The Impact of Reusable Packaging knowledgeability and Environmental Attitude on Pro-Environmental Behavior

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Abstract

In the post-pandemic era, both sustainable packaging design and consumers who engage in sustainable consumption behavior are necessary for environmentally responsible growth of e-commerce. Guided by the theory of planned behavior, there are two research purposes of this study: 1. discuss and analyze the impact of demographic factors on consumers' knowledge about reusable packaging, and their environmental attitude and pro-environmental behaviors based on surveys in the current literature; 2. explore whether there is a significant relationship between consumers' knowledgeability of reusable packaging and environmental attitude on pro-environmental behaviors. A four-part questionnaire surveyed: 1. demographic information, 2. knowledgeability of reusable packaging, 3. environmental attitude, 4. pro-environmental behavior. The questionnaire was randomly distributed to online shoppers. This study utilizes descriptive analysis, correlation analysis, regression analysis, and mediation analysis to test the proposed hypotheses. The results of the study show that consumers' reusable packaging knowledgeability and environmental attitude have significant influence on their pro-environmental behavior. Although environmental attitude has a significant impact on pro-environmental behavior and partially mediates the relationship between reusable packaging knowledgeability and pro-environmental behavior, the impact of environmental attitude is relatively small compared to reusable packaging knowledgeability. This suggests that consumers' reusable packaging knowledgeability is the main factor influencing their pro-environmental behavior, especially their level of knowledge about packaging materials. In addition, this study also shows that the impact of consumers' packaging knowledgeability and environmental attitude on pro-environmental behavior are influenced by gender, age and income levels.

Keywords: Consumers, Reusable packaging, Environmental attitude, Pro-environmental behavior

1. Introduction

The pandemic has not only had a far-reaching impact on politics, economics, and education (Ghiabi, 2021; Li, 2021; Shevchenko et al., 2020), but also on people's lifestyles which had to adapt to dramatic changes (Bentlage et al., 2020; Li et al., 2021; Xiang et al., 2020). In the wake of the pandemic, many

schools have shifted to online education, and companies are allowing employees to work from home. During the pandemic, “zero contact”, “remote” and “online services” became new research trends (Kang et al., 2022), creating new business opportunities despite the severe human and economic toll of the pandemic worldwide (Passaris, 2021). Overall, while the Covid19 pandemic has impacted the industrial and economic development of countries, it has also prompted industries to adapt by using technologies such as telematics, artificial intelligence, virtual reality, information security, automated production lines and other technologies to improve delivery systems for online purchases. For example, the use of smart electronics to network the purchase of products and services is already a new industrial format. Since the outbreak of the Covid19 pandemic, the environmental damage caused by packaging waste from online shopping has become a serious global issue (Chueamuangphan et al., 2019; Kim et al., 2022; Majumdar, 2021). This pandemic has stimulated online shopping, leading to a significant increase in food packaging waste, but especially in non-biodegradable food packaging waste (de Oliveira et al., 2021). With the new trend of working from home resulting in increasing products purchases online, the issue of waste generated by online shopping is also gaining attention (Sharma et al., 2020; Tripathi et al., 2020). There has been a significant increase in the frequency of online shopping and packaging waste post-pandemic (Ikiz et al., 2021), and the current surge in packaging waste from online shopping has raised environmental concerns (Liu et al., 2020; Sievering, 2020). Current studies have shown that online shopping generates 4.8 times more packaging waste than offline shopping, and in the next decade online shopping could generate an additional 10% of packaging waste (Kim et al., 2022). During the pandemic, the use of single-use plastics increased to alarming levels, negatively impacting waste recycling. At the same time, the frequency of waste collection and recycling was reduced, resulting in the generation of large amounts of waste (Kim et al., 2022). The consumer's attitude towards packaging is usually to simply throw it away. To transform e-commerce into green commerce, companies need to invest in packaging innovation and sustainable supply chain mechanisms, including reverse logistics systems to promote reuse and recycling, while consumers need to demonstrate sustainable consumption behavior (Chueamuangphan et al., 2019). Currently, there is a lack of research on the disposal of packaging used for delivery to online consumers. In the area of food packaging, which accounts for 15.7% of total municipal waste, food suppliers should improve their packaging practices to avoid further growth, while food service platforms should improve environmental protection mechanisms (Liu et al., 2020). Studies have shown that there are significant differences in the attitudes and behaviors of urban and rural residents toward packaging waste (Cai et al., 2021). Disposal of packaging waste has become an urgent issue. The main purposes of this study are as follows:

- Review the current literature on reusable packaging, environmental attitude, and pro-environmental behavior.
- Discuss and analyze the impact of demographic factors on consumers' knowledgeability about reusable packaging, environmental attitude, and pro-environmental behaviors.
- Discuss and analyze whether there is a significant relationship between consumers'

knowledgeability of reusable packaging and environmental attitude on pro-environmental behaviors.

This research is primarily based on the framework of the theory of planned behavior (TPB). TPB emphasizes that external conditions and abilities can affect an individual's intrinsic motivation, which in turn influences attitudes and ultimately actual behaviors (Stern, 2000). More specifically, an individual's level of environmental protection knowledge will affect their intrinsic motivation toward environmental protection. Individuals with higher motivation levels tend to form stronger pro-environmental attitudes and ultimately engage in more pro-environmental behaviors (De Leeuw et al., 2015). Guided by TPB, this study examines whether consumers' mastery of reusable packaging knowledge influences their environmental attitudes and green behaviors. According to TPB, environmental knowledge is an important antecedent impacting environmental attitudes and behaviors (Kollmuss & Agyeman, 2002). When consumers possess richer knowledge regarding material properties and reuse models of reusable packaging, it can strengthen their intrinsic motivation to engage in green behaviors, thus forming more positive environmental attitudes and taking more green actions. The reusable packaging knowledge scale designed in this study aims to measure subjects' mastery of knowledge in this domain, which can comprehensively investigate the key influencing factors.

Through this study, we can understand the current status of consumers' knowledgeability about reusable packaging, environmental attitude, and pro-environmental behavior, which can provide the basis for evaluating potential business services for online shoppers. Data from consumers' knowledgeability of reusable packaging, environmental attitude, and pro-environmental behavior can clarify user profiles and develop relevant design strategies based on group segmentation results. Finally, the relevance of consumers' knowledge of reusable packaging and environmental attitude on pro-environmental behavior can help promote green development in the reusable packaging industry.

2. Literature review

2-1 Reusable packaging

With the increase in environmental awareness, more and more companies are supporting the use of environmentally friendly packaging materials. To reduce the disposable packaging waste generated by online shopping, guidance is needed for green packaging initiatives and implementation plans. Meanwhile, the establishment of a comprehensive packaging recovery system has become a hot topic of research in various countries and regions (Georgiopoulou et al., 2021; Su et al., 2020; Weber Macena et al., 2021). Reusable packaging is one of the categories of recycled products where the design of packaging must follow the principles of sustainability to conserve natural resources, optimize their use and minimize the negative impact on the environment. Increasing the recyclable content and reusability of packaging options can reduce their environmental footprint (Foundation, 2013; Stotz et al., 2017). Reusable packaging works when online shopping platforms, packaging return logistics companies, and consumers are all connected to create a complete reusable packaging operating model. As a representative example of a company providing reusable packaging in Taiwan, Package+ Company

found that in practice, the reusable packaging cycle is divided into four stages: packaging is leased to online sellers, products are shipped in reusable packaging, consumers return packaging to collection locations, and logistic companies collect and clean packaging for reuse. Some scholars believe that existing logistics companies can be used to develop a reverse logistics system, which effectively creates new opportunities for companies to develop sustainable models for reusable packaging which will be more environmentally friendly than recycling of waste packaging material (Lai et al., 2022).

Studies have shown that the higher the psychological perception of being empowered to recycle waste (reflecting meaning, competence, choice, and influence), the more individuals tend to engage in recycling and waste reduction activities (Chen et al.,2019). In the development of reusable packaging systems, various countries and regions have used different development strategies. To promote the development of reusable packaging, three different types of regulatory strategies can be broadly classified: subsidies, fines, and tax incentives. It has been pointed out that tax incentives for companies to make green decisions may be the most appropriate policy for China, as the world's largest consumer market, because incentivizing tax policies can strike a good balance between the development of new industries and environmental protection (Xiao et al., 2020). Meanwhile, in Taiwan's small consumer market, the Taiwanese government has opted for a subsidy policy. In 2019, Taiwan's Environmental Protection Administration established the “Guidelines for Online Shopping Packaging Reduction” which promotes reusable packaging for online purchases, and focuses on: reduction of packaging, use of environmentally friendly materials, and reusing packaging to reduce waste, which is one of the key goals of the guidelines (Min & Galle, 1997), In Taiwan's first three-month pilot program to promote reusable packaging practices in 2020, the average return rate of reusable packaging was only 25% by consumers, with return rates ranging from 20% to 80% among different participating companies. In reviewing the program, EPA Deputy Director of Waste Management Liu Rui-xiang identified three areas that need to be addressed to promote the development of reusable packaging: increasing consumers' packaging return behavior, providing incentives and pressure on consumers to return packaging, and stricter packaging regulations (Bor et al., 2004).

There are four main factors that influence consumers' willingness to pay for reusable packaging: environmental protection, the quality of green packaging, effective product protection, and the price of packaging. According to the estimated results, although most consumers have insufficient knowledge about green packaging, they still have a strong willingness to buy. In addition, it was observed that compared with the price and appearance of green packaging, consumers pay more attention to the practicality of green packaging, such as convenience, reusability, and effective product protection (Hao et al., 2019).

2-2 Environmental attitude

Environmental attitude is one of the core concepts of environmental psychology, which usually refers to concern for the environment (Baierl & Bogner, 2023; Preston & Shin, 2022). Environmental attitude is a multidimensional construct that encompasses cognitive, affective, and evaluative orientations towards the environment. It is influenced by a variety of factors, including individual,

social, and contextual factorss (Gifford & Nilsson, 2014; Jaich, 2022; Woo & Kim, 2019). Environmental attitude refers to an individual's consistent and sustainable internal thoughts about the environment to evaluate environmental issues based on beliefs, goals, and behavioral intention towards the environment (Hines et al., 1987). Environmental attitude determines human behaviors, which is one of the factors affecting environmental quality (Schultz et al., 2004). Environmental attitude can be divided into three factors: cognitive, affective, and intentional, which varies with age, gender, socioeconomic status, country of origin, urban or rural residence, religion, politics, values, personality, experience, education, and knowledge about reusable packaging (Feinberg & Willer, 2013; Gifford & Sussman, 2012).

Various scales and measures have been developed to assess environmental attitude. For instance, the New Ecological Paradigm (NEP) scale developed by Dunlap and Van Liere (1978) measures an individual's ecological worldview and includes items related to beliefs about humanity's relationship with nature and the need for environmental protection. The Environmental Attitude Scale (EAS) developed by Kals et al. (1999) measures cognitive, affective, and evaluative dimensions of environmental attitude. Other measures include the Environmental Concern Scale, the Connectedness to Nature Scale, and the Pro-Environmental Behavior Scale, among others. These measures have been widely used in environmental psychology research to assess individuals' environmental attitude.

Understanding individuals' environmental attitude is crucial for promoting pro-environmental behaviors and addressing environmental challenges (Mónus, 2022). Further research can explore the complex interactions among various factors that shape environmental attitude and how it evolves over time (Miller et al., 2022). It can also investigate the effectiveness of interventions aimed at promoting positive environmental attitude and behaviors, and the implications of environmental attitude for policy-making and sustainability initiatives (Meng & Si, 2022; Wilkie & Trotter, 2022).

2-3 Pro-environmental behavior

Pro-environmental behavior seeks to solve the problems of climate change, environmental pollution, and loss of biodiversity which is caused by human activity. Ultimately, it is human actions can lead to greater understanding, mitigate, or exacerbate these problems (Lange & Dewitte, 2019). In fact, it has proven quite difficult to define what kind of behavior is considered beneficial for the environment. The standards for environmental protection are continuously changing, which shows that pro-environmental behavior is determined by culture and history. Additionally, environmental protection is a relative term because the impact of one behavior on the natural environment must be considered in the context of other behaviors (Schultz & Kaiser, 2012). Interdisciplinary fields such as environmental psychology, industrial and organizational psychology, behavioral analysis, environmental education, or consumer research all are studying the impact of human behavior, both beneficial and harmful, on the natural environment.

Studies have shown that sustainable pro-environmental behaviors may bring feelings of happiness, and even though it is sometimes costly or unpopular behavior, sustaining such behaviors is also beneficial to society because it helps the earth and the people who live in it (Aknin et al., 2018; Curry

et al., 2018; Hui et al., 2020). Psychologically, positive emotions (caused by nature or other reasons) can directly influence pro-environmental behavior. In particular, feelings of self-transcendence, such as awe, empathy, and gratitude, which can be promoted by nature, can cultivate pro-social behavior. Most behaviors that are beneficial to the environmental are also beneficial to society (Zelenski & Desrochers, 2021). In addition, the positive impact of environmental attitude on pro-environmental behavior is offset by its behavioral costs (Kaiser & Lange, 2021), which means that when formulating environmental protection design strategies, we need to consider how to reduce the cost and burden on environmentalists.

3. Materials and method

The research object is people who shop online and a questionnaire was distributed to a random sample of online shoppers. Participants scanned the QR code to access the survey. They voluntarily responded to the academic prompts and had the option to discontinue the survey at any point. As a result, all participants were willing to complete the questionnaire based on the principles of informed and voluntary participation. The survey sample of this study comes from online shoppers in China who know about recycling packaging. The content of the research questionnaire is divided into four parts: demographic information, scale for reusable packaging knowledgeability, scale for environmental attitude, and scale for pro-environmental behavior. After completing the first draft of the questionnaire, it was pre-tested, and the results of the pre-test are used for factor analysis, item analysis, reliability, and validity analysis to check the appropriateness of the questions and to facilitate the completion of the formal test questionnaire. The research framework is shown in Figure 1.

Firstly, the pre-test was conducted. After completing the first draft of the questionnaire and to ensure its reliability and validity, the questionnaire was distributed online. The total number of questionnaires in this study is three. Except for the first one, which is a self-developed scale for reusable packaging knowledgeability, the other two scales for environmental attitude and pro-environmental behavior are mature scales that have been verified by use. Therefore, there is no need to repeat the pre-testing process for the Environmental Attitude Scale and the Pro-environmental Behavior Scale.

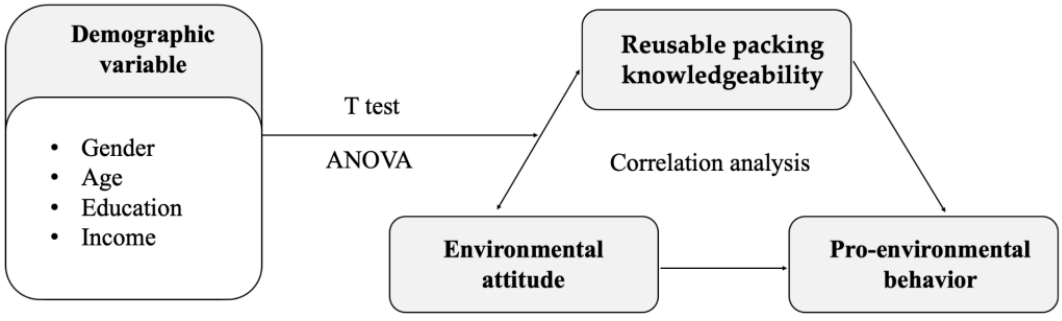

Figure 1. Research architecture diagram

This study utilized descriptive analysis, correlation analysis, regression analysis and mediation analysis to examine the hypothesized relationships among key variables. Descriptive analysis was performed to understand respondents" characteristics. Correlation analysis was conducted to explore the correlations between variables. Multiple regression analysis was applied to determine the influence of independent variables on dependent variables. Mediation analysis using the bootstrapping method was performed to explore the mediating role of environmental attitude. These statistical techniques provide rigorous examination of the proposed research model and hypotheses. Explanations in plain language are presented in the methodology section to enhance readability.

In addition to the basic demographic data, the total number of questions in this study is 44, but the total number of questions in the first questionnaire is only 15. According to Comrey (1988), when the number of questions in the scale is less than 40, the average sample size is about 150, but the better sample size is 200, since more subjects should be included in the factor analysis (DeVellis,1991). Scholars Tinsley and Tinsley (1987) suggested that the ratio of the number of questions to the pre-test sample size should be between 1:5 to 1:10 for factor analysis. According to the above suggestions, this study predicts that for a total of 66 samples recovered, 1 questionnaire will be invalid, with an effective recovery rate of ninety-seven percent. The gender representation in the sample size was fairly balanced, with men accounting for 53.8%; the age of respondents has a normal distribution centered in the 26- and 30-years old range, with an average age of 35.

After the pre-sample test was completed, a research sample of 510 questionnaires were randomly distributed, with 504 valid responses, for a 99% response rate. The gender ratio between men and women is balanced, with a normal distribution of responses centered in the 26 - 30 age range, with an overall average age of 31.

3-1 Scale for knowledgeability of reusable packaging

An operational system for reusable packaging for online purchases involves re-usable packaging manufacturers, e-commerce vendors, and logistics companies for collection (physical sites), to create financially and environmentally sustainable business models. This circular operating system has four steps: goods delivery, packaging return, collection and cleaning, and re-lease to e-commerce vendors, as shown in Table 1.

Table 1. Reusable packaging operation pattern of online shopping

Items	Content
Goods delivery	**E-commerce companies ships products in reusable packaging.**
Packaging return	**After receiving the goods, the consumer returns the packaging to a cooperative collection location.**
Recovery and Cleaning	**Cooperative logistics providers collect the packaging and send it out for cleaning.**
Lease of reusable packaging	**Leasing companies lease recyclable packaging to e-commerce**

Compared with traditional cardboard boxes and damaged plastic bags, reusable packaging has many advantages. According to the official introduction of Taiwan's Package+ Company, the materials of the Package+ reusable packaging are made from recycled bottles and glass, which are waterproof, cleanable, impact resistant, trackable, and can be reused more than 50 times. This rate of average use

can reduce carbon emissions by about 1.2kgs and 300 grams of disposable packaging waste per purchase. This innovative business model provides an environmentally sustainable product and service that is increasing consumers' pro-environmental behavior (Coelho et al., 2020).

According to the analysis above, reusable packaging knowledgeability can be divided into three areas: understanding reusability as solution (items 1-5), understanding of the operational model (items6-10) and packaging materials (items 11-15), as shown in the following Table 2. A five-point Likert scale was used, with five statements ranging from 1 to 5 indicating “strongly disagree” to “strongly agree” , where “1” indicates “strongly disagree” , “2” indicates “not quite agree” , “3” indicates “unclear/uncertain” , “4” indicates “somewhat agree” , and “5” indicates “strongly agree”. After the pre-test questionnaire was collected, this study used the correlation between the items and the revised total score and t-test to analyze the items. Through the t-test of extreme value high and low grouping, it showed that the critical ratio (CR value) of each item reached a significant level ($p<.05$), and the high and low grouping could be distinguished. For confirmatory factor analysis, the KMO value test and Bartlett spherical test were first. conducted, and it was found that the KMO value was 0.854, the approximate chi-square distribution of Bartlett spherical test was 672.558, the degree of freedom was 105, and the significance was 0.00. The results showed that the scale for knowledgeability of reusable packaging had considerable validity, which was sufficient for factor analysis.

During the factor analysis, three factors were extracted, and the characteristic root values. were all greater than 1. The variance interpretation rates of these three factors after rotation were 25.348%, 24.802%, and 23.295%, respectively, and the cumulative variance interpretation rate after rotation was 73.445%. The maximum variance rotation method (varimax) is used for rotation to determine the corresponding relationship between factors and research items. In this study, Cronbach's α value is used to test the reliability of the scale for knowledgeability of reusable packaging. The α values of each construction surface are divided into 0.911, 0.881 and 0.918, and the total α value is 0.902, which shows good internal consistency and reliability.

Table 2. Scale of reusable packaging knowledge

No.	Item	Score (1~5)
1	I understand that reusable packaging is a category of recycled products.	
2	I understand that packaging design must follow the principle of circularity in order to conserve natural resources.	
3	Reusable packaging can increase the recyclability of recycled materials in packaging options, which can reduce the environmental impact.	
4	Reusable packaging should minimize the negative impact on the environment.	
5	Reusable packaging is the way to solve the environmental problems from online shopping packaging.	

6	I understand that online purchases are shipped in a way that allows the packaging to be reused.
7	I understand “packaging return” means consumers return the packaging to a cooperative location after receiving the goods.
8	The cooperative logistics industry will recycle the packaging and send it out for cleaning.
9	Leasing companies should lease reusable packaging to e-commerce vendors.
10	I understand that the operational model of reusable packaging is goods delivery, packaging return, recovery and cleaning of packaging, and leasing of packaging.
11	Reusable packaging materials should be waterproof.
12	Reusable packaging materials should be stained resistant.
13	Reusable packaging materials should provide protection from impact.
14	If the present conditions continue, we will soon suffer a serious ecological disaster.
15	Man is destroying the environment.

3-2 Environmental attitude scale

The content of the environmental attitude scale in this study was developed using the environmental attitude scale from Cheng-Hung Liu (2022), which was designed by this scholar with reference to the New Ecological Paradigm (NEP) scale of Dunlap et al. (2000) and modified with reference to the Chinese scale translated by Jhang Jian, S.-J et al. (2018). A five-point Likert scale was used with five statements ranging from 1 to 5 where “1” indicates “strongly disagree”, “2” indicates “somewhat agree”, “3” indicates “neither agree” or “disagree”, “4” indicates “somewhat agree”, and “5” indicates “strongly agree”.

After item analysis, reliability analysis, and factor analysis, the scale can be divided into three factor constructs: questions 1-6 assess “anti-anthropocentrism”, questions 7-10 assess “the fact of growth limitations”, and questions 11-13 assess “ecological balance”, as shown in Table 3.

Table 3. Environmental attitude scale

No.	Item	Score (1~5)
1	Humans are the masters of all things.	
2	Human intelligence will not make the Earth uninhabitable.	
3	Human beings will eventually learn more about the workings and laws of nature and thus have the power to control it.	
4	Humans have the power to alter the natural environment to suit their needs.	
5	The so-called “ecological crisis” facing humanity ought to be an exaggeration.	

6	The balance of nature is strong enough to counteract the impact of modern industrial nations.
7	Humanity ought to be severely damaging the environment.
8	If this situation continues, we will soon suffer a serious ecological disaster.
9	The earth's natural resources are abundant if we can learn how to use them.
10	The world's population ought to be approaching the limit of what the planet can support.
11	The balance of nature ought to be fragile and easily disturbed.
12	Human interference with nature often has disastrous consequences.
13	Despite their special abilities, human beings ought to be still subject to the laws of nature.

Table 4. Pro-environmental behavior scale (PEB)

No.	Item	Score (1~5)
1	I often discuss environmental issues with others.	
2	I have participated in the local community of environmental organizations.	
3	I will participate in environmental protection activities with young people.	
4	I have worked with others to solve environmental problems.	
5	I have improved the soil or wildlife habitat on private land.	
6	I have improved land or wildlife habitat on public land.	
7	I have conducted wildlife research and ecological monitoring to protect my way of life.	
8	I have advocated for wildlife conservation.	
9	I recycle or reuse products.	
10	I have the behavior of conserving energy or water resources.	
11	I have the behavior of picking up garbage/not littering.	
12	I have engaged in environmentally friendly consumption.	
13	I have voted and participated in political decisions.	
14	I have written letters on environmental issues.	
15	I have voiced my demands on environmental issues.	
16	I have donated money to environmental causes.	

3-3 Pro-environmental behavior scale

This scale is based on the work of Markle (2013) and Larson et al. (2015) and was modified for the purposes of this study into 16 questions, which has been divided into four parts: social environmentalism, land stewardship, conservation lifestyle, and environmental citizenship. A five-point

Likert scale was used, with five statements ranging from 1 to 5 indicating “strongly disagree” to “strongly agree”, where “1” indicates “strongly disagree”, “2” indicates “not quite agree”, “3” indicates “unclear/uncertain”, “4” indicates “somewhat agree” and “5” indicates “strongly agree”, as shown in Table 4.

4. Result

4-1 Background analysis of the samples

The demographic variables of participants in this study include gender, age, and educational level and income levels. The numbers and percentages of each are shown in Table 9. In terms of “gender”, the participants were balanced with men accounting for 50.2%; the age of participants were normally distributed around the age range of 26 to 30 years old, with an average age of 31; in terms of educational level, the vast majority of the participants have at least completed high school (48.2%) and 39.0% having completed 4-year college. In terms of income level, the data shows that the majority of participants have “Occasionally insufficient” income, which accounted for 46.4%, and 34.7% have “almost sufficient” income.

Table 5. Analysis of differences in reusable packaging knowledgeability, environmental attitude, and pro-environmental behavior with “gender” (N=504)

Items		Gender (Mean ± S.D.)		F
		Male(n=253)	Female(n=251)	
Reusable packaging knowledgeability	Packaging material	2.89±1.21	3.27±1.19	12.30*
	Reusability as solution	2.85±1.23	3.36±1.24	21.15*
	Operational model	2.82±1.14	3.41±1.16	33.77*
Environmental attitude	Anti-anthropocentrism	2.93±1.18	3.35±1.2	15.6*
	Limitation of earth's resources	2.67±1.32	3.05±1.25	11.11*
	Ecological balance	3.05±1.45	3.43±1.43	8.85*
	Social environmentalism	2.78±1.19	3.18±1.24	13.94*
Pro-environmental behavior	Land management	2.96±1.28	3.28±1.29	7.69*
	Sustainable lifestyles	2.98±1.36	3.52±1.3	21.53*
	Environmental citizenship	2.74±1.07	3.18±1.17	19.88*

* $p<0.05$

4-2 Demographic differences in knowledgeability, attitude, and behavior

4-2.1 Gender differences in knowledgeability, attitude, and behavior

Analysis of the differences in reusable packaging knowledgeability, environmental attitude, and pro-environmental behavior by demographic variables. From Table 5, ANOVA (One-way ANOVA) is used to examine the differences between genders on 10 items: reusable packaging materials, reusability as solution, reusability operating model, anti-anthropocentrism, limitation of Earth's resources, ecological balance, social environmentalism, land management, sustainable lifestyle, and

environmental citizenship. From Table 5, significant differences are seen in reusable packaging knowledgeability (“packaging materials”), environmental attitude, and pro-environmental behaviors according to gender, and women scored higher on the mean of each comparative component.

Table 6. Analysis of differences in reusable packaging knowledgeability, environmental attitude, and pro-environmental behavior with “age”

Items	Age (Mean ± S.D.)							
	≤18(n=52)	18~25(n=112)	26~30(n=123)	31~40(n=116)	41~50(n=70)	≥51(n=31)	≥60(n=13)	F
Packaging material	2.32±0.99	2.94±1.27	3.27±1.16	3.37±1.15	3.04±1.24	2.87±1.22	3.32±1.16	5.76*
Reusability as solution	2.38±1.15	2.9±1.25	3.27±1.21	3.51±1.19	3.17±1.21	2.77±1.4	2.66±1.29	6.55*
Operational model	2.3±0.98	3.02±1.21	3.28±1.19	3.43±1.11	3.03±1.12	3.16±1.25	3.29±1.09	6.52*
Ant-anthropocentrism	2.42±1.08	3.03±1.19	3.4±1.15	3.42±1.19	3.09±1.19	2.98±1.21	2.63±1.16	6.06*
Limitation of Earth's resources	2.09±1.11	2.8±1.3	3.04±1.27	3.04±1.21	2.89±1.38	2.96±1.53	2.94±1.37	4.03*
Ecological balance	2.65±1.52	2.93±1.43	3.6±1.36	3.46±1.4	3.08±1.44	3.57±1.38	3.15±1.7	4.54*
Social environmentalism	2.76±1.18	2.8±1.28	3.06±1.24	3.26±1.17	2.86±1.2	3.31±1.16	2.42±1.31	2.54*
Land management	2.38±1.03	3.0±1.33	3.26±1.33	3.43±1.27	3.03±1.21	3.49±1.18	2.94±1.43	4.90*
Sustainable lifestyles	2.52±1.19	3.12±1.31	3.17±1.4	3.82±1.21	3.14±1.37	3.42±1.4	3.23±1.26	6.75*
Environmental citizenship	2.28±0.81	2.79±1.06	3.1±1.11	3.35±1.19	2.91±1.15	2.72±1.18	2.92±1.18	6.70*

4-2.2 Age differences in knowledgeability, attitude, and behavior

Table 6 shows results from use of ANOVA (One-way ANOVA) to examine the impact of age on a total of 10 items: packaging materials, reusability as solution, operational model, anti-anthropocentrism, Limitation of Earth's resources, eco-logical balance, social environmentalism, land management, sustainable lifestyle, and environmental citizenship. It can be seen from Table 11 that the differences in knowledgeability about reusable packaging, environmental attitude and pro-environmental behaviors among different age groups is significant, and the higher the age of the sample population, the higher their reusable packaging knowledgeability, environmental attitude, and pro-environmental behaviors.

4-2.3 Education level differences in knowledgeability, attitude, and behavior

One-way ANOVA was used to determine the impact of educational level on knowledgeability about packaging material, reusability as solution, operational model, anti-anthropocentrism, limitation of Earth's resources, ecological balance, social environmentalism, land management, sustainable lifestyle, and environmental citizenship. Table 7 shows that the various “educational levels” showed a significant difference in understanding of the “operational model” ($F=3.224$, $p=0.022<0.05$). The higher the “educational level” of the sample, the higher their attitude toward “environmental citizenship”. There is no significant difference in environmental attitude and pro-environmental behaviors by educational level.

Table 7. Analysis of differences in reusable packaging knowledgeability, environmental attitude, and pro-environmental behavior with educational level (N=504)

Items	Educational level (Mean ± S.D.)				F
	Under high school (n=24)	High school(n=197)	College(n=243)	Graduate School(n=40)	
Packaging Materials	2.52±1.11	3.05±1.21	3.15±1.23	3.1±1.14	2.03
Reusability as Solution	2.78±1.28	2.97±1.29	3.21±1.23	3.29±1.21	2.17
Operational Model	2.52±1.15	3.06±1.2	3.17±1.17	3.4±1.09	3.22*
Anti-anthropocentrism	2.85±1.26	3.12±1.24	3.18±1.18	3.19±1.12	0.61
Limitation of Earth's resources	2.69±1.29	2.81±1.31	2.91±1.29	2.96±1.35	0.43
Ecological balance	2.68±1.52	3.24±1.47	3.25±1.44	3.46±1.38	1.50
Social environmentalism	2.97±1.2	2.88±1.17	3.06±1.27	2.95±1.31	0.77
Land management	2.54±1.3	3.15±1.29	3.12±1.31	3.25±1.21	1.78
Sustainable lifestyles	3.17±1.39	3.09±1.35	3.39±1.34	3.27±1.4	1.80
Environmental citizenship	2.65±1.15	2.87±1.12	3.04±1.14	3.12±1.19	1.72

* $p<0.05$

4-2.4 Income Level Differences in Knowledgeability, Attitude, and Behavior

The analysis of variance (ANOVA) was used to examine the differences between income levels on 10 items: packaging materials, reusability as solution, operational model, anti-anthropocentrism, Limitation of Earth's resources, ecological balance, social environmentalism, land management, sustainable lifestyle, and environmental citizenship. Significant differences are seen according to income levels in reusable packaging knowledgeability, environmental attitude (with exception for limitation of Earth's resources), and pro-environmental behavior as shown in Table 8.

The results showed that there were significant differences in knowledge about packaging material, reusability as solution, the operational model, anti-anthropocentrism, limitation of Earth's resources, ecological balance, social environmentalism, land management, sustainable lifestyle, and environmental citizenship by gender and age; significant differences in knowledge about the operational model by educational level; and significant differences in packaging material knowledge, reusability as solution, the operational model, anti-anthropocentrism, ecological balance, social environmentalism, land management, sustainable lifestyle, and environmental citizenship by income level. There are significant differences in knowledge of the operational model by educational level; there are significant differences in packaging material knowledgeability, reusability as solution, operating model, anti-anthropocentrism, ecological balance, social environmentalism, land management, sustainable lifestyle, and environmental citizenship with income level. Results are summarized in Table 9.

Table 8. Analysis of differences in reusable packaging knowledge, environmental attitude, and pro-environmental behavior with "income level"

Items	Income (Mean ± S.D.)				F
	Almost insufficient (n=59)	Occasionally insufficient (n=235)	basically sufficient (n=175)	Very sufficient. (n=35)	
Packaging material	2.41±1.07	2.93±1.2	3.34±1.19	3.9±0.87	16.42*

Reusability as Solution	2.4±1.14	2.94±1.21	3.47±1.23	3.54±1.22	14.89*
Operational Model	2.46±1.08	2.98±1.19	3.32±1.14	4.09±0.62	18.27*
Anti-anthropocentrism	2.66±1.16	3.01±1.21	3.32±1.16	4.0±0.96	11.96*
Limitation of Earth's resources	2.75±1.27	2.74±1.32	3.0±1.27	3.22±1.29	2.42
Ecological balance	2.9±1.41	3.15±1.5	3.39±1.4	3.63±1.33	2.91*
Social environmentalism	2.67±1.17	2.85±1.24	3.15±1.2	3.54±1.2	5.95*
Land management	2.5±1.09	3.13±1.27	3.27±1.35	3.31±1.3	5.68*
Sustainable lifestyles	2.8±1.18	2.96±1.37	3.62±1.28	4.07±1.0	15.71*
Environmental citizenship	2.44±0.98	2.81±1.1	3.2±1.16	3.64±0.99	13.12*

* $p<0.05$

Table 9. A summary of the analysis of differences in reusable packaging knowledgeability, environmental attitude, and pro-environmental behavior with different demographic variables(N=504)

Items	Gender	Age	Education	Income
Packaging material	*	*	—	*
Reusability as solution	*	*	—	*
Operational Model	*	*	*	*
Anti-anthropocentrism	*	*	—	*
Limitation of Earth's resources	*	*	—	—
Ecological balance	*	*	—	*
Social environmentalism	*	*	—	*
Land management	*	*	—	*
Sustainable lifestyles	*	*	—	*
Environmental citizenship	*	*	—	*

*** : significant difference ; —: no significant difference**

4-3 Analysis of differences in reusable packaging knowledgeability, environmental attitude, and pro-environmental behavior with different demographic variables

4-3.1 Correlation analysis of reusability packaging knowledgeability, environmental attitude, and pro-environmental behavior

Table 10. Correlation analysis of reusable packaging knowledge, environmental attitude, and pro-environmental behavior (N=504)

	Reusability as Solution	Packaging material	Operational Model	Anti-anthropocentrism	The fact of limits to growth	Ecological balance	Social environmentalism	Land manage-ment	Sustainable lifestyles	Environmental citizenship
Reusability as Solution										
Packaging material	.875*									
Operational Model	.881*	.861*								
Anti-anthropocentrism	.290*	.275*	.304*							
Limitation of Earth's resources	.256*	.263*	.284*	0.082						
Ecological balance	.106*	.116*	.139*	0.026	0.032					
Social environmentalism	.335*	.312*	.334*	.251*	.167*	.108*				
Land management	.337*	.301*	.309*	.158*	.155*	.111*	.260*			
Sustainable lifestyles	.252*	.264*	.330*	.227*	.176*	.088*	.333*	.199*		
Environmental citizenship	.290*	.295*	.297*	.153*	.166*	.107*	.212*	.250*	.171*	

Table 10 shows the correlation analysis used to examine the relationship between knowledge of packaging materials, reusability as solution, the operational model, anti-anthropocentrism, limitation of Earth's resources, ecological balance, social environmentalism, land management, sustainable lifestyles, and environmental citizenship. Specifically, the correlation between reusable packaging knowledgeability and environmental attitude was highest with packaging material knowledgeability and anti-anthropocentrism (.30), and the rest of the correlations were significantly positive. In the analysis of the correlation between knowledgeability of reusable packaging and pro-environmental behavior, the highest correlations were found between knowledgeability about packaging materials and sustainable lifestyle, knowledge about packaging materials and social environmentalism, reusability as solution and social environmentalism, and reusability as solution and land management (.33), and the rest of the correlations were significant and positive. When analyzing the correlation between environmental attitude and pro-environmental behavior, sustainable lifestyles had the highest correlation with anti-anthropocentrism (.22), and the rest had significant positive correlations.

Table 11. The summary of regression analysis of environmental attitude on knowledge of reusable packaging (N=504)

Item	Non-standardized coefficients	Standardized coefficients	t	Adjusted R^2	Tolerance	VIF
Packaging Materials	0.29	0.21	2.184*	0.09	1.16	5.27

*** p<0.05**

4-3.2 The influence of reusable packaging knowledgeability on environmental attitude

General linear regression was used to analyze the predictive power of reusable packaging knowledgeability on environmental attitude. The results are presented in Table 11. It shows that Only “Packaging Materials” has a significant positive effect on environmental attitude, and the adjusted R^2 is 0.05 (ΔF = 27.09), which shows that within reusable packaging knowledgeability, “packaging material knowledge” has 9% explanatory power on environmental attitude, and the standardized regression coefficient is positive, indicating that the better the consumer's “packaging material knowledge”, the better their environmental attitude.

4-3.3 The impact of environmental attitude on pro-environmental behavior

Using general linear regression to analyze the predictive power of environmental attitude on pro-environmental behavior, the results are shown in Table 12. “Anti-anthropocentrism” significantly affects pro-environmental behavior, and the adjusted R^2 is 0.06(ΔF= 33.59), which shows that “anti-anthropocentrism” has 6% explanatory power for pro-environmental behavior, and the standardized regression coefficient is positive, indicating that the stronger the environmental attitude of “ecological balance”, the better the pro-environmental behavior. Belief in the limitation of Earth's resources has a significant impact on pro-environmental behavior, and the adjusted R^2 is 0.33(ΔF= 251.91), which shows that understanding the limitation of Earth's resources has 33% explanatory power to pro-environmental behavior, and the standardized regression coefficient is positive, indicating that the stronger the consumer's environmental attitude is, the better his pro-environmental behavior. Belief in

the value of ecological balance significantly affects pro-environmental behavior, and the adjusted R^2 is 0.01(ΔF= 9.59), indicating that valuing ecological balance has 1% explanatory power to pro-environmental behavior, and the standardized regression co-efficient is positive, indicating that the stronger the consumer's environmental attitude about "ecological balance", the better his pro-environmental behavior. Among the three surveyed environmental attitude, "limitation of Earth's resources" is the most predictive of pro-environmental behavior.

Table 12. The summary of regression analysis of environmental attitude on pro-environmental Behavior (N=504)

Variance	Non-Standardized coefficients	Standardized coefficients	t	Adjusted R^2	Tolerance	VIF
Anti-anthropocentrism	0.12	0.20	5.75*	0.06	0.99	1
Limitation of Earth's resources	0.37	0.55	15.89*	0.33	0.99	1
Ecological balance	0.06	0.11	3.24*	0.01	0.99	1

*** p<0.05**

4-3.4 The influence of reusable packaging knowledgeability on pro-environmental behavior and the mediating effect of environmental attitude

In the diagnosis of collinearity, there is no serious collinearity problem because the variance fluctuation factors (VIF value) are all less than 10.

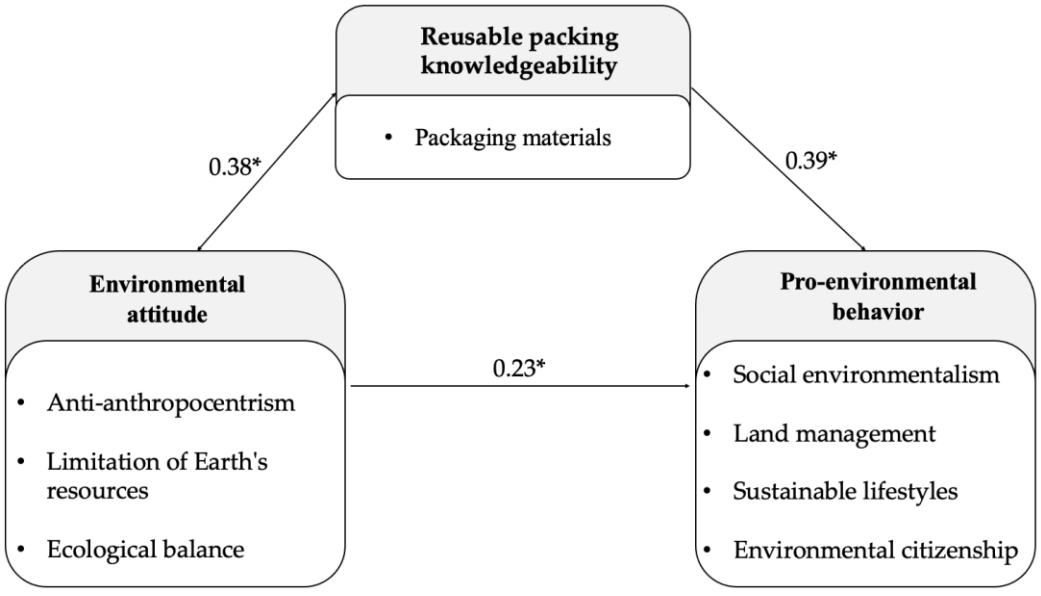

Figure 2. Path analysis of reusable packing knowledgeability, environmental attitude, and pro-environmental behavior

5. Discussion

5-1 Impact of knowledgeability of reusable packaging on consumers

Through statistical analysis of the data, it is found that knowledgeability of reusable packaging is impacted by different demographic variables such as gender, age, educational level and income level. Our research finds out elder consumers may have more established environmental attitudes and behaviors compared to younger consumers who are still developing their eco-consciousness. This finding is controversial in academia. Fuchs' (2023) study proves that senior students may have higher environmental awareness, as students' knowledge of environmental sustainability increases with academic progression. However, some studies argue that younger people have stronger environmental awareness (Fan & Joffre, 2020). The controversy may stem from differences in survey samples. If both younger and elder people share the same educational upbringing, elder people may have higher environmental awareness due to accumulating more knowledge about environmental protection. If the age gap between younger and elder generations is substantial, with discrepancies in receiving environmental information, the younger cohort may demonstrate better environmental awareness. Our study also finds that females often demonstrate greater environmental concern. This finding aligns with previous studies, as research by Hojnik et al. (2019) highlights that female consumers express greater environmental concern, consciousness of eco-products, and perceived environmental responsibility than male consumers. Additionally, our finding that consumers with higher disposable income may be more willing and able to pay premiums for reusable products is consistent with existing research showing that consumers with higher disposable incomes may indeed be more willing and capable of paying premiums for certain goods, including reusable and eco-friendly items (Khairunnisa & Setiartiti, 2020). Finally, our finding that consumers with higher education levels tend to have greater environmental awareness and concern, and they are more receptive to messaging about sustainability issues (Sun et al., 2020), reinforces that education equips people with the knowledge to make informed eco-conscious decisions. The traditional research view believes that educational level is the main factor that affects people's knowledgeability about an issue. This study shows that in addition to educational level, gender and income levels are also influential factors that affect consumer adoption of reusable packaging models (Chirilli et al., 2022). The research shows that the relationship between educational level and knowledge about a reusable packaging operational model is significant, but the relationship between educational level and knowledge about packaging materials and reusability as an environmental solution is not significant. This result might be due to increased awareness of sustainable development globally, and the vigorous promotion of the reusable packaging industry by various governmental organizations. Compared with knowledgeability about packaging materials and reusability as an environmental solution, consumers are more likely to be knowledgeable about the operational model of reusable packaging systems because it has greater impact on their daily lives.

Pertaining to the effect of reusable packaging knowledge on consumers, corporations may implement tactics including educational campaigns, trials, and green points initiatives regarding reusable packaging to enrich consumers' cognizance of reusable packaging and thereby influence their environmentally conscious actions (Arora et al., 2022; Centobelli et al., 2021). Concurrently,

policymakers could promulgate regulations mandating product eco-labeling, furnish tax motivations for green manufacturing and consumption, and champion reuse over mere recycling (Khan et al., 2019). Future inquiries could conduct cross-national juxtapositions of diverse countries' consumer perspectives on reusable packaging to illuminate localization strategies. Experimental research methodologies can directly manipulate reusable packaging knowledge and observe its impact on behaviors. These recommendations could assist enterprises and authorities in devising strategies, and additionally offer avenues for augmenting academic research.

5-2 Promoting societal environmental attitude

Early studies on adults as well as more recent ones find that elder people report engaging in more pro-environmental behaviors than younger people (Gifford & Nilsson, 2014), meanwhile, the research results shows that the elder consumers are, the stronger their environmental attitude and pro-environmental behavior. This result might be explained by elder populations having more personal experiences with the effects of environmental damage which may increase pro-environmental behavior (Al-Shetwi, 2022; Conroy & Berke, 2004). They may also be more concerned about the legacy they leave for future generations and therefore may be motivated to take action for the environment. For consumers with higher income levels, they tend to value and pursue environmentally sustainable lifestyles, so they are more likely to pay more attention to environmental concerns. Therefore, consumers with higher income are more likely to engage in green consumption behaviors because they tend to have greater concern for the environment. In this study, it is found that educational levels have little to do with environmental attitude. This may be explained by the current emphasis on environmental concerns at nearly all levels of society, especially the broad promotion of green products in industry, governmental policies that promote sustainable development, or even in the simple daily pro-environmental habits of family members. These all can act to minimize the influence of educational level on environmental attitude. Belief in the limitations in capacity of the earth's resources to sustain human life and activity has no significant influence on environmental attitude, which may mean that consumers are optimistic about the future of the environment. As many countries are currently facing the phenomenon of declining numbers of births along with an increasingly aging population, consumers may not fear that human populations will exceed the carrying capacity of the earth.

To promote a more positive environmental attitude in society, corporations could augment the availability and accessibility of eco-conscious products, and pioneer charity endeavors to increase cognizance of environmental safeguarding (Guzmám & Castro, 2023). Government entities may bolster environmental pedagogy and propaganda campaigns to ingrain citizens' ecological awareness from an early age (Pu et al., 2021). Future research could use long-term analysis to assess the effects of specific interventions on the development of environmental attitudes, or utilize experimental approaches to study the effectiveness of environmental education (Bezerra et al., 2022), or harness experimental methodologies to examine the efficacy of environmental education. Cross-border comparative pursuits could additionally pinpoint factors influencing environmental attitude evolution transnationally. These propositions aspire to furnish enterprises and policymakers with pathways to enhance public

environmental attitude, and concurrently inaugurate directions for academia to thoroughly probe this subject matter.

5-3 The significant relationship between reusable packaging knowledgeability, environmental attitude, and pro-environmental behavior

It is found that reusable packaging knowledgeability, environmental attitude and pro-environmental behavior are significantly related to each other, which shows that a broader knowledge about reusable packaging among consumers is an influential factor in improving environmental attitude and pro-environmental behavior. Although marketing for the current reusable packaging industry is developing, many enterprises emphasize the negative environmental impacts of the current wasteful packaging and the benefits of eco-friendly packaging material, but rarely promote awareness of reusable packaging as a way to improve people's pro-environmental attitude and eco-friendly behaviors. If consumers are expected to have more environmentally positive attitudes for dealing with packaging waste, the publicity on reusable packaging policies should be increased, especially in the classification and application of environmentally protective materials to help consumers have stronger environmental attitudes. Consumers with more knowledgeability of reusable packaging usually have stronger environmental attitude and more pro-environmental behaviors. They are also more inclined be concerned about the impact of their daily behaviors on the environment and are willing to support the operational model of the reusable packaging industry through practical actions. From the path analysis of knowledgeability about reusable packaging, environmental attitude, and pro-environmental behaviors, we can know that the pro-environmental behavior of consumers comes not only from the knowledgeability about packaging materials, but also from holding environmental beliefs of “anti-anthropocentrism”, “limitation of Earth's resources”, and the need for “ecological balance”. Because there has been much research done already to establish the impact of environmental attitude on pro-environmental behavior, this study's result shows that consumers' knowledgeability about reusable packaging is a more important factor for improving pro-environmental behavior.

In accordance with the preceding discourse, businesses could educate consumers about environmental issues and the benefits of using recyclable packaging, and offer rewards to encourage the purchase of reusable products. Governments could provide tax incentives for companies that use recyclable packaging, or establish regulations to promote the reuse of materials. Research could be conducted to assess the effectiveness of these initiatives and understand how consumer behavior influences their impact. These proposals aim to help companies and policymakers promote environmentally friendly behavior among consumers and create opportunities for academic research into the underlying causes.

6. Conclusion

Increased pro-environmental behaviors can spur demand for more reusable products which will present new opportunities for enterprises. Developing a reusable packaging industry is included in low-

carbon emission targets of several governments, and it also is key to promoting and upgrading the traditional packaging industry. Because it is important for consumers to translate their attitudes toward reusable packaging into pro-environmental behavior, guided by the theory of planned behavior, this study explores the impact of consumers' knowledgeability of reusable packaging and environmental attitude on pro-environmental behavior from an environmental psychology perspective. Although consumers' environmental attitude significantly affects pro-environmental behavior, it is less significant than the impact of knowledgeability of reusable products, though it is still a mediator between reusable packaging knowledgeability and environmentally protective behavior. Knowledgeability of reusable packaging is the main factor affecting consumers' environmentally protective behavior, especially consumers' knowledge of packaging materials. Secondly, this study also shows that consumers' reusable packaging knowledgeability, environmental attitude and pro-environmental behavior are influenced by gender, age, and income levels. Previous research shows that the current reusable packaging industry is still in its infancy and exploration stage, and the research mainly focused on developing the operational model and applications of reusable packaging. Related research on the relationship between consumers' online shopping behavior and willingness to take necessary actions to complete the cycle for the successful reuse of packaging is still relatively lacking. The results show that gender, age, income levels, and knowledgeability about reusable packaging will significantly affect environmental attitude and pro-environmental behavior. The academic significance, industrial application, shortcomings, and prospects of the research are as follows.

6-1 Academic application

In this study, a test scale of knowledgeability about reusable packaging was designed, and the development of this scale as a tool can be used for further study on how to develop more effective reusable products and systems. Besides environmental attitude, knowledgeability about reusability is a more influential factor, so more studies should focus on how to increase knowledgeability about reusable products and processes. Finally, this study confirms that environmental attitude has a mediating effect between knowledgeability about reusable packaging and environmentally protective behavior, so environmental attitude should still be considered when studying how to increase pro-environmental behaviors.

6-2 Industrial application

The current research can shed some light on industrial development of reusable products and the operational models needed to support them. First, strategic promotion of consumers' environmentally protective behavior increases consumer demands for sustainable products which can guide industry-wide goals, not just marketing campaigns. It is very important to communicate an industry's commitment to environmentally sustainable practices, including reusability, to gain customer brand recognition. As a strategic action, the promotion of consumers' knowledge about the environmental advantages of reusable packaging should be recognized and supported by governmental agencies and the packaging industry. Governmental agencies should formulate policies to support industrial

development of reusable packaging and systems to support their use. Both industry and government should also focus on improving consumers' attitudes toward protecting the environment and knowledgeability about reusable recycled products. At the same time, it is necessary to carefully study the expected priorities of their target customers in their design of reusable packaging and continuously update according to customer's needs.

6-3 Limitation and suggestion

The following limitations of this study may indicate future research directions:

1. Relying exclusively on quantitative methodologies and self-reported data may be susceptible to inherent biases. It is suggested that future research could benefit from incorporating qualitative studies to provide additional valuable insights. A mixed-methods approach, combining questionnaires with in-depth interviews, has the potential to yield more nuanced findings, thereby bolstering the credibility and robustness of the study's conclusions.
2. The limitations on the sample in this study were somewhat inevitable, as the prevalence of online shopping surged during the pandemic for safety reasons, leading to a rise in packaging waste. Despite the challenges posed by the pandemic, forthcoming research should contemplate incorporating offline consumers into the sample. Encompassing diverse demographics, beyond solely online shoppers, could enhance the broader relevance of the research findings.

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消費者循環包裝認知態度對環境保護行為的影響

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摘要

在後疫情時代，電子商務的成長受益於可持續的包裝設計和可持續消費行為。本研究有兩個研究目的：1.根據當前文獻中的調查，討論和分析人口因素對消費者對循環包裝的知識，以及他們的環境態度和環境保護行為的影響;2.探索消費者對循環包裝的知識和環境態度對環境保護行為是否存在顯著關係。問卷調查由四個部分組成：1.「基本資料」、2.「循環包裝知識量表」、3.「環境態度量表」、4.「環境保護行為量表」。問卷調查隨機分發給在線購物者。研究結果顯示，消費者對循環包裝的知識和環境態度對他們的環境保護行為有顯著影響。儘管環境態度對環境保護行為有顯著影響，並且在循環包裝知識和環境保護行為之間部分中介關係，但相對於循環包裝知識，環境態度的影響相對較小。這表明，消費者對循環包裝的知識是影響他們的環境保護行為的主要因素，特別是他們對包裝材料的瞭解程度。此外，本研究還表明，消費者的包裝知識和環境態度對環境保護行為的影響受到性別、年齡和收入水平的影響。

關鍵詞：循環經濟、循環包裝、綠色消費、環境態度、環境保護行為