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EDITED BY
Idiano D'Adamo,
Sapienza University of Rome, Italy

REVIEWED BY
Jolita Kruopienė,
Kaunas University of Technology, Lithuania
Can Trinh,
Troy University, United States

*CORRESPONDENCE
Bethan Thompson
✉ bethan.thompson@sruc.ac.uk

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Adoption of returnable packaging depends on price, deposit, and material, with spillovers from recycling and reuse

Bethan Thompson*, Faical Akaichi and Luiza Toma

Scotland's Rural College (SRUC), Edinburgh, United Kingdom

Introduction: Policies to reduce packaging waste increasingly promote reusable formats, yet evidence on consumer demand for returnable packaging remains limited. This study examines preferences, willingness to pay, and behavioural spillovers in the adoption of returnable packaging for food and non-food products in the UK.

Methods: We conducted a nationally representative discrete choice experiment across two product categories: a food item (flaked corn cereal) and a non-food household cleaner. Alternatives varied by price, deposit level, number of prior uses, container material (glass versus plastic), and return location. Multinomial logit and latent class models were used to estimate preferences, willingness to pay, and heterogeneity in acceptance. Secondary analysis linked stated choices to self-reported recycling and reuse behaviours, self-efficacy, and environmental concern to test for behavioural spillovers and psychological influences.

Results: Higher prices and deposit levels reduced the likelihood of selecting returnable options, while glass was generally preferred to plastic. Prior uses influenced acceptance only for the cleaner, and return location had little effect in either category. Latent class models consistently identified two segments: cost-conscious sceptics, who are typically older, more price-sensitive, and more likely to reject returnables; and open-minded adopters, who are younger, less price-sensitive, and already more engaged in refill behaviours. Secondary analysis indicates positive behavioural spillovers: individuals reporting stronger engagement in recycling and reuse behaviours were more likely to adopt returnable packaging. By contrast, self-efficacy and environmental concern played a weaker and more context-specific role, particularly in the food category.

Discussion: The findings suggest that experience with circular practices offers a stronger foundation for adoption of returnable packaging than general pro-environmental attitudes alone. Deposit levels must be carefully calibrated to avoid deterring uptake, and material choices should be aligned with product contexts. Adoption strategies may be improved by targeting consumer segments, prioritising those already practising reuse and recycling. To our knowledge, this is the first discrete choice experiment to quantify willingness to pay for returnable packaging across categories while explicitly testing behavioural spillovers. The study demonstrates that spillover operates through transferable competencies rather than system-specific familiarity, that psychological constructs predict preferences context-dependently, and that established circular practices outperform attitudinal measures in predicting acceptance, supporting behaviour-based intervention strategies.

KEYWORDS

choice experiment, consumer behaviour, packaging, returnable, reusable

1 Introduction

Existing policies and regulations on waste and circular economy and, more specifically, packaging have evolved to reflect environmental targets, technological innovation, and consumer preferences. The most recent, and the most stringent regulatory framework for packaging waste management in the European Union (EU) is the new Packaging and Packaging Waste Regulation (PPWR) 2025, which aims to reduce packaging waste across EU member states (European Parliament and the Council of the European Union, 2025). Several implementing articles, such as Art. 12(6) on harmonising labels for reusable packaging, deposit-return systems, are likely to encourage wider adoption of refillable containers and returnable packaging systems. Similar measures have been contemplated in the UK; Scotland's Circular Economy and Waste Route Map to 2030, for example, plans to introduce extended producer responsibility for packaging in conjunction with the other UK governments (Scottish Government, 2024). Against this policy backdrop, our focus is on consumer-facing reusable packaging formats, particularly returnable systems, and how their design influences acceptance and use.

The implementation of reusable packaging systems is an important component of the circular economy since reusable packaging systems incorporate elements of long-lasting design and reuse (Geissdoerfer et al., 2017). Any type of packaging has three main functions: protection, handling facilitation and communication (Lindh et al., 2016). Returnable packaging is a type of reusable packaging which consumers borrow, prefilled with a product, and return to the retailer once the product has been used and is distinct from refillable packaging which is kept by the consumer (Terzioglu et al., 2024). This poses challenges to the protection and handling facilitation on the consumer side that need to be addressed. Understanding how consumers interact with new consumption models such as returnable packaging systems has been identified as a key research gap in circular economy consumer behaviour (Coelho et al., 2020; Serra and Alfinito, 2025; Vidal-Ayuso et al., 2023). This gap matters because the environmental benefits of returnable packaging depend on how consumers actually use the system (Bradley and Corsini, 2023). This includes how frequently packaging is reused (Molina-Besch et al., 2019; Pålsson and Olsson, 2023; Corona et al., 2024; Thomassen et al., 2024) and how reliably packaging is returned (Accorsi et al., 2025). These dependencies underline the need for further research to build a clearer view of the attributes and user factors that shape behaviour.

This study addresses these gaps using a discrete choice experiment (DCE) with a representative UK sample. We elicit preferences for returnable packaging for products, flaked corn breakfast cereal and household cleaner, varying five attributes: product price, deposit level, number of previous uses, container material (plastic, glass, metal) and return location (from home vs. to shop). To our knowledge, this is the first discrete choice experiment to quantify willingness to pay (WTP) for returnable packaging. The study is original in estimating WTP across a food and a non-food category whilst decomposing the roles of deposit size, material, prior-use counts, and return mode. It is rigorous, using a nationally representative UK sample (n = 824), statistically efficient fractional-factorial designs, multinomial logit and latent-class models, and cross-treatment comparisons. Its significance lies in showing how specific system features shape demand and which consumer segments are most receptive to returnables, providing evidence to calibrate deposit levels and return options in policy and retail practise.

2 Materials and methods

2.1 Background

2.1.1 Product attributes

Returnable packaging systems are a subset of reusable packaging systems, along with refillable systems (Terzioglu et al., 2024). Returnable systems are comparatively new and face acceptance challenges where environmental performance and user experience can pull in opposite directions especially around deposit design and concerns about prior use and hygiene (Heeremans et al., 2025). Packaging materials combined with consumer understanding of the environmental sustainability of those materials are also important attributes to be considered to understand whether returnable systems are likely to achieve environmental benefits (Groth et al., 2023).

Deposits help retailers run returnable systems by prompting reliable returns and better care of items, which reduces damage and loss and improves the environmental benefits (Šuškevičė and Kruopienė, 2021). The level of deposit is however, important for consumer acceptance. In a study of reusable pizza packaging, Tenhunen-Lunkka et al. (2024) found that deposits between €5 and €10 were considered acceptable by consumers and were associated with increased care for the packaging and improved return rates. Trials of returnable prefilled returnable packaging have taken place in the UK (Tesco, 2022) at lower deposit levels but have not become mainstream. There are limited insights available into the results of trials, however, it seems that consumers did not perceive an environmental benefit to reusable packaging compared to recycling.

Prior use, hygiene and safety concerns has been an area of more significant research. Qualitative studies have underscored that concerns around cleanliness and contamination are key barriers to reuse, affecting both refillable and returnable systems (Long et al., 2022; Miao et al., 2023). Consumers are less willing to reuse containers that exhibit physical signs of previous use, particularly in contexts involving shared use, as in returnable systems (Baird et al., 2022; Collis et al., 2023). Work on refillable systems (also referred to as bulk or unpackaged formats) indicates that health and environmental concerns influence purchase intentions, but that greater familiarity with eco-sustainability concepts moderate these effects (De Canio, 2023). Providing safety information can also increase the likelihood of consumers selecting reusable packaging (Mastria et al., 2024). These results suggest that whilst reuse frequency is critical for achieving environmental benefits, it may conflict with user acceptance. Together, these studies highlight the interplay between visible wear, perceived safety, and behavioural willingness to engage with packaging that has undergone multiple use cycles.

Research on consumer preferences for materials in returnable systems is limited however, we know that packaging material is likely to be important from wider circular packaging research (Ketelsen et al., 2020). Packaging material affects consumer preferences for

improved recyclability (Borg et al., 2022; Fogt Jacobsen et al., 2022; Klaiman et al., 2016), compostability (Allison et al., 2021), and packaging that incorporates more recycled material or bio-based materials (Friedrich, 2020; Wensing et al., 2020; Macht et al., 2023; Siddiqui et al., 2023; Herrmann et al., 2022). Macht et al. (2023) for example found that higher perceived eco-friendliness of packaging was associated with higher purchase intention and that this effect was stronger for people with higher green consumption values. Most consumers were not willing to pay more for bulk products with reusable (refillable) packaging, even if they were interested in purchasing more bulk items, although they did not consider the potential mediating effect of brand (Patreau et al., 2023). However, willingness to pay for packaging can be influenced by more than just packaging material and can also include factors such as brand image but this seems to vary by packaging type with biodegradable packaging having the strongest effect (Plotkina et al., 2025).

There is malignment in the literature about consumer confusion about the environmental benefits of packaging material (Groth et al., 2023; Ketelsen et al., 2020). For example, metal and glass require more uses to arrive at a break even GHG emissions but are often perceived to be more sustainable than plastic (Fetner and Miller, 2021). However, the break-even point also depends on energy sources and washing procedures. This is challenging to communicate but important. Consumers have been found to be willing to pay for packaging that they perceive to be sustainable but not for packaging where the impact is uncertain (Herrmann et al., 2022) and it is not always clear that reusable packaging has a lower impact compared to single-use options on all environmental metrics (Thomassen et al., 2024). Given the number of variables at play in assessing the environmental impact, including consumer behaviour, it should not be surprising that there is confusion.

2.1.2 Individual characteristics and perceptions

A range of individual-level factors have been found to influence consumer engagement with reusable packaging systems. For example, familiarity with package-free products, environmental concerns, and personal norms have been identified as necessary conditions for adoption (De Canio, 2023). Other factors such as convenience, perceived environmental sustainability, storage constraints, eating occasion, product availability, and deposit amount have also been reported to influence intentions to use and recommend reusable packaging, including in the context of take-away food (Tenhunen-Lunkka et al., 2024). These factors are often interrelated. The following sections review key behavioural constructs, including perceived effort, familiarity, environmental values, spillover effects, and their relationship with consumer preferences for returnable packaging.

Performance expectancy, effort expectancy, social influence, and affective factors influenced intentions to use reusable packaging systems (Heeremans et al., 2025). Amongst these, social motivations, particularly contributing to environmental goals, were the strongest, followed by financial benefits. This finding sits in tension with broader literature on reuse behaviours, where the barrier of convenience features prominently. Examples include Zhu et al.'s (2022) review identified inconvenience as a major barrier to reuse, whilst Fogt Jacobsen et al. (2022) and Geiger et al. (2022) found perceived effort as a significant barrier to packaging waste avoidance and recycling behaviours, respectively.

Familiarity with reuse systems appears to function as a critical moderator of consumer engagement with sustainable packaging behaviours, though its effects operate through multiple mechanisms. De Canio (2023) demonstrated that familiarity moderated consumer willingness to pay premium prices for pro-environmental packaging, including both sustainably packaged and bulk products, whilst Greenwood et al. (2021) observed heightened engagement with systems already embedded in consumer experience, such as milk delivered in glass bottles. This familiarity effect may partly explain Keller et al.'s (2021) finding that consumers demonstrated greater willingness to bring their own cups than to participate in returnable cup schemes, a disparity potentially attributable to unfamiliarity with returnable systems. As well as practical experience, familiarity with reuse systems may also facilitate engagement through affective pathways. Balatsas-Lekkas et al. (2024) found that emotional responses, alongside perceived behavioural control, predicted intention to use reusable bottle systems across Finland, Germany, and the UK, contexts where such schemes were already familiar to participants. Plotkina et al. (2025) demonstrate a related mechanism: higher perceived effort in handling sustainable packaging amplified the mediating role of brand image on willingness to pay, suggesting that brand recognition may generate positive emotional associations that offset effort-related barriers. Together, these findings indicate that familiarity may reduce psychological resistance by fostering affective comfort with sustainable packaging behaviours.

Pro-environmental personal norms demonstrate a positive association with the purchase of unpackaged food, operating independently of perceived barriers such as low awareness and limited product availability (Marken and Hörisch, 2019). The absence of mediation by these barriers suggests that environmental values may exert direct effects on behaviour rather than being filtered through practical considerations. This direct influence aligns with findings that perceived environmental contribution serves as an important motivator for bulk product purchases (De Canio et al., 2024). However, an exclusive focus on individual environmental values risks obscuring the structural determinants of reuse behaviours. Whilst reuse initiatives are frequently framed through the lens of individual environmental concern, their uptake depends substantially on broader systemic conditions, including commercial incentives, regulatory frameworks, and the design of provisioning systems (Beswick-Parsons et al., 2023). This suggests that values-based motivations, though significant, operate within, and are potentially constrained or enabled by larger infrastructural contexts.

Behavioural spillovers refer to the phenomenon where engagement in one behaviour influences the likelihood of engaging in another, related behaviour. They can be positive or negative. Plastic packaging waste avoidance and recycling behaviours demonstrate relatedness contingent on shared motives and understanding, providing evidence of spillover (Fogt Jacobsen et al., 2022). Meta-analytic evidence indicates that positive spillovers occur more reliably when initial and subsequent behaviours share similarity and when interventions target intrinsic motivation (Maki et al., 2019). Additional antecedents associated with spillover include perceived behavioural control or self-efficacy, consistent environmental values, and prior familiarity with similar behaviours. However, average effect sizes for spillover remain small, with some instances showing negative effects

for actual behaviour and policy support (Maki et al., 2019). This variability suggests that positive spillovers require shared psychological and contextual conditions rather than occurring automatically. Spillover appears most likely when both behaviours draw on common antecedents such as environmental values, self-efficacy, or familiarity. This interpretation aligns with recent work emphasising that understanding mechanisms of action is critical to explaining when spillover, or co-occurrence, between behaviours is likely to manifest (Human Behaviour Change Project, 2025).

2.2 Choice experiment

The data were collected in the UK using a discrete choice experiment-based survey to understand how consumers value different attributes of reusable packaging systems for two different products: flaked corn breakfast cereal and household cleaner. A choice experiment is a quantitative research technique that involves asking individuals to state their preference over alternative scenarios, products or services. Several attributes describe each alternative. Individuals' responses are used to determine whether the attributes significantly influence their preferences. The responses are also used to determine the relative importance of the attributes. Choice experiments have been used extensively in different research disciplines (e.g., marketing, health economics, environmental economics, and the economics of transport) due to their close resemblance to real-world decision-making (Hensher et al., 2015). In this study, the survey consisted of a choice task followed by a questionnaire.

2.2.1 Attributes

In the choice task, each respondent was successively shown 12 different choice cards and was repeatedly asked to select their preferred options, whether one of the two product options or the opt-out option. Respondents were always able to opt-out and choose not to purchase any of the alternatives.

The product options in each choice card were described in terms of five attributes: cost of purchase, deposit, number of previous uses, material of parent container, and return location. Here we draw on the latest understanding of circular packaging archetypes (Terzioglu et al., 2024) and research that has identified factors thought to affect consumer preferences for reusable system attributes (Baird et al., 2022; Miao et al., 2023) to design the attributes of discrete choice experiment. It also draws on evidence of studies that have estimated WTP for unpackaged items (Herrmann et al., 2022) and willingness to reuse various product / packaging combinations (Greenwood et al., 2021).

The cost of purchase was established through market research into these products in the major UK supermarkets. We reviewed the selection of products used in the Tesco (2022) trial and we chose one food and one non-food product that had similar price ranges so that comparison was simplified. The cost of deposit range was established through information from the Tesco reusable packaging trial to see the range of deposits that were used for different types of packaging. Number of uses and material of parent container were selected based on the literature described above which highlighted the importance of these aspects to consumers of reusable products. Return location was chosen as a novel attribute based on Terzioglu et al.'s (2024) typology. Respondents were provided with a description of the attributes and their levels. Attribute descriptions and their levels are outlined in Table 1.

TABLE 1 Attributes of the choice experiment.

Attribute	Level	Description
Cost of purchase	£0.75	Amount to be paid for the product.
	£1.35	
	£1.95	
	£2.55	
Deposit	£1.00	Cost of the deposit for the reusable container.
	£2.50	
	£4.00	
	£5.50	
Number of previous uses	5	Number of times the container had been used prior to the respondent making the decision to purchase.
	10	
	15	
	20	
Material of parent container	Plastic	What the reusable container was made from
	Metal	
	Glass	
Return location	Return from home	Packaging returned from home via pick-up delivery service. Book a time slot for pick up or return via online shopping delivery.
	Return to shop	Packaging is returned to retailer. Drop used packaging off at deposit point in any branch of the retailer from which it was purchased.

Attributes	Option 1	Option 2	Opt-Out
Cost of purchase	£0.75	£1.55	None of these alternatives
Returnable location	Return to shop	Return from home	
Deposit	£1.00	£2.50	
Number of previous uses	10	15	
Material of parent container	Plastic	Glass	
Which option do you prefer?	○	○	○

FIGURE 1
Example of one of the choice cards used in the study.

2.2.2 Design

Based on the attribute levels, a full factorial design would yield 384 profiles, resulting in 73,536 possible choice sets. Due to the associated time and cognitive burden, presenting respondents with such an extensive set of choice tasks would be impractical. Therefore, a statistically efficient fractional factorial design was generated using Ngene software (ChoiceMetrics, 2018). This reduced design included only 12 profiles whilst enabling robust estimation of all main effects. The efficient designs for the two product categories were obtained after 25,000 iterations with 500 Halton draws per iteration, yielding D-error values of 0.126 for the flaked corn breakfast cereal design and 0.122 for the household cleaner design. Each final design consisted of 12 choice sets with three alternatives per set (two product options and an opt-out option). An example of a choice card used in the study is shown in Figure 1. Note that the same attribute levels but slightly different choice card were presented for each condition based on the pilot data.

2.3 Measurement of spillover behaviours and drivers

After the experiment respondents were asked about their familiarity with reusable packaging, their recycling and reuse behaviours, their self-efficacy and level of environmental concern. To test whether we could detect any spillover effects between different circular packaging behaviours we chose to measure two circular behaviours related to packaging: recycling and reuse. We created an index of eight recycling, and six reuse behaviours related to packaging. These were adapted from Baird et al. (2022) to focus on packaging. Self-efficacy was measured using the generalised self-efficacy scale proposed by Schwarzer (1997). Respondents' environmental values were measured using to Schwartz's value questions (Schwartz, 2012) including the additional environmental values they proposed. We also included two questions on current refillable use and familiarity with returnable systems prior to the survey. This builds on Heeremans et al. (2025) finding that potential lack of familiarity could hinder robust and reliable insights.

2.4 Data collection

Data from 824 respondents was collected through the market research company Dynata between February and March 2024. Respondents were drawn from a representative UK sample stratified by nation (England, Northern Ireland, Scotland, Wales), age, gender, and employment according to the most recent census information available. Table 2 outlines the profile of the sample and treatment groups.

To qualify for the survey respondents had to be over 18 and were asked to indicate whether they had purchased flaked corn breakfast cereal and a household cleaner (from a list of five different products) in the previous 3 months. If they had purchased both they were randomly allocated to the relevant condition. If they purchased one or the other, they were allocated to the relevant condition. This resulted in 405 respondents in the cleaner treatment condition and 419 in the cereal treatment condition.

2.5 Data analysis

We estimated a multinomial logit (MNL) and a latent class model (LCM) for each treatment condition to explore both average preferences and unobserved heterogeneity in responses. The MNL model provided baseline estimates of attribute-level preferences across the full sample, whilst the LCM allowed us to identify distinct segments of respondents with differing preference structures. Using the resulting two-class models, we conducted a series of t-tests to examine demographic and behavioural characteristics associated with class membership, helping to explain some of the heterogeneity observed in the latent classes. This approach enabled us to move beyond average effects and better understand which types of consumers are accepting of reuse systems. Choice modelling was conducted in R using the Apollo package (Hess and Palma, 2019).

In addition to obtaining information on respondents' preferences, the use of discrete choice models allows the derivation of measures designed to determine the amount of money individuals are willing to give up to obtain some benefit from the non-price attributes of the product (e.g., lower deposit, higher number of uses). Such measures are referred to as measures of willingness to pay (WTP). The most used

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TABLE 2 Socio-demographics of sample.

Variable	Percentage n = 824	Percentage cereal n = 419	Percentage cleaner n = 405
Gender			
Female	51	48	54
Male	49	52	46
Age			
18–24	10	10	11
25–34	16	18	15
35–44	16	21	11
45–54	18	19	17
55–64	17	11	23
65–99	23	21	24
Employment			
Employed (full or part-time)	57	64	48
Self-employed	11	9	13
Retired	17	14	20
Stay-at-home parent/Carer	5	4	7
Student	3	4	3
Unemployed	7	4	9
Other	1	1	1
Education			
Postgraduate/Doctorate	17	18	18
University degree or equivalent	28	30	26
Post-school vocational or technical qualifications	7	6	7
Vocational or technical qualifications	9	9	10
Higher secondary education	17	18	16
Secondary education	18	17	20
Other	2	2	3
Country			
England	84	85	83
Scotland	8	7	8
Wales	5	5	4
Northern Ireland	3	2	4

approach to calculate consumers' WTP consists of computing the ratio of two estimated parameters, holding all else constant. WTP is commonly expressed as the negative ratio of the non-price attribute coefficient (e.g., deposit, return location) to the price/cost coefficient (i.e., the estimated coefficient for the "Total cost") described in Equation 1:

$$WTP_{non-price\ attribute} = -\frac{\beta_{non\ price\ attribute}}{\beta_{price}} \quad (1)$$

3 Results

In the cleaner treatment, options one and two from the choice card were chosen 74.67% of the time, respectively, whilst the opt out was chosen 25.33% of the time. In the cereal treatment, options one and two from the choice card were chosen 78.7% of the time, respectively, whilst the opt out was chosen 21.3% of the time. The opt-out alternative had a negative coefficient in both conditions (−1.89 in cleaner, −2.29 in cereal), indicating that, on average, the reusable packaging options were preferred over opting out. Nonetheless, the opt-out was selected in approximately 25% of cleaner treatment, and 21% of cereal treatment, suggesting that a notable share of respondents still rejected all reuse options.

In both the cleaner and cereal treatment conditions we found that higher-priced products were less likely to be selected (Table 3). Sensitivity to price change estimates were consistently negative and between −1 and 1 across both product categories, indicating that demand for reusable packaging options was price inelastic and as the price increases, the demand decreases. Sensitivity to price increased in magnitude at higher price points, with values reaching

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TABLE 3 Multinomiallogit results for cleaner and cereal treatment samples.

Attribute	Cleaner (n = 405)			Cereal (n = 419)			Poe test
	Estimate	Std. error	p value	Estimate	Std. error	p value	
Cost	−0.437	0.035	0.000***	−0.470	0.034	0.000***	0.410
Deposit	−0.325	0.018	0.000***	−0.313	0.019	0.000***	0.482
Number uses	0.006	0.003	0.035*	−0.001	0.001	0.125	0.025*
Glass	0.202	0.049	0.000***	0.083	0.037	0.024*	0.047*
Metal	0.055	0.054	0.309	−0.028	0.037	0.455	0.201
Shop return	0.002	0.001	0.065	0.069	0.046	0.137	0.045*
Opt out	−1.891	0.118	0.000***	−2.297	0.116	0.000***	0.000*

Default material = plastic, default return location – home. * = 0.05, ** = 0.01, *** = 0.001.

−0.79 for cleaner, and −0.81 for cereal at £2.55. Whilst consumers appeared price sensitive in both treatments, cereal options showed slightly greater sensitivity at higher prices, consistent with a marginally lower willingness to pay for reuse in food packaging contexts.

Choices with higher deposits were less likely to be selected in the cleaner treatment (−0.325, $p = 0.000$) and the cereal treatment (−0.313, $p = 0.000$). This indicates that the willingness to pay (WTP) for a deposit in the cleaner treatment is -£0.74 per £1 increase in deposit cost. This suggests that, on average, a £2.50 deposit reduces cleaner utility by approximately £1.85, unless balanced by other valued attributes such as material or number of uses. In the cereal treatment the WTP for a deposit was -£0.67 per £1 increase in deposit cost. This implies that a £2.50 deposit would imply a disutility of £1.66.

The coefficient for number of uses was small but positive and significant for cleaner (0.006, $p = 0.035$) but was not significant for cereal. This indicates that for returnable cleaner packaging there is a positive WTP of +1.4p per additional previous use so a container with 20 previous uses is valued (20–5) × 1.4p = 21p more than one with only 5 uses.

We also found that glass was preferred over plastic, and this effect was stronger in the cleaner treatment (0.202, $p = 0.000$) than the cereal treatment (0.083, $p = 0.024$). In the cleaner treatment WTP for glass was £0.46, meaning consumers are willing to pay 46p more for glass vs. plastic which was the baseline option in the model. In the cereal treatment respondents WTP for glass was £0.18. This is much lower than WTP for glass cleaner packaging, suggesting a weaker preference for glass cereal packaging.

We conducted the Poe test to determine if the results of each model were significantly different from one another. Of those coefficients where at least one of the pair were significant, we found that there were significant differences in preferences for number of uses and glass as material. We also found that those in the cleaner treatment condition were slightly more likely to opt out than purchase than in the cereal treatment condition.

3.1 Latent class models

We ran a two-class latent class models, one for the cleaner treatment condition and one for the cereal treatment condition to try to understand more about heterogeneity of preferences within our sample. The results are reported in Table 4.

Two consistent consumer segments emerged across both treatment conditions. Class one ("Cost-Conscious Sceptics") are highly price (−0.662, $p = 0.000$) and deposit (−1.014, $p = 0000$) sensitive, more likely to opt out of reuse options (−1.935, $p = 0.000$), and typically older. They are less likely to be engaged in refill behaviours. Class one ("Open-Minded Adopters") show lower aversion to cost (−0.425, $p = 0.000$) and deposit (−0.262), are less likely to opt out (−3.278, $p = 0.000$), and are more likely to prefer glass (0.255, $p = 0.000$). This group tends to be younger and more likely to already engage in refillable product use, despite no greater reported familiarity with returnable systems. These findings suggest that age-related attitudes and behaviours may shape receptiveness to reuse models, with younger consumers offering a stronger base for early adoption.

3.2 Secondary analysis

We extracted the posterior probabilities from the latent class models for every individual in the sample and converted their likelihood of being in a class into new variable. From there we compared the average scores for each class for current recycling behaviour, current reuse behaviour, self-efficacy, and environmental concern. We compared the average scores using simple test statistics to determine if the results between the classes were significantly different from one another. The scores and results of the tests are presented in Table 5.

We found that in the cleaner treatment condition, members of class two were more likely to report engaging in recycling and reuse behaviours than members of class one. They were also more likely to report higher levels of generalised self-efficacy and environmental concern. In the cereal treatment condition, we found that members of class two were also more likely to report recycling and reuse. The difference in levels reported was greater in the cereal treatment condition than the cleaner treatment condition. We did not observe any significant differences in generalised self-efficacy or environmental concern between class one and two in the cereal treatment condition.

4 Discussion

4.1 Reflections on product attributes

Our findings provide evidence that several packaging attributes influence consumer preferences for returnable systems. Price and

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TABLE 4 Latent class results.

Attribute	Cleaner (n = 405)			Cereal (n = 419)		
	Estimate	Std Error	p value	Estimate	Std. error	p value
Class one						
Cost	−0.662	0.101	0.000	−0.795	0.126	0.000
Deposit	−1.014	0.103	0.000	−0.793	0.174	0.000
Number uses	−0.001	0.010	0.938	−0.012	0.010	0.219
Glass	0.012	0.144	0.931	−0.062	0.143	0.666
Metal	−0.108	0.170	0.525	−0.298	0.176	0.091
Shop return	0.291	0.187	0.121	0.387	0.143	0.007
Opt out	−1.935	0.322	0.000	−2.295	0.347	0.000
Class two						
Cost	−0.425	0.038	0.000	−0.416	0.037	0.000
Deposit	−0.262	0.020	0.000	−0.238	0.021	0.000
Number uses	0.005	0.004	0.181	0.002	0.004	0.569
Glass	0.255	0.068	0.000	0.098	0.061	0.106
Metal	0.094	0.064	0.144	−0.043	0.059	0.470
Shop return	−0.014	0.058	0.808	−0.008	0.049	0.864
Opt out	−3.278	0.166	0.000	−3.755	0.380	0.000
Class one delta	0.000	NA	NA	0.000	NA	NA
Class two delta	2.762	0.781	0.000	1.543	0.708	0.029
Class one age	0.000	NA	NA	0.000	NA	NA
Class two age	−0.289	0.073	0.000	−0.176	0.080	0.028
Class one gender	0.000	NA	NA	0.000	NA	NA
Class two gender	−0.326	0.242	0.178	−0.140	0.239	0.560
Class one refill	0.000	NA	NA	0.000	NA	NA
Class two refill	0.300	0.121	0.013	0.443	0.120	0.000
Class one return	0.000	NA	NA	0.000	NA	NA
Class two return	−0.507	0.272	0.062	−0.357	0.231	0.122

TABLE 5 Secondary analysis results.

Variable	Class one Mean score	Class two Mean score	Difference in scores	Test statistic	Parameter	p value
Cleaner						
Recycling	3.277	3.501	−0.225	−2.340	220.864	0.020
Reuse	3.366	3.572	−0.206	−2.080	226.832	0.039
Self-efficacy	3.586	3.746	−0.160	−2.525	219.169	0.012
Environment concern	4.131	4.401	−0.270	−2.553	199.153	0.011
Cereal						
Recycling	3.292	3.671	−0.379	−4.129	186.073	0.000
Reuse	3.520	3.773	−0.253	−2.825	202.923	0.005
Self-efficacy	3.757	3.854	−0.097	−1.577	209.461	0.116
Environment concern	4.282	4.422	−0.140	−1.486	208.886	0.139

deposit were strong negative predictors of choice across both products, consistent with previous studies showing that consumers are sensitive to direct costs associated with reusable packaging (Patreau et al., 2023; Tenhunen-Lunkka et al., 2024). Although deposits have been shown to encourage returns and reduce damage (Šuškevičė and Kruopienė, 2021), the strength of aversion to even modest deposit levels in this study indicates that deposit design must be carefully calibrated to avoid deterring adoption.

The number of previous uses showed a small positive effect in the cleaner treatment, in line with evidence that hygiene and safety concerns may be less pronounced for non-food items (Baird et al., 2022; Collis et al., 2023). This result contrasts with the cereal condition, where no significant preference for use history was found, suggesting heightened sensitivity to reuse in food packaging contexts, consistent with qualitative research (Long et al., 2022; Miao et al., 2025; Miao et al., 2023). Glass was preferred over plastic, particularly in the cleaner condition, echoing findings that consumers associate glass with quality and eco-friendliness despite its higher environmental break-even point in many greenhouse gas emission LCA assessments (Greenwood et al., 2021; Herrmann et al., 2022; Fetner and Miller, 2021). Whilst life cycle assessments often focus on greenhouse gas emissions or resource use, public concerns about plastics frequently centre on issues such as microplastic pollution and the long-term persistence of plastic waste in ecosystems (Gontard et al., 2022). Observing how these broader perceptions shape consumer choices is therefore crucial for understanding the adoption and acceptance of different packaging materials in reuse systems. An avenue for future research could be to trial images of different materials at different levels of (safe) wear and tear.

Preferences for return location were weak, with a small preference for shop return only observed in class one of the cereal treatment. This is notable given prior evidence suggesting that return-from-home is less popular (Heeremans et al., 2025). The low salience of return type may reflect limited familiarity with these systems, suggesting that further research is needed to understand how experience with operational models influences acceptance.

These findings have implications for how reusable packaging is implemented in supply chains. In a recent review of the barriers to reusable packaging adoption from a supply chain perspective, Rane et al. (2025) highlight product safety, the need to reorganise supply chains, and the management of package shelf life and biodegradation as key barriers to adopting reusable packaging, alongside the challenge of keeping cost per reuse low. The stronger reservations we observe for cereal relative to cleaner, and the limited role of prior uses in the food context, are consistent with product-safety concerns being particularly salient for food applications. At the same time, the substantial disutility associated with higher deposits in both categories indicates that the costs of reorganising reverse logistics and meeting safety requirements cannot simply be passed on to consumers through high deposits; instead, they must be managed through efficient packaging logistics and system design. Packaging, product and logistics operations as an integrated system and emphasises that packaging innovations must deliver both sustainability and logistical efficiency (García-Arca et al., 2017). Our behavioural estimates therefore provide demand-side inputs that can help supply-chain actors judge which combinations of deposit levels, product categories and material choices are likely to be acceptable when designing reusable packaging systems.

4.2 Consumer segments

Latent class analysis revealed two distinct segments, supporting previous findings that personal characteristics shape willingness to adopt reuse systems (Heeremans et al., 2025; Greenwood et al., 2021). The more open segment (Class two) was younger and more likely to already engage in refill behaviours, consistent with studies emphasising the role of familiarity in enabling reuse adoption (De Canio, 2023; Keller et al., 2021). Interestingly, this group was not more familiar with returnable systems specifically, suggesting that experience with adjacent behaviours such as refilling may be sufficient to lower perceived barriers. This pattern aligns with evidence that behavioural spillover occurs most readily when behaviours share similarity (Maki et al., 2019). Refilling and returning systems require comparable competencies, remembering to bring containers, planning purchases in advance, and accepting non-standardised experiences, suggesting that skills and mental models developed through refill behaviour may transfer to returnable systems even without direct experience with the latter. The younger demographic profile of the open segment may further reflect generational differences in exposure to contemporary reuse cultures, including zero-waste retail spaces and normalised use of reusable coffee cups. This suggests that broader cultural familiarity, shaped by social influence and shifting consumption norms (Heeremans et al., 2025), may operate alongside personal behavioural experience to reduce psychological barriers to new reuse systems. Class two was also less sensitive to deposit and product cost and had stronger preferences for glass in the cleaner treatment condition, indicating greater willingness to absorb inconvenience or higher upfront cost. This aligns with the finding that pro-environmental adopters often show higher tolerance for logistical or financial burden when their environmental goals are supported (Plotkina et al., 2025).

4.3 Individual characteristics

Secondary analysis of self-reported behaviours and attitudes provided mixed evidence for the role of environmental values, self-efficacy, and behavioural spillover in shaping preferences for returnable packaging. In the cleaner condition, members of the more open segment (class two) reported higher environmental concern and self-efficacy, as well as more frequent recycling and reuse behaviours. This aligns with previous findings that pro-environmental values and confidence in one's ability to act sustainably are positively associated with willingness to adopt packaging innovations (De Canio et al., 2024; Marken and Hörisch, 2019). It also supports claims from the spillover literature that shared antecedents can facilitate the adoption of related behaviours when they are similar or operate in the same domain (Fogt Jacobsen et al., 2022; Maki et al., 2019).

However, these associations were not observed in the cereal condition, and differences across most indicators were not statistically significant. This lack of consistent or strong effects is notable. It suggests that whilst pro-environmental values and efficacy beliefs may support reuse in certain contexts, they are not sufficient or uniformly predictive across product types. This echoes findings from Maki et al. (2019), who reported small and sometimes negative average spillover effects, and cautioned against assuming motivation in one behavioural domain will necessarily transfer to another.

The weaker role of these constructs in the cereal condition may reflect product-specific barriers, such as heightened hygiene concerns or unfamiliarity with reuse for food packaging. Alternatively, it may point to the limits of values-based segmentation when other structural or sensory considerations, such as material feel, packaging cleanliness, or food safety are more salient to consumers. The absence of stronger effects is important, highlighting that whilst values and beliefs are often cited as critical drivers of pro-environmental behaviour, their influence may be contingent on contextual or perceptual factors not captured in simple attitudinal measures.

These findings suggest that interventions to promote returnable packaging cannot rely solely on appealing to environmental values or assumptions of behavioural consistency. Instead, they must consider the specific behavioural and perceptual barriers relevant to each product context and focus on supporting the conditions that enable reuse, such as reducing effort, increasing familiarity, and making reuse visible, convenient, and socially endorsed.

4.4 Food and non-food products

The differences observed between the cereal and cleaner conditions highlight the importance of product context in shaping consumer responses to returnable packaging. In the cereal condition, attributes such as number of previous uses and self-efficacy did not significantly influence preferences, whereas these factors showed greater relevance in the cleaner condition. This may reflect heightened hygiene concerns and stronger risk aversion in the context of food products, consistent with previous literature indicating greater consumer sensitivity to visible signs of reuse and contamination risk for edible goods (Baird et al., 2022; Miao et al., 2025). Conversely, the cleaner condition appeared more amenable to packaging reuse, potentially due to lower perceived health risks and greater familiarity with similar systems (e.g., refillable cleaning products). These contrasts suggest that consumer acceptance of reusable packaging is not uniform across product categories, and that interventions should be tailored to account for the specific barriers and drivers associated with different usage contexts.

5 Conclusion

This study used a discrete choice experiment with a nationally representative UK sample to examine how consumers evaluate prefilled returnable packaging for a food and a non-food product. Across both categories, higher prices and deposits reduced selection of returnable options, with demand remaining price inelastic at the tested levels. Glass containers were preferred over plastic for the household cleaner whilst prior uses had a small positive effect only in the non-food context. Return location (home vs. shop) played a limited role overall.

Latent-class models revealed two consistent segments. Cost-conscious sceptics were typically older, highly sensitive to price and deposit, and more likely to opt out. Open-minded adopters were younger, reported greater engagement with existing refill behaviours, and showed a stronger preference for glass in the cleaner category. These patterns suggest that early adoption may be higher where consumers already interact with refillable packaging, and that preferences are product-specific, particularly in relation to food.

The findings have several implications. First, deposit design matters: even modest increases suppress selection, so deposit levels should be calibrated to balance return performance with acceptance. Second, material perceptions shape choices; whilst glass attracts a premium, communication should acknowledge life-cycle trade-offs that vary by context. Third, category choice is consequential: the weaker role of prior uses for cereal points to heightened hygiene and risk sensitivity in food applications, implying that expectations for uptake and supporting measures should differ between food and non-food launches. Finally, segment differences indicate scope to tailor implementation: mainstream offers should account for a sizeable price-sensitive group, whilst pilot deployments could focus on settings with higher concentrations of reuse-engaged consumers.

Limitations include reliance on stated choices, a single decision point (not repeated use/return behaviour), and a limited set of materials and return mechanisms. It could also benefit from more realistic pictures of the product packaging at the various stages of reuse. Future work should combine field trials with panel designs to track return compliance and repeated use, test brand and quality cues, and integrate behavioural data with life-cycle assessment to quantify realised environmental gains under observed use patterns.

To our knowledge, this is the first discrete choice experiment to quantify willingness to pay for returnable packaging across categories whilst explicitly testing for behavioural spillovers. By estimating heterogeneity and reporting policy-relevant trade-offs (price, deposit, material, prior uses), the study provides decision-ready evidence for PPWR-aligned implementation and for firms designing returnable offers in consumer markets. Beyond estimating preferences, the study advances behavioural theory in three ways: first, it demonstrates that spillover operates through transferable competencies across reuse formats, not system-specific familiarity; second, it reveals context-contingent effects of environmental values and self-efficacy, showing these constructs predict preferences for non-food but not food packaging, where product-specific concerns dominate; and third, it suggests that consumer segments are better distinguished by current circular behaviours than by attitudinal measures, providing evidence for behaviour-based rather than values-based intervention strategies. Together, these findings provide robust, policy-relevant evidence for the design of returnable packaging systems that account for both system attributes and the behavioural foundations of adoption.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by SRUC Social Science Ethics Committee. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

BT: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Writing – original draft, Writing – review & editing. FA: Conceptualization, Investigation, Methodology, Software, Validation, Writing – review & editing. LT: Funding acquisition, Project administration, Writing – review & editing.

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Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/frsus.2025.1715510/full#supplementary-material

References

Accorsi, R., Bartolotti, G., Guidani, B., Manzini, R., and Ronzoni, M. (2025). Reusable food primary packaging in retail supply chain: a multi-objective optimization framework. *Sustain. Prod. Consum.* 56, 364–384. doi: 10.1016/j.spc.2025.04.003

Allison, A. L., Lorencatto, F., Michie, S., and Miodownik, M. (2021). Barriers and enablers to buying biodegradable and compostable plastic packaging. *Sustainability* 13:1463. doi: 10.3390/su13031463

Baird, H. M., Meade, K., and Webb, T. L. (2022). This has already been used! A paradigm to measure the point at which people become unwilling to use reusable containers. *J. Clean. Prod.* 363:132321. doi: 10.1016/j.jclepro.2022.132321

Balatsas-Lekkas, A., Luomala, H., and Pennanen, K. (2024). Factors associated with Finnish, German and UK consumers' intentions to test, buy and recommend reusable fast-moving consumer goods packaging. *Sustain. Prod. Consum.* 52, 210–227. doi: 10.1016/j.spc.2024.10.011

Beswick-Parsons, R., Jackson, P., and Evans, D. M. (2023). Understanding national variations in reusable packaging: commercial drivers, regulatory factors, and provisioning systems. *Geoforum* 145:103844. doi: 10.1016/j.geoforum.2023.103844

Borg, K., Lennox, A., Kaufman, S., Tull, F., Prime, R., Rogers, L., et al. (2022). Curbing plastic consumption: a review of single-use plastic behaviour change interventions. *J. Clean. Prod.* 344:131077. doi: 10.1016/j.jclepro.2022.131077

Bradley, C. G., and Corsini, L. (2023). A literature review and analytical framework of the sustainability of reusable packaging. *Sustain. Prod. Consum.* 37, 126–141. doi: 10.1016/j.spc.2023.02.009

ChoiceMetrics (2018). Ngene 1.2 user manual and reference guide. Sydney, Australia: NGene.

Coelho, P. M., Corona, B., ten Klooster, R., and Worrell, E. (2020). Sustainability of reusable packaging–current situation and trends. *Resourc. Conserv. Recycl. X* 6:100037. doi: 10.1016/j.rcrx.2020.100037

Collis, B., Baxter, W., Baird, H. M., Meade, K., and Webb, T. L. (2023). Signs of use present a barrier to reusable packaging systems for takeaway food. *Sustainability* 15:8857. doi: 10.3390/su15118857

Corona, B., Tunn, V. S. C., and van den Broek, K. L. (2024). Integrating consumer behaviour into the environmental assessment of circular packaging: a scoping review. *Int. J. Life Cycle Assess.* 29, 80–98. doi: 10.1007/s11367-023-02218-1

De Canio, F. (2023). Consumer willingness to pay more for pro-environmental packages: the moderating role of familiarity. *J. Environ. Manag.* 339:117828. doi: 10.1016/j.jenvman.2023.117828

De Canio, F., Viglia, G., and Lombart, C. (2024). Package-free products: how to improve pro-environmental buying behaviors among consumers. *Technol. Forecast. Soc. Change* 198:122995. doi: 10.1016/j.techfore.2023.122995

European Parliament and the Council of the European Union (2025). Packaging and Packaging Waste Regulation, 2025/40. Regulation (EU) 2025/40 of 19 December 2024 on packaging and packaging waste, amending Regulation (EU) 2019/1020 and Directive (EU) 2019/904, and repealing Directive 94/62/EC (OJ L, 2025/40, 22.1.2025). Available at: http://data.europa.eu/eli/reg/2025/40/o

Fetner, H., and Miller, S. A. (2021). Environmental payback periods of reusable alternatives to single-use plastic kitchenware products. *Int. J. Life Cycle Assess.* 26, 1521–1537. doi: 10.1007/s11367-021-01946-6

Fogt Jacobsen, L., Pedersen, S., and Thøgersen, J. (2022). Drivers of and barriers to consumers' plastic packaging waste avoidance and recycling – a systematic literature review. *Waste Manag.* 141, 63–78. doi: 10.1016/j.wasman.2022.01.021

Friedrich, D. (2020). Consumer behaviour towards wood-polymer packaging in convenience and shopping goods: a comparative analysis to conventional materials. *Resour. Conserv. Recycl.* 163:105097. doi: 10.1016/j.resconrec.2020.105097

García-Arca, J., Garrido, A. T. G.-P., and Prado-Prado, J. C. (2017). "Sustainable packaging logistics". The link between sustainability and competitiveness in supply chains. *Sustainability* 9:1098. doi: 10.3390/su9071098

Geiger, J. L., van der Werff, E., Berfu Ünal, A., and Steg, L. (2022). Context matters: the role of perceived ease and feasibility Vis-à-Vis biospheric values in recycling behaviour. *Resour. Conserv. Recycl. Adv.* 16:200122. doi: 10.1016/j.rcradv.2022.200122

Geissdoerfer, M., Savaget, P., Bocken, N. M. P., and Hultink, E. J. (2017). The circular economy – a new sustainability paradigm? *J. Clean. Prod.* 143, 757–768. doi: 10.1016/j.jclepro.2016.12.048

Gontard, N., David, G., Guilbert, A., and Sohn, J. (2022). Recognizing the long-term impacts of plastic particles for preventing distortion in decision-making. *Nat. Sustain.* 5, 472–478. doi: 10.1038/s41893-022-00863-2

Greenwood, S. C., Walker, S., Baird, H. M., Parsons, R., Mehl, S., Webb, T. L., et al. (2021). Many happy returns: combining insights from the environmental and behavioural sciences to understand what is required to make reusable packaging mainstream. *Sustain. Prod. Consum.* 27, 1688–1702. doi: 10.1016/j.spc.2021.03.022

Groth, C., Wegmann, C., and Meyerding, S. G. H. (2023). Perception of product sustainability: the case of processed tomatoes – a qualitative study in Germany. *J. Retail. Consum. Serv.* 71:103214. doi: 10.1016/j.jretconser.2022.103214

Heeremans, E., De Temmerman, J., Slabbinck, H., and Geuens, M. (2025). Packaging the future: determinants of use intentions and incentive structures of reusable packaging systems. *Resour. Conserv. Recycl.* 212:107961. doi: 10.1016/j.resconrec.2024.107961

Hensher, D. A., Rose, J. M., and Greene, W. H. (2015). Applied choice analysis. 2nd Edn. Cambridge: Cambridge University Press.

Herrmann, C., Rhein, S., and Sträter, K. F. (2022). Consumers' sustainability-related perception of and willingness-to-pay for food packaging alternatives. *Resour. Conserv. Recycl.* 181:106219. doi: 10.1016/j.resconrec.2022.106219

Hess, S., and Palma, D. (2019). *Apollo*: a flexible, powerful and customisable freeware package for choice model estimation and application. *J. Choice Model.* 32:100170. doi: 10.1016/j.jocm.2019.100170

Human Behaviour Change Project. (2025). Human Behaviour Change Project. Available online at: https://www.humanbehaviourchange.org/

Keller, E., Köhler, J. K., Eisen, C., Kleihauer, S., and Hanss, D. (2021). Why consumers shift from single-use to reusable drink cups: an empirical application of the stage model of self-regulated behavioural change. *Sustain. Prod. Consum.* 27, 1672–1687. doi: 10.1016/j.spc.2021.04.001

Ketelsen, M., Janssen, M., and Hamm, U. (2020). Consumers' response to environmentally-friendly food packaging – a systematic review. *J. Clean. Prod.* 254:120123. doi: 10.1016/j.jclepro.2020.120123

Klaiman, K., Ortega, D. L., and Garnache, C. (2016). Consumer preferences and demand for packaging material and recyclability. *Resour. Conserv. Recycl.* 115, 1–8. doi: 10.1016/j.resconrec.2016.08.021

Lindh, H., Williams, H., Olsson, A., and Wikström, F. (2016). Elucidating the indirect contributions of packaging to sustainable development: a terminology of packaging functions and features. *Packag. Technol. Sci.* 29, 225–246. doi: 10.1002/pts.2197

Long, Y., Ceschin, F., Harrison, D., and Terzioğlu, N. (2022). Exploring and addressing the user acceptance issues embedded in the adoption of reusable packaging systems. *Sustainability* 14:6146. doi: 10.3390/su14106146

Macht, J., Klink-Lehmann, J., and Venghaus, S. (2023). Eco-friendly alternatives to food packed in plastics: German consumers' purchase intentions for different bio-based packaging strategies. *Food Qual. Prefer.* 109:104884. doi: 10.1016/j.foodqual.2023.104884

Maki, A., Carrico, A. R., Raimi, K. T., Truelove, H. B., Araujo, B., and Yeung, K. L. (2019). Meta-analysis of pro-environmental behaviour spillover. *Nat. Sustain.* 2, 307–315. doi: 10.1038/s41893-019-0263-9

Marken, G. H., and Hörisch, J. (2019). Purchasing unpackaged food products. *Sustainab. Manage. Forum* 27, 165–175. doi: 10.1007/s00550-020-00490-5

Mastria, S., Vezzil, A., and De Cesarei, A. (2024). Switching to reuse: the impact of information on consumers' choices for reusable food packaging. *Sustainability* 16:5937. doi: 10.3390/su16145937

Miao, X., Magnier, L., and Mugge, R. (2023). Switching to reuse? An exploration of consumers' perceptions and behaviour towards reusable packaging systems. *Resour. Conserv. Recycl.* 193:106972. doi: 10.1016/j.resconrec.2023.106972

Miao, X., Magnier, L., and Mugge, R. (2025). How many times should i use my reusable packaging? Exploring the role of an environmental break-even point in shaping consumers' intention to reuse. *Circ. Econ. Sust.* 5, 625–652. doi: 10.1007/s43615-024-00437-8

Molina-Besch, K., Wikström, F., and Williams, H. (2019). The environmental impact of packaging in food supply chains—does life cycle assessment of food provide the full picture? *Int. J. Life Cycle Assess.* 24, 37–50. doi: 10.1007/s11367-018-1500-6

Pålsson, H., and Olsson, J. (2023). Current state and research directions for disposable versus reusable packaging: a systematic literature review of comparative studies. *Packag. Technol. Sci.* 36, 391–409. doi: 10.1002/pts.2722

Patreau, V., Bernard, S., Leroux, J., Bellemare, M., and Morissette, J. (2023). Consumer interest and willingness to pay for in-bulk products with reusable packaging options. *Front. Sustain.* 4:8917. doi: 10.3389/frsus.2023.1228917

Plotkina, D., Rabeson, L., and Bambauer-Sachse, S. (2025). The role of green brand image in explaining European consumers' reactions to different types of sustainable packaging. *J. Retail. Consum. Serv.* 84:104228. doi: 10.1016/j.jretconser.2025.104228

Rane, S. B., Abhyankar, G. J., and Kirkire, M. S. (2025). Barriers to adoption of reusable packaging from supply chain perspective: multi criteria decision making analysis and industry 4.0 strategies. *Opsearch*. doi: 10.1007/s12597-024-00900-y

Schwartz, S. (2012). An overview of the Schwartz theory of basic values. *Online Read Psychol Cult* 2:1116. doi: 10.9707/2307-0919.1116

Schwarzer, R. (1997). The assessment of optimistic self-beliefs: comparison of the German, Spanish, and Chinese versions of the general self-efficacy scale. *Appl. Psychol.* 46, 69–88. doi: 10.1111/j.1464-0597.1997.tb01096.x

Scottish Government (2024). Scotland's circular economy and waste route map to 2030

Serra, L. S., and Alfinito, S. (2025). Consumer behavior in the circular economy: a systematic review of high-impact studies. *Circ. Econ. Sust.* doi: 10.1007/s43615-025-00679-0

Siddiqui, S. A., Profeta, A., Decker, T., Smetana, S., and Menrad, K. (2023). Influencing factors for consumers' intention to reduce plastic packaging in different groups of fast-moving consumer goods in Germany. *Sustainability* 15:7625. doi: 10.3390/su15097625

Šuškevičė, V., and Kruopienė, J. (2021). Improvement of packaging circularity through the application of reusable beverage cup reuse models at outdoor festivals and events. *Sustainability* 13:247. doi: 10.3390/su13010247

Tenhunen-Lunkka, A., Balatsas-Lekkas, A., Mouazan, E., Palola, S., Ngo, T., Salo, M., et al. (2024). Implementing a circular business model for reusable packaging: multidisciplinary learnings from reusable pizza packaging. *Sustain. Prod. Consum.* 48, 62–83. doi: 10.1016/j.spc.2024.05.006

Terzioglu, N., Ceschin, F., Jobling, S., and Tarverdi, K. (2024). Archetypes to categorise upstream packaging strategies for a circular economy. *Resour. Conserv. Recycl. Adv.* 21:211. doi: 10.1016/j.rcradv.2024.200211

Tesco (2022). Use. Reuse. Repeat. Sharing learnings on reusable packaging. UK: Tesco Resuse Report.

Thomassen, G., Peeters, E., Van Hee, N., Noëth, E., Du Bois, E., Boone, L., et al. (2024). The environmental impacts of reusable rice packaging: an extended comparative life cycle assessment. *Sustain. Prod. Consum.* 45, 333–347. doi: 10.1016/j.spc.2024.01.014

Vidal-Ayuso, F., Akhmedova, A., and Jaca, C. (2023). The circular economy and consumer behaviour: literature review and research directions. *J. Clean. Prod.* 418:137824. doi: 10.1016/j.jclepro.2023.137824

Wensing, J., Caputo, V., Carraresi, L., and Bröring, S. (2020). The effects of green nudges on consumer valuation of bio-based plastic packaging. *Ecol. Econ.* 178:106783. doi: 10.1016/j.ecolecon.2020.106783

Zhu, Z., Liu, W., Ye, S., and Batista, L. (2022). Packaging design for the circular economy: a systematic review. *Sustain. Prod. Consum.* 32, 817–832. doi: 10.1016/j.spc.2022.06.005