Recycling Household Waste: A study on Young University Students in Karachi, Pakistan through the lens of extended Theory of Planned Behaviour with a moderating role of Convenience and Consumer Innovativeness

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Abstract

Karachi, being the largest city of Pakistan is facing the challenge of urban waste disposal. This makes academicians study the reasons for poor recycling culture and behaviour in Pakistan. The objective of this study is to analyse the factors impacting consumer recycling behaviour 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 behavioural 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 behaviour.

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 of university students in Karachi. The data has been analysed using Smart PLS version 4. Path analysis and Structural Equation Modelling (SEM) have been further used to analyse 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 recycle intention. Consumer innovativeness was found to have a positive significant impact on the relationship between recycling intention and behaviour, while convenience was found to insignificantly moderate the relationship between recycling intention and behaviour.

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 behaviour, with same can be applied to educational institutions for curriculum designing. Moreover, marketers can enhance recycling behaviour 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.

Keywords: Recycling; Household Waste; Theory of Planned Behaviour; Convenience; Innovativene

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Introduction

Rising population, economic advancement, and urbanization have led to a surge in resource use, leading to a higher global rate of waste production (Raihan & Tuspekova, 2022). This has brought environmental challenges tied to waste management to the forefront. Sustainable management of waste has emerged as a challenge for developing countries as inadequate waste handling practices could lead to problems with the environment, human health, resource use, aesthetics, and land use (Zand & Heir, 2020)

The global waste is expected to rise to whopping 3.40 billion tonnes by 2050 with the South Asian region expected to experience the most rapid growth, almost doubling its waste growth (The World Bank, 2018). Presently, over half of the waste in South Asian region is openly discarded (Petro Kapinga & Hin Chung, 2020). The escalating waste growth in these areas will significantly impact the environment, health, and economic well-being, requiring the need for immediate measures.

Karachi is marked as a beta global city, and one of the largest in South Asia, having a metro area population of approximately 17 million in the year 2023 with an annual growth rate of 2.35% (World Population Review, 2023). Karachi is, religiously and ethnically, the most diverse city with seven District Municipal Corporations (DMCs) named as: Karachi East, West, Central, South, with additional municipalities of Malir, Korangi, and Kemari. Karachi Metropolitan Corporation (KMC) runs the Municipal Administration of Karachi and is responsible for the solid waste management of the city. As per recent statistics, approximately 16,500 tons of solid waste is generated per day in Karachi, with an average household generating waste of 0.44 kg per capita per day (International Trade Administration, 2022). Figure 1 shows the waste collection mechanism of Karachi as

mentioned by the report of Karachi Chamber of Commerce and Industry (KCCI).

Figure 1: Karachi Waste Collection Mechanism-Source (KCCI, 2018)
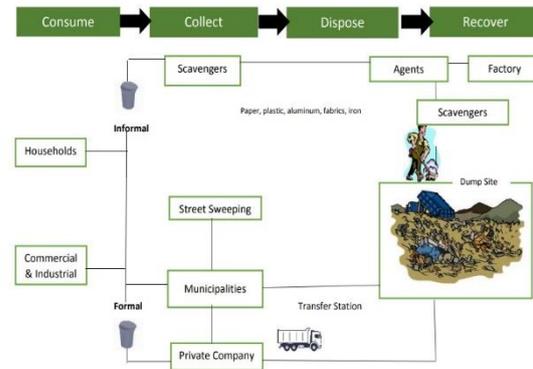
A study by Ahmed and Ahmed (2022) highlighted Pakistan's need of 170 landfill sites to manage approximately 30.8 million tonnes of waste produced annually, with an aim of achieving a waste collection efficiency of over 90%. Karachi, the largest city of Pakistan, currently, does not have a properly designed 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 behaviour, 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 behaviours, we can identify gaps in awareness and knowledge about recycling and develop targeted interventions and educational campaigns to foster pro-environmental behaviours.

1.1 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 behaviours, 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 Behaviour (TPB) has been widely adopted by researchers to study and explain the antecedents of recycling intention and behaviour. TPB framework incorporates attitudes, subjective norms, and perceived behavioural control as determinants of intention and behaviour. However, existing research barely applies this theory to young Pakistani and has ignored important factors such as packaging, environmental concern, consumer innovativeness, and convenience which might be strong predictors of recycling intention and behaviour. 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 behaviour.

1.2 Research Questions

1. RQ1: What is the impact of the core components of the TPB—attitudes, subjective norms, and perceived behavioural control—in shaping recycling intentions and behaviour among young Pakistanis?

2. RQ2: What is the effect of additional dimensions of TPB namely packaging and environmental concern on recycling intentions among young Pakistanis?

3. RQ3: Do convenience to recycle and consumer innovativeness moderate the relationships between the extended TPB's determinants and recycling intentions and behaviours among young Pakistani households

1.3 Research Objectives

1. *Objective 1:* To examine the influence of the core components of the TPB (attitudes, subjective norms, and perceived behavioural control) on recycling intentions and behaviour 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 behaviours among young Pakistanis.

1.4 Significance of the Study

The current study integrates the extended TPB framework with the Diffusion of innovation theory for providing a refined understanding of recycling intentions and behaviours 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 centres of Pakistan, particularly in cities coping with severe waste management challenges like Karachi.

1. Literature Review

TPB is a widely recognized theoretical framework for studying, understanding and predicting human behaviour, particularly in the context of eco-friendly behaviour (L. Chan & Bishop, 2013). It suggests that a person's inclination to carry out a particular action is shaped by their attitudes towards the behaviour, subjective norms (the perceived societal pressures to engage or not engage in a behaviour), along with perceived behavioural control (the perceived simplicity or complexity of executing the behaviour) (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 behaviours 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 behaviour (Mahmud and Osman, 2010; Mamun et al., 2018). However, few researchers argue that TPB alone does not adequately explain recycling intention behaviour alone, suggesting that the TPB model should integrate more constructs to enhance its explanatory power (G. 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 moderating role of Convenience between Recycling Intention and Behaviour.

Additionally, the research seeks to incorporate the Diffusion of Innovation (DOI) theory. DOI theory 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 researches, 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 behaviour, providing insights into how varying levels of innovativeness can influence the translation of intentions into actual recycling behaviour.

Components of Extended TBP, DOI Theory, and Conceptualization of Hypothesis:

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

2.1 Attitude and Recycling Intention

Researchers have argued about the significant impact of attitude on consumer behaviour 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 the 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 favourably 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 behaviour. 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, we have developed the following hypothesis:

H1: Attitude significantly influences Recycling Intention

2.2 Subjective Norms and Recycling Intention

Subjective norms signify the influence of others in predicting consumer behavioural decisions. Family and peer pressure have been accepted as the most prominent influencers in consumer recycling behaviour. Consumer is inclined towards adopting aa recycling behaviour 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 behaviours.

Previous Studies have contrasting findings regarding how subjective norms affect recycling intentions. In Hong Kong, Chan (1998) discovered a favourable association between behavioural 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 behaviours 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 and Ha, 2014), showed that subjective norms indirectly influence recycling intentions by forming positive attitudes, personal norms, and perceived behavioural control, highlighting the significance of social norms and

pressures in promoting pro-environmental behaviours like recycling. Based on these considerations, we have developed the following hypothesis:

H2: Subjective Norms significantly influence Recycling Intention

2.3 Perceived Behavioural Control (PBC), Recycling Intention and Recycling Behaviour

PBC is a key construct in the TPB, which theorizes that an individual's perceived control over a behaviour influences their intentions and subsequent behaviour. Numerous studies have examined the relationship between PBC and recycling behaviour 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 behaviours.

Another study by (Mai & Nguyen, 2023) applied the TPB and found that behaviour intention influenced recycling behaviour. Specifically, PBC was identified as an important influencing factor on the intention to perform recycling behaviour. The study showed that enhancing perceived behavioural control can significantly influence individuals' intentions to engage in recycling activities, thereby promoting sustainable practices in waste management. Similarly, (Mahmud & Osman, 2010) stated that PBC was the strongest factor in predicting both recycling intention and behaviour among university students. Based on these considerations, we have developed the following hypotheses:

H3: PBC significantly influences Recycling Intention

H4: PBC significantly influences Recycling Behaviour

2.4 Packaging, Recycling Intention and Recycling Behaviour

Packaging is a crucial component in the marketing mix, serving multiple roles including protection, containment, convenience, information conveyance, and marketing (Deliya and Parmar, 2012;Raheem et al., 2014). In the realm of academic inquiry, packaging has been examined through holistic and analytical approaches. According to holistic studies (Rokka and Uusitalo, 2008; Rundh, 2009; Underwood, 2003; van Birgelen et al., 2009; Wells et al., 2007), packaging influences consumer behaviour as a whole, whereas analytical approaches analyse 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 colours, 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 and Parmar, 2012; Raheem et al., 2014). According to several studies (Rokka and Uusitalo, 2008; 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 behaviour. 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, we have developed the following hypotheses:

H5: Packaging significantly influences Recycling Intention

H6: Packaging significantly influences Recycling Behaviour

2.5 Environmental Concern and Recycling Intention

An individual's awareness of, sensitivity to, and readiness to take action 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 and Bisai, 2018; Prakash and Pathak, 2017). Additionally, research by (Heo & Muralidharan, 2019) argued environmentally conscious young customers have high intention to purchase eco-friendly products as well in order to lessen their impact on the environment. Following on these considerations, we have developed the following hypothesis:

H7: Environmental Concern significantly influences Recycling Intention

2.6 Recycling Intention and Recycling Behaviour

Recycling intention derives its core concept from the concept of intention in the original TPB model (Rise et al., 2003). Recycling behaviour, on the other hand, is shaped by an individual's determination or intention to engage in a specific behaviour 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 behaviour (Shalender & Sharma, 2021), which is supported by previous research claiming that intention is the direct precursor to behaviour. Aboelmaged (2021) concluded that in a developing nation, recycling behaviour 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 behaviour. For example, a study on selective waste collection in Romania did not explicitly state the direct impact of recycling intention on actual recycling behaviour, instead emphasizing other factors that influence consumer behaviour. Based on these considerations, we have developed the following hypotheses:

H8: Recycling Intention significantly influences Recycling Behaviour

2.7 Convenience as a moderator between Recycling Intention and Recycling Behaviour

Convenience refers to the closeness of recycling centres, 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 behaviours (Zatul Himmah et al., 2023). Moreover, studies by ((Matiiuk and Liobikienė, 2021; McDonald and Ball, 1998; Sidique et al., 2010), found that convenience, including factors like the distance to recycling centres and the availability of time, plays a significant role in influencing recycling behaviour and waste sorting behaviour. 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

behaviour (Knickmeyer, 2020). Greater convenience leads to greater recycling intentions and recycling behaviour. Following these arguments, we have developed the following hypothesis:

***H9:*** Convenience moderates the relationship between Recycling Intention and Recycling Behaviour

2.8 Consumer Innovativeness as a Moderator between Recycling Intention and Recycling Behaviour

Study by Liu et al. (2022) suggests that, while recycling intention is a predictor of recycling behaviour, the relationship is not simple and is influenced by a variety of other factors and norms, indicating a possible gap between intention and actual behaviour in certain contexts. Keeping in view, Consumer innovativeness is critical in predicting the intention to adopt innovations, according 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 behaviour. 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 behaviour. Innovative customers, who are more willing to adopt new practices (Yen et al., 2020), may effectively bridge the intention-behaviour 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 behaviour.

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

Figure 2: Conceptual Framework
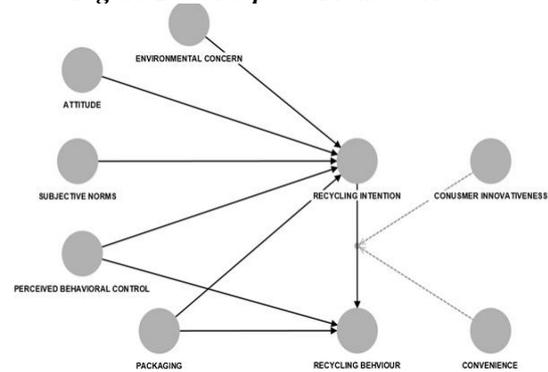
3.Methodology

The hypothetico-deductive approach was used to test the conceptualized hypotheses which were based on the extended TPB and DOI theory. One of the advantages of the hypothetico-deductive approach is that it allows marketers to develop a clear understanding of the relationship between different variables and tests the effectiveness of different marketing strategies.

3.1 Research Instrument

A structured questionnaire was used to collect the quantitative data from residents of Karachi city, studying in universities to study their intention and behaviour 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.

3.2 Measurement of Constructs
The second section has questions on constructs, each having multiple items as indicated in the table 1. The constructs have been adapted from previous studies, with their sources identified in below mentioned table:

Table 1: 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 and Tung, 2010;Ajzen, 2002; Arvola et al., 2008; Siraj et al., 2022)
3	Perceived Behavioural 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 and Geuens, 2010)
7	Environmental Concern	5	(Jaiswal and Kant, 2018;Testa et al., 2020; Trivedi et al., 2018)
8	Convenience	4	(Thi Thu Nguyen et al., 2018)
9	Recycling Behaviour	5	(Ramayah et al., 2012)

Our conceptualized model consists of three variables from the TPB. We 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.

3.3 Sampling and Data Collection
Non-probability convenience sampling approach was used, and a survey questionnaire was utilized as the research design for examining the viewpoints of respondents. Survey questionnaires, according to (Sekaran and Bougie, 2016), are the most dominating information-gathering technique only when specialists are aware of their explicit goals and have the right evaluation abilities to gauge relevant elements.

The questionnaire was administered in the city of Karachi, which is the largest and most industrialized city in Pakistan. The city of Karachi faces severe waste management issues, resulting in major landfills at public and landmark sites. The data was collected from young adults studying in high-ranking universities in Karachi since it was assumed that they have a proper understanding of English as it is a prerequisite for their admission. Moreover, the students have a basic understanding of recycling and waste disposal issues in Karachi.

900 questionnaires were distributed via the Internet, out of which 639 usable responses were obtained, having a response rate of 71%. Participation in the study was on a voluntary basis. 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 question and consent was sought before collection of the data.

The Quantitative data was analysed using Smart PLS 4.0. Descriptive analyses were

done on PLS 4 along with reliability, validity, and path significance. In addition, the bootstrapping resampling method was used for data analysis.

the consumer household that plays an active role in recycling. Table 2 below illustrates the descriptive information of the respondents.

4. Research Findings

Descriptive analysis was performed to analyse the demographic characteristics of

Table 2: Demographic profile of the 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%

As per the research findings, 54.1% of the respondents considered themselves responsible for disposing of their household waste and 44.9% denied the responsibility of segregating and disposing of their

household waste. The frequency in percentage with which the respondents recycled different materials is shown in the following table and chart respectively.

Table 3: 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

Figure 3: Recycling Frequency by materials

Recycling Frequency of Different Materials
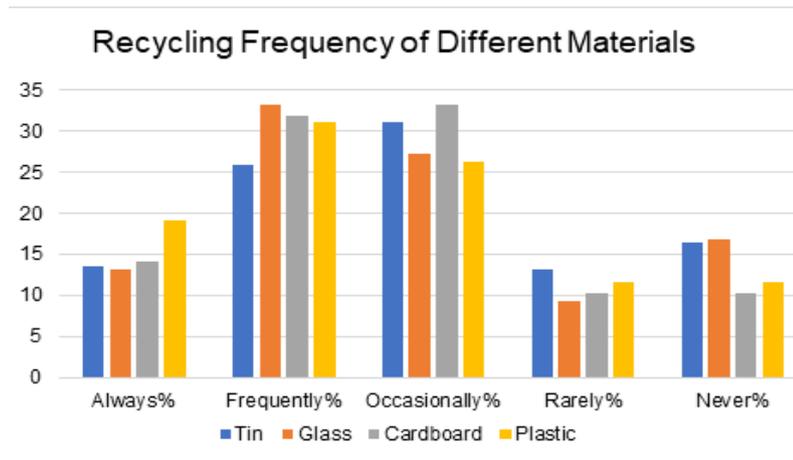
We calculated the Cronbach Alpha value for each scale, with values ranging from 0.894 (ATT) and 0.702 (PBC). These findings showed a satisfactory level of reliability, with coefficient alphas beyond the established cutoff value of 0.70 (Hair, 2010). AVE values were greater than the cut-off value (above 0.5 indicates an acceptable level of convergent validity), 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 λ are at least 0.5, and (c) AVE values are greater than or equal to 0.5. The results are presented in table 4.

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 4: Factor loading, Cronbach Alpha, Composite Reliability and AVE*

Constructs and Measurement Items	Standarized factor loading	Cronbach's Alpha	Composite Reliability	AVE
ATTITUDE (ATT)		0.849	0.892	0.624
ATT1	0.73			
ATT2	0.81			
ATT3	0.80			
ATT4	0.79			
ATT5	0.81			
SUBJECTIVE NORMS (SN)		0.740	0.83	0.504
SN1	0.70			
SN2	0.71			
SN3	0.78			
SN4	0.81			
SN5	0.77			
PERCEIVED BEHAVIORAL CONTROL (PBC)		0.702	0.803	0.507
PBC1	0.74			
PBC2	0.79			
PBC3	0.63			
PBC4	0.67			
PACKAGING (PKG)		0.734	0.834	0.559
PKG1	0.75			
PKG2	0.83			
PKG3	0.74			
PKG4	0.66			
RECYCLE INTENTION (RI)		0.854	0.895	0.632
RI1	0.78			
RI2	0.86			
RI3	0.78			
RI4	0.82			
RI5	0.73			
CONSUMER INNOVATIVENESS (INN)		0.871	0.906	0.658
INN1	0.78			
INN2	0.84			
INN3	0.77			
INN4	0.84			
INN5	0.82			
ENVIRONMENTAL CONCERN (EC)		0.851	0.894	0.628
EC1	0.76			
EC2	0.86			
EC3	0.70			
EC4	0.84			
EC5	0.80			
CONVENIENCE (CN)		0.765	0.843	0.576
CN1	0.83			
CN2	0.78			
CN3	0.80			
CN4	0.61			
RECYCLING BEHAVIOUR (RB)		0.843	0.889	0.616
RB1	0.75			
RB2	0.80			
RB3	0.82			
RB4	0.72			
RB5	0.82			

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 of 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 influenced the relationship between RI and RB.

The path coefficient values are shown in figure number 4. As indicated, the strongest determinant of recycling behaviour 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 TBP framework.

Figure 4: Path coefficients and p-values
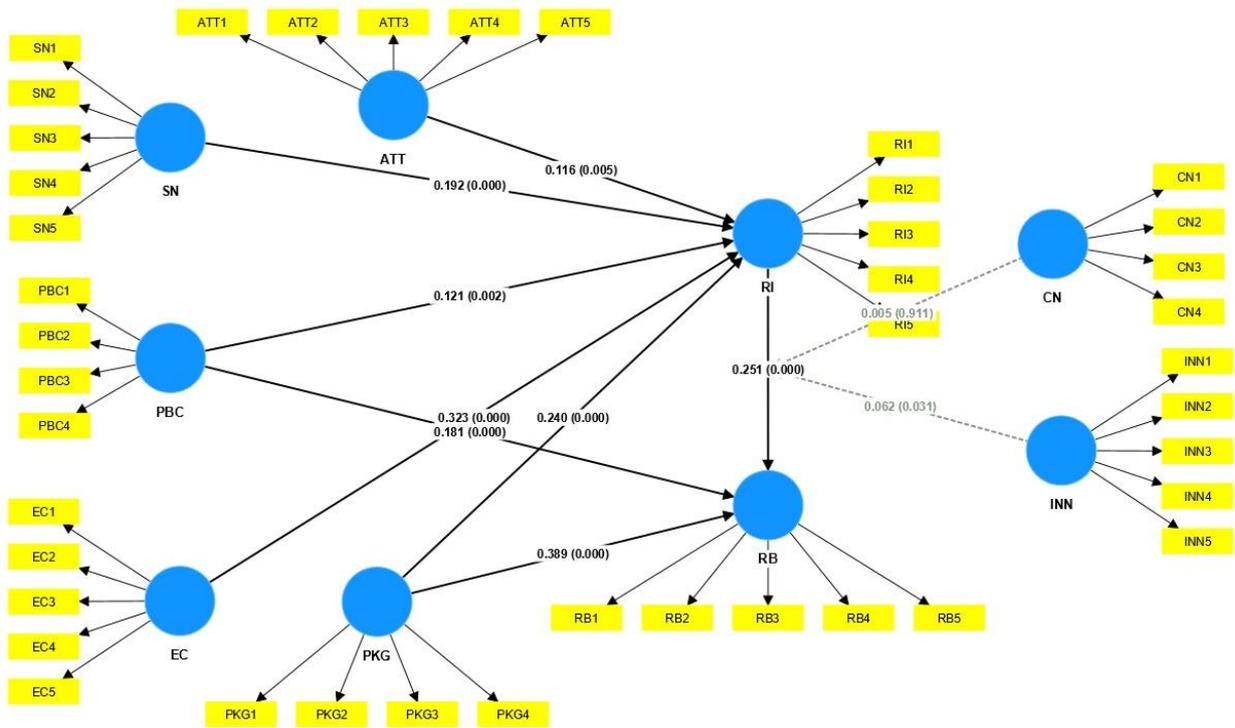
The results of SEM indicate Summary of hypotheses on the basis of path analysis is depicted in the following table.

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 behaviour among young Pakistani university students.

5. *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 Behavioural 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 behaviour.

Our findings about established TBP constructs is consistent with other studies conducted in Asia. As per a study conducted by (Pakpour et al. (2014) in Iran on household recycling behaviour, TBP constructs and additional variables of self-identity, moral obligation, and past recycling behaviour were strong predictors of household waste behaviour. The findings of studies conducted in Malaysia by (Juliana et al., 2022; Mahmud and Osman,

2010) confirmed that subjective norms and perceived behavioural 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 our 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 involved the perception of youth in recycling studies. The importance of youth engagement in recycling studies cannot be denied as the population of Pakistan comprises 60% of youth (UNDP, 2022), this makes our research notably important since this study involved young people in recycling research giving it a more focused view of the recycling reality. Environmentally conscious individuals feel a strong sense of responsibility towards their surroundings. They understand the importance of conserving resources and preserving eco-systems 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 behaviour (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 plant for current and future generations (Niyommaneerat et al., 2023).

Our 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 behaviours 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.

Our 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 colour, material, and graphics, making packaging a significant factor in stimulating consumers' waste sorting and recycling behaviour (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 make a decision 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, colours, and visuals can encourage communication about eco-friendly features of the product, thus, motivating them to recycle. Clear labeling about recycling centres 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 behaviour, our research indicates that people are more likely to actually 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 behavioural studies, theory of reasoned action, theory of planned behaviour, and social cognitive theory, the intention is considered to be a significant predictor of behaviour, but at times, other factors may change the intention-behaviour relationship and may prevent one from acting on his or her intentions. Thus, intention is not a sole predictor of a person's behaviour.

Innovativeness has been studied in the past in different contexts (Rahman and Kharb, 2018; Venkatraman and 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 behaviours including recycling (M. T. Rahman et al., 2020). With respect to consumer behaviour studies, consumer innovativeness has been used as a moderator in the past (Kim and Cha, 2021; Lao, 2014; Muraguri et al., 2020; Zhang and Dong, 2023). The finding of our research found a significant moderating role in consumer innovativeness between recycling intention and recycling behaviour among young Pakistanis. There are a number of 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 behaviour. 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.

Our 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 behaviour, certain other variables such as demographic, psychographic characteristics, culture, and attitude also play an active role in bridging the intention behaviour gap of households. This explains the absence of proper waste disposal behaviour 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, filthy odor, 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 of sorting facilities and a proper segregation infrastructure positively influences recycling behavioural 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 of 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. Our study proved convenience does not significantly predict recycling behaviour. 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.

6. Implications

On the basis of the above discussion, our 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 behaviour by taking into account environmental concerns, packaging, convenience, and consumer innovation. These variables have not been given due attention in their role in shaping pro-environmental behaviours among households in Pakistan.

It is important to incorporate recycling-related communication in advertising in order to influence recycling attitudes among consumers. Eco-friendly packaging and marketing campaigns that focus on creating environmental consciousness and benefits must be developed to influence consumers' recycling habits. Moreover, marketers must collaborate with influencers, community leaders, and celebrities to promote recycling and encourage responsible waste management practices, thus influencing subjective norms which in turn is a strong predictor of intention and behaviour. Marketers can also offer incentives, such as rewards or discounts to encourage recycling behaviour among consumers. Our research findings clearly identify the importance of packaging variables in recycling behaviour.

Therefore, marketers must develop innovative, eco-friendly colours, graphics and materials to appeal to eco-conscious and innovative customers. Corporate social responsibility initiatives such as educational programs, workshops, and events relating to environmental awareness can encourage households to engage in recycling.

There is an intense need for proper recycling infrastructure including waste collection centers, waste separation facilities and recycling bins that are more accessible and are perceived to be more convenient by households in order to foster recycling behaviour among the masses. Local industries and businesses must be encouraged to participate in recycling programs by providing them with tax incentives or subsidies for recycling initiatives such as sustainable packaging. Recycling education programs must be developed in schools, colleges, and universities in order to educate citizens about the environmental benefits of recycling. Partnering with NGOs and environmental organizations through campaigns and competitions can serve as a catalyst to engage youth in nationwide recycling programs. There should be legislation for mandatory recycling programs for organizations and households. Penalties for improper waste disposal must be implemented. Additionally, there is an intense need for collaborative partnerships between marketers, businesses, government agencies, and environmental organizations to create a holistic approach to promoting recycling. Partnerships with tech startups for innovative recycling solutions should be encouraged. The discussed components can make recycling more accessible, engaging, and efficient for Pakistani households.

7. Limitations

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 behaviour through longitudinal studies in different cities of Pakistan in order to understand the role of culture and geographic location (rural, urban) may influence recycling patterns, habits, preferences, attitude and behaviour. 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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