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How Many Times Should I Use My Reusable Packaging? Exploring the Role of an Environmental Break-Even Point in Shaping Consumers' Intention to Reuse

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Abstract
With growing awareness of packaging waste and pollution, reusable packaging systems (RPSs) appear to be a solution to mitigate the environmental impact of single-use packaging. Nevertheless, RPSs only become less environmentally harmful than single-use after each packaging is reused a minimum number of times, which is defined as the environmental break-even point (e-BEP). A lack of knowledge regarding this critical threshold may lead consumers to be overly optimistic about their reuse behaviour, resulting in insufficient reuse. Communicating e-BEPs can motivate conscious reuse but may also have drawbacks. We used a mixed-method approach consisting of an experiment (N=276) with four e-BEP conditions (absent, low, medium and high) followed by open-ended questions. The quantitative findings showed that regardless of the e-BEP level, consumers neglected the efforts it implied and consistently exhibited positive perceptions. Nevertheless, the qualitative findings revealed several misperceptions of e-BEPs due to limited understanding. In a subsequent post-test (N=208), we uncovered the role of consumers' prior experience with reusable packaging on their evaluations and behavioural intentions. Experienced consumers who have used reusable packaging seem to be more aware of specific challenges in reuse. They exhibited heightened green scepticism and reduced perceived consumer effectiveness in response to high (versus low) e-BEPs. Conversely, inexperienced consumers appeared unaffected by e-BEP conditions. Based on these results, we proposed the potential effect of e-BEPs on consumer evaluations and derived theoretical and practical implications to encourage sustained reuse behaviour in the long run.

Keywords Reuse · Packaging · Sustainable consumption · Consumer behaviour · Communication

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Introduction

Reusable packaging systems (RPSs) can only offer environmental benefits in comparison to single-use equivalents if these are reused a minimum number of times by consumers [1, 2]. In this paper, we define this critical juncture as the environmental break-even point (e-BEP) of RPSs. Despite the essential importance of surpassing the e-BEP, it is not guaranteed that consumers will achieve this naturally.

Unlike single-use packaging, typically discarded after the product is consumed, packaging in RPSs is intended to be reused multiple times by either the same or different consumers through refill or return schemes [3, 4]. Consequently, RPSs have been continuously proposed as an effective solution to the single-use packaging crisis [3, 5], because they aim to keep packaging material circulated in a closed loop and can thus help to reduce packaging waste and the increasing demand for new packaging materials [6].

Reusable packaging is usually made from durable materials to support extended use and requires additional energy for cleaning and transportation [7, 8]. Therefore, to achieve a lower environmental footprint, each packaging must reach its e-BEP, a minimum number of reuses after which reusable packaging is less environmentally harmful than its single-use equivalents [1, 8, 9]. This metric is used to measure the environmental performance of an RPS, usually through a life cycle assessment (LCA) comparing different types of reusable and single-use packages [10, 11]. For instance, reusable takeaway polypropylene (PP) containers demonstrate environmental benefits after being reused 3–39 times in comparison to extruded polystyrene containers [12]; PP reusable coffee cups achieve the e-BEP after ± 50 uses when compared to PP single-use cups [1]; stainless-steel coffee cups even require 140 reuse times to offset the environmental impact compared to single-use takeaway cups [7]. These studies showed that whichever material is chosen for reusable packaging, ensuring sufficient reuse and thereby surpassing the e-BEP of the RPS is essential to make the CE effective in reducing the environmental impact of packaging. Consequently, RPSs should help consumers adapt their behaviours and guide consumers to perform sufficient reuse practices [5, 9], while preventing unintended consequences that may offset environmental gains [13].

Several recent studies indicated that consumers generally exhibit positive attitudes towards the concept of reuse and express high intentions to adopt RPSs [14, 15]. However, actual reuse behaviours especially the number of reuses per packaging can vary drastically among consumers [2, 9]. Challenges include overconsumption of reusables, underuse due to forgetfulness, discontinuation in favour of single-use options, and premature disposal [16, 17]. These unintended behaviours may partly stem from the gap between consumer subjective perception of packaging sustainability and objective LCA results, in that consumers often overestimate the sustainability of their packaging choices due to limited knowledge [18]. Without being informed of e-BEPs, consumers can inaccurately deem that they have already behaved sustainably when they first began using an RPS, unaware that their packaging never passed the e-BEP throughout its entire lifespan, thereby leading to more detrimental environmental consequences than single-use packaging [1]. Communicating the e-BEP can be beneficial in helping new consumers purchase reusable packaging consciously and serving as a reminder for sustained reuse.

Despite the merits of communicating e-BEPs for RPSs, there are also some potential drawbacks. First, the e-BEP communicates that reusable packaging is made of more

resource-intensive materials or consumes additional energy [19], potentially triggering consumers' green scepticism about the intrinsic sustainability of reusable packaging. This may make them doubt whether using robust, reusable packaging is a more sustainable option compared to lightweight single-use packaging. Second, passing a high e-BEP might be viewed as difficult because it requires frequently reusing the same packaging over a certain period [1]. Consumers may question the effectiveness of their individual reuse behaviour in contributing to environmental sustainability, deterring their intention to continue reusing the RPS.

While multiple studies have examined consumer perceptions towards the sustainability of reusable packaging [8, 14], empirical studies that test the effects of communicating e-BEPs on consumer perceptions remain scarce. The purpose of this study was two-fold: (a) to quantitatively examine the effect of different e-BEP conditions on consumers' green scepticism, perceived consumer effectiveness and intention to reuse, and (b) to explore consumers' estimations of reuse times and to understand their underlying rationales qualitatively.

Theoretical Background and Hypotheses Development

The Influence of an e-BEP on Consumers' Intention to Reuse

Various studies suggest that providing consumers with comparable and numerical information about environmental impacts can aid informed purchase decisions, such as using eco-labels or CO2 emission levels on the packaging [20, 21]. Similarly, the e-BEPs represent numerical indicators that allow consumers to compare the environmental impact of reusable packaging with single-use alternatives. Moreover, e-BEPs can also serve as concrete goals for consumers to judge their performance and anticipate either the satisfaction of achievement or the disappointment of failure [22]. This notion aligns with the goal-setting strategy, which has proven to be successful in encouraging sustainable consumption, such as household energy conservation [23], preference for unpackaged products over packaged ones [24], and selection of sustainable products [25].

Our study assesses the effect of e-BEPs on shaping consumers' intention to reuse. We define intention to reuse as the likelihood that consumers will continue engaging with an RPS after trying it once. While an e-BEP provides a concrete goal for consumers to strive for and is likely to influence intention to reuse an RPS, we propose that this effect varies depending on the communicated e-BEP level. Prior research has shown that while difficult goals can lead to greater achievement, goals set at too high a level may deter individuals from initial action [26]. Goals are more likely to be effective motivators when perceived as attainable [27]. Hence, when consumers are presented with a low e-BEP, the perceived low effort of meeting this goal may enhance their intention to reuse. In contrast, a high e-BEP may be perceived as demanding, potentially hindering consumers' initial adoption and diminishing their intention to reuse. Accordingly, we hypothesize:

H1 *Consumers' intention to reuse the RPS will be higher when a low e-BEP is communicated, in comparison to when a high e-BEP is communicated.*

The Role of Green Scepticism and Perceived Consumer Effectiveness

Despite the use of sustainable materials in packaging being increasingly advertised [28, 29], consumers still have a limited understanding of the environmental impact associated with packaging [9], and their perceptions may diverge from LCA outcomes [30, 31]. Some recent qualitative studies found this also applies to RPSs. When environmental communication of RPSs is absent, consumers may demonstrate green scepticism or worry PRSs produce more carbon footprints due to additional transportation and cleaning and doubt the effectiveness of their reuse actions in RPSs [15, 32]. Consequently, consumers expect to notice the environmental analysis associated with reusable packaging [15, 32].

Drawing from a measure of scepticism developed by Mohr et al. [33], we define green scepticism as consumers' doubts about the intrinsic sustainability of reusable packaging. Green scepticism often arises from mislabelling, misinterpretation, and misrepresentation of products [34]. Consequently, even though consumers may want to purchase green products, green scepticism may lead them to deter the purchase or discontinue existing green purchases [35]. Previous studies have suggested enhancing consumer trust in eco-products by communicating their environmental impact transparently [36, 37]. In our study, an e-BEP represents a threshold that aims at improving consumers' understanding of the environmental performance of reusable packaging. However, a potential challenge arises as consumers may associate a high e-BEP with high resource demands and additional energy consumption, raising doubts about the packaging's intrinsic sustainability, and thereby triggering green scepticism. Therefore, we propose:

H2 *Consumers' green scepticism about the RPS will be lower when a low e-BEP is communicated, in comparison to when a high e-BEP is communicated.*

In addition to green scepticism, previous research has highlighted the importance of perceived effectiveness at every stage of sustainable consumer behaviour and decision-making [38]. Perceived consumer effectiveness is defined by Ellen et al. [39] as the extent to which individuals believe their actions can make a difference in solving a problem. In most cases, consumers are more likely to engage in sustainable behaviour when the environmental benefits are communicated, as they are aware of the positive outcomes of their actions [40]. If consumers are informed of e-BEPs, they might be more convinced that they can contribute to the environment after achieving these numbers. However, whether consumers can surpass an e-BEP in reusable packaging may vary depending on the specific e-BEP level. Previous research has indicated that consumers prefer and commit to easily attainable goals in their sustainable actions, as they perceive such goals as a quick way to realize sustainable changes [41]. In contrast, an abstract or difficult goal may lead to green fatigue and demotivation due to a lack of hope for a meaningful change [42]. Correspondingly, we expect that a low e-BEP represents an easy goal and a high e-BEP represents a difficult goal. We hypothesize:

H3 *Perceived consumer effectiveness about using RPSs will be higher when a low e-BEP is communicated, in comparison to when a high e-BEP is communicated.*

Serial Mediation of Green Scepticism and Perceived Consumer Effectiveness

Building on the above arguments, we also proposed examining the serial mediation effect of green scepticism and perceived consumer effectiveness on the relationship between e-BEP levels and intention to reuse. Prior studies have consistently shown a negative correlation between green scepticism and perceived consumer effectiveness [43], while perceived consumer effectiveness is positively related to green purchase intention [40]. Based on our hypotheses above, we anticipate that a lower e-BEP will lead to reduced green scepticism towards an RPS, thus improving perceived consumer effectiveness about reuse behaviour and, ultimately leading to a higher intention to reuse this RPS than that with a higher e-BEP. Accordingly, we expect:

H4 *The green scepticism and perceived consumer effectiveness serially mediate the effect of e-BEP levels on the intention to reuse the RPS.*

Methods

Pre-test for Determining the Environmental Break-Even Points Used in the Study

To establish e-BEP conditions, we conducted a pre-test with 41 participants recruited from Prolific. Prolific is a platform based in the UK that helps researchers recruit participants globally and has produced high-quality data for scientific research [8, 44]. The pre-test used a within-subjects design with seven e-BEP levels (3 to 45 times) for rice packaging. Rice was selected as our target product because it usually comes in single-use plastic bags, paper bags or cardboard boxes, which makes various e-BEPs of reusable packaging possible. Besides, rice is a dry staple food product readily available in supermarkets, and consumers can easily imagine using RPSs for it. For each e-BEP, participants rated their perceived effort to reach it on a 7-point scale (1= 'It will be easy to reach'; 7= 'It will be difficult to reach'). A repeated-measures ANOVA was performed to evaluate the effect of these e-BEP levels on perceived effort. Results are presented in Table 1. Post-hoc pairwise comparisons with a Bonferroni adjustment indicated that all stimuli were significantly (or marginally) different from each other. We decided on 5 and 45 to represent low and high e-BEPs (M_{low}=1.73 vs. M_{high}=5.24, p<.001). Besides, we included 25 as a boundary condition to represent a medium e-BEP (M_{medium}=4.07) that participants perceive as neither easy nor difficult to reach. These three selected numbers align with the LCA of reusable plastic packaging compared to single-use alternatives made of plastic or cartons [45, 46].

Table 1 Means (M) and standard deviations (SD) of perceived effort

	M	SD
3 times	1.46	1.00
5 times	1.73	0.92
10 times	2.61	1.60
15 times	3.29	1.85
25 times	4.07	2.10
35 times	4.88	2.06
45 times	5.24	2.01

Study Design and Stimuli of the Main Study

We adopted a mixed-method approach to provide both quantitative and qualitative insights. A between-subject design with a single factor consisting of four conditions (environmental break-even point: absent vs. low vs. medium vs. high) was used. The stimuli consisted of four reusable packaging labels for rice designed by the researcher using the digital graphic design software Adobe Illustrator CC 2022. Basic information about rice, a rice picture and a reuse logo were consistently shown on all labels. A fake brand, 'Sunrice', was created to make the stimuli realistic and avoid brand biases [47]. The control condition contains a sentence 'This packaging is reusable.' In three experimental conditions, an additional sentence about the e-BEP 'It will have a lower environmental impact than single-use packages after being reused 5/25/45 times.' was added. Figure 1 shows the final design of the stimuli.

In addition, a professionally produced video was used in the survey to demonstrate all the steps of using an RPS and stimulate participants to consider the potential barriers of RPSs in their evaluations. To maintain neutrality and eliminate potential biases, the video excludes the face of the actor, focusing solely on hand movements throughout the process. This prevents potential biases resulting from a lack of identification (e.g., age, gender and culture) with the actor in the video. Figure 2 provides a visual storyboard of this video.

Data Collection and Sample

The online survey was created using Qualtrics and distributed to 281 participants recruited via Prolific in May 2023. The participant pool of Prolific is known for its demographic diversity [44]. Several pre-screen criteria of interest were used based on the following criteria: age between 18 and 75 years to ensure competence in using the RPSs presented in this study; residency in the UK or the Netherlands, where reusable packaging is available in the market; fluency in English to comprehend the textual scenarios and questions; and being the primary grocery shopper in the household to provide more informed responses about packaging. Participants were informed that their responses would be anonymous and confidential, reducing the social desirability bias. Each participant was randomly presented with one of the four experimental conditions. After watching the video and reading the information on the assigned label, participants responded to a series of questions about the packaging and their individual characteristics. Each participant was paid £ 1.5 for completing the survey in approximately 10 min. The study was approved by the Human Research Ethics Committee of Delft University of Technology (reference number: 2544).

Measures and Open-Ended Questions

The measurement scales used in this study were mainly adapted from previously validated instruments to suit the context of reusable packaging. Items in each scale were displayed in a random order. The reliability of all the scales was adequate with Cronbach's alpha, with all scores above 0.70 indicating good internal consistency [48]. All construct items used a seven-point scale, as presented in Appendix Table 4.

Previous studies have shown consumers seem overly optimistic about RPSs [14, 15]. It is thus crucial to instil a more realistic mindset and stimulate critical evaluations within the study. To achieve this, the survey started with an open-ended question prompting par-

Fig. 1 Packaging labels with absent, low (5 times), medium (25 times) and high (45 times) e-BEPs

ticipants to identify potential barriers to adopting this RPS. Following this, participants assessed use complexity, product availability and value barriers associated with RPSs (adapted from [49, 50]). These questions were not subject to a specific analysis but aimed to trigger deliberate responses. Subsequently, to test our hypotheses, participants rated the dependent variables and mediators including intention to reuse (ITR), which is the extent to which participants would be likely to reuse the packaging to purchase rice; green scepticism (GS), which represents the doubt or certainty about the intrinsic sustainability of reusable packaging; and perceived consumer effectiveness (PCE), which is related to the belief in their ability to contribute to the environment by adopting this RPS (adapted from [40, 51]). One item "To show you are still paying attention, please select 'strongly disagree'" was inserted between the items of PCE and acted as an attention check to prevent the inclusion of respondents who did not pay sufficient attention to the questionnaire. Additionally, we also asked participants to estimate the number of reuses per year (i.e. reuse frequency per year) and the number of years they would reuse this packaging (i.e. lifespan of packaging),

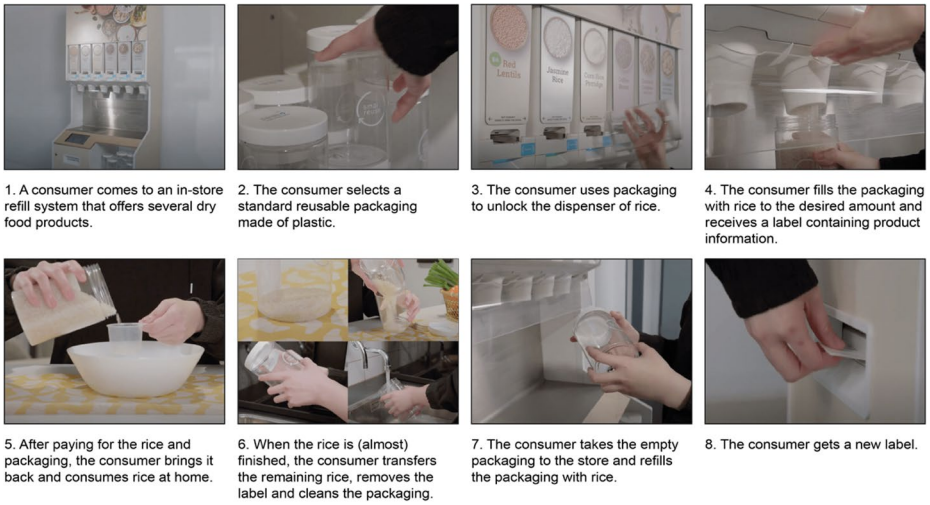

Fig. 2 Visual storyboard consisting of video screenshots

complemented by open-ended questions seeking rationales for their estimates. After that, participants also responded to two manipulation checks regarding the information meaningfulness of the e-BEP (adapted from [52]) and the perceived effort to achieve the e-BEP (self-developed). Green purchase behaviour (GPB) was measured as a control variable to remove potential bias due to higher environmental concern of certain participants. The questionnaire ended with several questions about demographic characteristics including age, gender, and education level, as well as the size of the household.

Results

Attention Check and Manipulation Check

Five participants who failed the attention check were excluded from the analysis to maintain data quality. This resulted in 276 responses that also fully completed the questionnaires being examined (age range between 18 and 75 years, M_{age}=41.46, SD_{age}=13.81, female: 52.9%, male: 46.7%, prefer not to say: 0.4%). The results of the independent t-test showed that participants perceived a higher information meaningfulness of the e-BEP when it was present on the packaging than when it was absent ($M_{present}$=5.71 vs. M_{absent}=1.87, t (274) = -18.89; p<.001). The one-way ANOVA test with linear contrasts indicated a positive linear trend for perceived effort across e-BEP levels (M_{low}=3.43 vs. M_{medium}=4.24 vs. M_{high}=4.54, p<.001), suggesting that higher e-BEP levels were perceived as more effortful for consumers to surpass. Therefore, our manipulations of the e-BEP conditions were successful.

The Effects of e-BEP Conditions on Intention to Reuse, Green Scepticism and Perceived Consumer Effectiveness

To determine how e-BEP conditions influence consumers' evaluations and behavioural intentions, we conducted three separate analyses of covariances (ANCOVAs) with ITR, GS and PCE as the dependent variables, e-BEP conditions as an independent variable, and GPB as a covariate. When the covariate was not significant, we removed it from the ANCOVAs. The assumption of homogeneity of variances was violated for ITR and PCE. The bootstrap method was therefore used for non-parametric analyses as it does not make any assumptions about the sampling distributions [53]. The current study used 5000 bootstrapped samples with a 95% confidence interval to provide robust estimates [54]. After controlling for GPB, there were no significant differences in ITR between the different e-BEP conditions ($F(3,271)=0.37$, $p=.78$). We compared means and standard deviations (SD) of each dependent variable in the studied conditions. As can be seen in Table 2, participants have positive ITR in all conditions (all means > 4.00). Besides, there was no significant difference in GS between ($F(3,271)=2.06$, $p=.11$) and PCE ($F(3,271)=1.11$, $p=.35$) between the different e-BEP conditions. These results do not support ***H1***, ***H2*** and ***H3***, suggesting that e-BEP conditions did not significantly impact any of these three dependent variables. As there was no significant effect found, we did not further examine the hypothesis of the serial mediation of GS and PCE (***H4***).

Reuse Frequency and Lifespan of Packaging

Quantitative Analysis of Numerical Estimations

The results of numerical estimations showed that the reuse frequency and lifespan of each packaging varied greatly from 0 to 100, with mean values of 14.13 reuses per year and 6.77 years in usage. This resulted in the total number of reuses of one packaging varied from 0 to 10,000 with a mean value of 159.27 times. To ensure the accuracy of our analysis, we did an outlier test to exclude extreme values. Specifically, we excluded values above the upper quartile plus three times the interquartile range - the number of reuses above 302 ($N=23$). Subsequently, one-way ANOVA analyses were performed on the remaining samples ($N=253$). The results revealed that the total reuse times did not statistically differ between the e-BEP conditions ($M_{absent}=52.43$ vs. $M_{low}=39.51$ vs. $M_{medium}=38.59$ vs. $M_{high}=41.37$, $p=.51$)[1].

Qualitative Analysis of the Rationale for the Estimations

The qualitative responses were collected from all participants ($N=276$) and coded using Atlas.ti, a qualitative analysis software. We followed an inductive procedure that intended to group conceptually similar topics into more general codes, resulting in 53 codes across

[1] To verify that the removal of the outliers did not influence the findings, we also performed a non-parametric Kruskal-Wallis test on the full dataset ($N=276$). The results corroborated the findings of the one-way ANOVA, showing no significant differences in the estimation of total reuse times among the four conditions ($H(3)=5.203$, $p=.157$). This consistency across different statistical methods ensures a correct interpretation and enhances the validity of our findings.

Table 2 Descriptive statistics of dependent variables for all conditions in the main analysis

	Absent e-BEP (N=70)	Low e-BEP: 5 times (N=70)	Medium e-BEP: 25 times (N=68)	High e-BEP: 45 times (N=68)
				
Intention to reuse (ITR)[a]	4.90 (1.51)	4.74 (1.64)	4.65 (1.80)	4.66 (1.95)
Green scepticism (GS)[a]	2.90 (1.40)	2.97 (1.48)	3.24 (1.48)	3.46 (1.78)
Perceived consumer effectiveness (PCE)[a]	5.03 (1.33)	4.88 (1.60)	5.04 (1.49)	4.69 (1.83)

[a]Means are reported (constructs measured on scales 1 to 7); standard deviations in brackets

eight categories (Appendix Table 5). Most findings aligned closely with previous qualitative interview research on RPSs (see [15]). For this study, our analysis primarily focused on elaborating the five categories relevant to consumer responses to the e-BEPs, thereby seeking additional insights for the main study.

General Optimism Towards the Concept of Reuse

Overall, most participants expressed a strong sense of optimism towards reuse. Some consumers considered RPSs a permanent practice and a future mainstream. Many participants believed they could continue reusing packaging until it was broken or lost. In addition, some participants anticipated that reusing packaging could demonstrate their environmental responsibility to the planet and contribute to waste reduction.

> *(50 years) If they're around for the rest of my life, and it works, then I would use it for the rest of my life. (P98)*

The Lack of References to Make Quantitative Estimations of Reusable Packaging

Despite positive anticipations, participants struggled to make quantitative estimations of reusable packaging without references or physically experiencing the RPS. Their estimations about the reuse frequency primarily relied on several factors, such as grocery shopping frequency, packaging size, and product demands.

> *(12 times per year) This is a vague estimate, and the realistic number greatly depends on the product. Some products I need to rebuy nearly every week, while other products only once or twice a year. (P175)*

Estimating the lifespan of each reusable packaging was even more difficult. Some participants expressed a lack of knowledge regarding packaging durability and emphasized the need for additional information to make accurate assessments. Perceptions of plastic packaging varied, with some participants viewing plastic as long-lasting while others considered it non-durable. Participants tended to refer to their prior experience with similar plastic containers to make a guess.

> *(3 years) It's a complete guess, no way to tell without trying it. (P17)*
> *(1 year) I can't really estimate the durability of a product that I've never used. (P105)*

Diverse Interpretations of the e-BEP

Most participants who were informed of e-BEPs generally recognised that increased reuse times of packaging could amplify positive environmental impacts. However, some participants in the high e-BEP condition reported that this number was too high and would not start using this packaging at all (i.e. total reuse time equals 0). This suggested that a high e-BEP could be viewed as a potential barrier that demotivated the initial adoption.

(0 years) Too much hassle, especially as it states that it takes 45 uses before it lowers the environmental impact. (P280)

It is worth noting that two participants wrongly interpreted the e-BEP as the lifespan of packaging, mistakenly using it as a reference for judging the durability of packaging. Consequently, their estimations of reuse times and packaging lifespan were also counted according to this e-BEP.

(2 years) The life expectancy of the containers is 45 uses. (P233)

Low Involvement in Reusable Packaging

Packaging is seen as a low-involvement item. Several participants reported that packaging is always sold at an affordable price and easily makes its money worthy. Therefore, these participants usually make purchase decisions without considering the number of reuses. Some participants expressed that they would initially adopt the RPS for fun but failed to repeat this behaviour in the long term due to boredom. As a result, participants can put the packaging aside or purchase a new one.

(1 time) I think this idea would be fun for the first time but is not realistic for long-term use (P64).

Besides, some participants mentioned that plastic packaging can generate scratches or superficial damage, which makes it less desirable. Participants preferred to use neat-looking packaging to store food and tended to replace their worn-out reusable packaging. Additionally, several participants reported they only paid little attention to their reusable packaging and sometimes expected that they would lose or break it as a result.

(6 years) Things like this are liable to be left behind sometimes, maybe they break, but I wouldn't be so attached to them and not mind buying a new one. So, I probably wouldn't prioritize looking after it. (P196)

Forgetfulness in Reusing Packaging

Many participants acknowledged that remembering to bring their reusable packaging requires additional mental effort. People admitted that they could easily forget their reusable packaging and would obtain new ones or temporarily switch to buying single-use packaging, especially during spontaneous shopping trips. The negative consequences noted included reusable packaging being excessively purchased, accumulated at home, and left unused in storage, which would eventually hinder its role in waste reduction.

(2 times per year) I would maybe use it once or twice and then forget about it. It will just become another jar in the kitchen. (P132)

Summary

The qualitative results reveal that many participants had a limited understanding of the implications of e-BEPs, and found it difficult to make quantitative estimations without physically using reusable packaging. Given the limited availability of RPSs in the market [55], consumers may never have engaged with RPSs before participating in the study. Existing literature suggests that people might be overly optimistic about adopting socially desirable behaviours but tend to forget or encounter inconvenience in unfamiliar routines [56]. A recent qualitative study highlights consumers who had prior experience with reusable packaging reported more practical barriers in habit changes than inexperienced consumers [57]. Therefore, we assumed that consumers who have never reused packaging may not fully recognise the barriers to changing their habits and may not believe it would be hard to embed reusable packaging in their grocery routines.

In light of these considerations, we posited that the lack of experience may contribute to a general sense of optimism, which could explain the non-significant differences in ITR, GS and PCE across e-BEP conditions. Consequently, we decided to further explore the effects of the e-BEP conditions on the dependent variables under the distinction between experienced and inexperienced consumers with reusable offerings.

Post-test and Analysis

For the post-test, we revisited all participants of the main study to inquire about their prior experience with reusable packaging. It was executed by asking an additional question: 'Have you ever used any reusable packaging similar to the one showcased in the study?' We incorporated several reusable packaging examples that can be viewed as 'similar' experiences, including but not limited to reusable coffee cups on the go, products delivered in returnable containers, private refillable containers, and freshly squeezed orange juice in refillable bottles.

Out of the initial 276 participants in the main study, we received 208 responses in our post-test. We examined whether the subset of the sample included in this post-analysis (N=208) was comparable to the full sample analysed in the main study (N=276). Results of T-tests showed that there were no significant differences in terms of the means of ITR (M_{subset}=4.78 vs. M_{full}=4.74, p=.82), GS (M_{subset}=3.17 vs. M_{full}=3.14, p=.81) and PCE (M_{subset}=4.93 vs. M_{full}=4.91, p=.82). Furthermore, demographics were also similar (ages all ranges between 18 and 75 years, M_{subset} = 42.35 vs. M_{full} =41.46, p=.49, female: 54% and 53%, respectively). These results demonstrate that the subset of the sample and the full sample are comparable, demonstrating that the post-test data was not biased towards any particular subgroup. Based on the responses to our additional question, we created a dummy variable for prior experience with reusable offerings using 0 for inexperienced participants (N=120) and 1 for experienced participants (N=88).

The Main Effect of Experience on Intention to Reuse, Green Scepticism and Perceived Consumer Effectiveness

We conducted three ANCOVAs with experience (0 and 1) as the independent variable, and ITR, GS and PCE as the dependent variables. GPB was included as a covariate. Our

results revealed no significant effect of experience on either ITR ($M_{experienced}$ = 4.65 vs. $M_{inexperienced}$ = 4.87, p=.35) or the total number of reuses ($M_{experienced}$=37.03 vs. $M_{inexperienced}$ = 37.48, p=.95). However, experience had a notable effect on both GS (F (1,205)=6.09, p<.05) and PCE (F (1,205)=5.18, p<.05). Participants with prior experience in general report higher GS ($M_{experienced}$ = 3.48 vs. $M_{inexperienced}$ = 2.95) and lower PCE ($M_{experienced}$ = 4.65 vs. $M_{inexperienced}$ = 5.13) compared to inexperienced participants. This result indicates that experienced consumers tend to be more critical in their evaluations of RPSs than inexperienced consumers. Descriptive statistics are presented in Table 3, and the results are illustrated in Fig. 3. Subsequent analyses were performed separately for the inexperienced and experienced groups.

The Effect of e-BEP Conditions on Intention to Reuse, Green Scepticism and Perceived Consumer Effectiveness of Inexperienced and Experienced Consumers

First, we conducted three ANCOVAs for the inexperienced group (N=120) with e-BEP conditions as an independent variable, and ITR, GS and PCE as dependent variables while controlling for GPB as a covariate. No significant effects of e-BEP conditions on dependent variables were observed in the inexperienced group (all p values>0.10), consistent with the results of our main study.

Next, we performed three ANCOVAs for the experienced group (N=88). When the results were significant, we conducted post-hoc tests adjusted with the Bonferroni correction for pairwise comparisons to determine where the differences occurred between the conditions. The assumption of homogeneity of variances was violated for ITR and PCE, and bootstrap methods were applied using 5000 generated samples with a 95% confidence interval.

Intention to Reuse (ITR) Bootstrap analysis indicated no main effect of e-BEP conditions on ITR for the experienced group (F (3,83)=1.78, p=.16). A marginal effect of e-BEP conditions on ITR was identified between the low and high e-BEP condition (B=0.94, SE=0.50, p=.07, 95% CI: [-0.07, 1.89]). Specifically, experienced consumers exhibit higher ITR when a low e-BEP is communicated compared to when a high e-BEP is communicated (M_{low}=5.43 vs. M_{high}=4.29, p=.07). This is in line with the direction of **H1** but for experienced consumers only.

Green Scepticism (GS) The results of ANCOVA demonstrated a significant main effect of e-BEP conditions on GS (F (3,83)=4.24, p<.01). Specifically, experienced consumers have

Table 3 Descriptive statistics of dependent variables for all conditions in the post-analysis

	Inexperienced groups (N=120)				Experienced groups (N=88)			
	Absent (N=33)	Low (N=29)	Medium (N=32)	High (N=26)	Absent (N=21)	Low (N=21)	Medium (N=21)	High (N=25)
Intention to reuse (ITR) [a]	4.83 (1.71)	4.53 (1.64)	4.66 (1.85)	4.84 (1.85)	5.14 (1.26)	5.43 (1.33)	4.68 (1.73)	4.29 (2.09)
Green scepticism (GS) [a]	2.93 (1.29)	2.93 (1.32)	3.11 (1.42)	3.10 (1.43)	2.81 (1.64)	2.85 (1.22)	3.55 (1.63)	4.20 (1.63)
Perceived consumer effectiveness (PCE) [a]	5.24 (1.30)	4.91 (1.46)	5.02 (1.67)	4.78 (1.77)	4.90 (1.60)	5.45 (1.12)	5.05 (1.24)	4.05 (1.94)

[a]Means are reported (constructs measured on scales 1 to 7); standard deviations in brackets

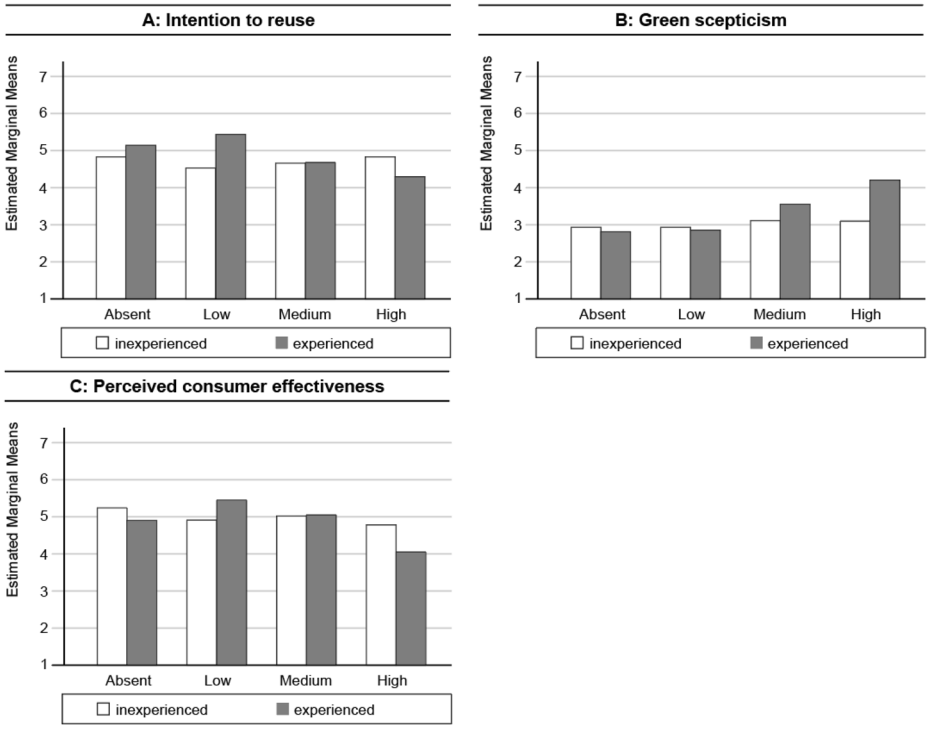

Fig. 3 Bar charts showing the differences in the intention to reuse (A), green scepticism (B) and perceived consumer effectiveness (C) of inexperienced participants and experienced participants for all conditions in the post-analysis

significantly lower GS for reusable packaging with a low e-BEP than that has a high e-BEP (M_{low}=2.85 vs. M_{high}=4.20, p=.05). This aligns with **H2** but for experienced consumers only. Additionally, GS for reusable packaging with a high e-BEP was significantly higher than that without an e-BEP (M_{high}=4.20 vs. M_{absent}=2.81, p<.05). No significant difference was found between the low and absent e-BEP conditions (M_{low}=2.85 vs. M_{absent}=2.81, p>.10). These findings suggest that communicating a high e-BEP may increase GS in the experienced group.

Perceived Consumer Effectiveness (PCE) Bootstrap analysis indicated a significant main effect of e-BEP conditions on PCE for the experienced group (p=.05). Specifically, the mean difference between the low e-BEP condition and the high e-BEP condition (B = -1.17, SE = 0.47, p<.05, 95% CI: [-2.10, −0.25]) reached statistical significance whereas the mean difference between the low e-BEP and absent e-BEP conditions (B = 0.37, SE = 0.39, p=.35, 95% CI: [-0.37, 1.13]) did not. These results suggest that experienced consumers are more likely to have higher PCE when a low e-BEP is communicated, in comparison to when a high e-BEP is communicated (M_{low}=5.45 vs. M_{high}=4.05, p<.05). This aligns with **H3** but for experienced consumers only.

Mediating Effect

The results of ANCOVAs indicated that experienced participants were in general more sensitive to the increasing e-BEP levels, whereas the inexperienced participants were not. As we found significant differences, we further tested whether the relationship between levels of e-BEPs and ITR is serially mediated by GS and PCE for the experienced group.

We performed a serial mediation test (PROCESS macro, model 6 with 5000 bootstrapped samples; [58]) with e-BEP levels (including low, medium and high levels) as a three-condition independent variable, GS and PCE as mediators (in that order), and ITR as the dependent variable. The PROCESS results showed a negative and significant indirect effect (B = −0.22; SE = 0.14; 95%CI: [-0.55; −0.02]) and an insignificant direct effect of e-BEP levels on ITR (p = .94), supporting the mechanism described in this model[2] presented in Fig. 4. Therefore, we concluded that for experienced participants, the GS and PCE serially mediate the effect of e-BEP levels on the ITR, aligning with ***H4*** but for experienced consumers only.

Discussion

The current shift from single-use packaging to reusable alternatives presents an attractive opportunity to reduce environmental impacts. RPSs are often marketed with innovative features (e.g. financial incentives and smart technologies) and environmental benefits (e.g. reduction of food and packaging waste) [59, 60], yet we should note that these positive attributes can trigger consumers' optimism towards RPSs and result in insufficient reuse in practice. This study examined the role of e-BEPs in shaping consumers' intention to use the packaging. Below, we draw theoretical and practical implications from our findings.

Theoretical Implications

Overall, our study advances the understanding of consumer perceptions regarding the environmental break-even point (e-BEP) of reusable packaging. We move beyond e-BEPs based on LCA and frame e-BEPs as consumer-oriented goals to investigate subjective consumer responses. This approach aims to link consumer reuse behaviour directly with the environmental impact of RPSs, promoting more informed decision-making and conscious reuse, while considering the potential drawbacks of presenting such e-BEPs.

First, while prior studies on reusable packaging mainly focused on exploring consumer preferences for RPSs [8, 61], their adoption drivers and potential barriers [15, 62], we contribute to the literature by examining the effects of different e-BEPs as a specific intervention within RPSs. By investigating variations in e-BEP conditions, we revealed that consumers consistently expressed a high intention to reuse the packaging, low green scepticism about the intrinsic sustainability of reusable packaging and high perceived consumer effectiveness about their reuse behaviour. Although these findings contradict our initial hypotheses, they align with other research on RPSs, which demonstrates great consumer optimism towards

[2] We also examined for a reversed causality, estimating a serial mediation model in which perceived consumer effectiveness was an antecedent to green scepticism. This serial mediation path mediational model was not significant (B = −0.15; SE = 0.12; 95%CI: [-0.42; 0.04]).

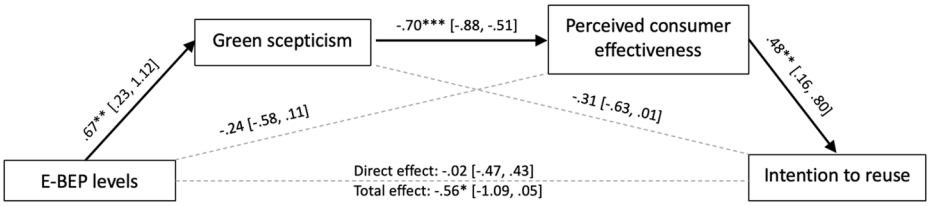

Fig. 4 Serial multiple mediation of e-BEP conditions relationship to intention to reuse, including green scepticism as the first mediator and perceived consumer effectiveness as the second mediator ($n=67$). Green purchase behaviour is included as a covariate. *$p<.05$. **$p<.01$. ***$p<.001$. The values shown are unstandardised coefficients

RPSs. For instance, a cross-country study discovered that the drivers (e.g. positive attitudes and subjective norms) of reusable packaging generally outweigh practical barriers (e.g. situational constraints and hygienic concerns) in influencing consumer intention to avoid single-use plastics [63]; and a study on digital reuse systems found that presenting information about the traceability of containers or technology used does not influence consumers' willingness to engage in these systems, and suggested a potential ceiling effect where consumers are willing to engage with reuse systems regardless of their descriptions [60]. Our study extends these findings by showing that even when presented with high e-BEPs that will be challenging to reach for many FMCGs, consumer responses towards RPSs under different e-BEP conditions remain positive and stable. On the one hand, this is positive as it will encourage many consumers to adopt a wide range of RPSs when these are introduced to the market. On the other hand, there is a big risk associated with such optimism. Consumers' optimism about their future behaviour is likely to be unrealistic because these thoughts are constructed around an ideal behaviour [64]. This could lead to a discrepancy between their initial optimism and actual reuse behaviours over time. More research is needed to explore how consumers use RPS with different e-BEPs and to uncover if consumers can achieve different e-BEPs in practice.

Next, our study demonstrates that consumers with and without reuse experience significantly differentiate in their e-BEP perceptions. These findings contribute to prior literature on the importance of consumer segmentation for the adoption of new RPSs. However, while previous studies have suggested that consumers who have performed reuse behaviours are more likely to adopt reusable packaging [8, 15], our findings demonstrate that experienced consumers can also be more critical towards reuse. Specifically, our study found that experienced participants are more sensitive to RPSs with relatively higher e-BEP, which is reflected in increased green scepticism and decreased perceived consumer effectiveness. This aligns with a study showing that experienced consumers prioritise practical issues in the retail environment [57]. Prior experience with reuse may lead to more deliberate reflections on the ease of the behaviour and greater attention to the e-BEP communicated on the packaging. Additionally, we uncovered a significant serial mediation path among experienced consumers, where e-BEP levels can indirectly influence the intention to reuse through green scepticism and perceived consumer effectiveness. This finding extends the existing literature about how green scepticism and perceived consumer effectiveness influence behaviour intentions [43]. Drawing on the diffusion of innovation theory, experienced consumers are often early adopters with high environmental knowledge and awareness [65] and may use e-BEP information to make purchase decisions. While it is important to

increase the total number of consumers engaged in RPSs, the challenge also emerges in retaining existing adopters. It is therefore crucial to enhance the satisfaction of adopters as they appear more open to a wide range of product categories for RPSs [57], and can act as opinion leaders, spread positive word-of-mouth, and accelerate the diffusion of reusable packaging innovations [66].

Furthermore, our study uncovered diverse consumer comprehension of e-BEPs. We found that some consumers can misinterpret an e-BEP as the lifespan of the packaging, judging the durability of the packaging and estimating their total reuse times based on the e-BEP. This underscores the potential risks associated with displaying e-BEP information on packaging, as it may inadvertently trigger premature disposal or replacement of reusable items once the e-BEP is met. Moreover, many consumers in the high e-BEP condition reported they will not use this reusable packaging at all, suggesting that a high e-BEP can deter consumers' initial adoption of RPSs. These insights emphasise the need for effective consumer education about the meaning of e-BEP displayed on packaging, and highlight the need for clear, transparent communication to prevent misconceptions.

Practical Implications

Our study implies that simply presenting an e-BEP on packaging is not insufficient to encourage consumers to effectively use RPSs and gain environmental benefits. Consumers need a better understanding of what the e-BEP entails and the negative environmental consequences of insufficient reuse of RPSs. Stakeholders across the board should collaborate to tackle the challenges of the e-BEP of RPSs, making RPSs environmentally beneficial for the transition to a Circular Economy.

To raise awareness about the potential problems of not sufficiently reusing RPSs and the role of e-BEPs in this respect, governments can launch educational campaigns. These campaigns could explain the concept of the e-BEP, emphasise the environmental and social benefits of reusable packaging, and provide practical tips for maximising reuse. Furthermore, governments can support the reuse programs in collaboration with local companies that offer reusable packaging options. These reuse programs can list reuse opportunities and highlight specific e-BEPs reported by companies, motivating consumers to compare different options, and fostering conscious consumption.

To encourage the widespread application of the e-BEP, policymakers could establish regulations requiring e-BEP information to be included in RPSs, as well as set standards and certifications for reusable packaging to verify its durability and sustainability. This would improve the overall credibility of e-BEPs.

In the marketing context, retailers could communicate e-BEPs of RPSs through various techniques to enhance accessibility and information richness. Recent qualitative research has indicated that both experienced and inexperienced consumers are willing to check online information for RPSs [57], suggesting the potential to convey e-BEPs in a digital format (e.g. QR codes, RFID and barcodes) [60, 67]. Additionally, a digital product passport has been suggested to support the traceability of each packaging unit, which ensures better monitoring and management throughout its lifecycle [67]. This initiative requires collaboration in the supply chain, especially when the same reusable packaging is used across different brands. Nevertheless, the use of digital technologies will also negatively contribute to

the overall environmental impact of the whole system, which should be accounted for when deciding if this type of e-BEP is worthwhile for RPSs.

While communicating the e-BEP can provide certain benefits, promoting RPSs with a high e-BEP may encounter challenges and require efforts from different stakeholders. First of all, manufacturers need to ensure the packaging materials are durable enough to meet the high e-BEPs. Consumers can deem packaging with damages unacceptable due to contamination risks, safety concerns and perceived decreased quality of the product [68, 69]. To tackle consumer green scepticism, manufacturers could communicate the production process and provide additional information about material attributes and quality. To prevent consumers from replacing the packaging more or less directly after passing its e-BEP, we advise retailers to communicate e-BEP as a milestone rather than an ultimate goal. Some innovative strategies can be implemented, such as gamification design with goal-setting features that allow consumers to unlock progressive reuse challenges or set personalised goals beyond the e-BEP of RPSs; or tailored feedback mechanisms that enable consumers to monitor the impact of their continued adoption of the RPS. These may infuse a sense of excitement and achievement, thereby encouraging long-term adoption of the RPS. Additionally, to foster the development of a new habit of reuse, providing consumers with convenient services and infrastructures (e.g. subscription models and deposit return schemes) can establish a long-term commitment to the RPS, due to which surpassing a high e-BEP may feel less effortful.

Overall, the e-BEP is recognised as a robust metric for evaluating the effectiveness of RPSs in reducing environmental impact [5, 45]. While developing durable reusable packaging remains necessary to support long-term reuse practice, it is equally crucial to cut down on the environmental impact of the system. This can be done by selecting materials with a lower environmental impact for refillable packaging, optimal packaging design for transportation, efficient collection schemes and centralised cleaning processes for returnable packaging [8, 45], and finally ensuring end-of-life recycling of each packaging.

Limitations and Avenues for Future Research

Although this study provides interesting results, several limitations open avenues for future research.

First, our study employed an experimental setting with hypothetical scenarios presented through online questionnaires. While this approach enabled us to compare consumer responses with high internal validity, participants may give socially desirable answers without following these behaviours in real-life situations. Future research could employ field studies in a retailing context, thereby obtaining behavioural data regarding RPSs with different e-BEPs. Another opportunity for future research is to conduct longitudinal studies that track changes in consumer responses to RPSs with different e-BEPs over time. Besides, we did not provide participants with the option to select single-use packaging and cannot predict their preference when both options are available. Further research could explore how consumers respond to e-BEPs when they make actual purchase decisions between single-use packaging and reusable packaging for the same products.

Second, our study specifically examined plastic packaging within a single product category (i.e., rice). This narrow focus may limit the generalizability of our findings to other product categories. Future research could replicate our results across various product cat-

egories, or experiment with reusable packaging made of other materials (e.g. metal, glass, or recycled materials) with more challenging e-BEPs. Notably, calculating e-BEPs for standardised packaging may pose challenges considering that it can contain various products and replace different types of initial packaging. This requires additional support from future LCA studies to provide trustworthy references for those e-BEPs.

Third, we conducted the post-test after the main study and encountered limitations in reaching the entire sample. The reduced sample size may hamper the robustness and generalization of the results presented in the post-analysis. Future research could recruit more diverse participants at different stages of engagement with reusable packaging. Additionally, it would be interesting to investigate at which engagement stage green scepticism and perceived consumer effectiveness are the most prominent in influencing intention to reuse. Reflecting on the samples, we used standard samples in Prolific with selection based on several demographic criteria. Even though this enabled us to obtain a wide variety of participants, the sample was not necessarily representative of the full population. Future studies could recruit representative samples from different countries to capture the trend of the target population and enhance the generalisability of results.

Lastly, even though we explicitly mentioned in the survey that reusable packaging may exhibit traces of usage due to multiple cleaning and transportation actions, our scenarios showed flawless packaging. Changes in the appearance of packaging can influence consumers' willingness to use it, and consumers are unlikely to accept reusable packaging worn out above a certain level [14, 70]. Future research could explore scenarios incorporating usage traces for different e-BEPs. This would offer additional insights about whether e-BEP conditions with a used appearance may influence consumer acceptance and optimism towards reusable packaging.

Conclusion

To conclude, communicating an e-BEP can prompt consumers to have a more deliberate reflection on reusable packaging. Our study suggests that for reusable packaging to achieve a positive environmental impact through consumer engagement, the challenge may not only emerge in attracting new consumers but also in bridging the gap between consumers' initial optimism towards reuse and corresponding reuse behaviours in the long run. Our findings offer insights for the management and design of future RPSs. Effective RPSs should promote conscious purchase and encourage a sufficient number of reuses without raising consumers' green scepticism about the intrinsic sustainability of reusable packaging or weakening perceived consumer effectiveness about reuse behaviour. By addressing these challenges, RPSs can facilitate broader adoption and realise environmental benefits in the long run.

Appendix

Table 4 Measurement scales

Use complexity (adapted from [49]) Compared to buying conventional pre-packaged products from the shelf, taking all steps into account (fill– take back home– store– consume– clean– bring to the store– refill), I think this reusable packaging system… (1) is simple to use(7) is complicated to use (1) is easy to use(7) is difficult to use (1) requires low effort to use(7) requires high effort to use	α = 0.89
Product availability (adapted from [50]) What do you think about the product types in this reusable packaging system? (1 = strongly disagree, 7 = strongly agree) - I think this reusable packaging system will only propose a narrow range of products. - The variety or range of product types will be poor in this reusable packaging system. - Not all product variants will be available in this reusable packaging system.	α = 0.82
Value barriers (adapted from [50]) I think this reusable packaging… (1 = strongly disagree, 7 = strongly agree) - Has no advantages compared to single-use packaging. - Has lower quality than single-use packaging. - Is not helpful for environmental protection in reducing single-use packaging.	α = 0.74
Intention to reuse (repurchase) (adapted from [51]) To what extent will you reuse this packaging to purchase rice again? (1) highly unlikely(7) highly likely (1) highly improbable(7) highly probable (1) highly uncertain(7) highly certain (1) no chance at all(7) very good chance	α = 0.98
Perceived consumer effectiveness (adapted from [40]) Please indicate how much you agree with each of the following statements. (1 = strongly disagree, 7 = strongly agree) I can have a positive effect on the environment by adopting this reusable packaging system. I feel I can help solve natural resource problems by adopting this reusable packaging system. I can protect the environment by adopting this reusable packaging system. I feel capable of helping solve environmental problems by adopting this reusable packaging system.	α = 0.95
Green scepticism (adapted from [51]) Based on the video and the information on the label, it is… (1) Doubtless to (7) Doubtful that this packaging is environmentally friendly. (1) Certain to (7) Uncertain that this packaging is less damaging to the environment. (1) Sure to (7) Unsure that this packaging meets high environmental standards. (1) Unquestionable to (7) Questionable that this packaging is better for the natural environment.	α = 0.95
Information meaningfulness (adapted from [52]) This label on the packaging… (1 = strongly disagree, 7 = strongly agree) provides meaningful information on the minimum times this packaging should be reused to decrease the negative environmental impact. provides useful information on the minimum times this packaging should be reused to decrease the negative environmental impact. helps increase my understanding of the minimum times this packaging should be reused to decrease the negative environmental impact.	α = 0.98
Perceived effort to achieve the BEP (self-developed) How easy do you think it will be to reach the required minimum times of reuse to decrease the negative environmental impact of packaging? (1) It will require low effort to reach(7) It will require high effort to reach (1) It will take a short time to reach(7) It will take a long time to reach (1) It will be easy to reach(7) It will be difficult to reach (1) It will be very possible to reach (7) It will be impossible at all to reach	α = 0.92

Table 4 (continued)

Green purchase behaviour [40] Please indicate how much you agree with each of the following statements. (1 = strongly disagree, 7 = strongly agree) I make a special effort to buy products that are made from sustainable materials. I have switched products for sustainability-related reasons. When I have a choice between two equal products, I purchase the one less harmful to the environment. I have avoided buying a product because it has potentially harmful environmental effects.	$\alpha = 0.90$

Table 5 List of categories and codes

Categories (8)	Codes (53)
General optimism towards the concept of reuse	Using packaging until it is broken or lost
	Contributing to waste prevention
	Future mainstream
	Lifelong practice
	Environmental responsibility to the planet
The lack of references to make quantitative estimations of reusable packaging	Physical usage is necessary to make quantitative estimations
	Grocery shopping frequency
	Packaging size
	Demands for specific products
	A lack of knowledge about the durability of packaging
	Desires for additional information
	The durability of plastic is controversial: long-lasting vs. degradable over time
	Referring to prior experience with similar containers
Diverse interpretations of the e-BEP	Associations between reuse times and environmental impacts
	High e-BEPs demotivate the initial use due to the perceived effort required
	Confusion between lifespan and e-BEPs
	Using e-BEP as a reference for judging packaging durability
	E-BEPs influence the estimations of packaging lifespan
Low involvement in reusable packaging	Packaging is low-involved and easily worth the money
	No expectations about packaging lifespan
	Making purchase decisions without considering reuse times
	Short-term effect of hedonic pleasure
	Boredom with the same packaging and desire for newness
	Wear and tear and superficial damages make packaging less desirable
	Regular replacement due to the desire for neat-looking packaging
	Limited attention
	Unconscious loss
Forgetfulness in reusing packaging	Remembering to bring it required additional mental effort
	Excessive purchase of reusables
	Temporally switch to buying single-use packaging
	Being unused in storage and accumulation
	Spontaneous shopping
Scepticism about the environmental impact of reusable packaging	Sustainability of the packaging material
	Extra resources and energy consumption in manufacturing packaging and systems
	Tangible environmental impact
Cost related to reusable packaging	Upfront deposit
	Multiple packaging purchases
	Expensive product offerings

Table 5 (continued)

Categories (8)	Codes (53)
Usability and practicality of reusable packaging	Availability of the system and products
	Dissatisfaction with the product offerings
	Extra effort in washing
	Transferring residue
	The complexity of the system and performance risks
	Spillage triggers hygienic concerns
	Sticking to the status quo
	Product freshness loss
	More space is required for storage
	Disability in using the system
	Preference for private containers or paper bags
	Time-consuming in the shop (e.g. waiting in a queue, operating the system)
	A lack of online options
	Habitual purchase behaviour towards products
	Recycling packaging is easier than reusing it

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Lise Magnier: Conceptualization, Methodology, Writing– review & editing, Supervision.
Ruth Mugge: Conceptualization, Methodology, Writing– review & editing, Supervision.

Data Availability Data will be made available on request.

Declarations

Competing Interests On behalf of all authors, the corresponding author states that there is no conflict of interest.

References

1. Cottafava D, Costamagna M, Baricco M, Corazza L, Miceli D, Riccardo LE (2021) Assessment of the environmental break-even point for deposit return systems through an LCA analysis of single-use and reusable cups. Sustainable Prod Consum 27:228–241. https://doi.org/10.1016/j.spc.2020.11.002
2. Caspers J, Süßbauer E, Coroama VC, Finkbeiner M (2023) Life cycle assessments of takeaway food and beverage packaging: the role of consumer behavior. Sustainability 15:4315. https://doi.org/10.3390/su15054315

3. Coelho PM, Corona B, ten Klooster R, Worrell E (2020) Sustainability of reusable packaging–current situation and trends. Resour Conserv Recycling: X 6:100037. https://doi.org/10.1016/j.rcrx.2020.100037
4. Muranko Ż, Tassell C, van der Laan AZ, Aurisicchio M (2021) Characterisation and environmental value proposition of reuse models for fast-moving consumer goods: reusable packaging and products. Sustain (Switzerland) 13:1–35. https://doi.org/10.3390/su13052609
5. Bradley CG, Corsini L (2023) A literature review and analytical framework of the sustainability of reusable packaging. Sustainable Prod Consum 37:126–141. https://doi.org/10.1016/j.spc.2023.02.009
6. Zhu Z, Liu W, Ye S, Batista L (2022) Packaging design for the circular economy: a systematic review. Sustainable Prod Consum 32:817–832. https://doi.org/10.1016/j.spc.2022.06.005
7. Changwichan K, Gheewala SH (2020) Choice of materials for takeaway beverage cups towards a circular economy. Sustainable Prod Consum 22:34–44. https://doi.org/10.1016/j.spc.2020.02.004
8. Greenwood SC, Walker S, Baird HM, Parsons R, Mehl S, Webb TL, Slark AT, Ryan AJ, Rothman RH (2021) Many happy returns: combining insights from the environmental and behavioural sciences to understand what is required to make reusable packaging mainstream. Sustainable Prod Consum 27:1688–1702. https://doi.org/10.1016/j.spc.2021.03.022
9. Du Rietz S, Kremel A (2024) Consumer Behavior as a challenge and opportunity for circular food packaging—a. Syst Literature Rev CircEconSust 4:413–438. https://doi.org/10.1007/s43615-023-00290-1
10. Betts K, Gutierrez-Franco E, Ponce-Cueto E (2022) Key metrics to measure the performance and impact of reusable packaging in circular supply chains. Front Sustain 3:910215. https://doi.org/10.3389/frsus.2022.910215
11. Hitt C, Douglas J, Keoleian G (2023) Parametric life cycle assessment modeling of reusable and single-use restaurant food container systems. Resour Conserv Recycl 190:106862. https://doi.org/10.1016/j.resconrec.2022.106862
12. Gallego-Schmid A, Mendoza JMF, Azapagic A (2018) Improving the environmental sustainability of reusable food containers in Europe. Sci Total Environ 628–629:979–989. https://doi.org/10.1016/j.scitotenv.2018.02.128
13. Das A, Konietzko J, Bocken N, Dijk M (2023) The Circular Rebound Tool: a tool to move companies towards more sustainable circular business models. Resour Conserv Recycling Adv 20:200185. https://doi.org/10.1016/j.rcradv.2023.200185
14. Magnier L, Gil-Pérez I (2023) Should the milkman return? The effect of a reusable packaging on product perceptions and behavioural intentions. Food Qual Prefer 112:105037. https://doi.org/10.1016/j.foodqual.2023.105037
15. Miao X, Magnier L, Mugge R (2023) Switching to reuse? An exploration of consumers' perceptions and behaviour towards reusable packaging systems. Resour Conserv Recycl 193:106972. https://doi.org/10.1016/j.resconrec.2023.106972
16. Herweyers L, Bois ED, Moons I (2024) Use - clean - repeat: understanding user, product, and context to design for long-term reuse. Resour Conserv Recycl 204:107511. https://doi.org/10.1016/j.resconrec.2024.107511
17. Tassell C, Aurisicchio M (2023) Refill at home for fast-moving consumer goods: uncovering compliant and divergent consumer behaviour. Sustainable Prod Consum 39:63–78. https://doi.org/10.1016/j.spc.2023.04.018
18. Boesen S, Bey N, Niero M (2019) Environmental sustainability of liquid food packaging: is there a gap between Danish consumers' perception and learnings from life cycle assessment? J Clean Prod 210:1193–1206. https://doi.org/10.1016/j.jclepro.2018.11.055
19. Fetner H, Miller SA (2021) Environmental payback periods of reusable alternatives to single-use plastic kitchenware products. Int J Life Cycle Assess 26:1521–1537. https://doi.org/10.1007/s11367-021-01946-6
20. Camilleri AR, Larrick RP, Hossain S, Patino-Echeverri D (2019) Consumers underestimate the emissions associated with food but are aided by labels. Nat Clim Change 9:53–58. https://doi.org/10.1038/s41558-018-0354-z
21. Krah S, Todorovic T, Magnier L (2019) Designing for packaging sustainability. The effects of appearance and a better eco-label on consumers' evaluations and choice. Proceedings of the International Conference on Engineering Design, ICED 2019-Augus:3251–3259. https://doi.org/10.1017/dsi.2019.332
22. Andor MA, Fels KM (2018) Behavioral economics and energy conservation– a systematic review of non-price interventions and their causal effects. Ecol Econ 148:178–210. https://doi.org/10.1016/j.ecolecon.2018.01.018
23. Abrahamse W, Steg L, Vlek C, Rothengatter T (2007) The effect of tailored information, goal setting, and tailored feedback on household energy use, energy-related behaviors, and behavioral antecedents. J Environ Psychol 27:265–276. https://doi.org/10.1016/j.jenvp.2007.08.002

24. Tate K, Stewart AJ, Daly M (2014) Influencing green behaviour through environmental goal priming: the mediating role of automatic evaluation. J Environ Psychol 38:225–232. https://doi.org/10.1016/j.jenvp.2014.02.004
25. Kanay A, Hilton D, Charalambides L, Corrégé JB, Inaudi E, Waroquier L, Cézéra S (2021) Making the carbon basket count: goal setting promotes sustainable consumption in a simulated online supermarket. J Econ Psychol. https://doi.org/10.1016/j.joep.2020.102348. 83:
26. Locke EA (1996) Motivation through conscious goal setting. Appl Prev Psychol 5:117–124. https://doi.org/10.1016/S0962-1849(96)80005-9
27. Locke EA, Latham GP (2002) Building a practically useful theory of goal setting and task motivation: a 35-year odyssey. Am Psychol 57:705–717. https://doi.org/10.1037/0003-066X.57.9.705
28. Granato G, Fischer ARH, van Trijp HCM (2022) A meaningful reminder on sustainability: when explicit and implicit packaging cues meet. J Environ Psychol 79:101724. https://doi.org/10.1016/j.jenvp.2021.101724
29. Magnier L, Schoormans J (2015) Consumer reactions to sustainable packaging: the interplay of visual appearance, verbal claim and environmental concern. J Environ Psychol 44:53–62. https://doi.org/10.1016/j.jenvp.2015.09.005
30. Ertz M, François J, Durif F (2017) How consumers react to environmental information: an experimental study. J Int Consumer Mark 29:162–178. https://doi.org/10.1080/08961530.2016.1273813
31. Steenis ND, Van Herpen E, Van Der Lans IA, Ligthart TN, Van Trijp HCM (2017) Consumer response to packaging design: the role of packaging materials and graphics in sustainability perceptions and product evaluations. J Clean Prod 162:286–298. https://doi.org/10.1016/j.jclepro.2017.06.036
32. Liu W, Zhu Z, Ye S (2023) A Framework towards Design for Circular Packaging (DfCP): design knowledge, challenges and opportunities. CircEconSust 3:2109–2125. https://doi.org/10.1007/s43615-023-00264-3
33. Mohr LA, Eroğlu D, Ellen PS (1998) The development and testing of a measure of skepticism toward environmental claims in marketers' communications. J Consum Aff 32:30–55. https://doi.org/10.1111/j.1745-6606.1998.tb00399.x
34. Grebmer C, Diefenbach S (2020) The challenges of green marketing communication: effective communication to environmentally conscious but skeptical consumers. Designs 4:1–16. https://doi.org/10.3390/designs4030025
35. Nguyen TTH, Yang Z, Nguyen N, Johnson LW, Cao TK (2019) Greenwash and green purchase intention: the mediating role of green skepticism. Sustain (Switzerland) 11:1–16. https://doi.org/10.3390/su11092653
36. Polyportis A, Magnier L, Mugge R (2022) Guidelines to foster consumer acceptance of products made from recycled plastics. Circular Econ Sustain. https://doi.org/10.1007/s43615-022-00202-9
37. Navas R, Chang HJ, Khan S, Chong JW (2021) Sustainability transparency and trustworthiness of traditional and blockchain ecolabels: a comparison of generations x and y consumers. Sustain (Switzerland) 13. https://doi.org/10.3390/su13158469
38. Straughan RD, Roberts JA (1999) Environmental segmentation alternatives: a look at green consumer behavior in the new millennium. J Consumer Mark 16:558–575. https://doi.org/10.1108/07363769910297506
39. Ellen PS, Wiener JL, Cobb-Walgren C (1991) The role of perceived consumer effectiveness in motivating environmentally conscious behaviors. J Public Policy Mark 10:102–117. https://doi.org/10.1177/074391569101000206
40. Kim Y, Choi SM (2005) Antecedents of green purchase behavior: an examination of collectivism, environmental concern, and perceived consumer effectiveness. Adv Consum Res 32:592–599
41. Scott M, Barreto M, Quintal F, Oakley I (2011) Understanding goal setting behavior in the context of energy consumption reduction. Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics) 6946 LNCS:129–143. https://doi.org/10.1007/978-3-642-23774-4_13
42. White K, Habib R, Hardisty DJ (2019) How to SHIFT consumer behaviors to be more sustainable: a literature review and guiding framework. J Mark 83:22–49. https://doi.org/10.1177/0022242919825649
43. van der Waal NE, Folkvord F, Azrout R, Meppelink CS (2022) Can Product information steer towards sustainable and healthy food choices? A pilot study in an Online Supermarket. Int J Environ Res Public Health 19. https://doi.org/10.3390/ijerph19031107
44. Peer E, Brandimarte L, Samat S, Acquisti A (2017) Beyond the Turk: alternative platforms for crowdsourcing behavioral research. J Exp Soc Psychol 70:153–163. https://doi.org/10.1016/j.jesp.2017.01.006
45. Thomassen G, Peeters E, Van Hee N, Noëth E, Du Bois E, Boone L, Compernolle T (2024) The environmental impacts of reusable rice packaging: an extended comparative life cycle assessment. Sustainable Prod Consum 45:333–347. https://doi.org/10.1016/j.spc.2024.01.014

46. Zimmermann T, Bliklen R (2020) Single-use vs. reusable packaging in e-commerce: comparing carbon footprints and identifying break-even points. GAIA - Ecol Perspect Sci Soc 29:176–183. https://doi.org/10.14512/gaia.29.3.8
47. Orth UR, Campana D, Malkewitz K (2010) Formation of consumer price expectation based on package design: attractive and quality routes. J Mark Theory Pract 18:23–40. https://doi.org/10.2753/MTP1069-6679180102
48. Mackison D, Wrieden WL, Anderson AS (2010) Validity and reliability testing of a short questionnaire developed to assess consumers' use, understanding and perception of food labels. Eur J Clin Nutr 64:210–217. https://doi.org/10.1038/ejcn.2009.126
49. Adjei MT, Noble SM, Noble CH (2010) The influence of C2C communications in online brand communities on customer purchase behavior. J Acad Mark Sci 38:634–653. https://doi.org/10.1007/s11747-009-0178-5
50. Sang Y, Yu H, Han E (2022) Understanding the barriers to consumer purchasing of zero-waste products. Sustainability 14:16858. https://doi.org/10.3390/su142416858
51. Leonidou CN, Skarmeas D (2017) Gray shades of green: causes and consequences of green skepticism. J Bus Ethics 144:401–415. https://doi.org/10.1007/s10551-015-2829-4
52. Pettinico G, Milne GR (2017) Living by the numbers: understanding the quantification effect. J Consumer Mark 34:281–291. https://doi.org/10.1108/JCM-06-2016-1839
53. Preacher KJ, Hayes AF (2008) Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. Behav Res Methods 40:879–891. https://doi.org/10.3758/BRM.40.3.879
54. Banjanovic ES, Osborne JW (2016) Confidence intervals for effect sizes: applying bootstrap resampling. Pract Assess Res Eval 21
55. Steinhorst J, Beyerl K (2021) First reduce and reuse, then recycle! Enabling consumers to tackle the plastic crisis– qualitative expert interviews in Germany. J Clean Prod 313:127782. https://doi.org/10.1016/j.jclepro.2021.127782
56. Gollwitzer PM, Sheeran P (2006) Implementation intentions and goal achievement: a meta-analysis of effects and processes. Advances in experimental social psychology. Elsevier, pp 69–119
57. De Temmerman J, Slabbinck H, Vermeir I (2023) The full package of package-free retail environments: a mixed methods study on multiple stakeholder perspectives of package-free shopping. Sustainable Prod Consum 41:404–417. https://doi.org/10.1016/j.spc.2023.08.020
58. Hayes AF (2013) Introduction to mediation, moderation, and conditional process analysis: a regression-based approach. Guilford Press, New York, NY, US
59. Beitzen-Heineke EF, Balta-Ozkan N, Reefke H (2017) The prospects of zero-packaging grocery stores to improve the social and environmental impacts of the food supply chain. J Clean Prod 140:1528–1541. https://doi.org/10.1016/j.jclepro.2016.09.227
60. Matthews M, Webb TL (2023) Understanding consumer's willingness to engage with digital reuse systems. Sustainability 15:14560. https://doi.org/10.3390/su151914560
61. Noëth E, Van Opstal W, Du Bois E (2024) Introducing reusable food packaging: customer preferences and design implications for successful market entry. Bus Strat Env bse 3820. https://doi.org/10.1002/bse.3820
62. Long Y, Ceschin F, Harrison D, Terzioğlu N (2022) Exploring and addressing the user acceptance issues embedded in the adoption of reusable packaging systems. Sustainability 14:6146. https://doi.org/10.3390/su14106146
63. Herweyers L, Moons I, Barbarossa C, De Pelsmacker P, Du Bois E (2023) Understanding who avoids single-use plastics and why: a cross-country mixed-method study. J Clean Prod 414:137685. https://doi.org/10.1016/j.jclepro.2023.137685
64. Tanner RJ, Carlson KA (2009) Unrealistically optimistic consumers: a selective hypothesis testing account for optimism in predictions of future behavior. J Consum Res 35:810–822. https://doi.org/10.1086/593690
65. Thøgersen J, Haugaard P, Olesen A (2010) Consumer responses to ecolabels. Eur J Mark 44:1787–1810. https://doi.org/10.1108/03090561011079882
66. Perez-Castillo D, Vera-Martinez J (2020) Green behaviour and switching intention towards remanufactured products in sustainable consumers as potential earlier adopters. Asia Pac J Mark Logistics 33:1776–1797. https://doi.org/10.1108/APJML-10-2019-0611
67. Ellsworth-Krebs K, Rampen C, Rogers E, Dudley L, Wishart L (2022) Circular economy infrastructure: why we need track and trace for reusable packaging. Sustainable Prod Consum 29:249–258. https://doi.org/10.1016/j.spc.2021.10.007
68. Magnier L, Gil-Pérez I (2021) Reviving the milk man: consumers' evaluations of circular reusable packaging offers. 4th PLATE 2021 Virtual Conference

69. White K, Lin L, Dahl DW, Ritchie RJB (2016) When do consumers avoid imperfections? Superficial packaging damage as a contamination cue. J Mark Res 53:110–123. https://doi.org/10.1509/jmr.12.0388
70. Baird HM, Meade K, Webb TL (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. https://doi.org/10.1016/j.jclepro.2022.132321