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Recycling Intentions Among Karachi's University Students: An Extended Theory of Planned Behavior Approach Considering Convenience and Consumer Innovativeness

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Abstract

Karachi, the largest city of Pakistan is facing the challenge of urban waste disposal. This makes academicians study the reasons for poor recycling culture and behavior in Pakistan. The objective of this study is to analyze the factors impacting consumer recycling behavior in urban households. This study integrates the extended TPB model with the Diffusion of innovation theory to investigate the influence of attitude, subjective norms, perceived behavioral control, environmental concern, and packaging attributes on consumer recycling intention. Additionally, it also seeks to check the moderating role of convenience and consumer innovativeness between recycling intention and recycling behavior. The hypothetico-deductive approach was used to test the conceptualized hypotheses based on TPB and DOI theory. Non-probability convenience sampling method was used, and data was collected via internet-administered questionnaire from 639 participants comprising university students in Karachi. The data has been analyzed using SmartPLS version 4. Path analysis and Structural Equation Modelling (SEM) have been further used to analyze the direct and moderating relationship between the variables.

The results of this study confirmed a strong influence of the determinants of the extended TPB model on consumer recycling intention. Consumer innovation was found to have a positive significant impact on the relationship between recycling intention and behavior, while convenience was found to insignificantly moderate the relationship between recycling intention and behavior. The research findings can be used by the government in making policies relating to waste collection and creating awareness campaigns highlighting the advantages of recycling and sustainable consumption behavior, with the same can be applied to educational institutions for curriculum designing. Moreover, marketers can enhance recycling behavior through innovative sustainable packaging and proper recycling mechanisms. Certain initiatives on a public and private level relating to environmental awareness can greatly enhance the frequency of household recycling waste.

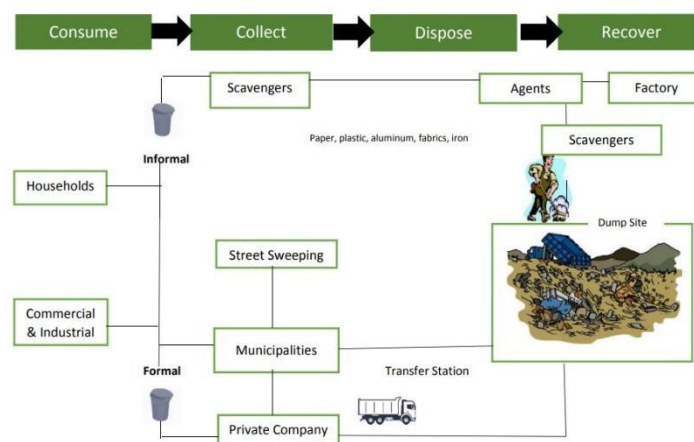
Introduction

Rising population, economic advancement, and urbanization have led to a surge in resource use, resulting in a higher global rate of waste production (Raihan & Tuspekova, 2022). This has brought environmental challenges related to waste management to the forefront. The sustainable management of waste has emerged as a significant challenge for developing countries, as inadequate waste handling practices can lead to issues concerning the environment, human health, resource use, aesthetics, and land use (Zand & Heir, 2020).

Global waste is expected to rise to a staggering 3.40 billion tonnes by 2050, with the South Asian region projected to experience the most rapid growth, nearly doubling its waste output (The World Bank, 2018). Currently, more than half of the waste in the South Asian region is openly discarded (Petro Kapinga & Hin Chung, 2020). The rapid increase in waste generation in these areas poses significant environmental, health, and economic risks, emphasizing the urgent need for immediate action.

Karachi is classified as a beta global city and is one of the largest cities in South Asia, with a metropolitan population of approximately 17 million as of 2023, growing at an annual rate of 2.35% (World Population Review, 2023). It is also the most religiously and ethnically diverse city in the region, divided into seven District Municipal Corporations (DMCs): Karachi East, West, Central, South, and the additional municipalities of Malir, Korangi, and Kemari. The Karachi Metropolitan Corporation (KMC) manages the municipal administration of Karachi and is responsible for the city's solid waste management. According to recent statistics, approximately 16,500 tons of solid waste is generated daily in Karachi, with the average household producing 0.44 kg of waste per capita per day (International Trade Administration, 2022). Figure 1 illustrates the waste collection mechanism in Karachi as reported by the Karachi Chamber of Commerce and Industry (KCCI).

Figure 1
Karachi Waste Collection Mechanism



Source: KCCI, 2018

A study by Ahmed and Ahmed (2022) highlighted Pakistan's need of 170 landfill sites to manage approximately 30.8 million tonnes of waste produced annually, with an aim of achieving a waste collection efficiency of over 90%. Karachi, the largest city of Pakistan, currently, does not have a properly designed landfill system for disposing of waste. All existing waste disposal locations are merely public dumps (Zuberi & Ali 2015). Moreover, despite the local government setting aside a significant PKR 12 billion (around \$40 million) for the Sindh Solid Waste Management Board, a majority of the waste is still carelessly discarded by residents on street corners (Khan et al., 2019).

Karachi's waste management has deteriorated, as it has in many other expanding cities, due to political oversight, financial and technological limitations, public awareness and behavior, and administrative challenges. Karachi's ongoing waste management issues are sounding alarm bells, especially with the looming threat of urban flooding that could seriously damage the city's structures and economy. Given Karachi's economic significance, both the National Disaster Management Authority (NDMA) and the

World Bank have pointed out the heavy financial losses from past floods, stressing the immediate need for better waste management and infrastructural changes. The 2020 floods in August were a reminder of this vulnerability and the pressing need for better policies in waste handling and infrastructure. Right now, Karachi's streets are littered, and its drains are blocked because the city hasn't set up proper waste disposal systems. If we don't act promptly with a comprehensive plan and better collaboration across stakeholders, Karachi could see even worse flooding in the future, affecting its people, economy, and overall well-being.

Among the key stakeholders that can significantly contribute to the recycling and waste management initiatives, are university students. Karachi is home to numerous universities and higher education institutions and university students, being a dynamic and influential group, can act as agents of change in promoting sustainable waste management practices. By studying their attitudes and behaviors, we can identify gaps in awareness and knowledge about recycling and develop targeted interventions and educational campaigns to foster pro-environmental behaviors.

Problem Statement

In a mega city like Karachi which is continuously facing an intensified problem of waste management, it becomes imperative to conduct an in-depth study on the recycling intentions and behaviors, predominantly amongst young Pakistanis as this segment is crucial for shaping the future by combating the problem of waste disposal through recycling mechanisms.

Young people are tech savvy and can easily be engaged in waste reduction and recycling initiatives by using social media platforms thus building and promoting an eco-conscious mindset early on, and creating a generation of environmentally conscious citizens. Their digital skills can be used to raise awareness about waste-related issues and activate recycling programs on a larger scale. Moreover, the passion and energy possessed by the younger generation can serve as a catalyst in lobbying for policy changes, demand for better waste management practices, and hold corporations and governments accountable for their environmental responsibilities.

The Theory of Planned Behavior (TPB) has been widely adopted by researchers to study and explain the antecedents of recycling intention and behavior. TPB framework incorporates attitudes, subjective norms, and perceived behavioral control as determinants of intention and behavior. However, existing research barely applies this theory to young Pakistanis and has ignored important factors such as packaging, environmental concern, consumer innovativeness, and convenience which might be strong predictors of recycling intention and behavior. This research endeavours to enrich the TPB framework by integrating additional dimensions of packaging and environmental concern. The research further integrates diffusion of innovation theory with TPB by examining the role of innovativeness on recycling behavior.

Research Questions

1. **RQ1:** What is the impact of the core components of the TPB—attitudes, subjective norms, and perceived behavioral control—in shaping recycling intentions and behavior among young Pakistanis?
2. **RQ2:** What is the impact of additional dimensions of packaging and environmental concern on recycling intentions among young Pakistanis?

3. **RQ3:** How convenience to recycle and consumer innovativeness moderate the relationships between recycling intentions and behaviors among young Pakistani households?

Research Objectives

1. **Objective 1:** To examine the influence of the core components of the TPB (attitudes, subjective norms, and perceived behavioral control) on recycling intentions and behavior among young Pakistanis.
2. **Objective 2:** To assess the impact of additional dimensions of the TBP (packaging and environmental concern) on recycling intentions among young Pakistanis.
3. **Objective 3:** To investigate whether consumer innovativeness and convenience in recycling moderate the relationships between the extended TBP's determinants and recycling intentions and behaviors among young Pakistanis.

Significance of the Study

The current study integrates the extended TPB framework with the DOI theory for providing a refined understanding of recycling intentions and behaviors among young Pakistanis. The insights derived could be crucial in devising educational initiatives, informed policies, and intervention strategies to kindle sustainable waste management practices, contributing to environmental preservation and enhanced public health in urban centers of Pakistan, particularly in cities coping with severe waste management challenges like Karachi.

Literature Review

Theory of Planned Behavior (TPB) and Diffusion of Innovation (DOI) Theory

TPB is a widely recognized theoretical framework for studying, understanding and predicting human behavior, particularly in the context of eco-friendly behavior (Chan & Bishop 2013). It suggests that a person's inclination to carry out a particular action is shaped by their attitudes towards the behavior, subjective norms (the perceived societal pressures to engage or not engage in a behavior), along with perceived behavioral control (the perceived simplicity or complexity of executing the behavior) (Ajzen 1991). This framework has been applied in research on diverse topics including but not limited to intention of using renewable energy (Liobikienė et al., 2021), intention to use electric cars (Moons & De Pelsmacker, 2015), usage of microplastics in beauty products (Deng et al. 2022), bottled water usage (Chatterjee & Barbhuiya 2021), life jacket usage (Giles et al. 2010), recycling habits (Echegaray & Hansstein 2017) and environmentally-friendly behaviors in the workplace (Yuriev et al., 2020).

TPB provides a systematic approach to study and identify the factors that impact recycling decisions. Numerous researchers have used it to conceptualize the factors that influence recycling intention and behavior (Mahmud & Osman, 2010; Mamun et al., 2018). However, few researchers argue that TPB alone does not adequately explain recycling intention behavior alone, suggesting that the TPB model should integrate more constructs to enhance its explanatory power (Zhang et al. 2021). Keeping in view, this study has added four new variables to the extended model of TPB. These variables are Packaging, Environmental Concern, along with the moderating role of Convenience between Recycling Intention and Behavior.

Additionally, the study seeks to incorporate the DOI theory that perceives innovation as a novel idea or practice (Rogers, 2003). Consumers can be classified into innovators, early adopters, early majority, late majority, and laggards based on the various stages of innovation diffusion (Rogers, 2003). According to previous research, innovators and early adopters typically have higher levels of consumer innovativeness than those in the later stages of adoption (Heidenreich & Handrich 2015). As a result, consumer innovativeness is likely to influence their intentions to adopt innovations (Stock et al., 2015). Recycling is still a novel concept and practice in developing countries (Xie et al. 2022), this research seeks to explore the moderating role of consumer innovativeness in the relationship between recycling intention and behavior, providing insights into how varying levels of innovativeness can influence the translation of intentions into actual recycling behavior.

Recycling Household Waste and Sustainability

Recycling plays a pivotal role in promoting sustainability particularly by aligning waste management strategies with circular economy (CE) principles (de Oliveira & Oliveria, 2023). The shift from a traditional linear economy, where resources are taken, used, and discarded, to a circular model emphasizes recycling as a core element (Puntillo et al., 2021). The CE concept is increasingly seen as a solution to global environmental challenges, including resource depletion and waste generation (Adami & Schiavon, 2021). Recycling contributes to sustainability by conserving resources, reducing pollution, and closing material loops within production systems (Kara et al., 2022). The incorporation of CE practices into waste management can enhance economic and environmental performance by transforming waste into valuable resources, thus driving progress toward sustainability goals (Mandpe et al., 2023). Sustainable waste management, particularly in developing economies, is essential for reducing environmental degradation and achieving global sustainability targets (Khajuria et al., 2022). This approach focuses on integrating recycling initiatives into broader waste management systems, aiming to process waste more efficiently and minimize the reliance on undamaged resources (Mandpe et al., 2023).

Recycling of household waste is especially crucial in the context of sustainability (Tong et al., 2021). Poorly managed municipal solid waste (MSW), commonly seen in developing countries, contributes to significant environmental hazards such as soil, air, and water contamination (Mohan & Joseph, 2021). Effective recycling systems are necessary to mitigate these risks and promote environmental sustainability (Zhang et al., 2022). Strategies such as waste segregation, resource recovery, and waste-to-energy technologies can substantially reduce the amount of waste directed to landfills, thereby minimizing their adverse environmental impact (Mor & Ravindra, 2023). Public education, community engagement, and the development of legislative frameworks mandating recycling are essential components of a successful recycling strategy (Hopson & Fowler, 2022). Moreover, the establishment of accessible recycling infrastructure and the incentivization of participation through rewards or tax breaks can facilitate greater engagement from households and businesses (Gibovic & Bikfalvi, 2021). These comprehensive measures, supported by multi-stakeholder collaborations, are vital for creating a circular economy that aligns with global sustainable development objectives.

Conceptualization of Hypotheses

The following section discusses each variable along with their research hypothesis.

Attitude and Recycling Intention

Researchers have argued about the significant impact of attitude on consumer behavior throughout the past 20 years (Sánchez et al., 2016). An individual's actions are positively affected by his or her attitudes, with environmental attitudes being determined by their views, feelings, and actions regarding the

environment (Liu et al., 2020). A study by Raza et al. (2022) focused on how attitude impacts the recycling intention in the context of pesticide container waste. The study's findings highlighted the significant role of attitude in encouraging recycling practices by showing that attitude significantly and favorably impacts the desire to recycle. Another research by Ali et al. (2022) investigated into the connection between environmental knowledge and recycling intention and discovered that raising environmental awareness and promoting eco-friendly attitudes can greatly boost recycling intention. Several studies have concluded that awareness of the widely acknowledged benefits of recycling significantly affects the formation of positive attitudes toward it (Tonglet et al., 2004; Wan et al., 2014), while Arli et al. (2020) found the opposite, whereby, the intention to recycle was not influenced by attitude toward the behavior. These contrasting findings collectively highlight the intricacies of the relationship between attitude and behavior, emphasizing the necessity for further investigation and contextual consideration within the Pakistani context. Based on these considerations, the authors have developed the following hypothesis:

H1: Attitude significantly influences Recycling Intention

Subjective Norms and Recycling Intention

Subjective norms signify the influence of others in predicting consumer behavioral decisions. Family and peer pressure have been accepted as the most prominent influencers in consumer recycling behavior. Consumers are inclined towards adopting recycling behavior if their family, peers, and neighbours are involved in such types of initiatives. The primary socialization agents are responsible for influencing individual beliefs, values, and behaviors.

Previous Studies have contrasting findings regarding how subjective norms affect recycling intentions. In Hong Kong, Chan (1998) discovered a favourable association between behavioral intention to recycle and subjective norms, showing the significant impact of mass communication. A study by Karim Ghani et al. (2013) highlighted the significance of subjective norms in shaping household solid waste management behaviors and waste segregation. Subjective norms, however, were found to be weak predictors in the TPB model in a number of research including a review by Armitage and Conner (2001) who attributed this to the limits of measurement methods. On the other hand, (Fornara et al., 2011; Park & Ha, 2014), showed that subjective norms indirectly influence recycling intentions by forming positive attitudes, personal norms, and perceived behavioral control, highlighting the significance of social norms and pressures in promoting pro-environmental behaviors like recycling. Based on these considerations, the authors have developed the following hypothesis:

H2: Subjective Norms significantly influence Recycling Intention

Perceived Behavioral Control (PBC), Recycling Intention and Recycling Behavior

PBC is a key construct in the TPB, which theorizes that an individual's perceived control over a behavior influences their intentions and subsequent behavior. Numerous studies have examined the relationship between PBC and recycling behavior among consumers. A study by Raza et al. (2022) on pesticide container recycling in Pakistan found PBC to be positively correlated with end users' adoption of recycling practices, indicating that when individuals believe they have control over their actions, they are more likely to engage in recycling behaviors.

Another study by Mai and Nguyen (2023) applied the TPB and found that behavior intention influenced recycling behavior. Specifically, PBC was identified as an important influencing factor on the intention to perform recycling behavior. The study showed that enhancing perceived behavioral control can

significantly influence individuals' intentions to engage in recycling activities, thereby promoting sustainable practices in waste management. Similarly, Mahmud and Osman (2010) stated that PBC was the strongest factor in predicting both recycling intention and behavior among university students. Based on these considerations, the authors have developed the following hypotheses:

H3: PBC significantly influences Recycling Intention

H4: PBC significantly influences Recycling Behavior

Packaging, Recycling Intention and Recycling Behavior

Packaging is a crucial component in the marketing mix, serving multiple roles including protection, containment, convenience, information conveyance, and marketing (Deliya & Parmar, 2012; Raheem et al., 2014). In the realm of academic inquiry, packaging has been examined through holistic and analytical approaches. According to studies by Rokka and Uusitalo (2008), Rundh, (2009), Underwood (2003), van Birgelen et al. (2009) and Wells et al. (2007), packaging influences consumer behavior as a whole, whereas analytical approaches analyze packaging components separately to determine their influence on consumers. Structure, graphics, and informational cues are used in green packaging, a sustainable type of packaging, to influence consumer decisions. Utilizing colors, visuals, and environmental labelling to transmit information and sway customer preferences, it focuses on decreasing overpackaging, optimizing container size and shape, and promoting eco refills (Deliya & Parmar, 2012; Raheem et al., 2014). According to studies by Rokka and Uusitalo (2008) and van Birgelen et al. (2009), satisfying customer needs like recyclability and tamper-proofing can increase product value and have a beneficial impact on consumer choices and behavior. A study by Roger-Loppacher et al. (2022) suggests that raising awareness about the benefits of recycling specific packaging materials and providing education on recycling procedures can enhance recycling intentions and bridge the gap between intention and action. The paper particularly highlights the potential of aluminium packaging to be recycled indefinitely and its environmental benefits. Based on these considerations, the authors have developed the following hypotheses:

H5: Packaging significantly influences Recycling Intention

H6: Packaging significantly influences Recycling Behavior

Environmental Concern and Recycling Intention

An individual's awareness of, sensitivity to, and readiness to act for environmental protection is termed their degree of environmental concern (EC). A significant impact has been empirically proved between environmental concern and intention to recycle in previous academic work. A study by Dwivedy and Mittal (2013) discovered that customers' desire to participate in recycling was positively influenced by their environmental concerns. EC has been found to be a powerful predictor of environmentally friendly actions, particularly in developing countries (Chaudhary & Bisai, 2018; Prakash & Pathak, 2017). Additionally, research by Heo and Muralidharan (2019) argued environmentally conscious young customers have high intention to purchase eco-friendly products as well to lessen their impact on the environment. Following on these considerations, the authors have developed the following hypothesis:

H7: Environmental Concern significantly influences Recycling Intention

Recycling Intention and Recycling Behavior

Recycling intention derives its core concept from the concept of intention in the original TPB model (Rise et al., 2003). Recycling behavior, on the other hand, is shaped by an individual's determination or intention to engage in a specific behavior and is perceived as the subjective likelihood of the correlation between an individual and a specific action (Nadarajan et al. 2023). The TPB contends that intention is the most important predictor of behavior (Shalender & Sharma 2021), which is supported by previous research claiming that intention is the direct precursor to behavior. Aboelmaged (2021) concluded that in a developing nation, recycling behavior was notably influenced by recycling intention, along with other elements like habit, capability to recycle, condition of facilities, and the adequacy of recycling information. Some studies, however, suggest that intention does not necessarily translate into behavior. For example, a study on selective waste collection in Romania did not explicitly state the direct impact of recycling intention on actual recycling behavior, instead emphasizing other factors that influence consumer behavior. Based on these considerations, the authors have developed the following hypotheses:

H8: Recycling Intention significantly influences Recycling Behavior

Convenience as a moderator between Recycling Intention and Recycling Behavior

Convenience refers to the closeness of recycling centers, user-friendliness of the facilities, and the presence of temporary storage spaces for recyclables (Struk 2017). Based on recent literature, the hypothesis that convenience has a positive impact on recycling intention is substantiated by several studies. A study conducted among university students in Malaysia found that the convenience of availability of recycling infrastructure significantly correlates with recycling intention, emphasizing the role of convenience in influencing recycling behaviors (Zatul Himmah et al. 2023). Moreover, studies by Matiuk and Liobikienė, (2021), McDonald and Ball (1998) and Sidique et al. (2010), found that convenience, including factors like the distance to recycling centers and the availability of time, plays a significant role in influencing recycling behavior and waste sorting behavior. Recycling is a conscious effort requiring the household to engage in significant efforts such as sorting and storing the recyclable material thus highlighting the importance of convenience as a crucial determinant of recycling behavior (Knickmeyer 2020). Greater convenience leads to greater recycling intentions and recycling behavior. Following these arguments, the authors have developed the following hypothesis:

H9: Convenience moderates the relationship between Recycling Intention and Recycling Behavior

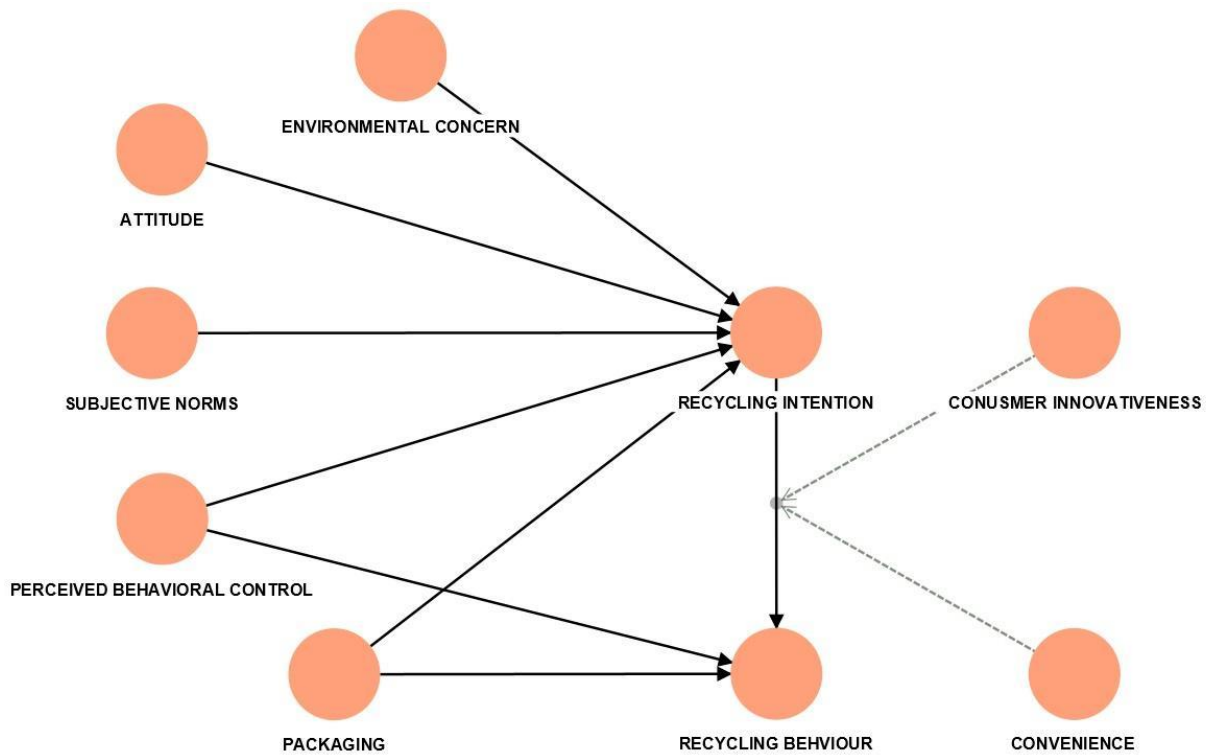
Consumer Innovativeness as a Moderator between Recycling Intention and Recycling Behavior

Study by Liu et al. (2022) suggests that, while recycling intention is a predictor of recycling behavior, the relationship is not simple and is influenced by a variety of other factors and norms, indicating a possible gap between intention and actual behavior in certain contexts. Keeping in view, Consumer innovativeness is critical in predicting the intention to adopt innovations, according to DOI theory (Rogers, 2003). According to Bowden and Corkindale (2005), innovative consumers are willing to venture and experiment with new things, even if they are unfamiliar with them. While there is evidence of a direct relationship between consumer innovativeness and purchase intentions (Persaud & Schillo 2017), existing research lacks insight into its role in recycling intention and behavior. Recycling, which is still a relatively new concept for Pakistani Households, frequently leaves individuals without experienced peers to guide their adoption of such environmentally friendly practices. This lack of guidance necessitates independent information-seeking and risk-taking decision-making. In this case, customer innovativeness can act as a moderator, potentially altering the dynamics between recycling intention and actual recycling behavior.

Innovative customers, who are more willing to adopt new practices (Yen et al., 2020), may effectively bridge the intention-behavior gap, allowing them to easily adopt recycling practices despite uncertainties. Thus, it is proposed to investigate the moderating role of consumer innovativeness between recycling intention and behavior.

H10: Consumer Innovativeness moderates the relationship between Recycling Intention and Recycling Behavior

Figure 2
Conceptual Framework



Source: The Author

Research Methodology

Population, Sample and Data

The young students studying in high ranked universities in Karachi were the target population of this research as they have a proper understanding of English. Proficiency in both written and oral English communication is a prerequisite for their admission, ensuring they are well-suited for participation in this study. The students were assumed to have understanding about recycling behaviors as the data was only collected from students who are enrolled in the business administration program and have completed the course of principles of marketing and ethics and social responsibility, since these courses have sustainability and ethical consumption included in their curriculum. A consent sign was signed by students as the participation in the research was completely voluntary. The respondents were ensured that their personal information; name and email address would not be shared with anyone and the data findings

would only be used for research purposes. The purpose of the research was communicated through the first few statements of the questionnaire and consent was sought before collection of the data.

A pilot study was conducted to ensure clear and thorough understanding of the questions included in the research instrument. The questions were found to be suitable in the context of the Pakistani market and did not require any modification. We have used standard factors identified in (Kotrlík et al., 2001) to determine the minimum sample size. It should be noted that when the population size is 10000 or more, then the sample size of 370 is sufficient for a research study with a margin of error of 0.05.

Non-probability convenience sampling approach was used, and a survey questionnaire was utilized as the research design for examining the viewpoints of respondents. 900 questionnaires were distributed via the Internet, out of which 639 usable responses were obtained, having a response rate of 71%. Majority of the respondents were male representing 71.5% of the total sample size. The data was collected from Gen Z only to probe the recycling behavior of young Pakistanis. The Table 1 shows the demographic profile of our respondents.

Table 1
Demographic Profile of Respondents

Demographic Information		Frequency	Percentage %
Gender	Male	457	71.5%
	Female	182	28.5%
	Total	639	100
Age	Less than 21 years old	162	25.4%
	21-30 years old	477	74.6%
Occupation	Employed	20	3.1%
	Self-Employed/ Business	32	5.0%
	Student	587	91.9%
Household members	3-5 members	366	57.3%
	6-8 members	205	32.1%
	Less than 3 members	30	4.7%
	more than 8 members	53	8.3%

Research Instrument and Measurements

A structured questionnaire was used to collect the quantitative data from residents of Karachi city, studying in universities to study their intention and behavior towards recycling. The questionnaire was developed on a 5-point Likert scale between 1-5, with 1 signifying strongly disagree and 5 signifying strongly agree. The instrument of data collection consisted of two sections. The initial section consisted of the questions relating to demographic characteristics of the respondents including age, gender, occupation, and education. Additional questions were asked relating to the recycling frequency of households and members in each household in Karachi city based on the packaging material including glass, paper/ cardboard, tin, and plastic.

The second section has questions on constructs, each having multiple items as indicated in table 2. The constructs have been adapted from previous studies, with their sources identified in table 2. Moreover, the complete questionnaire used for data collection is attached in the appendix.

Constructs and their measurement sources

Serial No.	Constructs	Items	Source
1	Attitude	5	(Wang et al., 2021; de Leeuw et al., 2015; Tonglet et al., 2004; Han, 2015)
2	Subjective Norms	5	(Chen & Tung, 2010; Ajzen, 2002; Arvola et al., 2008; Siraj et al., 2022)
3	Perceived Behavioral Control	4	(Chen & Tung 2010)
4	Packaging (Eco-friendly)	4	(Finisterra do Paço & Raposo 2010)
5	Recycle Intention	5	(Russell et al., 2017; Holland et al., 2006)
6	Consumer Innovativeness	5	(Testa et al., 2020; Vandecasteele & Geuens, 2010)
7	Environmental Concern	5	(Jaiswal & Kant, 2018; Testa et al., 2020; Trivedi et al., 2018)
8	Convenience	4	(Thi Thu Nguyen et al. 2018)
9	Recycling Behavior	5	(Ramayah et al., 2012)

The conceptualized model consists of three variables from the TPB. The authors have extended the TPB by adding three new constructs namely: Packaging, Environmental Concern and Convenience and, while taking consumer innovativeness from DOI Theory. These variables have been extracted from past academic literature.

The quantitative data analysis followed the rigorous approach outlined by Hair et al. (2022), beginning with evaluating the reflective model for indicator reliability through factor loadings. The authors assessed internal consistency using Cronbach's Alpha and Composite Reliability, followed by establishing convergent validity with Average Variance Extracted (AVE) and discriminant validity via the Heterotrait-Monotrait ratio (HTMT). Then the relationship between constructs was examined using PLS-SEM with SMARTPLS 4.0. The table below shows the factor loadings of each item, Cronbach alpha, Composite reliability and AVE values.

Table 3*Factor loadings, Cronbach Alpha, Composite Reliability and AVE*

Constructs and Measurement Items	Standardized factor loading	Cronbach's Alpha	Composite Reliability	AVE
ATTITUDE (ATT)		0.849	0.892	0.624
ATT1	0.734			
ATT2	0.808			
ATT3	0.800			

ATT4	0.794			
ATT5	0.811			
SUBJECTIVE NORMS (SN)		0.740	0.83	0.504
SN1	0.698			
SN2	0.713			
SN3	0.785			
SN4	0.810			
SN5	0.770			
PERCEIVED BEHAVIORAL CONTROL (PBC)		0.702	0.803	0.507
PBC1	0.743			
PBC2	0.792			
PBC3	0.628			
PBC4	0.674			
PACKAGING (PKG)		0.734	0.834	0.559
PKG1	0.748			
PKG2	0.830			
PKG3	0.745			
PKG4	0.658			
RECYCLE INTENTION (RI)		0.854	0.895	0.632
RI1	0.783			
RI2	0.857			
RI3	0.777			
RI4	0.816			
RI5	0.734			
CONSUMER INNOVATIVENESS (INN)		0.871	0.906	0.658
INN1	0.784			
INN2	0.843			
INN3	0.768			
INN4	0.838			
INN5	0.822			
ENVIRONMENTAL CONCERN (EC)		0.851	0.894	0.628
EC1	0.762			
EC2	0.855			
EC3	0.697			
EC4	0.841			
EC5	0.798			
CONVENIENCE (CN)		0.765	0.843	0.576
CN1	0.833			
CN2	0.777			
CN3	0.801			
CN4	0.607			
RECYCLING BEHAVIOR (RB)		0.843	0.889	0.616
RB1	0.752			
RB2	0.804			
RB3	0.823			
RB4	0.717			
RB5	0.823			

Research Findings

According to the research findings, 54.1% of the respondents considered themselves responsible for disposing of their household waste, while 44.9% denied responsibility for segregating and disposing of their waste. The percentage frequency of respondents recycling different materials is presented in the following table

Table 4.
Recycling Frequency by materials

Material	Always%	Frequently%	Occasionally%	Rarely%	Never%
Tin	13.6	25.8	31	13.1	16.4
Glass	13.1	33.3	27.2	9.4	16.9
Cardboard	14.1	31.9	33.3	10.3	10.3
Plastic	19.2	31	26.3	11.7	11.7

Further, the factor loadings for items of the constructs were assessed. All values of the factor loadings were above the cut-off value of 0.5 as recommended by Hair et al., (2021). The Cronbach Alpha value for each construct ranges from 0.894 (ATT) and 0.702 (PBC). These findings showed a satisfactory level of reliability, with coefficient alphas beyond the established cut-off value of 0.70 (Hair, 2010). AVE values were greater than the cut-off value with our lowest value being 0.504 (SN) and highest being 0.658 for consumer innovativeness. Additionally, composite reliability was also assessed, with our values exceeding 0.7, with lowest value of 0.803 for PBC, thus supporting the convergent validity of the latent constructs (Fornell & Larcker, 1981). Hair (2010) indicated that convergent validity is present when these three criteria are met: (a) CR values exceeding 0.7, (b) all standardized factor loadings are at least 0.5, and (c) AVE values are greater than or equal to 0.5. Moreover, for assessing the potential issue of common method bias, a full collinearity assessment was done. All our VIF values were lower than the cut-off value of 3.3, with lowest being 1.092 and highest being 2.570, hence common method bias was not a threat in our research (Kock, 2017).

Table 5
Discriminant Validity

	ATT	CN	EC	INN	PBC	PKG	RB	RI	SN
ATT	0.790								
CN	-0.169	0.760							
EC	0.604	-0.319	0.793						
INN	0.570	-0.306	0.766	0.811					
PBC	0.474	-0.108	0.470	0.552	0.712				
PKG	0.230	-0.234	0.332	0.382	0.493	0.748			
RB	0.214	-0.180	0.332	0.361	0.482	0.613	0.785		
RI	0.528	-0.200	0.625	0.631	0.567	0.541	0.538	0.795	
SN	0.536	-0.162	0.480	0.555	0.620	0.564	0.500	0.622	0.710

SEM was performed to test the research hypotheses. Table 4 shows the outcomes of our structural model indicating a significant relationship between ATT, SN, PBC, PKG, and EC with RI. Our H1, H2, H4, H6 and H7 were accepted as p-values of mentioned hypotheses were less than 0.05, along with t-statistics values greater than 1.96. Additionally, PBC, PKG, and RI were significantly related to RB, leading to acceptance of H3, H5 and H8. Additionally, the moderation analysis empirically proved that CI positively moderates the relationship between RI and RB, accepting H9. However, for H10, CN has insignificantly moderated the relationship between RI and RB.

The path coefficient values are shown in figure number 4. As indicated, the strongest determinant of recycling behavior and recycling intention is Packaging (eco-friendly) with path coefficient values of 0.389 and 0.24 respectively. Additionally, environmental concern has a path coefficient value of 0.323 with recycling intention. These empirical findings highlight the importance of added dimensions to the TPB framework. The results of SEM indicate summary of hypotheses based on path analysis is presented in Table 5.

Table 5
Hypothesis and their Summary

Hypothesis		Standard deviation	Path Coefficients	T statistics	P values	Status
H1	ATT -> RI	0.042	0.116	2.786	0.005	Accepted
H2	SN -> RI	0.045	0.192	4.238	0.000	Accepted
H3	PBC -> RB	0.043	0.181	4.89	0.000	Accepted
H4	PBC -> RI	0.039	0.121	3.081	0.002	Accepted
H5	PKG -> RB	0.041	0.389	10.873	0.000	Accepted
H6	PKG -> RI	0.037	0.240	6.547	0.000	Accepted
H7	EC -> RI	0.04	0.323	8.028	0.000	Accepted
H8	RI -> RB	0.053	0.251	4.787	0.000	Accepted
H9	INN x RI -> RB	0.029	0.062	2.163	0.031	Accepted
H10	CN x RI-> RB	0.04	0.005	0.112	0.911	Rejected

In structural equation modelling (SEM), the Standardized Root Mean Square Residual (SRMR) and Normed-Fit- Index (NFI) are measures of goodness-of-fit. A good fit is generally defined as having an SRMR value below 0.08 (Hu & Bentler 1998), which for our model is 0.072, showing that the residuals (the differences between the observed and predicted values) are minimal, while for NFI, value greater than 0.90 indicates a good fit (Bentler & Bonett 1980), which in case is 0.909. This shows the evidence that our model provides considerable insights into the factors responsible for recycling intention and behavior among young Pakistani university students.

Discussion

The waste management system in Pakistan is not only inefficient but also outdated as compared to other developing countries of the world. This leads to the problem of dumping recyclable materials into landfills. As per the discussion in Chapter 1, there is a clear absence of collection systems, proper recycling facilities, and networks for effective processing of recyclable material. Lack of awareness and understanding of environmental concerns related to recycling adds to the problem. The current study, therefore, addresses the motivators of recycling among young Pakistani households. The total combined variance explained by the established dimension of TBP (Attitude, Subjective Norms, and Perceived Behavioral Control) is 42.9%. As per the empirical findings of this research, environmental concern and packaging explained collectively 56.3% percent of the variance in the model, proving that environmental concern and packaging are two strong significant predictors of recycling intention. This high percentage of variance predicting recycling intention among young Pakistanis is a notable contribution to understanding household recycling behavior.

The authors' findings on established TPB constructs are consistent with other studies conducted in Asia. For instance, a study by Pakpour et al. (2014) in Iran on household recycling behavior found that TPB constructs, along with additional variables such as self-identity, moral obligation, and past recycling behavior, were strong predictors of household waste management behavior. The findings of studies conducted in Malaysia by (Juliana et al., 2022; Mahmud & Osman, 2010) confirmed that subjective norms and perceived behavioral control predicted recycling. However, attitude was found to be insignificantly related to recycling but was strongly dependent on environmental awareness. Additionally, research conducted in Saudi Arabia by Labib et al. (2021) showed that TBP constructs are of great importance in household participation of waste sorting and recycling. The results of this study adhere to research conducted in Pakistan by Hameed et al. (2022).

Although there are certain studies conducted in Pakistan that have proved the TBP variable to be significant predictors of recycling intention, there is a lack of research that involves the perception of youth in recycling studies. The importance of youth engagement in recycling studies cannot be overlooked, as youth make up 60% of Pakistan's population (UNDP, 2022). This study is particularly significant as it involves young people in recycling research, providing a more focused perspective on the realities of recycling behavior.

Environmentally conscious individuals feel a strong sense of responsibility towards their surroundings. They understand the importance of conserving resources and preserving ecosystems and they feel accountable for their actions that may harm the environment. Prior research indicates a strong influence of environmental knowledge on environmental concerns which has been proven to be a significant predictor of sustainable consumption behavior (Saari et al. 2021). The concern about environmental issues creates an awareness and a positive attitude towards the protection of the environment leading to high engagement in recycling activities (Gupta & Agrawal 2018). Environmentally concerned people pay heightened attention to environmental issues, which may be the biggest motivator to engage them in recycling commitments and practices (Chao et al., 2023). Recycling represents a tangible way for them to actively participate in environment stewardship and fulfil their duty to protect the planet for current and future generations (Niyommaneerat et al., 2023).

These research findings show a significant impact of environmental concern on the intention of Pakistani youth to recycle household waste, which can be attributed to a number of factors. Firstly, the youth's increased awareness of both local and global environmental problems has increased their awareness of their part in resolving these problems. The significance of sustainable practices is frequently emphasized in educational programs, which frequently serve to increase this awareness. Secondly, firsthand

encounters with Pakistan's environmental issues, such as air and water pollution, and urban flooding have given the youth a sense of urgency for embracing eco-friendly behaviors as they have witnessed the catastrophic impact of climate change in the floods of 2022. Thirdly, peer influence is essential because, once adopted by a few, environmentally conscious habits can spread quickly among young people. With quick access to information about the environmental advantages of recycling, the digital age further empowers them. Furthermore, their dedication to recycling household waste is strengthened by a cultural shift towards sustainable living, which is motivated by the younger generation's desire for a cleaner future. In essence, environmental concern is termed as a significant determinant of recycling intentions among Pakistani youth due to a confluence of environmental awareness, education, personal experiences, and cultural evolution.

The research findings confirm a significant relationship between packaging and recycling intention. These findings are consistent with the past research on packaging attributes and household recycling mechanisms. Packaging has a unique ability to communicate messages using visual elements such as color, material, and graphics, making packaging a significant factor in stimulating consumers' waste sorting and recycling behavior (Nemat et al., 2019). Apart from durability and beauty, the recyclability of a package motivates a consumer to engage in recycling practices. Recycling labels provide information relating to collection places for sorting and recycling centers. Therefore, proper labelling on a package encourages people to recycle (Brennan et al. 2023). Materials: including glass, metal, and cardboard have a higher probability of being recycled than plastic (Langley et al., 2011), while quality (ability to reuse or recycle), size, label, reliability, reseal ability, cleanability influence the desire to recycle (Mielinger & Weinrich, 2023). Thus, we can conclude consumers decide to recycle based on packaging attributes (Nemat et al., 2019).

Marketers can utilize the findings of this research to develop marketing strategies for engaging consumers in recycling and sustainable practices. Incorporation of attractive graphics, colors, and visuals can encourage communication about eco-friendly features of the product, thus, motivating them to recycle. Clear labelling about recycling centers and the environmental benefits of recycling may facilitate a consumer to sort and recycle waste. Design packaging that is easy to sort and separate during recycling will reduce consumers' hesitation and reluctance towards recycling. By incorporating these insights into their marketing efforts, companies can boost their brand's image on multiple platforms including social media to project their brand to be environmentally conscious and responsible. Businesses and policymakers can foster a culture of sustainability, responsible consumption, and recycling among environmentally conscious Pakistani youth, therefore contributing to an eco-friendly future in Pakistan.

For the relationship between recycling intention and recycling behavior, our research indicates that people are more likely to engage in recycling activities when they have a strong intention or motivation to do so. The findings for H8 are consistent with previous research conducted by (Arli et al., 2020; Latif et al., 2012; Wan et al., 2012). Moreover, as per the behavioral studies, theory of reasoned action, theory of planned behavior, and social cognitive theory, the intention is a significant predictor of behavior, but at times, other factors may change the intention-behavior relationship and may prevent one from acting on his or her intentions. Thus, intention is not a sole predictor of a person's behavior.

Innovativeness has been studied in the past in different contexts (Rahman & Kharb, 2018; Venkatraman & Price, 1990), but the widely accepted and applied global characteristics of innovativeness reflect the personality trait of willingness to change and as being innovators, they are more likely to indulge in pro-environmental behaviors including recycling (Rahman et al., 2020). With respect to consumer behavior studies, consumer innovativeness has been used as a moderator in the past (Kim & Cha, 2021; Lao, 2014; Muraguri et al., 2020; Zhang & Dong, 2023). The finding of our research found a significant moderating role in consumer innovativeness between recycling intention and recycling behavior among

young Pakistanis. There are several possible reasons for this. The digital age has exposed the young Pakistanis to global sustainability trends, impacting their recycling intentions. Their tech-savviness may allow them to access platforms promoting eco-friendly lifestyles, further influencing their behavior. Additionally, modern education in Pakistan emphasizes environmental consciousness, shaping their attitudes toward recycling. Lastly, a genuine desire for positive societal change, inherent in many young individuals, might drive them to view recycling not just as an environmental act, but as a broader contribution to their community.

The research hypothesis, H10, was not accepted proving that convenience did not moderate the relationship between recycling intention and behavior. In the past, few researchers have supported our conclusion (Nguyen et al., 2019; Yau, 2012), while few researchers have contradicted these findings. Convenience alone cannot predict a strong recycling intention and behavior, certain other variables such as demographic, psychographic characteristics, culture, and attitude also play an active role in bridging the intention behavior gap of households. This explains the absence of proper waste disposal behavior among Karachiites despite easily accessible garbage facilities available in every nook and corner of Karachi city. The images have been added to show that the red garbage bins are provided by the government to dispose of waste, but the lack of proper waste management facilities have resulted in a poor environment, dirty odors, and unhygienic condition on almost every street of Karachi. The convenience alone becomes meaningless if it is not backed by the proper infrastructure of waste sorting, recycling, and collection systems. This is consistent with past findings that advocated that improving sorting facilities and a proper segregation infrastructure positively influences recycling behavioral intention (Xu et al. 2017). Other researchers have identified that the basic barriers to recycling are ignorance, laziness and inconvenience (Hornik et al. 1995). A study conducted in China provided an important insight that despite convenient recycling bins, households were not involved in recycling because of several factors, among which education about recycling and ignorance were prominent factors. Situational factors such as poorly ventilated recycling stations raised hygiene and safety concerns among residents and made them reluctant to recycle, proving convenience alone cannot play a significant role if recycling stations are poorly managed (DiGiacomo et al. 2018). These findings adhere to our research conclusion. This study proved convenience does not significantly predict recycling behavior. It might be possible that perceived convenience, that is the perception of how easy it is to access recycling stations/bins, is more important than actual convenience. A future study must be conducted on perceived convenience instead of convenience.

Conclusion and Implications

Based on the above discussion, this research is extremely useful in providing valuable insights about the recycling paradigm for marketers, policymakers, practitioners, and academicians. It gives a holistic picture of understanding recycling intention and behavior by considering environmental concerns, packaging, convenience, and consumer innovation. These variables have not been given due attention in their role in shaping pro-environmental behaviors among households in Pakistan.

Theoretical Implication

This study contributes to the existing literature by expanding the Theory of Planned Behavior (TPB) through the integration of additional dimensions such as eco-friendly packaging, environmental concern, and consumer innovativeness, combined with elements from the Diffusion of Innovation (DOI) theory. The research highlights the significant role that packaging design and marketing communication play in shaping pro-environmental behaviors. It emphasizes how visually appealing and clearly labelled eco-friendly packaging can significantly influence consumer recycling intentions. By introducing these elements into the TPB framework, this study offers a more comprehensive model that focuses on the

determinants of recycling behavior, particularly in urban, developing country contexts, where such behaviors are still evolving.

Moreover, the study stresses the importance of social influence, suggesting that collaboration with influencers, community leaders, and celebrities can enhance subjective norms, thereby driving recycling behaviors. The inclusion of consumer innovativeness as a moderator in the relationship between recycling intention and behaviors adds another layer of insight into how novel pro-environmental practices are adopted. These contributions fill key gaps in existing theories by incorporating culturally and contextually relevant factors that have previously been underexplored in recycling studies. This enriched theoretical framework can guide future research on pro-environmental behaviors in similar settings.

Practical Implications

The research provides practical insights aimed at promoting widespread recycling behaviors through improvements in infrastructure, education, and cross-sector collaboration. It highlights the urgent need for well-distributed and accessible recycling facilities, including waste collection centers, separation facilities, and conveniently located bins that cater to households. The study advocates for incentivizing businesses and local industries to participate in recycling programs through tax breaks and subsidies, especially for those adopting sustainable practices like eco-friendly packaging. Additionally, integrating recycling education into the curricula of schools, colleges, and universities is emphasized as a critical step in cultivating a culture of environmental responsibility from a young age.

To create a comprehensive and effective recycling ecosystem, the study calls for collaborative partnerships between marketers, businesses, government agencies, NGOs, and environmental organizations. These partnerships could spearhead campaigns, competitions, and community outreach programs to engage the public, particularly youth. Furthermore, the research underscores the importance of legislative action, proposing mandatory recycling regulations for organizations and households, along with penalties for non-compliance. By also recommending partnerships with tech start-ups to develop innovative recycling solutions, the study outlines a holistic approach that can make recycling more accessible, engaging, and effective in Pakistan, ultimately contributing to sustainable waste management.

Limitations and Future Research

The current study is cross-sectional in nature and data has only been collected from Karachi, an economic hub of Pakistan. There is a need to investigate the recycling behavior through longitudinal studies in different cities of Pakistan to understand the role of culture and geographic location (rural, urban) may influence recycling patterns, habits, preferences, attitude and behavior. The research cannot be generalized for the entire country as Pakistan is marked by diverse cultures, in which local constraints play an active role. The response rate from males in our study as compared to the females was greater denoting a need to prove the reasons for this gender disparity. Cultural norms, education, time constraints, and environmental awareness, may explain the underlying reasons for the observed gender disparity. However, it is important to conduct a study, to fully gain an understanding of how gender and education affect the participation rate in a recycling study. This also gives rise to an important question about which gender is responsible for waste sorting is a particular gender responsible for waste sorting and household recycling dynamics. Practices can be different in rural and urban areas due to role diversity.

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