A Study on Factors Influencing Behavioral Intentions for Separating Recyclable Waste in Korea

C. S. M. Walimuni Arachchilage
Department of Management Information Systems, Faculty of Data Science for Sustainable Growth, Jeju National University, Republic of Korea
chathurimuthu7@gmail.com

Mona Chang (corresponding author)
Department of Tourism Development, Faculty of Data Science for Sustainable Growth, Jeju National University, Republic of Korea
cmn6861@jejunu.ac.kr

Publication Information:
Received 30 September 2023, Accepted 15 February 2024, Available online 24 April 2024
DOI: 10.21463/jmic.2024.13.1.04

Abstract

This study delves into the intricate relationship between individuals' environmental knowledge, awareness of the ban on disposable plastic cups, and intentions to separate recyclables. Grounded in the Theory of Planned Behavior, the research design, data collection, and methodology encompassed the acquisition of 483 valid samples from 16 major metropolitan cities and provinces in South Korea. Environmental knowledge was assessed, focusing on two pivotal factors: environmental harmfulness and recycling. Path Analysis, executed through Partial Least Squares Structural Equation Modeling (PLS-SEM), allowed for evaluating path coefficients, specific indirect effects, and total effects of latent variables within the research model.

The results illuminate the most influential pathways within the model. Individuals' attitudes toward separating recyclables substantially impacted their intentions to engage in separation behavior ($t = 9.420$, $R^2 = 0.380$, $p < 0.000$). Furthermore, environmental knowledge significantly shaped individuals' attitudes ($t = 8.607$, $R^2 = 0.271$, $p < 0.000$). Every hypothesis within the model was statistically significant, underscoring the robustness of the findings. An intriguing discovery was that the awareness of the ban on disposable plastic cups exerted a more pronounced influence on individuals' practical understanding of precise recycling methods, as opposed to their general knowledge about the harmfulness of plastics.

In conclusion, this study offers compelling evidence that residents' environmental knowledge and attitudes toward recycling play pivotal roles in boosting their active participation in waste separation efforts. These findings have substantial implications for environmental policy and awareness campaigns, emphasizing the need to foster knowledge and positive attitudes to promote sustainable recycling practices.

Keywords

environmental knowledge | separating recyclables | banning disposable plastic cups | theory of planned behavior | Jeju island

1. Introduction

Among the various products of human activity, waste stands out as something where less is better, and more can pose significant problems. Research forecasts alarming trends: by 2050, global waste generation is expected to reach 3.40 billion tons (Kaza et al., 2018), with plastic waste alone projected to hit 33 billion tons (Rochman et al., 2013). These figures underscore a stark warning: ignoring this growing tide of waste threatens to undermine the very fabric of our lives (Knickmeyer, 2020).

Jeju Island, South Korea's premier tourist destination, attracts between 10 and 15 million visitors annually (Ahmad & Kim, 2020; Chang & Lim, 2021). Renowned for its wellness offerings, especially in a post-COVID-19 era marked by travel restrictions, the island faces a critical challenge. Predictions based on big data from 2017 to 2018 estimate Jeju's annual waste generation could be between 5,759,967 to 7,648,811 tons by 2020 (Ahmad & Kim, 2020). Furthermore, marine waste around the island was estimated at 91,195 tons in 2019 (Kim et al., 2021), with household waste surging by 101.8% from 2008 to 2019. The per capita daily waste production of 1.77kg in 2019 starkly contrasts with 1.07kg in 2008 and exceeds the national average of 1.09kg (Choe & Lee, 2022).

A significant contributor to this issue is the proliferation of food and beverage establishments in tourist-heavy areas, particularly coffee shops and cafes. Seogwipo, a popular destination on Jeju Island, had an unusually high ratio of coffee shops at 7.44 per 1,000 people in 2019, dwarfing the national average of 1.80 (Statistical Geographic Information Service, 2021). With 2,121 coffee shops across the island, an estimated 63 million disposable plastic cups are discarded annually (The JoongAng, 2021).

Jeju's distinction as a "World Environmental Capital," recognized by UNESCO's triple crown in natural environment fields (biosphere reserve, World Natural Heritage, World Geopark), underscores its natural beauty as a pivotal tourism asset (Kang et al., 2013). However, ensuring sustainable waste management remains a perpetual challenge. Despite initiatives such as deploying a significant workforce to maintain around 2,370 clean houses, establishing Jeju-style waste banks, and installing CCTVs, the outcomes have not met expectations (Kim et al., 2020).

Addressing waste management, environmental conservation, and social conflicts at the community level in regions such as Jeju Island requires identifying pivotal factors that can shift public perception and behavior toward waste disposal. Highlighting the island's vulnerability and environmental scarcity, it is important to inform both residents and visitors about sustainable practices.

In Section 2, we will delve into the theoretical underpinnings of the study's key variables, guided by the Theory of Planned Behavior. Section 3 will detail the research methodology, followed by an analysis of the research findings in Section 4. Section 5 will discuss the implications and limitations of the study, setting the stage for the comprehensive conclusions presented in Section 6.

The overarching aim of this research is to investigate, measure, and analyze the impact of extended factors on encouraging participation in recycling activities, specifically focusing on waste separation and collection behaviors. This introduction sets a clear trajectory for addressing the urgent environmental challenges posed by waste, particularly on Jeju Island, through a systematic and theoretical inquiry.

2212-6821 © 2024 Institution for Marine and Island Cultures, Mokpo National University.
10.21463/jmic.2024.13.1.04 — https://jmic.online/issues/v13n1/4/

2. Literature reviews

2.1 Environmental knowledge for pro-environmental behaviors

Environmental knowledge serves as a critical foundation for forming values and attitudes towards environmental protection, ultimately fostering eco-friendly actions and informed decision-making in addressing environmental challenges (Izagirre-Olaizola et al., 2015; Liu et al., 2020). Vicente-Molina et al. (2013) define environmental knowledge as the ability to recognize facts, concepts, and patterns of behavior that support environmental conservation. Meanwhile, recycling knowledge, which encompasses specific know-how about recycling processes, plays a pivotal role in distinguishing between individuals who recycle and those who do not, thereby influencing recycling behaviors (De Young, 1988; Vining & Ebreo, 1990).

The presence of detailed knowledge on recycling or general environmental issues is crucial in shaping individuals' intentions towards recycling (Vining & Ebreo, 1990). A person well-informed about environmental challenges is more likely to engage in pro-environmental activities (Oğuz et al., 2010). Accessibility to guidelines on waste disposal and recycling information significantly eases participation in these programs, suggesting that the availability of recycling information can enhance recycling activities (Domina & Koch, 2002; De Young, 1988).

However, Kennedy et al. (2009) argue that while environmental knowledge is necessary, it alone may not suffice to foster individual eco-friendly behavior. This perspective aligns with studies showing that the correlation between subjective and objective knowledge regarding voluntary waste recycling is modest. This highlights the importance of coordinated efforts by governments, municipalities, corporations, and educational institutions in promoting environmental education (Ellen, 1994).

Otto & Pensini (2017) emphasize the critical role of environmental education in promoting eco-friendly behavior, suggesting that incorporating ecological motivation and nature-based education could make these initiatives more impactful by strengthening individuals' connection to nature.

Moreover, the influence of environmental education might vary across different contexts. For instance, Safari et al. (2018) propose that corporate training can significantly benefit from establishing a green culture through environmental knowledge, indicating that the workplace culture can enhance the effectiveness of education on eco-friendly behavior.

In the educational sector, Maurer and Bogner (2020) conducted experimental research in a primary school setting, revealing that environmental values, rather than knowledge per se, exerted a more substantial influence on children's environmental behaviors, underscoring the importance of 'Environmental Literacy' in cultivating a deeper understanding and appreciation for the environment.

These studies collectively underscore the multifaceted impact of environmental knowledge on fostering specific and comprehensive eco-friendly behaviors, highlighting the need for diverse approaches in environmental education and awareness initiatives.

2.2 Theory of Planned Behavior and Reducing Plastic Waste

Attitudes towards household waste disposal, subjective norms, and perceptions of behavioral control collectively shape an individual's intention to engage in specific behaviors, embodying the Theory of Planned Behavior (TPB). Ajzen (2002) introduced this theory, which suggests that individuals with more favorable attitudes, stronger subjective norms, and

greater perceived control are more likely to have a heightened intention to perform various actions. Subsequent research by Tonglet et al. (2004) and Ghani et al. (2013) applied the TPB framework to environmental contexts, specifically waste segregation behavior, demonstrating its relevance in predicting pro-environmental intentions.

Research indicates that positive attitudes and subjective norms enhance perceived control, bolstering the recycling motivation. Yet, tangible factors such as access to recycling facilities, appropriate knowledge, and convenience significantly influence recycling intentions. The inconvenience of time or space constraints can diminish this intent, highlighting the complexity of recycling behaviors (Tonglet et al., 2004).

Enhancements to the TPB model have introduced additional variables such as 'previous recycling behavior,' 'situational factors,' and 'recycling outcomes' to augment its demographic and explanatory scope. Initially, the TPB model accounted for 46% of the variance in recycling behavior. With these extensions, its explanatory power surged to 79%, demonstrating the enriched predictive capability of the extended model (Ioannou et al., 2011).

Furthermore, Xu et al. (2017) expanded the TPB framework to include household waste prediction, moral obligations, and demographic factors. Their findings underscore the significant predictive value of subjective norms, perceived behavioral control, past behaviors, and intentions on waste segregation, with past behaviors emerging as crucial predictors of intentions and actions. They also advocate for further research on how demographic factors and policy perceptions modulate waste segregation behavior.

The environmental impact of plastic waste, particularly single-use plastics, is profound. Annually, between 5 and 13 million tons of plastic waste enter the oceans, constituting over 80% of marine debris (Aubin et al., 2022), with consumption of disposable plastics increasing tenfold from 1960 to 2005 (Jambeck et al., 2015). In particular, the consumption of PET (polyethylene terephthalate) products, known for their light strength and chemical resistance, is rapidly increasing worldwide (Massey et al., 2008), causing a severe waste problem. In 2018, global consumption of PET bottles was estimated at 27.64 million tons (Plastic Europe, 2019), with disposable PET containers contributing to a staggering 5 billion PET bottles discarded annually (Laville & Taylor, 2017).

Despite the challenges associated with recycling PET bottles, advancements in recycling technology have opened new avenues for managing this waste effectively (Welle, 2013). The imperative to protect marine ecosystems and human health necessitates a dual approach of responsible consumption and production practices among plastic bottle manufacturers, highlighting the critical importance of sustainability in environmental conservation (Mwangi & Mokoena, 2019; Welle, 2013).

3. Methodology

3.1 Conceptual framework and methodology

The primary goal of this research is to assess how antecedent variables, defined within a tailored research model based on the Theory of Planned Behavior (TPB), influence participants' intentions to sort recyclable waste by type. The TPB, introduced by Ajzen (1991), delves into how enduring individual attitudes, shaped by specific beliefs, socially observed norms, and the perception of control over behavior, interplay to form behavioral intentions. This framework indicates that their attitudes drive individual behavior, perceived social pressures (subjective norms), and the ease or difficulty of the action (perceived behavioral control). Aimed at understanding the psychological underpinnings of decision-making, TPB has been a foundational theory in exploring how environmental considerations shape human behaviors.

In this study, we formulated hypotheses and designed a model to assess how the public's environmental knowledge and awareness of policies banning disposable plastic cups affect their intentions to separate and collect recyclable wastes within the framework of TPB. Various factors influence the complexity of human behavior in society, and the interaction of different elements may impact behavioral intentions in unique ways. This study aims to shed light on the selection of survey items based on the concept of distinguishing between items within a variable, a method often utilized in empirical research to uncover factors influencing behavioral intentions. Thus, the findings are anticipated to serve as a guide for researchers in choosing appropriate scale items for surveys.

The hypotheses established for this research framework are as follows:

H1. Environment knowledge influences the behavioral intention to separate recyclable wastes through the mediators of TPB.
H2. Awareness of the ban on disposable plastic cups influences the behavioral intention to separate recyclable wastes through the mediators of TPB.
H3. Attitude toward separate recyclable wastes affects the behavioral intention to separate recyclable wastes.
H4. Subjective norms affect the behavioral intention to separate recyclable wastes.
H5. Perceived behavioral controls affect the behavioral intention to separate recyclable wastes.

Further, this study investigates whether the influence of mediators varies with differences in environmental knowledge items.

The research model, predicated on these hypotheses, is delineated in Figure 1. To test these hypotheses, a path analysis using a structural equation model was employed. Environmental knowledge and awareness of the ban on disposable plastic cups serve as independent variables, while the intention to separate recyclable wastes is the dependent variable.

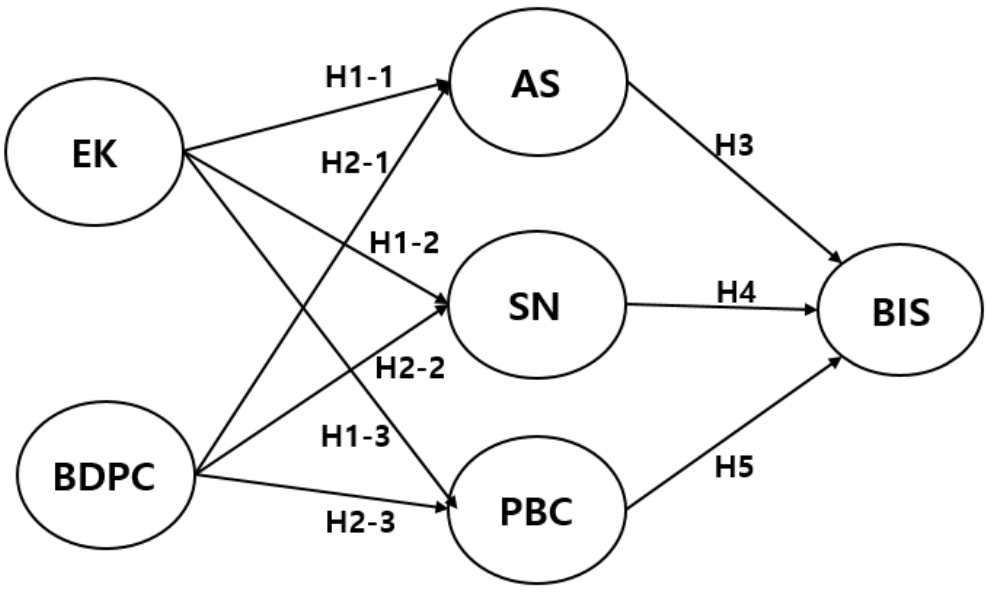

Fig 1. Research design: The research model in this study is designed to explore how Environmental Knowledge (EK) and awareness of the Ban on Disposable Plastic Cups (BDPC) influence individuals' intentions to separate recyclable wastes, utilizing the Theory of Planned Behavior as a framework. It examines the roles of Attitude toward Separation (AS), Subjective Norm (SN), and Perceived Behavioral Control (PBC) as mediators between environmental awareness and Behavioral Intention of Separation (BIS). It uses path analysis within a structural equation model to test these relationships.

2212-6821 © 2024 Institution for Marine and Island Cultures, Mokpo National University.
10.21463/jmic.2024.13.1.04 — https://jmic.online/issues/v13n1/4/

For statistical analysis, IBM SPSS version 24.0 was utilized for frequency analysis to delineate demographic characteristics and conduct basic reliability and factor analysis of the sample. Smart PLS 3.3.6 was employed to perform structural equation modeling. The partial least squares method was applied to discern the relationships between latent variables and to analyze the path effects for hypothesis testing. Notably, given that partial least squares do not presuppose a normal distribution, statistical significance was achieved through nonparametric bootstrapping, leading to the testing of the null hypothesis with zero external weight.

The subsequent section will present the demographic characteristics of the study participants and conduct a path analysis to evaluate the overall fitness of the research model.

3.2 Analysis

3.2.1 Demographic Characteristics

The survey was conducted over three weeks, from August 27 to September 15, 2021, targeting individuals across 16 metropolitan cities and provinces in mainland Korea, including Jeju Island.

Out of 482 participants, 341 were female, representing 57.7% of the sample, showcasing a notably high participation rate among women. Jeju Island residents constituted the largest demographic group, at 37.8% (182 participants), reflecting the survey's focus on the island. Participation from mainland cities was in alignment with their population sizes: Seoul (84 participants, 17.4%), Gyeonggi (79 participants, 16.4%), and Busan (25 participants, 5.2%). Notably, there were no participants from Sejong City.

Regarding monthly income, the largest segment of respondents (24.7%) reported the highest income bracket. Those earning between 1.99 million won and 4.99 million won were fewer, comprising 10.2% and 9.3% of the sample, respectively.

Age distribution was relatively even among participants in their 20s to 50s, ranging from 18.3% to 25.9%, but the 60s and older group was the smallest at 12.9%. The educational background showed that 276 participants (57.3%) had attended or graduated from university, while those with high school, college, or graduate-level education varied between 12.9% and 15.1%. Occupational distribution highlighted a predominance of white-collar workers (35.5%, 210 participants), followed by students (16.8%) and professionals (12.7%). Participants from other occupations, including full-time housewives, self-employed, service, technical workers, and those in agriculture and fishery, accounted for less than 10% each but participated across the board.

Family size distribution revealed that four-member families were the most common at 32.2%, with three, two, and single-member families following at 26.1%, 21.6%, and 12.9%, respectively. Families with five or more members were the least common at 7.3%. The detailed demographic characteristics of the study sample are presented in Table 1.

Table 1. Demographic characteristics

Categories		n	%	Categories		n	%
Gender	male	250	42.3	**Age**	20s	120	20.3
	female	341	57.7		30s	137	23.2
Region	Seoul	84	17.4		40s	153	25.9
	Busan	25	5.2		50s	108	18.3
	Daegu	16	3.3		60s & above	73	12.4
	Incheon	16	3.3	**Education**	high school	62	12.9
	Gwangju	13	2.7		college	71	14.7
	Daejeon	12	2.5		university	276	57.3
	Ulsan	3	0.6		graduate school	73	15.1
	Gyeonggi	79	16.4	**Occupation**	white collar	210	35.5
	Gangwon	11	2.3		professional	75	12.7
	Chungbuk	7	1.5		technician	23	3.9
	Chungnam	2	0.4		sales & service	32	5.4
	Jeonbuk	2	0.4		self-employed	38	6.4
	Jeonam	4	0.8		housewife	50	8.5
	Gyeongbuk	15	3.1		student	99	16.8
	Gyeongnam	11	2.3		primary industry	9	1.5
	Jeju	182	37.8		others	55	9.3
Income(won/month)	less than 1 million	95	19.7	**Family size**(person/family)	1	62	12.9
	1.0 ~ 1.99 million	49	10.2		2	104	21.6
	2.0 ~ 2.99 million	119	24.7		3	126	26.1
	3.0 ~ 3.99 million	88	18.3		4	155	32.2
	4.0 ~ 4.99 million	45	9.3		Five or more	35	7.3
	more than 5 million	86	17.8	**Total**		482	100.0

3.2.2 Model assessment

Table 2 presents the mean, standard deviation, variance inflation factor, and the reliability and validity of the questionnaire items per factor. Items EK3, PBC1, and BIS2 were excluded due to outer loadings below 0.7. Outer loadings are crucial for determining the Average Variance Extracted (AVE) value, essential for assessing Convergent Validity. Specifically, an item must exhibit an outer loading above 0.7 to ensure that the AVE exceeds the 0.5 threshold, confirming the item's adequacy in capturing the factor's essence (Fornell & Larcker, 1981; Hair et al., 2012).

The analysis confirms the reliability and validity of the measures, with Cronbach's alpha values ranging from 0.727 to 0.889 for each factor, indicating robust internal consistency. Composite Reliability scores between 0.829 and 0.917 further validate the high reliability of the factors, as assessed by both the SmartPLS and SPSS programs.

Table 2. PLS-SEM assessment results of measurement models

Latent Variables	Indicators	Mean	SE	VIF	Convergent Validity			Internal Consistency Reliability		
					Outer Loadings	Reliability	AVE	Cronbach's α	rho_A	Composite Reliability
Environmental Knowledge	EK1	4.639	0.634	1.673	0.757	0.573	0.549	0.727	0.829	0.829
	EK2	4.639	0.644	1.632	0.760	0.578				
	EK4	4.315	0.831	1.812	0.743	0.552				
	EK5	4.280	0.835	1.715	0.702	0.493				
Ban on Disposable Plastic Cups	BDPC1	4.218	0.887	2.209	0.881	0.776	0.740	0.823	0.895	0.895
	BDPC2	4.203	0.928	2.287	0.898	0.806				
	BDPC3	4.429	0.831	1.543	0.798	0.637				
Attitude toward Separation	AS1	4.664	0.558	1.581	0.761	0.579	0.622	0.847	0.891	0.891
	AS2	4.326	0.787	1.429	0.705	0.497				
	AS3	4.541	0.694	2.272	0.825	0.681				
	AS4	4.461	0.729	2.249	0.818	0.669				
	AS5	4.459	0.738	2.150	0.828	0.686				
SubjectiveNorm	SN1	4.089	0.897	2.056	0.763	0.582	0.690	0.889	0.917	0.917
	SN2	3.880	1.021	2.425	0.815	0.664				
	SN3	4.183	0.959	2.401	0.844	0.712				
	SN4	4.164	0.905	3.133	0.899	0.808				
	SN5	4.322	0.815	2.083	0.827	0.684				
Perceived Behavioral Control	PBC2	4.197	0.803	1.303	0.726	0.527	0.548	0.726	0.829	0.829
	PBC3	4.170	0.858	1.488	0.779	0.607				
	PBC4	3.898	1.073	1.422	0.730	0.533				
	PBC5	4.295	0.923	1.315	0.725	0.526				
Behavioral Intention of Separation	BIS1	4.604	0.637	2.119	0.846	0.716	0.689	0.849	0.898	0.898
	BIS3	4.537	0.638	2.064	0.845	0.714				
	BIS4	4.191	0.866	1.563	0.758	0.575				
	BIS5	4.554	0.678	2.347	0.867	0.752				

In PLS-SEM, to verify that each factor uniquely measures a distinct concept, two main criteria for assessing discriminant validity are commonly employed: the Fornell & Larcker criterion and the Heterotrait-Monotrait (HTMT) ratio. According to Fornell & Larcker, the square root of the AVE for each latent variable should exceed the highest correlation among the latent variables. Meanwhile, the HTMT ratio must be below a stringent threshold of 0.85 to ensure distinctness (Fornell & Larcker, 1981; Henseler et al., 2015). The data in Table 3 confirms that the measures for each factor meet both discriminant validity criteria.

Table 3. Discriminant validity

Fornell-Larcker Criterion							Heterotrait-Monotrait Ratio						
	AS	BDPC	BIS	EK	PBC	SN		AS	BDPC	BIS	EK	PBC	SN
AS	0.789						AS						
BDPC	0.567	0.860					BDPC	0.678					
BIS	0.715	0.642	0.830				BIS	0.838	0.772				
EK	0.597	0.455	0.601	0.741			EK	0.747	0.587	0.757			
PBC	0.489	0.490	0.623	0.488	0.741		PBC	0.621	0.631	0.791	0.668		
SN	0.509	0.454	0.540	0.407	0.394	0.831	SN	0.575	0.516	0.606	0.487	0.479	

4. Results

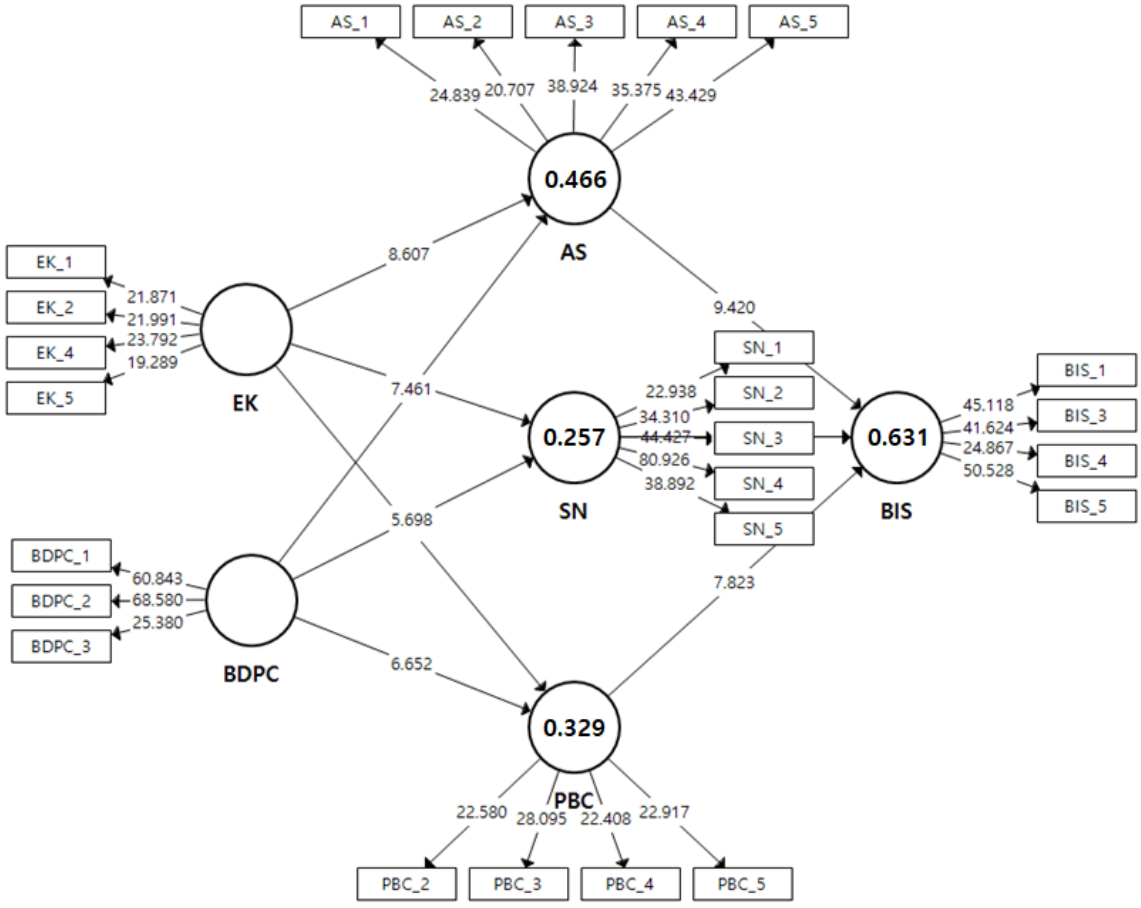

Fig 2. The Initial Path Model and its Effect

Figure 2 displays the path analysis results, highlighting the path coefficients for the dependent variables derived from the t-statistic values. The R^2 value, noted within the circle, represents the variance in the endogenous variables (causal factors) and their cumulative impact on mediators. While the effect size is gauged by an R^2 value of 0.5, a model's high explanatory power, due to a complex endogeneity structure, might not effectively delineate the causal relationship with specific variables. The predictive accuracy of the independent variables in PLS-SEM is assessed by R^2 and Q^2 values.

Furthermore, the f^2 value, with 0.15 considered a medium effect size, parallels the Q^2 value, indicating the magnitude of an exogenous construct's impact on the endogenous construct when removed from the model. This effect size is crucial for determining the significance of each construct's contribution to the model (Hair et al., 2019).

Table 4. Test results of hypothesis

Particular	Path	Hypothesis	f square*	Path Coefficient	T Statistics	P Values	95% BCa confidence interval	Results
Path Coefficients	EK → AS	**H1-1**	**0.271**	0.427	8.607	0.000	[0.320, 0.515]	Supported
	EK → SN	**H1-2**	0.069	0.253	4.672	0.000	[0.140, 0.354]	Supported
	EK → PBC	**H1-3**	0.132	0.334	7.054	0.000	[0.238, 0.423]	Supported
	BDPC → AS	**H2-1**	**0.206**	0.372	7.461	0.000	[0.269, 0.463]	Supported
	BDPC → SN	**H2-2**	0.122	0.338	5.698	0.000	[0.213, 0.451]	Supported
	BDPC → PBC	**H2-3**	0.135	0.338	6.652	0.000	[0.233, 0.435]	Supported
	AS → BIS	**H3**	**0.380**	0.467	9.420	0.000	[0.369, 0.560]	Supported
	SN → BIS	**H4**	0.058	0.173	3.818	0.000	[0.089, 0.264]	Supported
	PBC → BIS	**H5**	**0.212**	0.327	7.823	0.000	[0.243, 0.405]	Supported
Total Indirect Effects	**EK → BIS**			0.353	**9.473**	0.000	[0.276, 0.420]	
	BDPC → BIS			0.343	8.908	0.000	[0.261, 0.412]	
Specific Direct Effects	**EK → AS → BIS**			0.199	**6.073**	0.000	[0.140, 0.266]	
	EK → SN → BIS			0.044	3.046	0.002	[0.020, 0.077]	
	EK → PBC → BIS			0.109	5.576	0.000	[0.073, 0.152]	
	BDPC → AS → BIS			0.174	5.291	0.000	[0.112, 0.241]	
	BDPC → SN → BIS			0.059	2.712	0.008	[0.023, 0.110]	
	BDPC → PBC → BIS			0.111	4.641	0.000	[0.068, 0.160]	

Table 4 outlines the hypothesis testing results, including effect sizes, path coefficients, t-statistics, and the direct/indirect effects of all paths, ranked by their impact. Notably, the Total Indirect Effects, which combine the Specific Direct Effects and Direct Effects between the independent variables (EK & BDPC) and the dependent variable, were found to be minimal and thus not emphasized in this study. The most influential paths were identified as Attitude to Behavioral Intention (AS → BIS) and Environmental Knowledge to Attitude (EK → AS), both displaying significant total indirect effects. Among the six direct paths analyzed, the path from Environmental Knowledge to Behavioral Intention, mediated by Attitude (EK → AS → BIS), exhibited the strongest effects. Consequently, all hypotheses posited in this research were validated as significant.

Table 5. Comparison of the effect size in f^2, R^2, and Q^2 of different item groups by Environmental Knowledge

Path	f^2			Latent Variables	R^2			Q^2		
	EK_all	EK_1&2	EK_4&5		EK_all	EK_1&2	EK_4&5	EK_all	EK_1&2	EK_4&5
EK → AS	0.271	**0.236**	**0.089**	AS	0.466	**0.450**	**0.377**	0.283	**0.274**	**0.230**
EK → SN	0.069	0.042	0.041	SN	0.257	0.238	0.237	0.168	0.155	0.156
EK → PBC	0.132	**0.051**	**0.115**	PBC	0.329	**0.277**	**0.319**	0.175	**0.147**	**0.170**
BDPC → AS	0.206	**0.241**	**0.340**	BIS	0.631	0.631	0.630	0.429	0.429	0.428
BDPC → SN	0.122	**0.150**	**0.180**							
BDPC → PBC	0.135	**0.184**	**0.204**							
AS → BIS	0.380	0.378	0.378							
SN → BIS	0.058	0.059	0.058							
PBC → BIS	0.212	0.213	0.212							

The research revealed that Environmental Knowledge (EK) could be divided into two distinct categories, each demonstrating slightly different effects on the foundational Theory of Planned Behavior. Table 5 presents a comparative analysis indicating variances in explanatory power between EK1&2 and EK4&5 across three mediators and the impact observed through each path.

Specifically, the effect size (f^2) for Environmental Knowledge's impact on attitudes towards recycling (EK → AS) showed a significant reduction (from 0.236 to 0.089) when the analysis focused solely on EK4&5. This suggests a diminished influence of these items compared to EK1&2 on shaping attitudes.

Conversely, the effect size for the path from awareness of banning disposable plastic cups (BDPC → AS) saw an increase (from 0.241 to 0.340), with similar gains observed in the effect sizes on subjective norm (SN) and perceived behavioral control (PBC).

Thus, the influence of items 4 and 5 on Attitude (AS) is notably lower than that of items 1 and 2. This distinction is further supported by the R^2 and Q^2 values, which assess the explanatory power of items in conveying Environmental Knowledge. Meanwhile, the data indicate an enhanced explanatory power of the effect on Perceived Behavioral Control (PBC).

5. Discussion

5.1 Implications

Jeju Island, renowned for its unique natural beauty and environmental challenges, stands at the forefront of conservation efforts. The island's allure to tourists underscores the urgent need for effective waste management strategies, particularly against plastic pollution. Inspired by the global success of mandatory health warnings on cigarette packages —a measure proven to shift behaviors and adopted by 134 countries (Cunningham, 2022)—Jeju could adopt similar visual campaigns. These should vividly depict the consequences of plastic waste on health and ecosystems, aiming to foster responsible behaviors among locals and visitors alike.

However, Jeju's environmental commitment should resonate beyond its shores, aligning with the global pursuit of sustainability. As a celebrated destination, Jeju is poised to set a precedent in environmental stewardship, adhering to

the United Nations Sustainable Development Goals (SDGs).

Leveraging insights into behavioral intentions and adopting technologies like CCTVs and IoT devices, enhanced with deep learning (Chang et al., 2020), bolsters recycling and waste management efforts, particularly for challenging areas like coastlines. Such technological advancements reaffirm Jeju's dedication to sustainable practices, positioning it as a leader in environmental conservation on a global scale.

5.2 Limitations

This study's primary limitation lies in the reliance on self-reported data, a common issue in environmental norms research that may not fully capture the nuances of actual behavior (Thogersen, 2003). Future research could benefit from observational and experimental approaches to assess environmental behaviors more accurately. Furthermore, considering Jeju Island's annual influx of over 10 million tourists, the study's sample size might not comprehensively represent the diverse visitor demographics. Conducting comparative studies on the impact of plastic waste and reduction efforts across neighboring islands could offer valuable insights into the effects of island size and resident and tourist populations on environmental outcomes. Overcoming these limitations could involve longitudinal studies with panel groups, facilitating continuous observation and evaluation of behavior changes over time, both with and without policy interventions.

6. Conclusion

This study embarked on an empirical exploration to understand how perceptions of disposable plastic cups in coffee shops influence the intention to engage in recycling activities. Jeju Island, a leading tourist destination in Korea, was the focal point in 2021 when plastic waste garnered significant media and public attention.

Our findings confirm that all examined variables significantly impact behavioral intentions toward recycling. A nuanced re-analysis revealed distinctions within environmental knowledge: one dimension focusing on awareness of plastic waste's environmental impact and another on understanding the recycling process. This distinction highlighted that awareness more strongly influences attitudes, while knowledge about recycling processes plays a crucial role in perceived behavioral control.

Moreover, our study discovered that initiatives to reduce plastic waste, such as banning disposable plastic cups, significantly enhance specific recycling behaviors over general environmental awareness. This supports the notion, as evidenced by Frick et al. (2004), that targeted environmental education is essential for fostering effective conservation actions (Ellen, 1994).

Ultimately, this research underscores the importance of nuanced environmental knowledge in promoting sustainable practices. It suggests that Jeju Island's efforts to mitigate plastic waste can lead to broader engagement in environmental conservation, positioning the island as a paradigm of eco-friendly tourism. Such initiatives cultivate a more profound public interest in environmental sustainability and champion Jeju Island's legacy as an eco-island, encouraging active participation in preserving its natural beauty for future generations.

2212-6821 © 2024 Institution for Marine and Island Cultures, Mokpo National University.
10.21463/jmic.2024.13.1.04 — https://jmic.online/issues/v13n1/4/

Appendix. Survey Questionnaires

Environmental Knowledge (EK)

1. I know plastic causes environmental pollution.
2. I know plastic causes microplastic pollution in the ocean.
3. I am well aware of the types and uses of plastics. (Eliminated)
4. I know we need to wash recycled items before recycling.
5. I know I need to dissemble the composite items before recycling.

Awareness of Ban Disposable Plastic Cup (BDPC)

1. In Jeju Island, active policies such as a ‘ban on disposable cups in coffee shops’ are needed to protect the environment.
2. I will join active policies such as ‘ban the use of disposable cups in coffee shops’ to protect the environment of Jeju Island.
3. Both Jeju residents and tourists should actively participate in actions to protect the environment of Jeju Island.

Attitude toward separate (AS)

1. Separating waste is responsible.
2. Separating waste is good.
3. Separating waste is a critical way to reduce pollution.
4. Separating waste is a meaningful way to conserve natural resources.
5. I believe that my separating waste activities will improve environmental quality.

Subjective Norms (SN)

1. Most people who work with me think I should sort waste.
2. My friends expect me to engage in sorting behavior.
3. My family expects me to engage in sorting behavior.
4. Most people who are important to me think I should sort waste.
5. Most people who are important to me would approve of my sorting behavior.

Perceived Behavioral Control (PBC)

1. I know where the ‘Clean House-Recycling Center)’ is near my house. (Eliminated)
2. I know what items can be separated for recycling.
3. I have enough time to separate recyclable waste.
4. I have enough space at home to store recyclables for sorting.
5. There is a ‘Clean House-Recycling Center)’ near my house.

Behavioral Intention toward Separate (BIS)

1. I am willing to separate recyclable waste.
2. I have the intention to reuse valuable recycled items. (Eliminated)
3. I will try to separate household waste before disposing of them.
4. I intend to encourage classmates/colleagues to separate recyclable waste.
5. I am willing to separate recyclable waste by item.

2212-6821 © 2024 Institution for Marine and Island Cultures, Mokpo National University.
10.21463/jmic.2024.13.1.04 — https://jmic.online/issues/v13n1/4/

References

Ahmad, S. & Kim, D. H. 2020. Quantum GIS-based descriptive and predictive data analysis for effective planning of waste management. Ieee Access, 8, 46193-46205. (DOI: 10.1109/ ACCESS.2020.2979015).

Ajzen, I. 1991. The theory of planned behavior. Organizational behavior and human decision processes, 50, 179-211. (DOI: 10.1016/0749-5978(91)90020-T).

Ajzen, I. 2002. Perceived behavioral control, self-efficacy, locus of control, and the theory of planned behavior 1. Journal of applied social psychology, 32, 665-683. (DOI: 10.1111/j.1559-1816.2002.tb00236.x).

Aubin, S., Beaugrand, J., Berteloot, M., Boutrou, R., Buche, P., Gontard, N. & Guillard, V. 2022. Plastics in a circular economy: Mitigating the ambiguity of widely-used terms from stakeholders consultation. Environmental Science & Policy, 134, 119-126. (DOI: 10.1016 /j.envsci.2022.04.011).

Chang, M. et al. 2020. A CNN image classification analysis for 'Clean-Coast Detector' as tourism service distribution, Journal of Distribution Science, 18(1), pp. 15–26. (DOI: 10.15722/jds.18.01.20201.15).

Chang, M. & Lim, H. 2021. Structural relations of positive tourism impacts on residents' attitude and support for tourism development in Jeju. Jeju Natl. Univ. Tour, 41, 13-26. (DOI: 10.24907/jtir.2021.2.41.1.13).

Choe, H. & Lee, J. 2022. A study on introducing a youth dividend to Jeju Island 1: Measures to finance a citizens' dividend program from commons. In Commons Perspectives in South Korea. Routledge, 182-200. (DOI: 10.4324/9781003224280).

Cunningham, R. 2022. Tobacco package health warnings: a global success story. Tobacco Control, 31(2), 272–283. (DOI: 10.1136/tobaccocontrol-2021-056560).

Davies, J., Foxall, G. R., & Pallister, J. 2002. Beyond the intention–behaviour mythology: an integrated model of recycling. Marketing theory, 2, 29-113. (DOI: 10.1177/1470593102002001645).

De Young, R. 1988. Exploring the Difference Between Recyclers and Non-Recyclers: The Role of Information. Journal of Environmental Systems, 18, 341-351. (DOI: 10.2190/FBQC-5V5D-HHVC-V6X8).

Domina, T. & Koch, K. 2002. Convenience and frequency of recycling: implications for including textiles in curbside recycling programs. Environment and behavior, 34, 216-238. (DOI: 110.1177/0013916502342004).

Ellen, P. S. 1994. Do we know what we need to know? Objective and subjective knowledge effects on pro-ecological behaviors. Journal of Business Research, 30, 43-52. (DOI: 110.1016/0148-2963(94)90067-1).

Fornell, C. & Larcker, D. F. 1981. Structural equation models with unobservable variables and measurement error: Algebra and statistics. Sage Publications Sage CA: Los Angeles, CA. (DOI: 10.1177/002224378101800313).

Frick, J., Kaiser, F. G., & Wilson, M. 2004. Environmental knowledge and conservation behavior: Exploring prevalence and structure in a representative sample. Personality and Individual differences, 37, 1597-1613. (DOI: 10.1016/j.paid.2004.02.015).

Ghani, W. A. W. A. K., Rusli, I. F., Biak, D. R. A., & Idris, A. 2013. An application of the theory of planned behaviour to study the influencing factors of participation in source separation of food waste. Waste management, 33, 1276-1281. (DOI: 10.1016/j.wasman.2012. 09.019).

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. 2019. When to use and how to report the results of PLS-SEM. European business review, 31, 2-24. (DOI: 10.1108/EBR-11-2018-0203).

Hair, J. F., Sarstedt, M., Ringle, C. M., & Mena, J. A. 2012. An assessment of the use of partial least squares structural equation modeling in marketing research. Journal of the academy of marketing science, 40, 414-433. (DOI: 10.1007/s11747-011-0261-6).

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, 115-135. (DOI: 10.1007/s11747-014-0403-8).

Ioannou, T., Zampetakis, L. A., & Lasaridi, K. 2013. Psychological determinants of household recycling intention in the context of the theory of planned behaviour. Fresenius Environmental Bulletin, 22, 2035-2041).

Izagirre-Olaizola, J., Fernández-Sainz, A., & Vicente-Molina, M. A. 2015. Internal determinants of recycling behaviour by university students: a cross-country comparative analysis. International Journal of Consumer Studies, 39, 25-34. (DOI: 10.1111/ijcs.12147).

Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., Narayan, R. & Law, K. L. 2015. Plastic waste inputs from land into the ocean. Science, 347, 768-771. (DOI: 10.1126/science.126035).

Kang, H.-G., Kim, C.-S. & Kim, E.-S. 2013. Human influence, regeneration, and conservation of the Gotjawal forests in Jeju Island, Korea. Journal of Marine and Island Cultures, 2, 85-92. (DOI: 10.1016/j.imic.2013.11.003).

Kaza, S., Yao, L., Bhada-Tata, P., & Van Woerden, F. 2018. What a waste 2.0: a global snapshot of solid waste management to 2050. World Bank Publications: Washington, D.C. pp.17. (DOI: 10.1596/978-1-4648-1329-0).

Kennedy, E. H., Beckley, T. M., McFarlane, B. L., & Nadeau, S. 2009. Why we don't" walk the talk": Understanding the environmental values/behaviour gap in Canada. Human Ecology Review, 151-160.

Kim, B. Y., Joo, H. M., Lee, C. H., & Kim, K.-I. 2021. Analysis of the Generation Amount of Abandoned Marine Waste from Ships in the Northwest Sea of Jeju Island. Journal of the Korean Society of Marine Environment & Safety, 27, 81-87. (DOI: 10.7837/kosomes.2021.27.1.081).

Kim, S.-H., Kang, Y.-H. & Yoon, D.-H. 2020. Implementation of Monitoring System of the Living Waste based on Artificial Intelligence and IoT. Journal of IKEEE, 24, 302-310. (DOI: 10.7471 /ikeee.2020.24.1.302).

Knickmeyer, D. 2020. Social factors influencing household waste separation: A literature review on good practices to improve the recycling performance of urban areas. Journal of cleaner production, 245, 118605. (DOI: 10.1016/j.jclepro.2019.118605).

Laville, S., & Taylor, M. 2017. A million bottles a minute: World's plastic binge 'as dangerous as climate change'. The Guardian, June 28. https://www.theguardian.com/environment/2017 /jun/28/a-million-a-minute-worlds-plastic-bottle-binge-as-dangerous-as-climate-change. Accessed on 3 August 2023.

Liu, P., Teng, M. & Han, C. 2020. How does environmental knowledge translate into pro-environmental behaviors?: The mediating role of environmental attitudes and behavioral intentions. Science of the total environment, 728, 138126. (DOI: 10.1016/j.scitotenv. 2020.138126).

Massey, S., Cloutier, P., Sanche, L., & Roy, D. 2008. Mass spectrometry investigation of the degradation of polyethylene terephtalate induced by low-energy (< 100 eV) electrons. Radiation Physics and Chemistry, 77, 889-897. (DOI: 10.1016/j.radphyschem.2008.01.002).

Maurer, M. & Bogner, F. X. 2020. Modelling environmental literacy with environmental knowledge, values and (reported) behaviour. Studies in Educational Evaluation, 65, 100863. (DOI: 10.1016/j.stueduc.2020.100863).

Mwangi, H. W. & Mokoena, M. 2019. Using deep learning to detect polyethylene terephthalate (PET) bottle status for recycling. Glob J Comput Sci Technol, 19, 27-31. (DOI: 10.34257/gjcstgvol19is4pg27).

Oğuz, D., Çakci, I., & Kavas, S. 2010. Environmental awareness of university students in Ankara, Turkey. African Journal of Agricultural Research, 5, 2629-2636.

Otto, S. & Pensini, P. 2017. Nature-based environmental education of children: Environmental knowledge and connectedness to nature, together, are related to ecological behaviour. Global Environmental Change, 47, 88-94. (DOI: 10.1016/j.gloenvcha.2017.09.009).

Plastic Europe. 2019. Plastics – the Facts 2019. https://plasticseurope.org/wp-content/up loads /2021/10/2019-Plastics-the-facts.pdf. Accessed on 1 September 2023.

Rochman, C. M., Browne, M. A., Halpern, B. S., Hentschel, B. T., Hoh, E., Karaoanagioti, H. K., Rios-Mendoza, L. M., Takada, H., TEH, S. & Thompson, R. C. 2013. Classify plastic waste as hazardous. Nature, 494, 169-171. (DOI: 10.1038/494169a).

Safari, A., Salehzadeh, R., Panahi, R. and Abolghasemian, S. 2018. Multiple pathways linking environmental knowledge and awareness to employees' green behavior. Corporate Governance: The international journal of business in society, 18, 81-103. (DOI: 10.1108/CG-08-2016-0168).

Statistical Geographic Information Service. 2021. Number of coffee shops by year. https://sgis.kostat.go.kr/view/thematicMap/thematicMapMain_EN?stat_thema_map_id=DyqDKo9usM20160629174353430EKHJotIJLx&theme=CTGR_004&mapType=04. Accessed on 9 September 2023.

The JoongAng. 2021. Jeju uses 63 million disposable cups, rents a tumbler when renting a car. https://www.joongang.co.kr/article/24123590#home. Accessed on 9 September 2023.

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 and recycling, 41, 191-214. (DOI: 10.1016/j.resconrec.2003.11.001).

Vicente-Molina, M. A., Fernández-Sáinz, A., & Izagirre-Olaizola, J. 2013. Environmental knowledge and other variables affecting pro-environmental behaviour: comparison of university students from emerging and advanced countries. Journal of Cleaner Production, 61, 130-138. (DOI: 10.1016/j.jclepro.2013.05.015).

Vining, J. & Ebreo, A. 1990. What makes a recycler? A comparison of recyclers and nonrecyclers. Environment and behavior, 22, 55-73. (DOI: 10.1177/0013916590221003).

Welle, F. 2013. Is PET bottle-to-bottle recycling safe? Evaluation of post-consumer recycling processes according to the EFSA guidelines. Resources, Conservation and Recycling, 73, 41-45. (DOI: 10.1016/j.resconrec.2013.01.012).

Xu, L., Ling, M., Lu, Y., & Shen, M. 2017. Understanding household waste separation behaviour: Testing the roles of moral, past experience, and perceived policy effectiveness within the theory of planned behaviour. Sustainability, 9, 1-27. (DOI: 10.3390/su9040625).