiveness aimed at combating urban litter will be greatly improved.

Theoretical Background

TPB emerged as an extension of the TRA to address the shortcomings of the original model regarding behaviours that individuals have limited control over (Ajzen, 1991). TPB places significant emphasis on an individual's intention to engage in a specific behaviour, representing the motivational factors influencing behaviour and indicating the level of effort and commitment individuals are willing to invest to carry out the behaviour. Generally, stronger intentions are associated with a higher likelihood of performing the behaviour. However, for intentions to transform into actual behaviour, the specific behaviour must be within the individual's control, contingent on the availability of necessary resources and opportunities. This brings in the concept of attitude (A), perceived behavioural control (PBC), and subjective norm (SN) in determining the behavioural intention. In this paper, a theoretical framework is proposed based on the fundamental components of TPB with the incorporation of environmental theory knowledge (ETK) and incentive measures (IM) to predict the intention to reduce littering in urban areas.

Figure 1.

Framework model based on the Theory of Planned Behaviour (TPB).
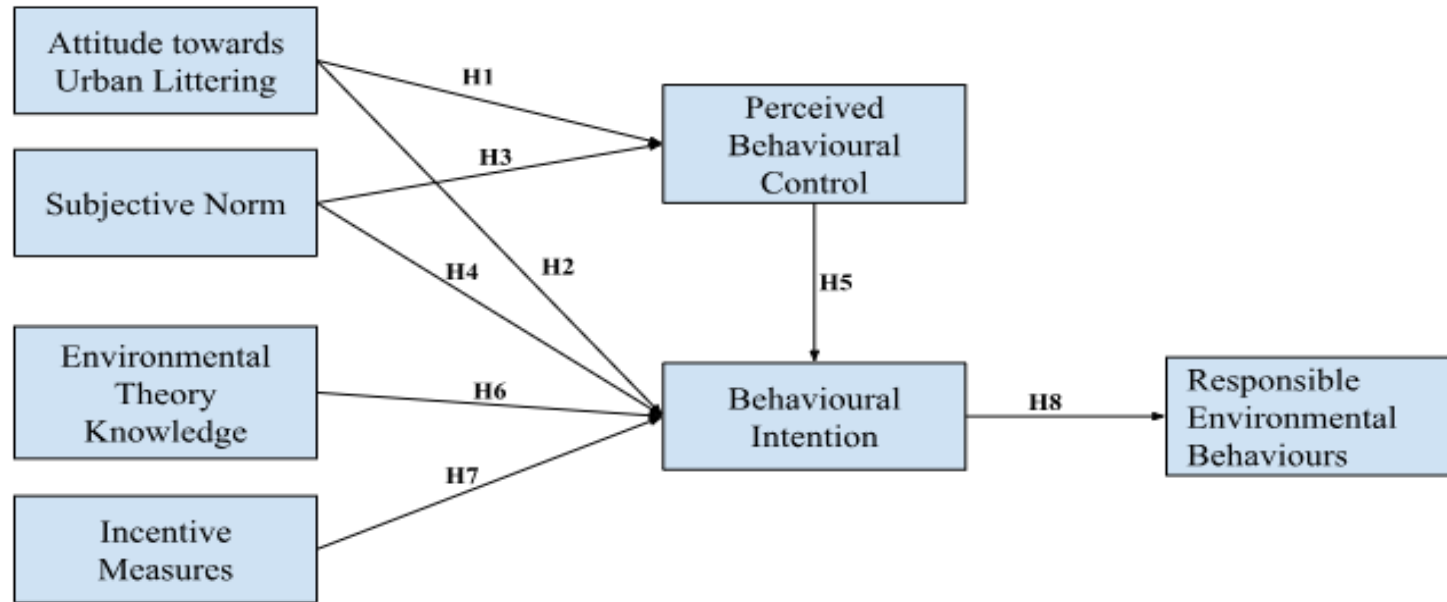
Attitudes towards urban littering (ATT), perceived behavioural control (PBC) and behavioural intention (BI)

Attitude reflects one's evaluation and inclination towards a particular behaviour based on cognitive beliefs and rational judgements of the perceived benefits and consequences associated with it. In the context of the environment, attitude refers to the cognitive and emotional evaluation of objects related to environmental protection (Ates, 2020). In theory, individuals with a positive attitude are expected to have a positive behavioural intention. This theory was substantiated by studies conducted by Ibrahim et al. (2021) and Hu et al. (2018), which demonstrated a direct association between the attitude of towards anti-littering and their intention to engage in such behaviour among Malaysian students and hikers in China. Nonetheless, one's attitude does not always serve as a reliable indicator of their inclination towards certain behaviours, as demonstrated by Arli et al. (2019) and Islam (2021). These studies indicated that there is no substantial correlation between one's attitude towards recycling and their recycling intention.

PBC refers to an individual's confidence in their ability to carry out a specific behaviour, considering past experiences, anticipated challenges, and barriers (Ajzen, 1991). In the context of recycling, Liu et al. (2021) revealed that PBC mediates the relationship between attitude and behavioural intention, with a lower level of PBC strengthening this mediation effect. However, Lin et al. (2021) found no substantial mediating role of PBC in the relationship between attitude and intention concerning marine responsible environmental behaviour in Taiwan. Similarly, Corsini et al. (2019) discovered that attitude directly impacts the intention to reduce waste. Despite the direct association between attitude and behavioural intention, limited research has focused on the mediation effect of PBC in the relationship between attitude and behavioural intention, as well as the direct impact of attitude on PBC. Based on these, the proposed hypotheses are:

H1: Attitude towards urban littering (ATT) has positive relationship with perceived behavioural control (PBC).

H2: PBC has a mediation effect on the relationship between attitude towards urban littering (ATT) and behavioural intention (BI).

Subjective norm (SN), perceived behavioural control (PBC) and behavioural intention (BI)

Subjective norm (SN) encompasses the perception of social pressure that affects a person's decision to adopt or avoid a behaviour (Ajzen, 1991). It involves the perceived influence from various sources including family, friends, colleagues, and business partners. In general, a stronger perceived SN leads to a more pronounced intention to engage in the target behaviour. Nevertheless, this theory has sparked controversy in various related studies. Fenitra et al. (2021) found a favourable impact of SN on the intention to engage in environmental protection in Yogyakarta, Indonesia. In contrast, an investigation by Ates (2020) has refuted this theory. Besides, Singh and Kaur (2021) discovered that SN directly influences individuals' intention to engage in anti-littering actions in New Delhi and Punjab, India. The structural equation modelling (SEM) analysis by Nguyen et al. (2018) also discovered a beneficial influence of social pressure on the behavioural intention of residents in Danang city, Vietnam, regarding electronic waste (e-waste) recycling. However, Y. Wang et al. (2020) found that SN does not significantly impact households' intentions to adopt waste sorting in China. The potential mediating role of PBC in the relationship between SN and BI has also been explored in certain studies, although such investigations are relatively scarce. Liu et al. (2021) revealed that PBC does not have a significant impact on the relationship between subjective norm and recycling intention. In the realm of environmental concerns, this has also raised a question of whether there is a significant relationship between subjective norm and PBC among Malaysians with regards to urban littering. In this research, the proposed hypotheses will be:

H3: There are positive association between subjective norm and perceived behavioural control.

H4: Perceived behavioural control mediates the relationship between subjective norm and behavioural intention.

Perceived behavioural control (PBC) and behavioural intention (BI)

According to TPB, BI can lead to the desired behaviour only if individuals have control over their actions (Ajzen, 1991). This introduces the interplay between PBC and BI in predicting specific behaviours. PBC assists individuals in determining how to act in response to challenges and circumstances they face during behaviour execution (Liu et al., 2021). Ideally, stronger behavioural intentions arise when individuals perceive greater control in minimizing anticipated obstacles However, the significance of PBC in this relationship may diminish when there is a lack of available information due to various changes and disruptions (Ajzen, 1991). Research on the influence of PBC on BI regarding environmental issues is somewhat contentious. V and Mathi (2022) found a positive impact of PBC on the household recycling intentions among smartphone and laptop users. Similarly, Zhang et al. (2015) also reported a significant association between PBC and the waste separation intention. On the contrary, a study by Islam (2021) suggested that PBC does not have a notable effect on the recycling intention of consumers in Bangladesh. Supporting this perspective, Strydom (2018) also demonstrated that PBC has no significant role on the recycling intention of South African. As a result, the proposed hypotheses will be:

H5: PBC towards the behaviour of urban littering is positively influencing the intention to stop littering.

Environmental theory knowledge (ETK) and behavioural intention (BI)

Environmental knowledge encompasses information about the facts, concepts, and connections of the natural environment and its ecosystems (Cheng et al., 2020; Hu et al., 2018). It is classified into environmental theory knowledge (ETK) and environmental practice knowledge (EPK). ETK involves the understanding of the theoretical impact of specific environmental issues on nature and society, while EPK comprehends the practical programmes and initiatives addressing these issues (Hu et al., 2018). Environmental knowledge has been widely studied in previous research to predict individuals' pro-environmental intentions. However, the conflicting outcomes of recent research have presented a challenging dilemma in this regard. Iman et al. (2019) and S. Wang et al. (2020), found a positive impact of environmental knowledge on pro-environmental intentions among educators in Indonesia and residents in China's Anhui Province, respectively. On the other hand, Levine and Strube (2012) has demolished the relationship between environmental knowledge and the intention of undergraduate students from Washington University to adopt the environmentally friendly behaviour. Hu et al. (2018) also reported insignificant association between ETK and litter management intentions among tourists visiting Huangshan National Park. Notably, there is limited research specifically focusing on the influence of ETK on BI. Therefore, this study aims to explore the correlation between ETK and anti-littering intentions. The proposed hypothesis will be:

H6: ETK is positively associated with the intention to stop littering.

Incentive measures (IM) and behavioural intention (BI)

Incentives refer to any factors that motivate an individual to modify their behaviour in a desired way. Monetary and non-monetary incentives help alleviate negative emotions associated with the costs, time commitment, difficulty, and inconvenience associated with the execution of environmentally friendly actions in different situations, thereby improving individuals' self-efficacy and inclination to participate in pro-environmental activities (Hu et al., 2018; Xu et al., 2018). Hence, a positive relationship between incentives and the intention to adopt pro-environmental behaviours is expected. Monetary incentives, such as discounts, coupons for food and beverage facilities, or loyalty points, have been frequently studied in comparison to non-monetary incentives (Line et al., 2017). Non-monetary incentives can be categorized into material incentives (e.g.: small gifts) and spiritual incentives (e.g.: appreciation letter or medals) (Hu et al., 2018; Mohd Noor et al., 2023). Studies conducted in China and Malaysia revealed that offering incentives significantly influenced people's willingness to engage in environmentally responsible actions, such as bringing down self-generated litter from the mountain or recycling e-waste (Hu et al., 2018; Mohd Noor et al., 2021). In addition, Line et al. (2017) also found that incentive measures could leads to a higher inclination to participate in sustainability programs. People can also be incentivized by surcharges. Asmuni et al. (2018) demonstrated that the use of plastic bags decreased by nearly half when stores imposed a levy on each plastic bag used in Malaysia. Similarly, Chen et al. (2023) found that incentive measures effectively encouraged farmers to show a higher willingness to sort household waste by manipulating benefits and costs. Overall, existing research consistently suggest that incentive measures play a vital role in influencing behavioural intentions related to environmental protection. With this, I hypothesize that:

H7: The incentive measures toward the behaviour of urban littering will significantly promote the intention to stop littering.

Behavioural intention (BI) and responsible environmental behaviours (REB)

TPB states that behavioural intention (BI) is recognized as the primary predictor of an individual's actions (Ajzen, 1991). In the realm of environmental studies, this association has been extensively explored. The current findings consistently establish the positive influence of BI on behaviour. Vorobeva et al. (2022) observed a strong impact of BI on the adoption of an innovative waste management system in Portugal. Regarding waste separation, Zhang et al. (2015), Y. Wang et al. (2020), and S. Wang et al. (2020) all provided support for the beneficial effect of BI on behaviour. Similarly, Strydom et al. (2018) and Arli et al. (2019) discovered that recycling behaviour is significantly influenced by recycling intention. Furthermore, Ates (2020) and Iman et al. (2019) demonstrated a significant correlation between pro-environmental behavioural intention and actual pro-environmental behaviour. To further explore the relationship between BI and REB in anti-littering, I hypothesize that:

H8: There are positive relationship between the behavioural intention and responsible environmental behaviours.

Methodology

A. Data Collection

A self-reported survey (approval code: SUREC 2022/044) was institutionally approved and distributed across social media for 2 weeks, starting from May 8 to May 19, 2023. The target population of this study was Malaysians aged 18 and above. As the survey questionnaires were designed in English, the participants must be able to read and understand English. Data collection was performed via the convenience sampling approach using online survey forms filled out by eligible participants. In this study, a total of 354 responses were collected, with 3 rejections. The final participation rate in the study was 99.15% (351/354) after excluding the rejected responses. 68.95% females and 31.05% males (M_{age} = 22.89; SD = 6.42) participated in this study with majority of them are undergraduates (79.77%) and not working (57.83%). The demographic characteristics of the final sample are shown in Table 1.

Table 1.

Demographic characteristics.

Demographics		Frequency	Percentage (%)
Gender	Male	109	31.05
	Female	242	68.95
Age	18 – 27	302	86.04
	28 – 37	33	9.40
	38 – 47	10	2.85
	48 – 57	4	1.14
	≥ 58	2	0.57
Ethnicity	Malays	33	9.40

	Chinese	290	82.62
	Indian	26	7.41
	Others	2	0.57
Education level	Primary school	2	0.57
	Secondary school	31	8.83
	Undergraduate degree	280	79.77
	Postgraduate	38	10.83
Monthly income (RM)	Not working	203	57.83
	Below RM1000	68	19.37
	RM1000 – RM1500	9	2.56
	RM1500 – RM2000	18	5.13
	RM2000 – RM2500	10	2.85
	RM2500 – RM3000	12	3.42
	RM3000 and above	31	8.83

Note. n = 351

B. Questionnaire Design

The questionnaires consisted of eight sections. Part A included three items (ATT1, ATT2, and ATT3) that assessed participants' attitude towards urban littering, based on the scale developed by Hu et al. (2018). In Part A, a 5-point Likert scale was used to indicate the level of satisfaction with each statement, ranging from 1 = very unbeneficial/very foolish/very meaningless to 5 = very beneficial/very wise/very meaningful. Part B consisted of three items (SN1, SN2, and SN3) that reflected subjective norms regarding urban littering, adapted from Wang et al. (2018). Part C

measured participants' knowledge of environmental theory using three corresponding items (ETK1, ETK2, ETK3), adopted from Hu et al. (2018). Part D included three items (PBC1, PBC2, and PBC3) that measured the influence of perceived behavioural control (PBC) on urban littering, adopted from Hu et al. (2018). Part E contained four items (IM1, IM2, IM3, and IM4) that assessed the significance of incentive measures on urban littering, modified based on the works of Zulkifli Mohd Nopiah et al. (2019), Chen et al. (2023), and Hu et al. (2018). Participants' behavioural intention against urban littering was measured in Part F with three corresponding items (BI1, BI2, and BI3) adopted from Hu et al. (2018). Part G included three items (REB1, REB2, and REB3) that measured responsible environmental behaviour, adopted from Wang et al. (2018). From Part B to G, a 5-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree was applied to indicate degree of agreement with each statement. Part H recorded the demographic information of the participants.

C. Measurement Instruments and Data Analysis

In this research, structural equation modelling (SEM) is a statistical technique applied to analyse and estimate intricate relationships among multiple variables. It assesses how well a theoretical model aligns with actual data. SEM extends the general linear model by incorporating factor analysis and path analysis. It deals with latent variables, which are unobservable concepts measured indirectly by multiple indicators. SEM takes into account measurement error in observed variables when estimating relationships, resulting in more accurate measurements of the theoretical concepts being studied (Zhang et al., 2015; Hair et al., 2021). Data was analysed using SPSS AMOS 27 and SPSS 29 statistical software. To assess the reliability and validity of the reflective measurement model, confirmatory factor analysis was utilized. Discriminant validity was also performed to examine the relationship between each variable and ensure that there is no significant correlation among the variables.

Results

A. Measurement Model Assessment

Confirmatory factor analysis was employed in this study to examine the measures within the proposed model using the maximum likelihood (ML) approach. To evaluate the internal reliability and convergent validity of the constructs, it was crucial to consider factor loading, average variance extracted (AVE), composite reliability (CR), and Cronbach's Alpha (α). The factor loadings of most measured items met the acceptable threshold of 0.5 or higher, except for IM1, IM2, and PBC1. Consequently, these unsatisfactory items were removed from the measurement model due to their weak relationships with their respective variables (Y. Wang et al., 2020). The AVE values for the variables ranged from 0.507 to 0.766, surpassing the recommended cut-off of 0.5, indicating strong reliability among the variables (Hair et al., 2021). Moreover, the CR values (ranging from 0.673 to 0.907) and α values (ranging from 0.656 to 0.907) of the variables were higher than the desirable threshold of 0.6. These findings

suggest a robust internal consistency reliability in the scale items (Fenitra et al., 2023; Wu et al., 2022). Table 2 presented the results of the internal reliability and convergent validity of the measures.

Table 2.
Measurement model assessment using confirmatory factor analysis (CFA) and reliability analysis.

Variable	Measurements	Factor loading (λ)	Average Variance Extracted (AVE)	Composite Reliability (CR)	Cronbach's Alpha (α)
Attitude towards urban littering (ATT)	ATT1	0.876	0.766	0.907	0.907
	ATT2	0.884			
	ATT3	0.865			
Subjective Norm (SN)	SN1	0.839	0.683	0.866	0.866
	SN2	0.859			
	SN3	0.780			
Environmental Theory Knowledge (ETK)	ETK1	0.769	0.708	0.879	0.876
	ETK2	0.882			
	ETK3	0.869			
Incentive Measures (IM)	IM3	0.857	0.639	0.688	0.773
	IM4	0.737			

Perceived Behavioural Control (PBC)	PBC2	0.681	0.507	0.673	0.656
	PBC3	0.742			
Behavioural Intention (BI)	BI1	0.777	0.722	0.886	0.883
	BI2	0.895			
	BI3	0.872			
Responsible Environmental Behaviours (REB)	REB1	0.791	0.669	0.858	0.854
	REB2	0.900			
	REB3	0.756			

Discriminant validity was evaluated based on two appoaches: Fornell-Lacker criterion and heterotrait-monotrait (HTMT) ratio. According to the Fornell-Lacker criterion, the correlation coefficient between each variable should be lower than the square root of the corresponding AVE values (Fornell and Lacker, 1981). In Table 3, it can be observed that the correlation coefficients between the variables in the model were indeed smaller than the square root of the AVE values. Furthermore, the HTMT ratios of the variables, ranging from 0.201 to 0.777, were also below the threshold of 0.85 (Rasoolimanesh, 2022). This indicates that the variables exhibit a lower level of correlation with each other compared to their shared variance with their respective constructs. These results indicate that the measures demonstrated satisfactory discriminant validity.

Table 3.
Discriminant validity.

Variable	ATT	SN	ETK	IM	PBC	BI	REB

ATT	*0.875*	0.429	0.388	0.296	0.777	0.716	0.503
SN	0.415	*0.827*	0.476	0.201	0.601	0.512	0.359
ETK	0.360	0.434	*0.842*	0.216	0.403	0.513	0.360
IM	0.356	0.250	0.255	*0.799*	0.254	0.363	0.255
PBC	0.588	0.535	0.335	0.267	*0.712*	0.773	0.543
BI	0.613	0.495	0.464	0.397	0.585	*0.850*	0.704
REB	0.449	0.473	0.583	0.353	0.426	0.638	*0.818*

Note. The values of square root of average variance extracted (AVE) are shown diagonally in bold italic. Correlations between the variables are shown below the diagonal (Fornell-Larcker criterion), while heterotrait-monotrait (HTMT) ratio of the variables are shown above the diagonal. ATT = attitude towards urban littering; SN = subjective norm; ETK = environmental knowledge; IM = incentive measures; PBC = perceived behavioural control; BI = behavioural intention; REB = responsible environmental behaviours.

B. Structural Model Assessment

To ensure the quality and appropriateness of the proposed framework, an assessment of the overall model fitness was conducted before further examining the relationships between the variables (Fenitra et al., 2023). The absolute fitness of the model was evaluated using chi-square (χ2), normed chi-square (χ2/df), and goodness of fit index (GFI). It is important to note that the chi-square value is influenced by the size of the model, meaning that models with more variables tend to have larger chi-square values (Newsom, 2023). The relative fitness of the model was assessed based on the comparative fit index (CFI), incremental fit index (IFI), and Tucker-Lewis index (TLI). Additionally, the root mean square error of approximation (RMSEA) was employed to evaluate the parsimonious fitness of the proposed model (Zhang et al., 2015). The overall model fit test resulted in a chi-square value of 325.82 with 138 degrees of freedom (df). The proposed model demonstrated an appropriate level of fitness with the observed data, as indicated by the goodness-of-fit indices presented in Table 4, all of which met the specified threshold values.

Table 4.
Structural model fitness (Goodness-of-fit).

Measurement Indices	Threshold value	Observed value	Result
χ^2/df	< 3	2.361	Acceptable
CFI	> 0.9	0.954	Acceptable
GFI	> 0.9	0.911	Acceptable
IFI	> 0.9	0.955	Acceptable
TLI	> 0.9	0.943	Acceptable
RMSEA	< 0.08	0.062	Acceptable

C. Path Analysis

In the SEM, the correlation between the variables of the proposed framework model was validated by bootstrapping with 5000 subsamples under a 95% bias-corrected confidence interval (CI). The effect size provides information about the extent of the differences between two variables. Based on Cohen's standard, the magnitude of the effect size can be categorized into three levels: small effect size ($f^2 < 0.5$), medium effect size ($f^2 = 0.5$-0.8), and large effect size ($f^2 = 0.8$ and above) (AlWahalbi et al., 2020). The results presented in Table 5 indicate that the effect size of behavioural intention (BI) on responsible environmental behaviour (REB) is the highest, with an f^2 value of 0.597 (medium effect size). Following this, urban littering attitude (ATT) towards perceived behavioural control (PBC) demonstrates an effect size of $f^2 = 0.368$ (small effect size), PBC towards BI shows an effect size of $f^2 = 0.241$ (small effect size), subjective norm towards PBC exhibits an effect size of $f^2 = 0.117$ (small effect size), environmental theory knowledge (ETK) towards BI displays an effect size of $f^2 = 0.048$ (small effect size), and incentive measures (IM) towards BI reveals an effect size of $f^2 = 0.024$ (small effect size).

The bootstrapping outcomes for the direct paths of the SEM model were shown in Table 5. The standardized path coefficient (β) denoted the degree and direction of association between the latent variables that are dependent and those that are independent. A p-value of less than 0.001, 0.01, or

0.05 is considered significant (Fenitra et al., 2023). A positive correlation was observed between the following variables: attitude towards urban littering and perceived behavioural control ($\beta = 0.496$, t = 11.364, p = < 0.001); subjective norm and perceived behavioural control ($\beta = 0.280$, t = 6.419, p = < 0.001); perceived behavioural control and behavioural intention ($\beta = 0.261$, t = 5.437, p = < 0.001); environmental theory knowledge and behavioural intention ($\beta = 0.173$, t = 4.218, p = < 0.001); incentive measures and behavioural intention ($\beta = 0.109$, t = 2.904, p < 0.01); and behavioural intention and responsible environmental behaviours ($\beta = 0.612$, t = 14.460, p = < 0.001). As a result, hypotheses 1, 3, 5, 6, 7, and 8 were supported.

Table 6 presented the results of bootstrapping for the indirect paths of the SEM model. This research revealed that perceived behavioural control played a mediating role in the positive relationship between attitude towards urban littering and behavioural intention ($\beta = 0.129$, t = 4.157, p < 0.001). Besides, subjective norm was also had an indirect effect on behavioural intention through perceived behavioural control ($\beta = 0.073$, t= 3.503, p = < 0.001). Hence, hypotheses 2 and 4 were supported. In the presence of perceived behavioural control, as shown in Figure 2, attitude towards urban littering demonstrated a direct correlation with behavioural intention ($\beta = 0.375$, t = 7.930, p < 0.001), whereas subjective norm did not significantly affect behavioural intention ($\beta = 0.081$, t = 1.861, p = 0.135). Both the direct path (ATT $\rightarrow$ BI, considering PBC) and indirect path (ATT $\rightarrow$ PBC $\rightarrow$ BI) of attitude towards behavioural intention were found to be significant, indicating that perceived behavioural intention acts as a partial mediator in this relationship. This partial mediation effect is complementary as both the direct and indirect effects were positively aligned (Nitzl et al., 2016). Moreover, perceived behavioural control is known to have a full mediation effect in the relationship between subjective norm and behavioural intention as the significance of attitudes towards behavioural intention diminished in the presence of perceived behavioural control (suppression effect). Attitude towards urban littering and subjective norm were responsible for 42.9% of the perceived behavioural control's variance. Additionally, 54% of the variance of the behavioural intention was explained by attitude towards urban littering, subjective norm, perceived behavioural control, environmental theory knowledge, and incentive measures. Behavioural intention accounted for 37.4% of the responsible environmental behaviours' variance.

Table 5.
Path analysis (direct effect).

Paths	Standardised path coefficient (β)	Standard Error (SE)	95% Bias-corrected Confidence Interval (CI)		f^2	t-value	Hypothesis Check
			Lower Bound	Upper Bound			
H1: ATT $\rightarrow$ PBC	0.496	0.053	0.389	0.593	0.368	11.364***	Supported

H3: SN → PBC	0.280	0.053	0.175	0.389	0.117	6.419***	Supported
H5: PBC → BI	0.261	0.056	0.150	0.371	0.241	5.437***	Supported
H6: ETK → BI	0.173	0.049	0.078	0.268	0.048	4.218***	Supported
H7: IM → BI	0.109	0.043	0.026	0.196	0.024	2.904**	Supported
H8: BI → REB	0.612	0.037	0.534	0.681	0.597	14.460***	Supported

Note. ATT is attitude towards urban littering; PBC is perceived behavioural control; SN is subjective norm; ETK is environmental knowledge; IM is incentive measures; BI is behavioural intention; REB is Responsible Environmental Behaviours. R squared (R^2) for PBC is 0.429; R squared (R^2) for BI is 0.540; R squared (R2) for REB is 0.374. ***$p < 0.001$, **$p < 0.05$

**Table 6.**
Path analysis (mediation effect).

Path	Standardised Path coefficient (β)			Standard Error (SE)	95% Bias-corrected Confidence Interval (CI)		t-value	Interpretation
	Total	Direct	Indirect		Lower Bound	Upper Bound		
H2: ATT → PBC → BI	0.504	0.375	0.129	0.031	0.074	0.198	4.157***	Complementary partial mediation; hypothesis is supported

H4: SN → PBC → BI	0.154	0.081	0.073	0.021	0.038	0.120	3.503***	Full mediation; hypothesis is supported

Note. ATT = attitude; PBC = perceived behavioural control; SN = subjective norm; BI = behavioural intention. ***$p < 0.001$

Figure 2.
Theory of Planned Behaviour (TPB) based SEM model with standardised path coefficient (β) and R squared (R^2).
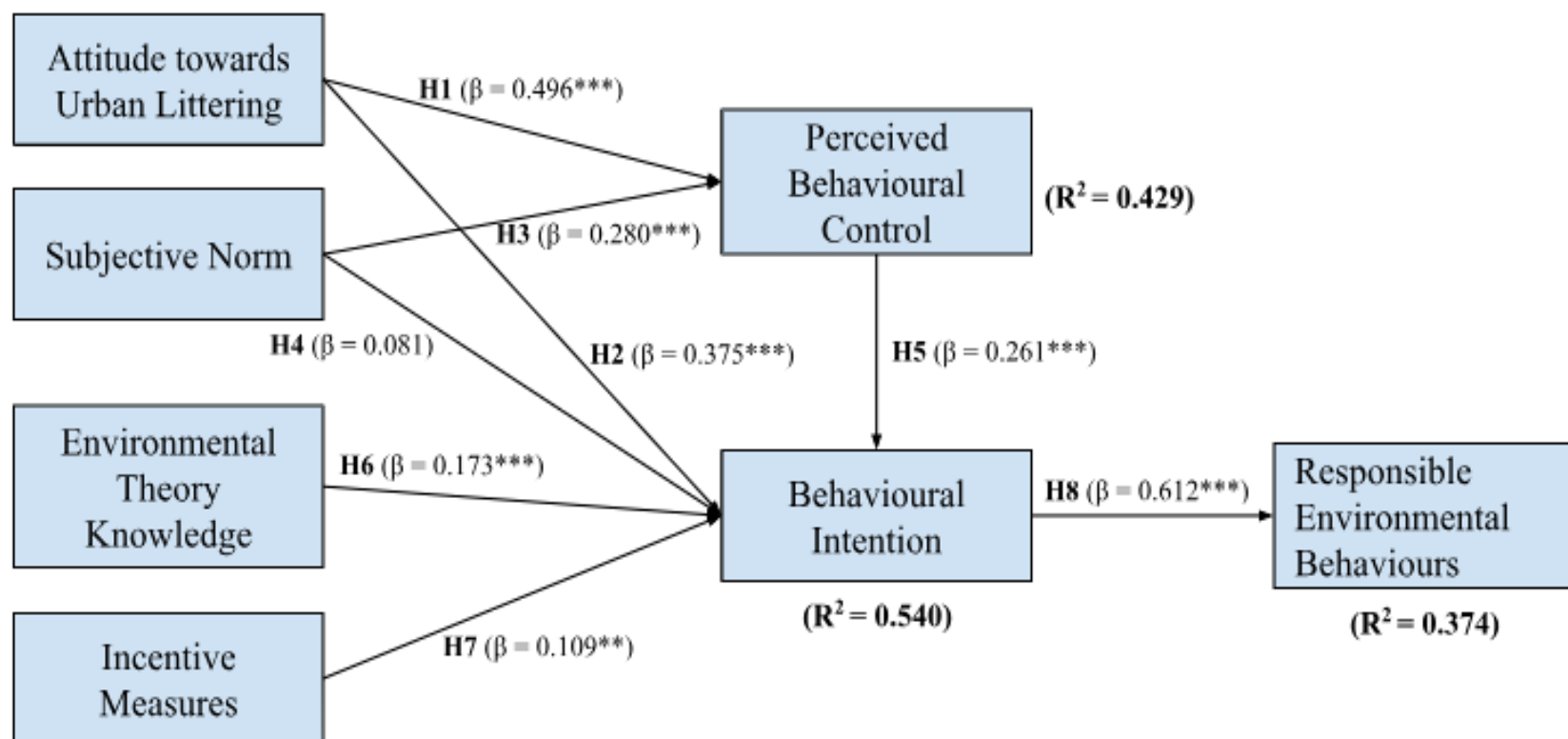
Discussion

My research aimed to investigate the littering behaviour of Malaysians in urban areas by employing the Theory of Planned Behaviour (TPB) and integrating environmental theory knowledge and incentive measures into the model. The results indicated that both the individuals' attitudes towards urban littering and subjective norms significantly affected their perceived control over their behaviour. This aligned with a similar study conducted in Nigeria by Ojedokun et al. (2022), which also supported the notion that attitudes have a greater impact on perceived behavioural control than subjective norms. In other words, individuals with positive attitudes towards urban littering are more likely to believe in their ability to effectively address littering issues compared to the influence of social norms.

La Barbera & Ajzen (2021) study proposed that perceived behavioural control plays a complementary role in partially mediating the connection between attitude and energy conservation intention, which supported my discovery in hypotheses 7 (refer to Table 6). In contrast, Lin et al. (2021) found a different pattern, where the perceived behavioural control fully mediated the link between attitude and marine responsible behavioural intention. My study highlighted that when individuals are more conscious of their attitudes towards urban littering, their intention to stop littering will be strengthened. Apart from that, the mediating role of perceived behavioural control in the relationship between subjective norm and behavioural intention was also supported by La Barbera & Ajzen (2021). Nevertheless, in this study, it was found that the mediation effect of perceived behavioural control in this relationship is only partial, which differs from the full mediation effect observed in my own study. In essence, the presence of social pressure together with a higher individuals' perceptions of their abilities in preventing littering could bring out a stronger intention to stop engaging in littering behaviour.

From my research, I discovered that perceived behavioural control, knowledge of environmental theory, and incentive measures directly influenced the intention to adopt responsible environmental behaviours. These results aligned with the findings of Hu et al. (2018) to some extent, which showed perceived behavioural control was the strongest predictor of waste management intention compared to environmental theory knowledge and incentive measures. However, the effect of environmental theory knowledge on behavioural intention was insignificant in this study, which deviated from its positive effect in my study. Furthermore, the significance of behavioural intention towards responsible environment behaviours was also proven in my study, consistent with the studies on waste management by Arli et al. (2019) and Vorobeva. et al. (2022). These studies observed a positive correlation between behavioural intention and pro-environmental behaviours, such as recycling and waste reduction. Therefore, individuals who possess a stronger intention to protect the environment are more likely to engage in appropriate pro-environmental behaviours, including littering prevention.

In my research, I focused solely on examining the influence of attitude towards urban littering, subjective norm, and perceived behavioural control on behavioural intention. However, Akmal Mustafa et al. (2023) revealed a noteworthy connection between subjective norm and perceived behavioural control with regards to zero waste behaviour. Besides, Akhtar et al. (2014) also demonstrated that attitudes towards climate change

have a positive impact on recycling behaviour. Hence, it becomes imperative for future studies to investigate the relationship between attitude, subjective norm, and perceived behavioural control concerning responsible environmental behaviours of Malaysians. Additionally, Ates (2020) and Sabri et al. (2019) highlighted the mediating role of behavioural intention in the relationship between attitude, subjective norm, and perceived behavioural control concerning pro-environmental behaviours. Consequently, it would be valuable to further investigate the mediation effect of behavioural intention in the association between attitude, subjective norm, and perceived behavioural control concerning anti-littering behaviour.

Furthermore, it should be noted that relying solely on perceived behavioural control might not accurately reflect the true behavioural control. Liu et al. (2021) emphasized that the convenience and accessibility of recycling programs, services, and facilities in influencing actual behavioural control. Rosenthal and Linder (2021) also found that the proximity of recycling and waste bins impacts individuals' usage behaviour. To gain a more comprehensive evaluation, future research should consider the convenience and accessibility of waste prevention programmes, services, and facilities in relation to anti-littering behaviour. In addition, Hu et al. (2018) revealed that there were no significant associations between environmental theory knowledge and environmental practical knowledge with anti-littering intention, while Ali et al. (2022) found that environmental knowledge has direct influence on recycling intention. Given that environmental theory knowledge and environmental practical knowledge are integral components of environmental knowledge, it raises the question of whether the combined impact of environmental knowledge or the individual effects of each component drive a person's pro-environmental intention. Therefore, it would be worthwhile for future research to explore the impact of the overall environmental knowledge or environmental practical knowledge on anti-littering intention independently, in addition to the effect of environmental theory knowledge in my study. By comparing the significant levels of the two components of environmental information, interesting insights can be gained by analysing the prediction strength of each element on behavioural intention.

There may be a potential demographic bias in my study as the participants were primarily undergraduate students. Zhang et al. (2015) have pointed out that waste separation behaviour can vary among individuals of different genders, ages, education levels, employment status, and income. Interestingly, in this study, the undergraduate group exhibited more positive behaviour compared to other groups. Additionally, Park (2018) found a significant association between income and recycling rates. Moreover, V and Mathi (2022) highlighted that gender and age could also influence recycling intention due to differing behavioural and social patterns in respective gender and age groups. To address this demographic bias issue, it becomes crucial to conduct future assessments of the impact of demographics on behavioural intention and responsible environmental behaviours. According to Xu et al. (2018), gender and income had a moderating effect on the relationship between economic incentives or social influence and waste separation behaviour of the residents in Zhejiang Province. Specifically, males and residents with higher income were more likely to respond positively to economic incentives and social influence, leading to the adoption of waste sorting behaviour. To develop a more comprehensive assessment, the mediating role of gender and income in these interactions should be examined in the future.

Conclusion

With the exclusion of subjective norm, various factors such as attitude, perceived behavioural control, environmental theory knowledge, and incentive programs have the potential to influence Malaysians' intentions to participate in environmentally conscious actions, ultimately leading to positive environmental behaviours. Both attitude and subjective norm can be particularly effective in promoting anti-littering intentions by bolstering perceived behavioural control in relation to anti-littering practices. This research sheds light on the significance of multiple predictors and mediators that contribute to understanding eco-friendly intentions and behaviours. To ensure impartiality in future studies, it is crucial to involve participants from diverse backgrounds. Moreover, the research significance could be further enhanced by incorporating and manipulating different predictors and mediators. Policymakers, campaign organizers, and advertising firms can leverage the influential predictors and mediators to encourage people to adopt anti-littering intentions and act responsibly towards the environment. This study highlighted the importance of using appropriate incentives, such as small gifts, appreciation letters, honorary titles, or penalties like fines, community services, and public benefit cancellations, to deter littering behaviour. Theory-oriented environmental knowledge was also shown to have a strong influence, making it crucial to disseminate such knowledge through effective educational channels, including campaigns, propaganda, television, social media, and billboard advertising. This approach can further foster the responsible environmental behaviours among Malaysians, resulting in a cleaner community.

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