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*Article*

# Signs of Use Present a Barrier to Reusable Packaging Systems for Takeaway Food

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**Abstract:** Single-use packaging is one of the biggest contributors to plastic waste, and reuse has been identified as a key strategy to reduce such waste. However, reusable containers typically become worn, which may influence how consumers think and feel about reuse. The present research explored whether and how evaluations of a takeaway food service changed depending on the appearance of a reusable container. Two studies were conducted (using opportunity sampling) to (i) investigate the effects that signs of use have on people's perceptions of reusable packaging systems using quantitative methods (Study 1) and (ii) understand the rationale underpinning these evaluations using qualitative methods (Study 2). Study 1 involved an online questionnaire where participants ($n = 292$) were shown images of reusable bowls for takeaway food with various levels of staining and asked to evaluate the container and the restaurant serving the food using rating scales. Study 2 involved in-person interviews where participants ($n = 22$) were given the opportunity to inspect either a clean bowl or a stained bowl and then were asked questions about the bowls. Signs of previous use seemed to undermine people's willingness to reuse containers in the future and were associated with more negative evaluations of the packaging, product, and restaurant serving the food. These findings provide insights into the factors that affect people's willingness to engage with reusable packaging systems, and we use these findings to suggest behavioural and design interventions that might mitigate negative evaluations and encourage reuse.

**Keywords:** reuse; contamination; consumer perceptions; sustainable packaging; behavioural design; circular economy

## 1. Introduction

The mass consumption of single-use plastics has created a waste problem that now pollutes every corner of the globe. The packaging sector is by far the greatest offender, contributing 54% of all non-fibre plastic waste generated globally [1]. Reusable packaging systems have the potential to significantly reduce waste and reduce the environmental impact of packaging through the transition towards a more circular economy [2]. However, action on reusable alternatives in primary packaging remains exploratory, and reusable packaging still represents just 0.2% of all primary packaging placed on the market in the UK [3]. One challenge is that reusable containers typically require more raw material to ensure that they are more durable than their single-use counterparts [2] and so need to be used multiple times to counteract the increased resources needed to produce them. For example, research has estimated that a reusable takeaway container made from steel must be used between 13 and 33 times before it is more environmentally friendly than single-use takeaway containers made from aluminium, polypropylene, or expanded polystyrene [4]. Given that reusable packaging will need to be used multiple times to ensure a more circular system of resources, and that multiple uses will typically lead to signs of wear

(e.g., scratches from cutlery, stains from repeated exposure to food, etc.), it is important to understand how consumers respond to packaging that shows signs of previous use.

However, the nature of fast-moving consumer goods has led people to become accustomed to pristine packaging and to view imperfections as problematic. For example, research has found that consumers tend to avoid packaging with superficial damage in a supermarket context [5], and other research has shown that people are largely unwilling to reuse containers that show signs of wear [6]. If reusable packaging is to have a positive environmental impact, then packaging with visible wear will likely need to be accepted by consumers so that each piece of packaging is able to complete enough use cycles to surpass its environmental break-even point (the minimum no. of reuses required for a reusable product to be environmentally better than the single-use equivalent [7]).

### 1.1. Contaminated Interactions: A Barrier to Reusable Packaging Systems

So why are people largely unwilling to reuse containers that show signs of wear [6]? One possibility is that signs of previous use indicate potential contamination. Baxter and colleagues suggest that the value of an object is reduced as it is used because it becomes 'contaminated' in some way [8]. For example, research has shown that people spend worn banknotes more quickly than new banknotes [9], and that consumers evaluate products less favourably if they know that they have been touched by another person [10]. These examples point to a phenomenon that Baxter and colleagues [8] have termed "contaminated interactions"—referring to the perception that objects which have been used multiple times, potentially by different users, shift from a higher quality state to one seen as "contaminated" in some way [11,12]. This contamination can be either sensory (i.e., experienced through the senses, e.g., seeing surface scratches) or imagined (i.e., a non-physical perception that causes an object's value to change, e.g., assumed to be touched by another person) and often acts as a barrier to the circular economy [11].

According to Baxter et al., concerns about contamination are driven by three mechanisms: (i) hygiene, (ii) utility, and (iii) territory [8]. Hygiene contamination occurs when people perceive indicators of use as posing a threat to their health. For example, Abbey et al. [13] found that remanufactured food processors, although fully refurbished, were perceived by consumers to be 'tainted' due to a fear that they may transfer pathogens. Similarly, Baird and colleagues [6] designed a paradigm to measure how the change in the appearance of a container influenced people's willingness to use that container. They found that people are relatively unwilling to use containers that show signs of wear, suggesting that signs of use serve as a contamination cue. Research has also suggested that the extent to which hygiene contamination is a concern for consumers may be affected by the type of product delivered by the packaging. For example, Abbey et al. [13] categorised different products according to whether the product is used "around you" (e.g., a remanufactured laptop, MP3 player, or toaster), "on you" (e.g., a remanufactured razor), or "in you" (e.g., a remanufactured electric toothbrush). They found that remanufactured toothbrushes generated higher feelings of disgust (likely an indicator of hygiene contamination) compared to remanufactured laptops and suggested that this was due to an 'intimacy scale' whereby the closer a product is to bodily intake, the less likely it is that consumers would be willing to reuse it. Similarly, White and colleagues [5] showed that superficial damage to packaging reduced people's intentions to purchase the product within if the contents of the packaging were destined for ingestion (e.g., baking soda) compared to packaging that contained a product that is not ingested (e.g., deodorant). Thus, it seems likely that concerns about contamination are likely to be greater for packaging that holds products that are consumed (e.g., food and drink).

Utility contamination occurs when indicators of use decrease the perceived value or functionality of the product or container. Utility contamination can include the technical function of the product (e.g., a hole in a bag for life likely means that the bag is no longer fit for purpose) and the aesthetics of the product and container. For example, a heavily stained bowl may not be viewed as functional, in the sense that people find it too unpleasant to

use [6]. The impact of aesthetics may, however, depend on individual differences (e.g., in the extent to which people tend to feel disgusted) and contextual factors (e.g., whether the person is a customer who will eat from the bowl or a member of staff serving food in the bowl) [6].

Finally, territorial contamination is the result of an object being perceived as belonging to someone else. Examples of territorial contamination include the body heat from a previous user leaving a chair warm, signalling to the next user that someone else has recently used it [8]. For example, Rozin et al. [14] found that people believe that laundering an item does not remove the essence of a previous user, commenting that "a sweater worn once by a healthy stranger and then laundered is less desirable than an unworn sweater" (p. 762). Territorial contamination might be a particular concern in reuse schemes that involve shared ownership (e.g., in the case of reusable containers for takeaway food), rather than schemes where people reuse their own containers (e.g., taking a reusable cup into a coffee shop). Preliminary research has found that people's willingness to reuse a container is influenced by who owns the container, such that people are less willing to reuse a container that is owned by a stranger compared to a container that is owned by themselves or someone they know [15]. These findings suggest that users' perceptions of reusable containers are likely influenced by the reusable packaging model that is adopted.

Figure 1 provides the model of contaminated interactions, describing the process by which a contaminator creates a contaminant (which can be real or imaged), and this contaminant changes a user's evaluation of an object producing a contaminated interaction [16].
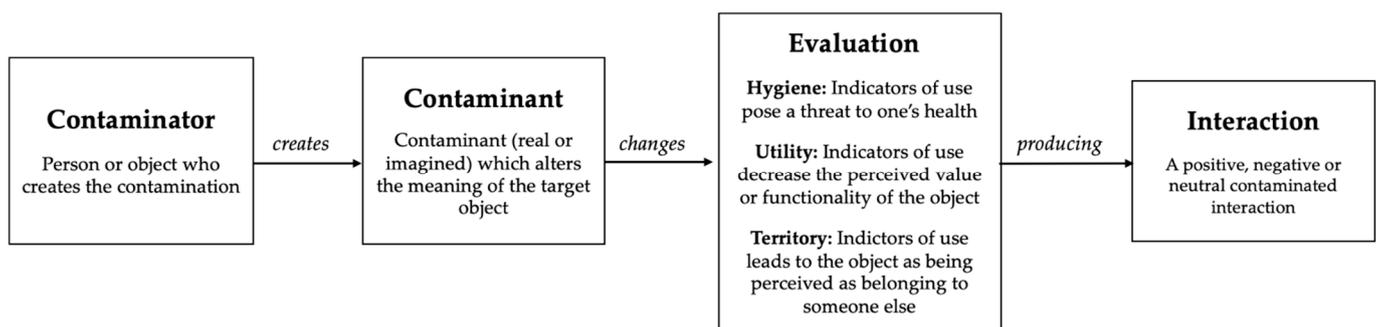


**Figure 1.** Model of contaminated interactions.

*1.2. Research Objectives*

Containers that show signs of previous use likely pose a significant barrier to the success and wide-scale adoption of reusable packaging systems. However, it is unclear whether and how users' perceptions and behaviour are affected by encountering containers that appear to have been used multiple times (and by multiple users). Thus, the aim of the present research was to explore whether and how people's evaluations of reusable containers—and the services that provide them—change when the containers show signs of previous use. The present research focused on one example of reusable containers—bowls for takeaway food—as it is currently one of the most prevalent applications of reusable packaging [17].

To ensure commercial relevance, a corporate partner who operates a reusable packaging system for takeaway food and drink worked alongside the research team. To maintain the confidentiality of the company, the present research will use the pseudonym "BowlCycle". "BowlCycle" is currently one of the largest reusable packaging companies in Europe, operating in eight countries with over 300,000 users (as of November 2022). The scheme has recently been introduced in the UK and provided the reusable takeaway containers for the present research.

The present research involved two empirical studies that explored whether and how people's evaluations of a takeaway food service are influenced by the appearance of the reusable container that is used to serve their food. Study 1 employed an online question-

naire (and quantitative methods) to explore how people's evaluations of reusable containers change when they show signs of use. Study 2 used in-person interviews (and qualitative methods) to allow participants to physically evaluate the bowls (as they would in real life) and to understand the rationale behind participants' evaluations of the bowls and restaurant. We then used the findings from Study 1 and Study 2 to identify behavioural and design interventions that might mitigate negative evaluations and encourage reuse.

## 2. Study 1

Study 1 examined whether and how participants' evaluations of reusable bowls for takeaway food and the restaurant serving the food differed according to the appearance of the bowl. Five images of bowls were created that varied from clean to highly stained (see Figure 2). Participants were randomly assigned to view one of the bowls and to answer a series of questions regarding their evaluations of the container and the restaurant serving the food. We hypothesised that greater staining would be associated with more negative evaluations of the container and the restaurant, and that greater staining would be associated with a decrease in how much participants would be willing to pay for the meal.
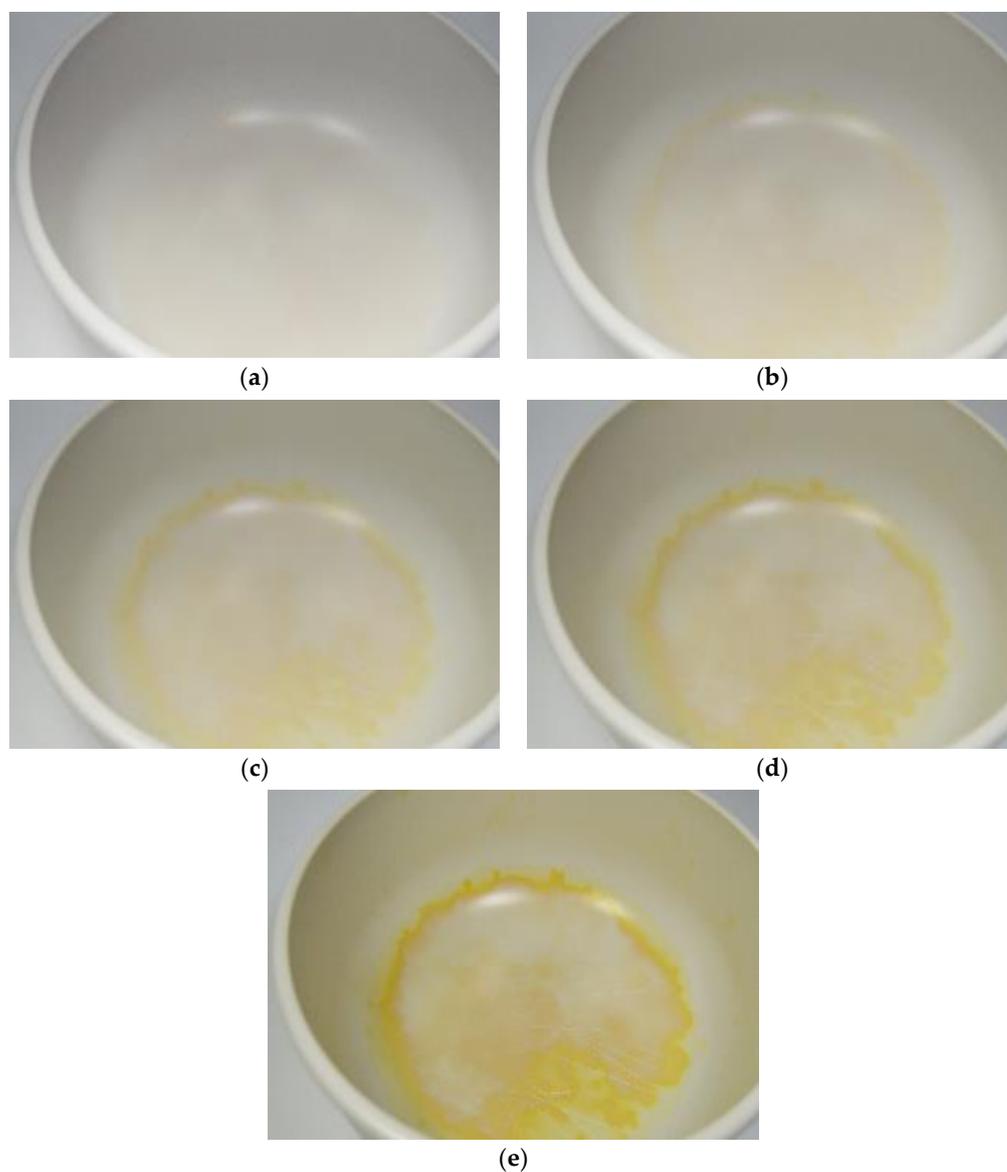
**Figure 2.** Image of the bowls used in Study 1 that varied according to the amount of visible use: (**a**) bowl 1, (**b**) bowl 2, (**c**) bowl 3, (**d**) bowl 4, and (**e**) bowl 5.

*2.1. Method*

2.1.1. Participants

An a priori power analysis (using G*Power) suggested that 305 participants would be required to detect a small effect, $f^2 = 0.02$, between five independent groups (i.e., the five bowls) and seven dependent variables (i.e., the different evaluations that we measured) with an alpha of 0.05 and power set at 80% [18]. $n = 292$ participants completed an online questionnaire hosted by Qualtrics in return for GBP 1.25. Participants were recruited via Prolific, were aged between 18 and 65 ($M = 26.81$, $SD = 8.81$), and were predominantly male (69.9%).

2.1.2. Materials and Procedure

(a) Scenario. Participants were asked to imagine that they were getting lunch "to-go" from a local vegetarian restaurant. A vegetarian restaurant was chosen because evidence suggests that meat products can elicit feelings of disgust, particularly among vegetarians [19], and our focus was on feelings of disgust that might arise from (re)use of the container, rather than the product that it contained. Participants were told that the restaurant had recently replaced their single-use packaging with reusable bowls in an attempt to be more sustainable. As such, they would be served their food in a bowl that had been used by previous customers and washed between uses. Participants were told that they would be shown an image of the bowl that their meal was served in and asked to answer a series of questions relating to their evaluations of the bowl and the restaurant (see Appendix A for the full details of the scenario presented to participants).

(b) Stimuli. Participants were then randomly assigned to see one of five bowls that varied in the extent to which they appeared used (see Figure 2). The images were created by digitally morphing an image of a new bowl with an image of a used bowl using Adobe Photoshop. The used bowl had completed 67 use cycles in the reuse system and reached a level of damage that was deemed unacceptable by a restaurant owner (hence its removal from the system and donation to research).

(c) Evaluations of the bowl and restaurant. These questions were adapted from Argo et al. [10] and Di Muro et al. [9] and included (i) how participants rated the quality of the restaurant, (ii) how much they would be willing to pay for the meal, (iii) how likely they would be to order from the restaurant again, (iv) how likely they would be to use reusable takeaway packaging in the future, (v) how willing they would be to eat out of the bowl again, and (iv) the extent to which the bowl made them feel disgusted (see Appendix B for full details). Participants were asked to respond on a 5- or 7-point Likert scale, and the order of the questions was randomised. We also asked participants to complete measures of individual differences in sensitivity to disgust (the Disgust Propensity and Sensitivity Scale-Revised [20]), pro-environmental identity (Green Identity Scale [21]), and reuse behaviour in other domains (five items adapted from Ertz et al. [22]). However, as the focus of this paper is whether and how signs of use affect evaluations, these measures are not considered further. However, further information and analyses relating to the relationship between individual differences and participants' evaluations of the reusable bowl and restaurant can be found online: https://osf.io/egvj2/?view_only=a6bc483ea14f40d69b04cc5959133a4a (accessed on 23 May 2023).

*2.2. Results*

Table 1 presents the descriptive statistics for the dependent variables for each of the bowls that were presented (where bowl 1 is the cleanest and bowl 5 is the most heavily stained). Multivariate Analysis of Variance (MANOVA) was conducted to explore whether the appearance of the takeaway bowl influenced participants' evaluations of the bowl and/or restaurant. Preliminary analyses were first conducted to establish whether the data met the statistical assumptions for subsequent analyses. The data were normally distributed (i.e., values of skew and kurtosis were between −2 and +2 [23]); however, there were outlying values on the variable measuring how much participants would be willing

to pay for the meal (i.e., values greater than $+/- 3$ standard deviations from the mean). As such, these participants ($n = 4$) were removed from the analysis. All of the analyses were conducted using SPSS, and the data and syntax can be found online: https://osf.io/egvj2 /?view_only=a6bc483ea14f40d69b04cc5959133a4a (accessed on 23 May 2023).

**Table 1.** Descriptive statistics for participants' perceptions of the bowl and restaurant according to the version of the bowl shown.

| Dependent Variable | Bowl 1 (*n* = 58) | | Bowl 2 (*n* = 57) | | Bowl 3 (*n* = 59) | | Bowl 4 (*n* = 59) | | Bowl 5 (*n* = 59) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| Perceived quality of the restaurant | 5.14 | 1.13 | 4.07 | 1.58 | 3.90 | 1.45 | 3.51 | 1.41 | 3.24 | 1.30 |
| Likelihood of returning to the restaurant | 5.10 | 1.65 | 4.19 | 1.89 | 3.59 | 1.86 | 3.32 | 1.62 | 3.08 | 1.80 |
| Likelihood of using reusable packaging again | 5.43 | 1.52 | 4.12 | 1.91 | 3.97 | 1.98 | 3.49 | 1.77 | 3.27 | 1.87 |
| Willingness to eat from the bowl again | 4.95 | 1.31 | 3.74 | 1.74 | 3.41 | 1.77 | 3.00 | 1.82 | 2.88 | 1.79 |
| Negative affect | 1.87 | 1.04 | 3.45 | 1.69 | 3.83 | 1.48 | 3.98 | 1.72 | 4.11 | 1.55 |
| Feelings of disgust | 1.71 | 0.94 | 3.09 | 1.65 | 3.40 | 1.57 | 3.39 | 1.64 | 3.77 | 1.56 |
| Amount (in GBP) willing to pay for meal | 5.70 | 2.53 | 5.40 | 3.16 | 5.53 | 3.15 | 5.55 | 2.93 | 5.07 | 3.43 |

*M* = mean and *SD* = standard deviation. All self-report measures were rated on 7-point scales, except for the measure assessing how much participants would be willing to pay for the meal, for which an open response box was provided. Due to outlying responses on the variable representing the amount that participants were willing to pay for the meal, *n* = 57 and *n* = 56 for Bowl 3 and Bowl 5, respectively.

Do Signs of Use Influence Participants' Evaluations of the Bowl and Restaurant?

MANOVA revealed a statistically significant difference in participants' evaluations of the bowl and restaurant according to the appearance of the bowl, $F(28, 1116) = 3.47$, $p < 0.001$, and $\eta_p^2 = 0.08$. In support of our hypothesis, an inspection of the univariate tests revealed that the appearance of the bowl was associated with the extent to which participants felt disgusted and experienced negative emotions, were willing to eat from the bowl again, use reusable packaging in the future, the perceived quality of the restaurant, and the likelihood that participants would return to the restaurant ($p's < 0.001$). However, in contrast to our hypothesis, the appearance of the bowl was not associated with how much participants were willing to pay for the food ($p = 0.852$). As can be seen in Table 1 and Figure 3, as the appearance of the bowl deteriorated, participants felt more disgusted, experienced greater negative affect, were less willing to eat from the bowl again, and were less willing to use reusable packaging in the future. Participants also rated the quality of the restaurant as lower and reported that they would be less likely to return to the restaurant.

As significant univariate tests were found, post hoc comparisons (using Tukey's HSD test) were conducted to identify which pairs of means were significantly different from each other. Tukey's HSD test is a type of post hoc test that tests all pairs of means while controlling for the probability of making one or more Type 1 errors (i.e., finding a significant difference when the results have occurred by chance). Post hoc tests revealed that participants' responses to the cleanest bowl (bowl 1) were significantly different to responses to all of the other bowls (i.e., bowls 2 to 5) on all of the dependent variables, except their willingness to pay. For example, there was a significant difference in participants' willingness to eat from the bowl again between participants who were presented with bowl 1 ($M = 4.96$, $SD = 1.32$, $p < 0.001$) and participants who were presented with bowl 2 ($M = 3.75$, $SD = 1.74$, $p < 0.001$), bowl 3 ($M = 3.41$, $SD = 1.77$, $p < 0.001$), bowl 4 ($M = 3.00$, $SD = 1.82$, $p < 0.001$), and bowl 5 ($M = 2.90$, $SD = 1.80$, $p < 0.001$), but there were no significant differences in participants' willingness to eat from the bowl again between participants who were presented with bowls 2, 3, 4, or 5 ($p's < 0.05$).

This suggests a non-linear relationship, such that there is a significant increase in negative evaluations and a significant decrease in positive evaluations when comparing the perfectly clean bowl (i.e., bowl 1) to a bowl with any sign of wear (i.e., bowls 2, 3, 4, or 5). However, when a bowl shows some signs of wear (i.e., bowls 2 to 5), there is little or no difference in participants' evaluations of the bowl and/or restaurant (although there

were significant differences between participants who saw bowl 2 and participants who saw bowl 5 on evaluations of the quality of the restaurant ($p = 0.015$) and the likelihood that they would return to the restaurant ($p = 0.011$; see Table 1 for means)). This suggests that any amount of visible damage or discolouration to the appearance of the bowl can influence people's evaluations of the restaurant and their willingness to order and eat from the restaurant again.
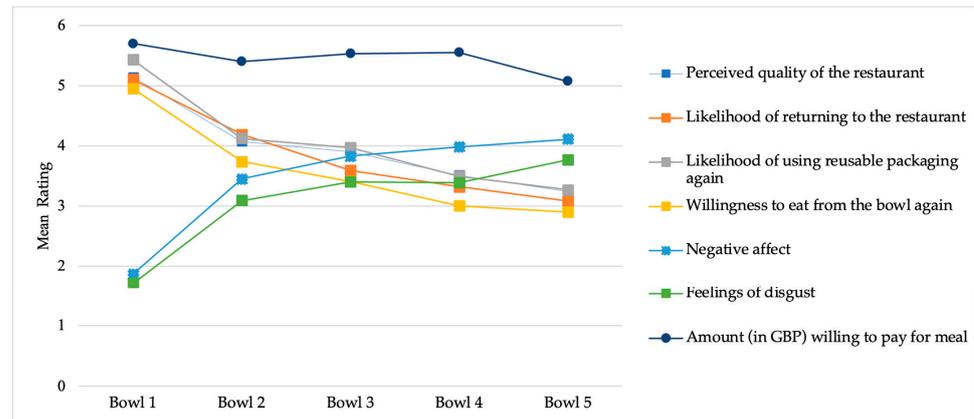


**Figure 3.** Mean ratings for perceptions of the bowl and restaurant according to the version of the bowl shown. All variables were measured on 5-point Likert scales, except for the "Amount (in GBP) that participants were willing to pay for the meal", which was measured using an open response box.

## 3. Study 2

Study 2 sought to build on the findings from Study 1 through in-person interviews, which allowed participants to physically evaluate the bowl (as they would in real life), rather than seeing and evaluating the bowls via digital images, and provided the opportunity to understand the rationale behind participants' evaluations of the bowls and restaurant.

### 3.1. Method

Study 2 used the same reusable bowls for takeaway food as Study 1, but only two variants were used: (i) a perfectly clean bowl (i.e., bowl 1) and (ii) a highly stained bowl (i.e., bowl 5; see Figure 4). Participants were randomly allocated to one of these two conditions and were not told that other participants would be shown a different bowl. Twenty-two students from the Dyson School of Design Engineering at Imperial College London (UK) took part in Study 2. No other demographics were collected from participants. The interview took approximately 25 min, and participants were compensated with a GBP 10 Amazon voucher for their time.
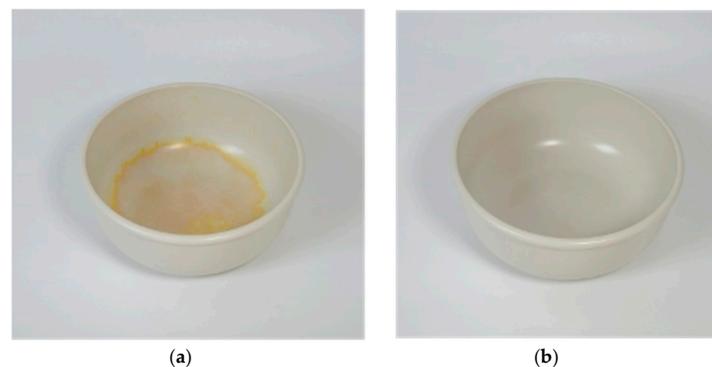


(**a**)                 (**b**)

**Figure 4.** Images of the bowls used in the interviews in Study 2: (**a**) a highly stained bowl (i.e., bowl 5) and (**b**) a perfectly clean bowl (i.e., bowl 1).

### 3.2. Materials and Procedure

Participants were asked to read the same scenario describing the reusable bowl scheme described in Study 1 (see Appendix A) and then shown either the perfectly clean bowl (i.e., bowl 1) or the very stained bowl (i.e., bowl 5). The other bowl was not visible to the participants. Participants were encouraged to pick up and inspect the bowl, before being asked to complete a questionnaire comprising the same six questions regarding their evaluation of the bowl and the (hypothetical) restaurant that might have served them food in that bowl, as described in Study 1 (Appendix B).

The interview commenced upon completion of the questionnaire. Participants were asked six questions, each with a number of follow-up prompts included as appropriate (see Table 2). The interview was not recorded, but notes were taken to capture key quotes and insights. A 'conversational' approach was adopted to capture participants' thoughts and attitudes through natural dialogue and a conversational tone [24]. On completion of the interview, participants were debriefed and shown the bowl that they did not see.

**Table 2.** List of interview questions and follow-up prompts.

| Interview Questions for Study 2 |
| --- |
| 1. You said you would be willing to pay £X for this meal, could you tell me a bit more about why you chose this amount?<br>• Why would you not be willing to pay more? |
| 2. You said you were X disgusted by the state of the bowl, why did the bowl make you feel this way?"<br>• How did the stains/scratches make you feel?<br>• Hundreds of people share and reuse restaurant bowls and plates. Does reuse bother you in that context? |
| 3. What is your opinion of reusable packaging for takeaway food following this experience?<br>• What is your opinion of the reusable packaging start up, 'BowlCycle' following this experience? |
| 4. You said you would be X willing to eat out of this bowl again, why did you choose this answer? |
| 5. If I told you that 67 people had eaten out of this bowl, how would that change your perception of the packaging?<br>• Hundreds of people share and reuse restaurant bowls and plates. Does reuse bother you in that context? |
| 6. For participants who saw the heavily stained bowl only: What do you think might have caused the scratches/stains?<br>• What do you think might have caused the scratches/stains?<br>• If I told you that careful laboratory testing confirmed that the bowl is completely sanitary and hygienic, does this reduce your concerns about others having used the bowl before you? |

### 3.3. Results

Interview notes were analysed using a discovery-oriented, thematic analytic approach [25]. Emerging themes were identified by iterative reading, revealing four key themes: (i) that packaging is invisible, (ii) sharing with strangers, (iii) feeling overrides logic, and (iv) recognisable damage.

3.3.1. Invisible Packaging

Participants rarely mentioned the wear to the bowl when considering how much they would pay for the meal. Instead, almost all participants (86%) referred to the quality of the food and the size of the portion. For example, one participant stated, *"I based the price on the average cost of lunch around campus, and the food in the picture looked good"*, while another participant said, *"It looks like quite a big bowl, so probably big portions too"*.

In this sense, participants seemed to view packaging as a facilitator—or system for delivering the desired product—and rarely considered the packaging as a part of the transaction. These findings align with those of Shaddy and Fishbach [26], which showed that people are more willing to pay for a desired product (e.g., an autographed book) than if those resources also seemed to go toward the means by which that product is delivered (e.g., a branded tote bag that contained the same autographed book). This might explain why Study 1 found that the level of wear of the bowl was not associated with the amount that participants were willing to pay for the meal in the sense that this question may have focused participants on the meal (the desired product) rather than the means by which it is delivered (the bowl). Some participants (27%) did, however, mention the quality of the bowl, remarking on the durability and sturdiness of the bowl compared to single-use containers (e.g., "*the bowl feels sturdy and strong*" and "*I would prefer [the reusable bowl] to normal packaging [because it's] a sturdy bowl, not weak like polystyrene*").

### 3.3.2. Sharing with Strangers

When participants were told that 67 strangers had eaten out of the bowl before (which was true for the used bowl), participants unanimously said that this would not bother them. Some participants (46%) reasoned that sharing crockery is normal in the context of a restaurant. For example, one participant remarked, "*When you eat in a restaurant you don't ask the waiter how many people have eaten off this plate before, that would be weird*". A few participants (18%) said that knowing that the bowl had been used previously would even improve the experience for them; for example, "*If people have used this bowl before and haven't died, it gives me confidence that I'll be fine!*". These comments stand in contrast to the findings of Study 1, which suggest that prior use of the container by other consumers is a barrier to reusable packaging systems. However, telling participants that users could have taken the bowls home for up to two weeks increased participants' concerns about possible contamination. For example, one participant who saw the used version of the bowl stated that "*They could have done anything with this bowl, they could have used it as a dog bowl!*". Therefore, it is possible that ambiguity over how the bowl had become stained in Study 1 led participants to be more concerned that others had used the bowl before them.

### 3.3.3. Feeling Overrides Logic

When asked if lab testing to certify that the bowl was hygienic and safe to use would change their perceptions of the reusable bowl, most participants (64%) answered that it would not. This suggests that users rely on their own perceptions of the bowl, which may be based on sensory inspection (e.g., touching, smelling, and looking) and narratives that they create to determine if it is suitable for their use. For example, one participant who was presented with a used bowl remarked, "*No, that wouldn't change anything, I know it's clean*". Knowing that the bowl was clean, however, did not prevent feelings of disgust. Many participants who thought that the bowl was clean still found the sight of the stain repulsive, for example, "*The stains are still very disgusting to me for some reason*". These findings suggest that an instinctive 'feel' for how clean the bowl is can override logical thinking. It may also suggest that providing evidence about the cleaning process may not increase people's willingness to use bowls that show signs of wear.

### 3.3.4. Recognisable Damage

When asked about the nature of the scratches and stains on the inside of the bowl, participants generally believed that the damage resulted from metal cutlery being used too firmly and foods such as curries being left in the bowl for long periods of time "*The staining reminds me of my own Tupperware after microwaving chicken curry*". This recognition, however, was also associated with the knowledge that cleaning does not always remove stains. For example, some participants (32%) said that they noticed stains remained even after being washed. "*My Tupperware gets like this at home, even after it comes out of the dishwasher, so I know it's clean*". This resulted in a feeling of familiarity and trust, as some participants viewed

the wear as 'normal'. Thus, knowledge of what caused the damage generally reduced the impact of the signs of use on perceptions. However, this also highlights that people try to piece together narratives for how wear has come to be, which can be a risk if wear is not easily attributable to an expected and benign interaction.

## 4. Discussion

The present research investigated whether and how signs of use affect people's perceptions of reusable containers, the products that they contain, and the establishments that provide those containers and products. Two studies presented participants with reusable bowls for takeaway food with various levels of staining, either in the form of images in a questionnaire (Study 1) or in person ahead of a brief interview (Study 2). Consistent with our hypothesis, the main finding was that any sign of previous use was associated with more negative evaluations of the bowl, the product that it contained, and the establishment that provided the takeaway. Signs of previous use also seemed to undermine people's willingness to reuse containers in the future. These findings are consistent with the idea that concerns about contamination represent a barrier to a more circular economy [11] and are associated with people's willingness to reuse packaging [6,15].

The findings support and extend our understanding of how contaminated interactions present a barrier to reuse systems. For example, the findings suggest that concerns about hygiene are largely driven by sensory inputs (i.e., the appearance of the bowl) and support previous evidence that even superficial damage to a container (e.g., a dented can or torn label) can act as a contamination cue that activates concerns about the health and safety of the product [5]. The findings also extend previous research, which has shown that people are less willing to reuse packaging and containers that show signs of wear [6,15] by indicating that there may be a non-linear relationship between the appearance of the bowls and participants' evaluations of the bowl and restaurant. That is, there was a significant difference in participants' evaluations when comparing a perfectly clean bowl to a bowl that showed any sign of wear, but there was no difference in participants' evaluations of the bowls that showed varying levels of wear. This suggests that any amount of visible damage or discolouration to the bowl can influence people's evaluations.

We expected that territorial contamination was likely to be a concern in reuse schemes that involve shared ownership, such as that described in the present research. Indeed, previous research has suggested that people's willingness to reuse a container is influenced by who owns the container, such that people are less willing to reuse a container that is owned by a stranger compared to a container that is owned by themselves or someone they know [15]. However, Study 2 suggested that prior use of the container is not always a barrier to reusable packaging systems. Indeed, some consumers drew an analogy between reusing cutlery and plates in a restaurant where the sharing of crockery is normal in the context of a restaurant. This may point to a potential avenue for future interventions to promote reuse by drawing analogies with where reuse is the norm in similar contexts.

### 4.1. Implications for Interventions to Promote Reuse

The findings of the present research suggest that signs of use can reduce people's willingness to engage in reuse systems. Therefore, strategies are needed to overcome concerns about contamination and promote reuse. Baxter and colleagues [12] developed a framework that outlines eight different strategies that can be used to mitigate contamination concerns for reusable products and containers. The interventions can be broadly categorised into two groups: (i) those that target the consumer via behavioural interventions that try to shift beliefs (e.g., attitudes and norms) and behaviours and (ii) those that target the container via design strategies to hide or disguise signs of wear and thus might be implemented by producers of packaging or those who provide packaging as a service. Below, we use this framework and the findings from Studies 1 and 2 to suggest a number of behavioural and design interventions that might be tested in future research (for an overview, see Table 3).

**Table 3.** Summary of possible intervention strategies to address contaminated interactions.

| Potential Design Intervention | Description | Category of Strategy (From Baxter et al. [12]) |
|---|---|---|
| Battle scars | Reframe scratches and stains as battle scars earned from fighting plastic waste. | Change meaning |
| Controlled allocation | Allocate damaged bowls to certain users. | Withdraw |
| Condition tracking | Track damage to bowls and punish via a financial penalty. | Condemn the contaminator |
| Surface scraping | Remove stains and scratches by cutting away a thin layer of the surface plastic. | Restore the target object |
| Durable materials | Select a more durable plastic for the bowl that is resistant to scratching/staining. | Protect the target object |
| Opaque spray | Restaurants cover the stains/scratches with an opaque soluble paint before filling. | Block the contaminant |
| Decommission guide | Guidelines could be given to restaurants on the exact conditions when bowls should be removed. | Remove the contaminant |
| Colourful patterns | Add bright colours to the bowls to overpower the aesthetic of stains/scratches. | Conceal the contaminant |

(a) Behavioural decontamination interventions. The three behavioural strategies suggested by Baxter and colleagues [12] include (i) altering how the user thinks about the contaminated target, (ii) preventing users from disengaging with reuse systems, and (iii) punishing users who create contamination.

Applying the first strategy to the context of reusing containers for food, interventions might seek to change the meaning that people associate with signs of use. For example, future research could look to reframe 'damage' to the bowl as 'battle scars' earned from fighting the battle against plastic waste. That is, the more damaged a bowl is, the more single-use plastic it has prevented—something which might be celebrated rather than avoided. This perspective could be communicated via marketing and the language used to describe reuse systems (e.g., through social media advertising supported by humanising cartoons that give 'personalities' to these containers), or a count on a smartphone application indicating the environmental benefit of reuse (e.g., amount of single-use plastic prevented), which might prompt users to be more lenient with the condition of the bowl. Restaurants might also be issued with a 'decommission guide' to prevent premature disposal of containers. This could include images that show the conditions when a bowl should be removed from the system.

To prevent users from disengaging from reuse systems (e.g., if they have a 'bad' experience, such as being served their food in a bowl that they consider to be unacceptably worn), the choice of the reusable bowl could be tailored. For example, the system could ensure that users never receive two highly used bowls in a row, or consumers could indicate the level of wear that they are prepared to accept. A number of reusable packaging systems for takeaway food, including "Bowl Cycle", have a transaction history whereby all bowls have a digital ID. This would facilitate a system where the type of bowl given to consumers is tailored according to their preferences, previous use, and/or dietary requirements (e.g., someone with a nut allergy could be sure that the bowl they have been given has never contained nuts).

The final behavioural strategy involves identifying ways to reduce the amount of wear inflicted by each user. Applying this idea to the context of reusable containers for takeaway food, scannable QR codes could be added to each bowl to allow restaurants to track the condition of each bowl after each use, potentially via a smartphone camera and a machine learning algorithm that quantifies the level of damage. As a result, new damage could be attributed to specific users, which might create a deterrent to treating the bowl roughly (e.g., via a financial or social penalty, such as a star rating).

(b) Design decontamination interventions. The five design strategies suggested by Baxter and colleagues [12] to reduce concerns about contamination from previous use include (i) restoring the container, (ii) preventing the container from becoming damaged or worn, (iii) preventing contact with the contaminant, (iv) eliminating the contaminant, and (v) disguising or covering the contaminant.

Applying the idea of restoring the container to the context of reuse systems for take-away food, many scratches and stains are only surface level, often inflicted by metal cutlery. Bowls could therefore be refurbished when they reach an unacceptable level of damage. This could involve using a lathe and a custom cutting tool to remove a few millimetres of surface material or reheating the bowl in a mould to restore the original finish. Bowls and containers could also be designed to be more resilient to potential causes of damage. For example, the bowl could be hardened against scratching and staining through material selection, additives, and/or surface coatings, increasing the average number of use cycles before the bowl reaches a 'used' state. Alternatively, to hide existing damage from users, a bright and colourful pattern on the surface of the bowl could be used - a technique that is used extensively in public transport seat covers to hide staining & wear. Restaurants could also consider spraying the bowls with a food-safe, opaque coating before filling them with food. This would create a barrier between the user and the perceived contaminant.

*4.2. Limitations and Further Research*

The present research has some methodological limitations that should be acknowledged. First, participants were not asked to eat out of the bowls, but instead saw an empty bowl—digitally in Study 1 and physically in Study 2. Some participants reported finding it difficult to imagine how they would feel if they actually had to eat from the bowl. Future research might use the same questionnaire and interview in a real-world context in which participants are asked to pay for and eat a meal from the bowl. Second, our motivation was to better understand perceptions of reusable packaging, but the research was constrained by the focus on a single context (i.e., takeaway food) and the use of a single stimulus (i.e., a bowl made of polypropylene). It is possible that people may be less concerned about prior use in the context of reusing packaging and containers for home or personal care products (e.g., packaging for shampoo or a cleaning spray) as they are not being ingested [5]. Similarly, perceived contamination resulted from sensory evaluations of marks and related narratives generated by users (e.g., that such marks were created by prior use). Such marking and related narratives may differ from other kinds of reusable packaging. For example, patina may be celebrated on vintage leather products, such as leather jackets, wallets, or briefcases. The generalisability of these results should therefore be considered conservatively to other types of packaging, packaging wear, and contexts. Additional work is needed to best understand the perception and willingness to use reusable packaging in a range of contexts, and we hope this work will offer some methodological and contextual insight to help guide future work.

**5. Conclusions**

Reusable packaging can reduce waste. However, containers need to be used multiple times to confer a benefit over single-use alternatives, and (re)use typically leads to signs of wear. The present research suggests that signs of use may create a 'contaminated interaction' that leads to negative evaluations of the product and undermines users' willingness to engage with reuse systems in the future. This observation is important as little attention is currently given (by researchers and those operating reuse schemes) to when and how signs of use are created and how these shift users' perceptions of the packaging, products, and associated services. While the current work has only explored one form of packaging (reusable bowls), the idea that signs of use will affect perceptions likely applies across all packaging that sees multiple uses and users during its life. Our hope is that the present research provides a methodological and conceptual foundation for future studies exploring other reusable packaging scenarios. If reuse is to fulfil its potential in reducing plastic waste, strategies are needed to 'decontaminate' interactions.

## Appendix A

The scenario presented to participants in Study 1.

Imagine this situation. You are getting lunch "to go" in your local town centre and you choose to eat at a vegetarian restaurant. In an attempt to become more sustainable, this restaurant has replaced its single-use packaging with reusable takeaway bowls. These bowls are part of a new system that requires you to eat out of a bowl that has potentially been used by many others. Similar to 'eat in' dishes, this bowl is thoroughly cleaned before each use. This new shared, reusable system reduce plastic waste. After ordering your meal, you take it home and eat it. Afterwards, you give the bowl a quick wash. Below is an image of the meal before you start eating.



**Figure A1.** An image of a reusable bowl used in the scenario presented to participants in Study 1.

You will now be shown an image of the reusable bowl after you have finished eating and after you have given it a quick clean."

## Appendix B

**Table A1.** Questions and response scales used to assess participants' evaluations of the takeaway bowl and restaurant used in Study 1.

| Question | Response Scale |
| --- | --- |
| How would you rate the quality of the restaurant? | 1 = Low Quality, 7 = High Quality |
| How likely are you to return to this restaurant in the near future? | 1 = Extremely Likely, 7 = Extremely Unlikely |
| Imagine that you returned this bowl to the restaurant who washed it and returned it to service. Would you be willing to eat out of this bowl again? | Yes, No |
| How likely are you to use reusable takeaway packaging again following this meal experience? | 1 = Extremely Likely, 7 = Extremely Unlikely |
| How much (in £) would you be willing to pay for this meal? | Open response box |
| How does the condition of the bowl make you feel? (i) Disgusted, (ii) Revolted, (iii) Unhappy, (iv) Angry, (v) Gross, (vi) Annoyed, (vii) Mad, (viii) Frustrated, (ix) Unclean | 1- Not at all, 7 = Very |

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