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IJBSI International Journal of Business Studies and Innovation

ISSN 2737-5331
Volume 6
Issue 1
International Journal of Business Studies and Innovation

Article

Consumer Psychology Driving Factors for the Implementation of Sustainable Circular Economy Packaging

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Received: Mar 29, 2025; **Revised:** May 11, 2025; **Accepted:** May 12, 2025; **Published:** Mar 30, 2026

Abstract: This study examines the psychological factors influencing consumer adoption of circular packaging within the context of increasing environmental concerns and sustainable consumption. With the proliferation of e-commerce and resulting packaging waste, circular packaging has emerged as a critical sustainable solution. However, its successful implementation depends significantly on consumer acceptance and behavior. Through a mixed-methods approach combining experimental design, focus group interviews, and quantitative surveys, this research investigates how environmental awareness, perceived value, price sensitivity, convenience requirements, and demographic factors shape consumer attitudes and behaviors toward circular packaging. Data from 210 participants revealed that price and convenience significantly impact adoption intentions, with education level moderating environmental awareness and sustainable behaviors. The findings demonstrate that enhancing consumer awareness about environmental benefits while addressing psychological barriers to adoption can substantially increase circular packaging acceptance. This research provides theoretical contributions to understanding consumer psychology in sustainable consumption contexts and practical insights for businesses and policymakers seeking to promote circular economy initiatives.

Keywords: Consumer psychology, Circular packaging, Sustainable consumption, Environmental attitudes, Behavioral intentions, Mixed-Methods research

1. Introduction

With accelerating global population growth and resource depletion, environmental sustainability has become an urgent global concern, prompting increased environmental consciousness and demand for sustainable consumption practices (White et al., 2020). Circular packaging has emerged as a promising sustainable solution that effectively reduces environmental pollution while moving the consumption ecosystem toward sustainable development (Coelho et al., 2020). However, the successful implementation of circular packaging systems depends significantly on consumer psychology and behavioral choices (Steenis et al., 2022).

Recent studies have documented a notable gap between consumers' environmental awareness and their actual purchasing behaviors (Vermeir et al., 2023). Although many consumers express environmental concerns, these considerations often yield to traditional factors such as price and convenience in purchasing decisions (Gong et al., 2020). This attitude-behavior gap underscores the importance of understanding the deeper psychological mechanisms that drive or impede the adoption of circular packaging solutions (Rokka & Uusitalo, 2021).

The circular economy paradigm has gained substantial attention in recent years, with packaging being a central focus due to its ubiquity and environmental impact (Jerzyk, 2020). Circular packaging represents a shift from the traditional linear "take-make-dispose" model toward solutions designed to be reused, recycled, or biodegraded while maintaining economic value (Coelho et al., 2020). This concept encompasses principles such as design for reuse, recyclability, use of recycled materials, and minimization of environmental impact throughout the product lifecycle.

Despite growing interest in sustainable packaging solutions, consumer adoption remains influenced by various psychological factors, including environmental attitudes, perceived behavioral control, subjective norms, and convenience considerations (Magnier & Crié, 2023). Understanding these psychological drivers is crucial for developing effective strategies to promote circular packaging adoption and close the attitude-behavior gap.

This study addresses several research gaps by examining the psychological factors influencing circular packaging adoption through a mixed-methods approach (Tashakkori, A., & Teddlie, C., 2021). Unlike previous research that primarily focused on stated

preferences or attitudes, this study combines experimental methods with qualitative interviews and quantitative surveys to gain a comprehensive understanding of consumer psychology in this context. The research is guided by the Theory of Planned Behavior (Ajzen, 2020) and aims to provide practical insights for businesses and policymakers seeking to promote circular economy initiatives.

The specific objectives of this study include:

1. Analyzing the influence of psychological factors (environmental attitudes, subjective norms, perceived behavioral control) on consumer willingness to adopt circular packaging
2. Exploring differences in circular packaging perception and adoption intentions among consumers with varying demographic characteristics
3. Examining the moderating effects of variables such as price sensitivity, convenience, and education level on circular packaging adoption
4. Providing practical recommendations for businesses and policymakers to enhance consumer engagement with circular packaging initiatives

2. Literature Review

2.1. Consumer Psychology and Sustainable Consumption

Consumer psychology examines how thoughts, beliefs, feelings, and perceptions influence purchasing decisions and relationships with products and services (Kardes et al., 2022). In the context of sustainable consumption, psychological factors play a crucial role in shaping environmentally responsible behaviors (Joshi & Rahman, 2019).

Recent research has highlighted the importance of understanding consumer decision-making processes in sustainable consumption contexts. Pachur and Hertwig (2019) note that consumers often employ various heuristics when making purchase decisions, particularly in complex situations involving sustainability trade-offs. These decision-making strategies are influenced by both internal factors (motivation, perception, attitudes) and external factors (social norms, cultural context, environmental cues).

The emotional dimensions of sustainable consumption have received increasing attention in recent literature. Pizzi et al. (2021) demonstrated that positive emotions toward sustainable products can significantly enhance purchase intentions, even when consumers face barriers such as higher prices or reduced convenience. Their research suggests that emotional appeals may be more effective than purely rational arguments in promoting sustainable consumption behaviors (Zhang, H., & Zhu, M., 2021).

Digital technologies have introduced new dimensions to consumer psychology in sustainable consumption contexts. According to Geiger et al. (2021), digital platforms and applications enable consumers to make more informed, sustainable choices by providing transparency about product environmental impacts and sustainability credentials. However, the effectiveness of these digital tools depends on consumers' digital literacy, trust in information sources, and motivation to engage with sustainability information.

2.2. Circular Packaging and Material Considerations

Circular packaging represents a paradigm shift in packaging design and management, emphasizing solutions that can be continually reused, recycled, or biodegraded while maintaining their value in the economy (Steenis et al., 2022). According to Molina-Besch et al. (2021), circular packaging encompasses several key principles: design for reuse, recyclability, use of recycled materials, and minimization of environmental impact throughout the lifecycle (Niero, M., & Kalbar, P. P., 2021).

Material selection plays a crucial role in circular packaging effectiveness. Guillard et al. (2022) emphasize that successful circular packaging systems require careful consideration of material properties, including durability for reuse, recyclability, and compatibility with existing recycling infrastructure. Their research indicates that mono-materials often provide better circularity outcomes compared to multi-layer packaging solutions, which can be challenging to recycle effectively.

Recent studies have explored innovative materials for circular packaging applications. Rhim et al. (2021) reviewed developments in biodegradable and compostable packaging materials, highlighting advances in biopolymers, cellulose-based materials, and protein-based films. These materials offer promising alternatives to conventional plastics but face challenges related to cost, performance properties, and scalability.

Consumer perception and acceptance of circular packaging materials vary significantly. Herbes et al. (2022) found that while consumers generally express positive attitudes toward sustainable packaging materials, their actual purchasing decisions are influenced by factors such as visual appeal, perceived quality, and functionality. This highlights the importance of designing circular packaging solutions that not only meet environmental criteria but also satisfy consumer expectations regarding performance and aesthetics.

2.3. Behavioral Intentions and The Attitude-Behavior Gap

Behavioral intentions represent an individual's planned or anticipated future behavior and serve as a critical link between attitudes and actual behavior (Ajzen, 2020). According to the Theory of Planned Behavior, behavioral intentions are the most immediate determinant of actual behavior and are influenced by attitudes, subjective norms, and perceived behavioral control.

Research by Vermeir et al. (2023) demonstrates that behavioral intentions in sustainable consumption contexts are shaped by multiple factors, including personal values, social influences, and situational constraints. Their meta-analysis of sustainable consumption studies reveals that while intentions strongly predict behavior in many contexts, various factors can create an intention-behavior gap, particularly in sustainability-related behaviors (Park, H. J., & Lin, L. M., 2020).

The formation of behavioral intentions involves both cognitive and affective processes. Wang et al. (2021) highlight how emotions and rational evaluation combine to influence the strength and direction of behavioral intentions toward sustainable products. Their research shows that positive emotions toward environmentally friendly products can strengthen intentions even when cognitive evaluations (such as price considerations) are less favorable (Singh, P., & Cooper, T., 2021).

Several studies have examined the factors influencing behavioral intentions in the context of sustainable packaging. Ketelsen et al. (2020) conducted a systematic review of consumer responses to environmentally friendly food packaging, finding that environmental concerns, health considerations, and product quality perceptions all influence intentions to purchase products with sustainable packaging. However, they also noted significant barriers to translating these intentions into actual purchasing behavior, including price sensitivity, convenience requirements, and habitual purchasing patterns (Sun et al., 2021).

2.4. Theoretical Framework

This study applies the Theory of Planned Behavior (TPB) as its primary theoretical framework, supplemented by concepts from the Value-Belief-Norm Theory and the Motivation-Opportunity-Ability model. The TPB posits that behavioral intentions are determined by attitudes toward the behavior, subjective norms, and perceived behavioral control (Ajzen, 2020). In the context of circular packaging adoption, this framework helps explain how consumer attitudes toward sustainable packaging, social expectations regarding environmentally responsible behavior, and perceived ability to engage with circular packaging systems influence adoption intentions (White, K., Habib, R., & Hardisty, D. J., 2019).

The Value-Belief-Norm Theory extends this framework by emphasizing the role of personal values and beliefs about environmental consequences in shaping pro-environmental behaviors (White et al., 2020). This theory suggests that consumers with stronger environmental values are more likely to form positive attitudes toward circular packaging and subsequently develop stronger adoption intentions.

The Motivation-Opportunity-Ability model provides additional insights by highlighting the importance of not only motivational factors (attitudes, values) but also opportunity factors (availability, price, convenience) and ability factors (knowledge, skills) in determining sustainable consumption behaviors (Geiger et al., 2021). This model helps explain why even highly motivated consumers may not adopt circular packaging if they face opportunity barriers such as high prices or inconvenience.

Based on these theoretical frameworks and the literature review, we propose the following hypotheses:

H1: Price and convenience significantly impact consumer intentions to adopt circular packaging.
H2: Consumers are willing to try circular packaging regardless of age, education level, or income.
H3: Education level is positively associated with environmental awareness and attitudes toward circular packaging.
H4: Exposure to circular packaging positively influences consumers' environmental attitudes and behaviors.

3. Materials and Methods

3.1. Research Design

This study employed a mixed-methods research design combining experimental methods, focus group interviews, and quantitative surveys. This methodological triangulation provides a comprehensive understanding of consumer psychology related to circular packaging adoption (Creswell & Creswell, 2021). The experimental component allowed for controlled assessment of packaging impacts on consumer behavior, while focus groups provided deeper insights into psychological motivations and decision-making processes. Quantitative surveys enabled statistical testing of relationships between key variables.

3.2. Experimental Design

The experimental component involved 60 participants (30 in the experimental group and 30 in the control group) recruited through stratified random sampling to ensure demographic diversity. Participants were stratified based on age, gender, education level, and income to ensure representativeness. The experimental group received products packaged in circular packaging materials with information about their environmental benefits, while the control group received identical products in conventional packaging.

Participants used the products for a two-week period and completed pre- and post-experience surveys measuring their attitudes, perceptions, and behavioral intentions. The experimental design controlled for potential confounding variables by ensuring product equivalence between groups and standardizing the information provided about the products. This approach allowed for causal inference regarding the impact of circular packaging exposure on consumer psychology and behavior.

3.3. Focus Group Interviews

Following the experimental phase, 10 participants from each group participated in semi-structured focus group interviews. These interviews explored participants' experiences, perceptions, and decision-making processes related to the packaging materials. The focus groups were conducted following the recommendations of Krueger and Casey (2022), with a trained moderator guiding discussions around key themes while allowing for emergent topics (Wilkerson et al., 2023).

The focus group interviews centered around four main themes:

1. Perceptions and attitudes toward circular packaging
2. Motivations and barriers to circular packaging adoption
3. Influence of social norms on packaging choices
4. Suggestions for improving circular packaging systems

The focus groups were audio-recorded, transcribed, and analyzed using thematic analysis to identify recurring patterns and insights (Stewart & Shamdasani, 2021). This qualitative component provided rich contextual data to complement the experimental and survey findings (Nyumba et al., 2018).

3.4. Quantitative Survey

Based on insights from the experimental phase and focus group interviews, a comprehensive survey was developed and administered to a larger sample of 210 participants. The survey utilized validated scales to measure key constructs, including environmental attitudes, subjective norms, perceived behavioral control, price sensitivity, convenience orientation, and behavioral intentions.

Consumer values were measured using items adapted from Schwartz's Value Survey, focusing on ten basic values: stimulation, self-direction, hedonism, achievement, power, security, conformity, tradition, benevolence, and universalism (Schwartz et al., 2022). Participants rated the importance of each value on a 5-point Likert scale (1 = very unimportant to 5 = very important).

Attitudes toward circular packaging were measured using a 5-item scale adapted from Martinho et al. (2022), with items such as "Circular packaging can be reused to reduce resource waste" and "The convenience of recycling circular packaging makes me want to use it." Responses were recorded on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree).

Behavioral intentions were assessed using a 3-item scale adapted from Vermeir et al. (2023), with items including "I would recommend the use of circular packaging" and "I am willing to purchase products with circular packaging." Environmental behavior was measured using a 3-item scale focusing on recycling behavior, willingness to pay premiums for environmentally friendly products, and engagement in sustainable consumption practices.

3.5. Data Analysis

The experimental data were analyzed using repeated measures ANOVA to assess changes in attitudes and behavioral intentions before and after exposure to circular packaging. Focus group data were analyzed using thematic analysis following the six-step approach outlined by Braun and Clarke (2021): familiarization with data, initial coding, searching for themes, reviewing themes, defining themes, and producing the report.

For the quantitative survey data, exploratory factor analysis was conducted to identify underlying dimensions of consumer values and attitudes. Reliability analysis using Cronbach's alpha assessed the internal consistency of measurement scales. Multiple regression analysis examined relationships between key variables and tested the proposed hypotheses. Independent samples t-tests and ANOVA were used to examine differences in attitudes and behaviors across demographic groups.

4. Discussion

4.1. Experimental Results

The experimental phase revealed significant differences between the experimental and control groups in their post-experience attitudes and behavioral intentions. Participants exposed to circular packaging showed more positive attitudes toward sustainable packaging ($M_{exp} = 4.32$, $M_{control} = 3.67$, $t(58) = 4.23$, $p < .001$) and stronger intentions to adopt circular packaging in the future ($M_{exp} = 4.18$, $M_{control} = 3.41$, $t(58) = 3.86$, $p < .001$).

A repeated measures ANOVA indicated a significant interaction effect between time (pre vs. post) and group (experimental vs. control) for environmental attitudes ($F(1,58) = 12.37$, $p < .001$, $\eta^2 = .18$), indicating that exposure to circular packaging positively influenced environmental attitudes over time. Similar interaction effects were observed for behavioral intentions ($F(1,58) = 9.85$, $p < .01$, $\eta^2 = .15$).

Table 1. Experimental Results.

Measure	Experimental Group (M ± SD)	Control Group (M ± SD)	t / F Value	p-Value	Effect Size (η^2 / R^2)
Attitude Toward Sustainable Packaging	4.32 ± —	3.67 ± —	$t(58) = 4.23$	$p < .001$	—
Intentions to Adopt Circular Packaging	4.18 ± —	3.41 ± —	$t(58) = 3.86$	$p < .001$	—
Environmental Attitudes (Pre vs. Post, Repeated Measures ANOVA)	—	—	$F(1,58) = 12.37$	$p < .001$	$\eta^2 = .18$
Behavioral Intentions (Pre vs. Post, Repeated Measures ANOVA)	—	—	$F(1,58) = 9.85$	$p < .01$	$\eta^2 = .15$

4.2. Focus Group Findings

Thematic analysis of focus group data revealed four primary themes related to circular packaging adoption: (1) environmental benefits and awareness, (2) price and value perceptions, (3) convenience and usability concerns, and (4) social influence and norms.

Participants consistently expressed positive attitudes toward the environmental benefits of circular packaging, with one participant noting: "After using the reusable packaging, I became more conscious about how much waste I was generating with regular packaging." However, price concerns emerged as a significant barrier, with participants indicating willingness to adopt circular packaging primarily when prices were comparable to conventional alternatives.

Convenience emerged as another critical factor, with participants emphasizing the importance of easy-to-use and accessible recycling systems. As one participant explained: "I want to be environmentally friendly, but if recycling the packaging takes too much effort or time, I probably won't do it consistently."

Education level appeared to influence participants' engagement with circular packaging, with higher-educated participants demonstrating greater awareness of environmental issues and more detailed knowledge about sustainable packaging materials. This observation supported the hypothesis that education level is associated with environmental awareness and attitudes toward circular packaging.

Table 2. Factor Analysis of Consumer Values.

Factor	Variance Explained (%)	Cronbach's α
Benevolence	24.7%	0.893
Power	18.2%	0.794
Security	15.1%	0.786
Achievement	11.3%	0.815

4.3. Quantitative Survey Results

4.3.1. Factor Analysis of Consumer Values

Principal component analysis with Varimax rotation was conducted on the consumer value items. The Kaiser-Meyer-Olkin measure verified the sampling adequacy (KMO = .83), and Bartlett's test of sphericity was significant ($\chi^2(45) = 712.46$, $p < .001$), indicating that correlations between items were sufficiently large for factor analysis.

Four factors were extracted, explaining 69.3% of the variance:

1. Benevolence (kind behavior): 24.7% of variance

2. Power: 18.2% of variance
3. Security: 15.1% of variance
4. Achievement: 11.3% of variance

These factors demonstrated good reliability with Cronbach's alpha values of .893, .794, .786, and .815 respectively.

Table 3: Factor Analysis of Consumer Values.

Factor	Variance Explained (%)	Cronbach's α
Benevolence (Kind Behavior)	24.7%	0.893
Power	18.2%	0.794
Security	15.1%	0.786
Achievement	11.3%	0.815

Additionally, the Kaiser-Meyer-Olkin (KMO) measure = .83, indicating good sampling adequacy, and Bartlett's test of sphericity ($\chi^2(45) = 712.46$, $p < .001$) suggests that correlations between variables were sufficiently large for factor analysis. These four factors collectively explain 69.3% of the total variance.

4.3.2. Attitudes Toward Circular Packaging

Measurement of attitudes toward circular packaging showed strong internal consistency (Cronbach's $\alpha = .897$). No significant differences were found in attitudes across gender, age, or income groups ($p = .712$). However, education level showed a significant effect on attitudes ($F(3,206) = 5.43$, $p < .01$, $\eta^2 = .07$). Post-hoc Scheffé tests revealed that participants with higher education levels (bachelor's degree or above) demonstrated more positive attitudes toward circular packaging compared to those with lower education levels ($M_{higher} = 4.28$, $M_{lower} = 3.79$, $p < .01$).

Table 4: Attitudes Toward Circular Packaging.

Analysis	Findings
Internal Consistency	Cronbach's α = .897 (strong reliability)
Demographic Differences	No significant differences in attitudes across gender, age, or income (p = .712)
Effect of Education Level	Significant effect found ($F(3,206) = 5.43$, $p < .01$, $\eta^2 = .07$)
Post-hoc Analysis (Scheffé test)	Higher education levels (bachelor's degree or above) showed more positive attitudes ($M_{higher} = 4.28$, $M_{lower} = 3.79$, $p < .01$)

4.3.3. Regression Analysis: Price and Convenience Effects

Multiple regression analysis was conducted to examine the effects of price and convenience on consumer behavioral intentions toward circular packaging. The regression model was significant ($F(2,207) = 46.72$, $p < .001$, $R^2 = .31$), explaining 31% of the variance in behavioral intentions.

Price perception emerged as a significant predictor of behavioral intentions ($\beta = -.42$, $p < .001$), indicating that higher price perceptions were associated with lower adoption intentions. This finding supports H1, confirming that price is a significant factor affecting consumer adoption of circular packaging. The standardized coefficient suggests that for every one standard deviation increase in price perception, behavioral intentions decrease by 0.42 standard deviations.

Convenience perception also significantly predicted behavioral intentions ($\beta = .36$, $p < .001$), with higher convenience perceptions associated with stronger adoption intentions. This finding further supports H1, highlighting the importance of convenience in consumer decision-making regarding circular packaging. The regression coefficient indicates that for every one standard deviation increase in convenience perception, behavioral intentions increase by 0.36 standard deviations.

Table 5: Regression Analysis – Price and Convenience Effects.

Predictor	β (Standardized Coefficient)	p-value	Interpretation
Price Perception	-0.42	< 0.001	Higher price perception → lower adoption intentions (supports H1)
Convenience Perception	0.36	< 0.001	Higher convenience perception → stronger adoption intentions (supports H1)

Regression Model Statistics:

- Significance: $F(2,207) = 46.72$, $p < .001$
- Explained Variance: $R^2 = .31$ (31% of behavioral intentions variance explained)

4.3.4. Demographic Differences in Adoption Intentions

Analysis of variance (ANOVA) was conducted to examine differences in circular packaging adoption intentions across demographic groups. No significant differences were found based on gender ($F(1,208) = 0.84$, $p = .36$) or income levels ($F(3,206) = 1.27$, $p = .29$). Age showed a marginally significant effect ($F(3,206) = 2.65$, $p = .05$, $\eta^2 = .04$), with younger participants (18-34 years) showing slightly higher adoption intentions compared to older participants (55+ years).

These findings partially support H2, indicating that consumers generally show a willingness to adopt circular packaging regardless of demographic characteristics, though some age-related differences may exist. The lack of significant differences across income groups is particularly noteworthy, suggesting that economic factors may not be as influential as initially hypothesized when controlling for other variables.

Table 6: Demographic Differences in Adoption Intentions.

Demographic Factor	**ANOVA Results**	**Findings**
Gender	$F(1,208) = 0.84$, $p = 0.36$	No significant differences
Income Level	$F(3,206) = 1.27$, $p = 0.29$	No significant differences
Age	$F(3,206) = 2.65$, $p = 0.05$, $\eta^2 = 0.04$	Marginally significant; younger participants (18-34 years) showed slightly higher adoption intentions than older participants (55+ years)

Key Insight: These results partially support H2. While demographics have minimal impact, younger consumers show slightly greater adoption intentions, and economic factors may be less influential than expected when other variables are controlled.

4.3.5. Education Level and Environmental Awareness

Analysis of the relationship between education level and environmental awareness revealed a significant positive correlation ($r = .39$, $p < .001$). Linear regression analysis showed that education level significantly predicted environmental awareness ($F(1,208) = 37.23$, $p < .001$, $R^2 = .15$), explaining 15% of the variance.

The regression coefficient ($\beta = .39$, $p < .001$) indicates that higher education levels are associated with greater environmental awareness. Furthermore, mediation analysis using the Baron and Kenny method revealed that environmental awareness partially mediated the relationship between education level and circular packaging adoption intentions (indirect effect = .18, 95% CI [.12, .25]).

These findings support H3, confirming that education level is positively associated with environmental awareness and attitudes toward circular packaging. The mediation effect suggests that education influences adoption intentions partially through its effect on environmental awareness.

Table 7: Education Level and Environmental Awareness.

Analysis	**Findings**
Correlation	Significant positive correlation ($r = 0.39$, $p < 0.001$)
Regression Analysis	Education level significantly predicts environmental awareness ($F(1,208) = 37.23$, $p < 0.001$, $R^2 = 0.15$)
Regression Coefficient	$\beta = 0.39$, $p < 0.001$ (Higher education → Greater environmental awareness)
Mediation Analysis (Baron & Kenny method)	Environmental awareness partially mediates the relationship between education and circular packaging adoption (indirect effect = 0.18, 95% CI [.12, .25])

Key Insight: Supports H3 – Education level is positively associated with environmental awareness and attitudes toward circular packaging.

4.3.6. Impact of Circular Packaging Exposure

Data from the experimental phase were integrated with survey responses to examine the effects of circular packaging exposure on environmental attitudes and behaviors. A regression analysis controlling for pre-exposure attitudes revealed that exposure to circular packaging significantly predicted post-exposure environmental attitudes ($\beta = .31$, $p < .001$) and self-reported environmental behaviors ($\beta = .27$, $p < .001$).

Path analysis using structural equation modeling (SEM) showed that exposure to circular packaging had both direct effects on environmental behaviors (β = .19, p < .01) and indirect effects through changes in environmental attitudes (β = .12, p < .01). The model demonstrated good fit (CFI = .97, TLI = .96, RMSEA = .042, SRMR = .035).

These findings support H4, indicating that exposure to circular packaging positively influences consumers' environmental attitudes and behaviors. The path analysis further reveals how exposure affects behavior, highlighting the mediating role of attitudinal changes.

Table 8: Impact of Circular Packaging Exposure.

Analysis	Findings
Regression Analysis	Circular packaging exposure significantly predicts: - Post-exposure environmental attitudes (β = .31, p < .001) - Self-reported environmental behaviors (β = .27, p < .001)
Path Analysis (SEM)	- Direct effect on behaviors (β = .19, p < .01) - Indirect effect through attitudes (β = .12, p < .01)
Model Fit	CFI = .97, TLI = .96, RMSEA = .042, SRMR = .035 (Good model fit)

Key Insight: Supports H4 – Exposure to circular packaging improves environmental attitudes and behaviors, with attitudes acting as mediators.

Table 9: Regression Analysis – Price and Convenience Effects on Behavioral Intentions.

Predictor	β	t Value	p-Value
Price Perception	-0.42	-6.81	p < .001
Convenience Perception	0.36	5.87	p < .001
Model Statistics	F(2,207) = 46.72		p < .001

4.4. Comprehensive Analysis

4.4.1. Structural Relationships Between Key Variables

A structural equation model was developed based on the Theory of Planned Behavior framework to understand the relationships between key variables further. The model examined the relationships between attitudes, subjective norms, perceived behavioral control, and behavioral intentions regarding circular packaging adoption.

The structural model demonstrated good fit (χ^2/df = 2.13, CFI = .95, TLI = .94, RMSEA = .048, SRMR = .041). Attitudes toward circular packaging (β = .43, p < .001), subjective norms (β = .28, p < .001), and perceived behavioral control (β = .31, p < .001) all significantly predicted behavioral intentions, explaining 58% of the variance (R^2 = .58).

The model also incorporated price perception and convenience as moderating variables. Multi-group analysis revealed that the relationship between attitudes and behavioral intentions was stronger for participants with lower price sensitivity (β_low = .54, β_high = .29, z = 3.21, p < .01) and higher convenience orientation (β_high = .57, β_low = .32, z = 2.95, p < .01).

Table 10: Structural Relationships Between Key Variables (SEM Analysis).

Variable	β (Standardized Coefficient)	p-value	Interpretation
Attitudes Toward Circular Packaging	0.43	< 0.001	Strong predictor of adoption intentions
Subjective Norms	0.28	< 0.001	Social influence plays a role
Perceived Behavioral Control	0.31	< 0.001	Higher perceived control → stronger intentions

Model Statistics:

- Significance: χ^2/df = 2.13
- Goodness of Fit: CFI = .95, TLI = .94, RMSEA = .048, SRMR = .041
- Explained Variance: R^2 = .58 (58% of the variance in behavioral intentions)

Table 11: Moderation Effects.

Moderating Variable	Low Sensitivity Group (β)	High Sensitivity Group (β)	z-score	p-value
Price Sensitivity	0.54	0.29	3.21	< 0.01
Convenience Orientation	0.57	0.32	2.95	< 0.01

Key Insight:

- Price perception moderates the relationship between attitudes and adoption intentions.
- Convenience orientation strengthens the link between attitudes and behavioral intentions.

Table 12: Structural Equation Model (SEM) Results for Circular Packaging Adoption.

Path	β	p-Value	Significant?
Attitudes → Behavioral Intentions	0.43	$p < 0.001$	Yes
Subjective Norms → Behavioral Intentions	0.28	$p < 0.001$	Yes
Perceived Behavioral Control → Behavioral Intentions	0.31	$p < 0.001$	Yes
Model Fit	$\chi^2/df = 2.13$, CFI = .95, TLI = .94, RMSEA = .048, SRMR = .041		

4.4.2. Latent Class Analysis of Consumer Segments

Latent class analysis was conducted to identify distinct consumer segments based on their attitudes, values, and behavioral intentions regarding circular packaging. A three-class solution provided the best fit according to BIC and entropy values.

Class 1 (32% of the sample) represented "Environmental Enthusiasts" characterized by strong environmental values, positive attitudes toward circular packaging, and high adoption intentions despite potential price premiums or convenience barriers.

Class 2 (41% of the sample) represented "Pragmatic Adopters" who showed moderate environmental concern and were willing to adopt circular packaging when it was convenient and economically feasible.

Class 3 (27% of the sample) represented "Resistant Consumers" who demonstrated lower environmental concern and were primarily motivated by price and convenience considerations, showing limited interest in circular packaging regardless of its environmental benefits.

These segments differed significantly in their responses to experimental manipulations, with Environmental Enthusiasts showing the strongest positive response to circular packaging exposure and Resistant Consumers showing the weakest response.

Table 13: Latent Class Analysis of Consumer Segments.

Consumer Segment	Percentage	Characteristics
Class 1: Environmental Enthusiasts	32%	Strong environmental values, positive attitudes, high adoption intentions despite price or convenience barriers.
Class 2: Pragmatic Adopters	41%	Moderate environmental concern, willing to adopt circular packaging when convenient and economically feasible.
Class 3: Resistant Consumers	27%	Low environmental concern, primarily motivated by price and convenience, limited interest in circular packaging.

Key Insight:

- Environmental Enthusiasts responded most positively to circular packaging exposure.
- Resistant Consumers showed the weakest response.

Table 14: ANOVA Results for Demographic Differences in Adoption Intentions.

Demographic Variable	F Value	p-Value	Effect Size (η^2)	Significant Differences?
Gender	$F(1,208) = 0.84$	$p = 0.36$	—	No
Income Level	$F(3,206) = 1.27$	$p = 0.29$	—	No
Age	$F(3,206) = 2.65$	$p = 0.05$	$\eta^2 = 0.04$	Marginal
Education Level	$F(3,206) = 5.43$	$p < 0.01$	$\eta^2 = 0.07$	Yes

4.4.3. Moderating Effects of Personal Values

Further analysis examined the moderating effects of personal values on the relationship between attitudes and behavioral intentions. Moderation analysis revealed that benevolence values strengthened the relationship between environmental attitudes and behavioral intentions (interaction term: $\beta = .18$, $p < .01$), while power values weakened this relationship (interaction term: $\beta = -.15$, $p < .05$).

These findings suggest that personal values are important in determining how attitudes translate into behavioral intentions regarding circular packaging. Consumers with stronger benevolence values (emphasizing concern for others' welfare) show a stronger connection between their environmental attitudes and adoption intentions. In comparison, those with stronger power values (emphasizing social status and dominance) show a weaker connection.

Table 15: Moderating Effects of Personal Values.

Personal Value	Effect on Attitude-Behavior Relationship	Interaction Term (β)	p-value
Benevolence Values (Concern for others' welfare)	Strengthen the relationship between environmental attitudes and behavioral intentions.	0.18	< 0.01
Power Values (Social status & dominance)	Weakens the relationship between environmental attitudes and behavioral intentions.	-0.15	< 0.05

Key Insight:

- Personal values significantly influence how attitudes translate into behavior.
- Consumers with strong benevolence values are likelier to act on their environmental attitudes.

4.4.4. Comparative Analysis of Packaging Types

The experimental phase included comparative evaluations of different types of circular packaging (reusable, recyclable, and biodegradable). Repeated measures ANOVA revealed significant differences in consumer perceptions and preferences across these packaging types ($F(2,116) = 8.74$, $p < .001$, $\eta^2 = .13$).

Reusable packaging received the highest ratings for perceived environmental benefits ($M = 4.58$, $SD = 0.64$), followed by biodegradable packaging ($M = 4.31$, $SD = 0.72$) and recyclable packaging ($M = 4.02$, $SD = 0.81$). However, recyclable packaging received the highest ratings for convenience ($M = 4.17$, $SD = 0.68$), followed by biodegradable packaging ($M = 3.86$, $SD = 0.77$) and reusable packaging ($M = 3.42$, $SD = 0.85$).

These findings highlight the trade-offs consumers perceive between environmental benefits and convenience across different circular packaging types. The preference for reusable packaging regarding environmental benefits but lower ratings for convenience further underscores the importance of addressing convenience barriers in circular packaging design.

Table 16: Comparative Analysis of Circular Packaging Types.

Packaging Type	Perceived Environmental Benefits (Mean ± SD)	Perceived Convenience (Mean ± SD)
Reusable Packaging	4.58 ± 0.64	3.42 ± 0.85
Biodegradable Packaging	4.31 ± 0.72	3.86 ± 0.77
Recyclable Packaging	4.02 ± 0.81	4.17 ± 0.68

Key Insight:

- Reusable packaging is rated highest for environmental benefits but lowest for convenience.
- Recyclable packaging is perceived as the most convenient.
- Highlights the trade-off between environmental impact and convenience in consumer preferences.

4.4.5. Temporal Stability of Attitude Changes

Follow-up surveys conducted one month after the experimental phase assessed the temporal stability of attitude changes resulting from circular packaging exposure. Paired samples t-tests revealed that positive attitude changes persisted over time for the experimental group ($M_{post} = 4.32$, $M_{follow\text{-}up} = 4.18$, $t(29) = 1.57$, $p = .13$), with no significant decline in attitudes.

However, behavioral intentions showed a small but significant decrease over time ($M_{post} = 4.18$, $M_{follow\text{-}up} = 3.92$, $t(29) = 2.43$, $p < .05$), suggesting that while attitudinal changes remained relatively stable, behavioral intentions may require reinforcement to maintain their strength over time.

These findings highlight the importance of continued exposure and reinforcement in promoting long-term adoption of circular packaging. While a single exposure can create persistent attitude changes, maintaining behavioral intentions may require more consistent intervention.

Table 17: Temporal Stability of Attitude Changes.

Measure	Post-Exposure (M ± SD)	Follow-Up (M ± SD)	t-value	p-value
Environmental Attitudes	4.32 ± X	4.18 ± X	1.57	0.13 (NS)
Behavioral Intentions	4.18 ± X	3.92 ± X	2.43	< 0.05

Key Insight:

- Attitude changes remained stable over time.
- Behavioral intentions declined significantly, suggesting the need for reinforcement strategies to sustain long-term behavior.

5. Conclusions

5.1. Summary of Key Findings

This study examined the impact of consumer psychology on circular packaging adoption, focusing on how psychological factors influence consumer acceptance and behavioral intentions. The research employed a mixed-methods approach combining experimental design, focus group interviews, and quantitative surveys to provide comprehensive insights into this complex relationship.

The key findings can be summarized as follows:

First, price and convenience emerged as the most significant factors affecting consumer adoption of circular packaging. Regression analysis revealed that price perception ($\beta = -.42$, $p < .001$) and convenience perception ($\beta = .36$, $p < .001$) were strong predictors of behavioral intentions, explaining 31% of the variance. These findings align with previous research by Ketelsen et al. (2020) and Herbes et al. (2022), who identified price and convenience as critical barriers to sustainable packaging adoption.

Second, education level showed a significant positive association with environmental awareness and attitudes toward circular packaging. Higher-educated consumers demonstrated more positive attitudes ($M_{higher} = 4.28$, $M_{lower} = 3.79$, $p < .01$) and greater environmental awareness ($r = .39$, $p < .001$). This relationship was partially mediated by environmental awareness, suggesting that education influences adoption intentions through its effect on environmental understanding.

Third, exposure to circular packaging positively influenced both environmental attitudes and behaviors. Path analysis revealed both direct effects on environmental behaviors ($\beta = .19$, $p < .01$) and indirect effects through attitudinal changes ($\beta = .12$, $p < .01$). These findings support the notion that experiential learning can be an effective strategy for promoting sustainable consumption behaviors.

Fourth, latent class analysis identified three distinct consumer segments with different attitudes and responses to circular packaging: Environmental Enthusiasts (32%), Pragmatic Adopters (41%), and Resistant Consumers (27%). These segments differed significantly in their value orientations, price sensitivity, and convenience requirements, highlighting the need for targeted approaches to promote circular packaging adoption.

Finally, personal values moderated the relationship between environmental attitudes and behavioral intentions, with benevolence values strengthening this relationship ($\beta = .18$, $p < .01$) and power values weakening it ($\beta = -.15$, $p < .05$). This finding underscores the importance of considering deeper psychological factors in understanding sustainable consumption behaviors.

Table 18: Summary of Key Findings.

Key Finding	Details
1. Price and Convenience as Key Factors	- Price perception negatively predicts behavioral intentions ($\beta = -0.42$, $p < .001$). - Convenience perception positively predicts behavioral intentions ($\beta = 0.36$, $p < .001$). - Together, these factors explain 31% of the variance in adoption intentions. - Aligns with findings from Ketelsen et al. (2020) and Herbes et al. (2022).
2. Education Level and Environmental Awareness	- Higher education level correlates with more positive attitudes ($M_{higher} = 4.28$, $M_{lower} = 3.79$, $p < .01$). - Stronger environmental awareness ($r = .39$, $p < .001$). - Environmental awareness partially mediates the relationship between education and adoption intentions.
3. Impact of Circular Packaging Exposure	- Direct effect on environmental behaviors ($\beta = 0.19$, $p < .01$). - Indirect effect through attitudinal changes ($\beta = 0.12$, $p < .01$). - Suggests that experiential learning enhances sustainable consumption.
4. Consumer Segments in Circular Packaging Adoption	- Environmental Enthusiasts (32%): Strong environmental values, high adoption intentions.

	- Pragmatic Adopters (41%): Moderate environmental concern, influenced by price and convenience. - Resistant Consumers (27%): Low environmental concern, primarily motivated by price and convenience. - Highlights the need for targeted strategies based on consumer segment differences.
5. Role of Personal Values in Behavioral Intentions	- Benevolence values strengthen the relationship between environmental attitudes and behavioral intentions ($\beta = 0.18$, $p < .01$). - Power values weaken this relationship ($\beta = -0.15$, $p < .05$). - Emphasizes the influence of psychological factors in sustainable consumption behavior.

5.2. Theoretical Implications

This research contributes to the theoretical understanding of consumer psychology in sustainable consumption contexts in several ways. First, it extends the application of the Theory of Planned Behavior to circular packaging adoption, demonstrating that attitudes, subjective norms, and perceived behavioral control collectively explain 58% of the variance in behavioral intentions. This supports the theory's applicability to sustainable packaging contexts while highlighting the importance of additional factors such as price perception and convenience.

Second, the study provides empirical support for the existence of an attitude-behavior gap in circular packaging adoption. While many consumers expressed positive attitudes toward circular packaging, their behavioral intentions were often constrained by practical considerations such as price and convenience. This finding aligns with the broader literature on sustainable consumption (Vermeir et al., 2023) and highlights the need for interventions that address both attitudinal and practical barriers to adoption.

Third, the research identifies important moderating factors in the relationship between environmental attitudes and behavioral intentions. The moderating effects of personal values (benevolence and power) and situational factors (price sensitivity and convenience orientation) provide a more nuanced understanding of when and for whom environmental attitudes translate into behavioral intentions. This contributes to the development of more sophisticated models of sustainable consumption behavior.

Fourth, the identification of distinct consumer segments through latent class analysis advances our understanding of consumer heterogeneity in sustainable consumption contexts. The three segments identified (Environmental Enthusiasts, Pragmatic Adopters, and Resistant Consumers) show different patterns of attitudes, values, and behavioral intentions, suggesting the need for differentiated theoretical models and interventions across these segments.

Finally, the temporal analysis of attitude and intention changes contributes to our understanding of the stability of psychological changes resulting from sustainable product exposure. The finding that attitudinal changes persisted over time while behavioral intentions showed some decline highlights the different psychological mechanisms underlying these constructs and has implications for theories of behavior change in sustainable consumption contexts.

5.3. Practical Implications and Conclusion

The findings of this study present significant practical implications for businesses, policymakers, and other stakeholders involved in promoting the adoption of circular packaging.

Addressing price and convenience barriers is essential for businesses to increase consumer acceptance of circular packaging. Companies should prioritize the development of circular packaging solutions that are cost-competitive with conventional alternatives while ensuring ease of use and recyclability. Furthermore, identifying distinct consumer segments underscores the need for targeted marketing strategies. Specifically, messaging for Environmental Enthusiasts should emphasize sustainability benefits, while Pragmatic Adopters are more responsive to convenience and moderate pricing. For Resistant Consumers, businesses should focus on demonstrating product value and minimizing disruptions to established consumption habits.

For policymakers, this research highlights the pivotal role of education in fostering environmental awareness and cultivating positive attitudes toward circular packaging. Policies that promote environmental education and increase public awareness of packaging waste issues could create a more receptive consumer base for circular packaging initiatives. Additionally, policies aimed at mitigating price barriers—such as subsidies for sustainable packaging development or tax incentives for circular packaging adoption—could alleviate economic constraints that currently hinder consumer adoption. Regulatory frameworks that standardize circular packaging systems could further enhance convenience by ensuring consistency in recycling and reuse processes across different products and regions.

For retailers and distributors, the study suggests that providing clear and accessible information on the benefits of circular packaging and appropriate disposal methods at the point of purchase can enhance consumer engagement. As demonstrated by our

experimental findings, in-store demonstrations, packaging take-back programs, and other experiential initiatives could facilitate direct consumer interaction with circular packaging, fostering more favorable attitudes and behaviors.

For packaging designers and manufacturers, our research underscores the necessity of balancing environmental benefits with user convenience. Comparative analyses of different packaging types reveal that consumers often perceive trade-offs between environmental impact and ease of use. To address this challenge, designers should prioritize the development of innovative circular packaging solutions that minimize perceived trade-offs, enhancing both sustainability and user experience.

Finally, for educational institutions and non-governmental organizations (NGOs), our findings emphasize the critical role of education in raising environmental awareness. Targeted educational campaigns should inform the public about packaging waste issues and provide practical knowledge on how to effectively engage with circular packaging systems, thereby fostering informed and proactive consumer behavior.

In conclusion, this study identifies key psychological and practical barriers to the adoption of circular packaging. It underscores the necessity of a collaborative approach among businesses, policymakers, retailers, designers, and educators. By addressing these barriers through comprehensive and coordinated strategies, stakeholders can contribute to the widespread adoption of circular packaging, ultimately promoting more sustainable consumption patterns and reducing environmental impact.

Author Contributions: Conceptualization, Y. Y. Chen and W. C. Wang; methodology, Y. Y. Chen; formal analysis, Y. Y. Chen; investigation, W. C. Wang; data curation, W. C. Wang; writing—original draft preparation, Y. Y. Chen; writing—review and editing, W. C. Wang; visualization, Y. Y. Chen; supervision, Y. Y. Chen. All authors have read and agreed to the published version of the manuscript.

Funding: This research did not receive external funding.

Institutional Review Board Statement: This investigation was deemed exempt from formal ethical review and approval as it posed no medical, psychological, or personal risks to participants. The research was conducted in full compliance with established institutional protocols and guidelines governing academic research endeavors.

Informed Consent Statement: The informed consent documentation pertaining to the questionnaire contents is provided in Appendix A. In accordance with anonymous review protocols, identifying information has been redacted from the displayed materials.

Data Availability Statement: The datasets generated and analyzed during the current study, comprising consumer behavior questionnaires and expert interview assessments, were anonymized in accordance with privacy regulations and institutional confidentiality policies. While expert identities remain confidential, relevant data may be obtained from the corresponding author upon submission of a reasonable scholarly request.

Acknowledgments: The authors extend their sincere gratitude to the panel of subject matter experts for their invaluable guidance and to the anonymous questionnaire respondents whose participation was instrumental to the successful completion of this research.

Conflict of interest: The authors declare no conflicts of interest.

Appendix A

Dear Participant,

We are currently conducting a research project entitled "Consumer Psychology Driving Factors for the Implementation of Sustainable Circular Economy Packaging," which aims to understand consumer habits and relevant factors associated with environmentally friendly packaging utilization. The questionnaire consists of five sections with a total of 50 questions and requires approximately 10 minutes to complete. We greatly appreciate your time and contribution.

This questionnaire is administered anonymously. The research team will make every effort to safeguard your privacy and maintain confidentiality, thereby minimizing potential risks. The future publication of this research will employ aggregate analysis methods; the data collected will not identify specific individuals. Results will be published in academic journals without any derivative commercial interests. Please feel free to decide whether to participate in this study. You may withdraw at any time without experiencing any pressure to continue. Please check the box below if you agree to participate in this research.

□ I understand the research content and participant rights and consent to participate in this study.

We sincerely appreciate your valuable time and participation in this research. Should you have any inquiries regarding this study or interest in learning about the research outcomes, please do not hesitate to contact us using the information provided below.

Principal Investigator: ○○○, Telephone: ○○○○○○○○, Email: ○○○○○○○○

Respectfully,

○○○, Principal Investigator

August 1, 2024

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