

# Investigating How Signs of Use Affect Users' Perceptions of Reusable Takeaway Packaging

Ben Collis

Dyson School of Design Engineering

Imperial College London

4996 words (excluding citations)

## Abstract

Reusable packaging has the potential to significantly reduce plastic waste from single-use packaging. However, to create durable containers that will survive long-term reuse, packaging designers must consider the inevitability of visible ageing and its associated behavioural implications. Through 3 studies, this work has explored issues arising from signs of use in reusable packaging and considered options to mitigate such issues. The results demonstrate that as reusable containers become more aged, negative perceptions increase significantly. Studies 1 & 2 shed light on the effect of ageing on perceptions through a contemporary example of reusable packaging. Both quantitative and qualitative methods were used to capture statistical significance and more nuanced effects. Study 3 explored solutions to this problem through a design framework, offering a proactive starting point for future packaging designers and reusable businesses to build more robust reusable packaging systems with behavioural barriers in mind.

**Keywords:** Reuse, Contamination, Consumer Perceptions, Sustainable Packaging, Behavioural Design

## 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 61% of all plastic waste generated in the EU (Geyer et al., 2017). Single-use behaviours are well ingrained in modern consumerist culture and are the main cause of this waste, catalysed by vast amounts of fast-moving consumer goods (Golding, 1999). The purpose of the 'throwaway society' is to ensure that the first user is also the last, quickly discarding the product after a single use (Cooper, 2008). In its current form, as soon as a piece of packaging has been opened and its contents consumed, it instantly becomes purposeless and is perceived as litter (Wever, 2010).

Reuse is a waste management strategy that aims to combat this; it is a key driving factor in achieving a more circular economy (Coelho et al., 2020). Reusable packaging is a growing solution within this area and is defined by the packaging Waste Directive 94/62/EC (European Commission, 2018) as, "packaging which has been conceived, designed and placed on the market to accomplish within its lifecycle multiple trips or rotations by being refilled or reused for the same purpose for which it was conceived". Plastic pollution is a massive and at the same time intensely personal environmental problem, it is shaped by the individual behaviours of people.

Rapid consumption has bred a preference for pristine packaging with no imperfections. For example, consumers have been shown to avoid imperfect packaging with superficial damage in a supermarket context (White et al., 2016). The very essence of reuse means consumers will have to grow accustomed to using potentially imperfect packaging with signs of previous use. This intrinsic inevitability is largely ignored by current reusable packaging products, with designers often only considering short term factors such as usability and aesthetic. Figure 1 shows an advert displaying a popular reusable packaging brand in a perfect and pristine condition. Figure 2 shows an image of the most successful reusable packaging application in recent history. There is a clear difference between these 2 images. If reusable packaging is to achieve its environmental goals and cut our plastic pollution, used packaging with visible wear may need to become a social norm so that each piece of packaging is able to complete

enough use cycles to surpass its environmental break-even point. Furthermore, there is a strong financial incentive to maximise use cycles as businesses will only achieve profit after enough use cycles have been completed to cover the initial cost of the packaging asset. Therefore, there is a clear need to understand and address the barriers to reusable packaging to ensure its adoption into the mass-market



**Figure 1:** Modern reusable packaging by LOOP



**Figure 2:** The Tiffin box – a 200-year-old food delivery lunchbox service in India

## 2 Conceptual Background

### 2.1 Contaminated Interactions

There have been several studies highlighting the behavioural difficulties in implementing reusable products. Research by Baxter et al. (2016) describes the process in which the value of an object is reduced as it is used, suggesting that it becomes 'contaminated' in some way. This idea of 'Contaminated Interactions' will form the theoretical basis of this paper. Contamination is driven by 3 mechanisms:

Firstly, *Hygiene*. This occurs when indicators of use are perceived to pose a threat to one's health. A recent study presents an example of hygienic contamination, showing that remanufactured food processors which had been fully refurbished were perceived by consumers to be disgusting and forever tainted due to a fear of pathogen transfer (Abbey et al., 2015). It has also been shown that the simple knowledge that another person has touched the product (Argo et al., 2006) or that it has come into contact with another 'disgusting' product (Rozin and Fitzsimons, 2007) can be enough to cause aversion

via the law of contagion: a magical law that suggests a non-physical link exists between objects that have touched, long after physical contact has ceased, until cleansed (Rozin et al., 1990).

Secondly, *Utility*. This occurs when indicators of use show a decrease in perceived value or functionality. An example of utility contamination is a chewed pen lid. Although there are some obvious hygienic concerns with pathogen transfer, the utility of the pen is also perceived as contaminated as the lid may no longer fit properly, causing the pen to dry out thus not fulfilling its functional purpose. Another study showed the reduction in perceived value of phone cases that had been artificially aged versus brand new ones due to aesthetic degradation (Lilley et al., 2016).

Thirdly, *Territory*. This is the result of an object perceived as being marked i.e., belonging to someone else. An example of territorial contamination is the body heat from a previous user leaving a chair warm, signalling to the next user that someone else has recently used it (Baxter et al., 2016). Another example from car sharing systems suggests that when users smell residual cigarette smoke, it signals to the current user that someone has recently used the car, contaminating the interaction for the current user (Bardhi and Eckhardt, 2012).

Contaminations can also be described as either *sensory* (experienced through the senses e.g., seeing surface scratches) or *imagined* (a non-physical perception that causes an object's value to change e.g., touched by a celebrity). This work was extended to the circular economy, showing through 14 case studies that reuse results in object avoidance and devaluation (Baxter et al., 2017a). Although these avoidance behaviours and barriers to reuse are well understood, there has been little research conducted regarding contamination in the context of reusable packaging. Understanding the cause of avoidance behaviours and designing to prevent them will be imperative if reusable packaging will ever replace single-use at scale.

A framework will be used for the design of 'decontamination' interventions, using 8 design strategies to reduce the impact of signs of use in reusable products (see Appendix Table 1, Baxter et al., 2017b). The design of products and services can have a significant effect on user behaviour and this aspect of circular design has been largely neglected (Wastling et al., 2018). This research will therefore investigate and suggest design interventions to reduce these feelings of disgust, aversion, devaluation, and object avoidance in the context of reusable packaging.

## 2.2 Contextual Factors

### 2.2.1 Nature of Contents

When considering the effects of packaging contamination, it is important to consider the type of product being sold within the packaging. One study found that remanufactured toothbrushes generated higher feelings of disgust when compared to remanufactured laptops (Abbey et al., 2015). It concluded that there existed 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. Products were broadly categorised into "Around you", "On you", and "In you". Another study showed that if the contents of the packaging were destined for ingestion (comparing baking soda to deodorant), there was a lower purchase intention when subjected to the same superficial packaging damage (White et al., 2016). This behaviour is not fully unjustified and evolutionary psychologists have explained that humans have a "behavioural immune system" - instinctive strategies to detect and defend against pathogens in the immediate environment (Neuberg et al., 2011). This links

directly to the 'hygiene' mechanism of contaminated interactions. Considering this, packaging designers must be careful when designing reusable packaging for more 'intimate' products. This research will therefore consider the type of product being packaged when designing interventions, understanding that the behavioural barriers will be more pronounced when the product is closer to bodily intake.

### 2.2.2 Ownership vs. Sharing

According to the Ellen MacArthur Foundation, all reusable packaging systems can be broadly grouped into 4 categories: refill from home, refill on the go, return from home, and return on the go (Ellen MacArthur Foundation, 2019). However, Muranko et al. (2019) suggests that the more important distinction when considering behavioural factors is that of ownership. They present 2 packaging ownership categories: 'exclusive' (owned by a single user e.g. personal Tupperware) or 'sequential' (shared between multiple users e.g. milkman bottles) and suggest that although sequential reuse offers greater convenience, it is more susceptible to negative perceptions from hygienic contamination. Furthermore, research has shown that disgust is greater when emanating from strangers as opposed to from oneself or familiar others (Peng et al., 2013). Therefore, this research will focus on sequential packaging as the issue of packaging contamination is more pronounced when shared between strangers.

## 3 Research Objectives

The objective of this work is to understand whether and how increasingly aged containers contaminate perceptions of reusable packaging and to identify and evaluate strategies to mitigate this. There are 2 main research questions:

*Q1) How do perceptions of the product, brand and packaging change as indications of use increase?*

*Q2) How might design interventions prolong use by reducing the level of contamination?*

Studies 1 & 2 will address research question 1, and study 3 will address question 2.

### 3.1 Context & Scoping Study

A scoping study was carried out prior to the main studies in order to better understand the problems faced by reusable packaging companies to ensure commercial relevance. 6 structured interviews were carried out with a variety of companies including Vytal, LOOP, Plaine Products, and Ozarka. These interviews revealed a common anxiety: there is significant uncertainty around how signs of use will impact uptake of their systems in the long-term as their reusable assets begin to age, confirming the necessity of this research. These early-stage discussions helped to shape the research objectives and study design.

The chosen context for this research is reusable packaging for takeaway food. This was chosen as it is one of the most prevalent current applications of reusable packaging, with many companies having reached a scale beyond early adopters and pilots, offering the best vantage point for the future of this technology. To ensure continued commercial relevance, a corporate partner in this context was selected: Vytal. They operate a packaging-as-a-service business in Germany with over 63,000 reusable containers currently in circulation and 550 participating restaurants/canteens. Vytal supplied the reusable containers that were used in the experiments.

## 4 Study 1 – Scales-Based Questionnaire

### 4.1 Overview

The purpose of study 1 is to measure how perceptions change as reusable containers become aged, addressing research Q1. The large-scale nature of this study (N=292) ensures that the effect of contextual factors, such as individual differences, are minimised.

### 4.2 Method

Study 1 adopts a between subjects' design by randomly assigning participants to one of 5 levels of bowl age through an online questionnaire. These bowls were presented through a close-up image of the inside face, allowing users to carefully examine its condition. The 5 images were created by digitally morphing a brand-new Vytal bowl with a used one in Photoshop to create 5 discrete steps of bowl damage (see Figure 3). The used bowl has completed 67 use cycles in Vytal's reusable packaging system, undergoing real-world use conditions, and reaching a level of damage that was deemed unacceptable by a German restaurant owner (hence its removal from the system). This created the most accurate experimental stimulus possible, in contrast to common artificial ageing methods used in similar studies such as Lilley et al. (2016).

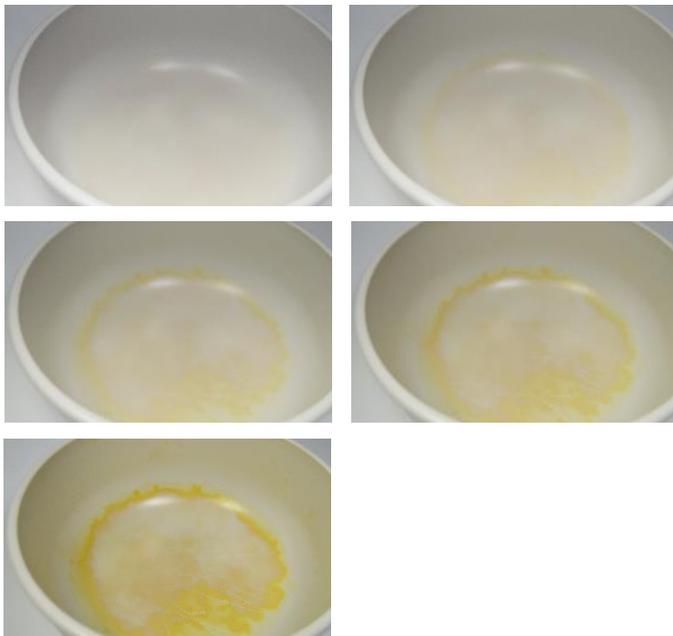


Figure 3: Images of 5 levels of bowl age, used in the Study 1 questionnaire.

Following a priori power analysis, 292 participants were recruited via Prolific and took part in the online questionnaire. Pilot testing revealed that the questionnaire would take no longer than 5 minutes, but participants were paid for 10 minutes to prevent rushing. Participants were first introduced to the idea of shared, reusable packaging to ensure all answers were equally informed in this respect. Participants were then given an accompanying story to set the scene and aid in imagining the context of use. An image of a Vytal bowl filled with food was also included at this stage to ensure consistent priming. Participants were then shown one of the 5 bowl images and asked to answer a series of semantic differential scales. These included perception of the restaurant and food; willingness to pay; restaurant quality; likelihood of return; perception of the Vytal brand; and disgust. Questions were adapted from Argo et al. (2006) and Di Muro et al. (2006) and followed a 7-point or 5-point Likert scale. Question order was randomised. See Appendix for a list of the specific questions.

To account for individual differences, 3 key self-report measures were collected after the main questions: disgust sensitivity (van Overveld et al., 2006); pro-environmental identity (Whitmarsh and O'Neill, 2010); and reuse behaviour (Ertz et al., 2017).

### 4.3 Results & Discussion

A one-way between subjects ANOVA was conducted on the data using bowl age as the independent variable and the 5 perception measures as the dependent variables. Results showed that increased bowl age lead to a significant effect across almost all measures, resulting in higher levels of disgust ( $F(4, 280) = 20.35, p < .001$ ), lower perception of quality ( $F(4, 280) = 16.28, p < .001$ ), reduced willingness to reuse the bowl ( $F(4, 280) = 14.06, p < .001$ ), and reduced willingness to return to the given restaurant ( $F(4, 280) = 11.37, p < .001$ ). See Figures 4 & 5. Post hoc comparisons using the Tukey HSD test indicated that increasing bowl age produced a non-linear increase in these measures. Taking the disgust measure as an example, when comparing bowl 1 ( $M_{b1}=2.14$ ) to bowls 2, 3, 4 and 5 ( $M_{b2}=3.86, M_{b3}=4.19, M_{b4}=4.41, M_{b5}=4.93$ ); there is a significant difference. However, there is no significant difference when comparing bowls 2, 3, 4, and 5 internally (excluding bowl 2 vs. bowl 5 which produced a marginal difference). Therefore, as the pristine bowl (bowl 1) was the only condition to produce low levels of disgust, these results suggest that any level of visible damage to the surface of the bowl will create feelings of disgust and negative perceptions. It seems that participants perceived bowl 1 as 'clean' and bowls 2, 3, 4, and 5 as almost equally 'dirty'. This non-linear increase in negative perceptions can be seen across all measures that produced a significant effect. The only measure to produce an insignificant difference was willingness to pay ( $F(4, 280) = 0.20, p = .94$ ), the reason for which will be further explored in study 2.

#### Combined Disgust Measure

1 = Not at all, 7 = Very

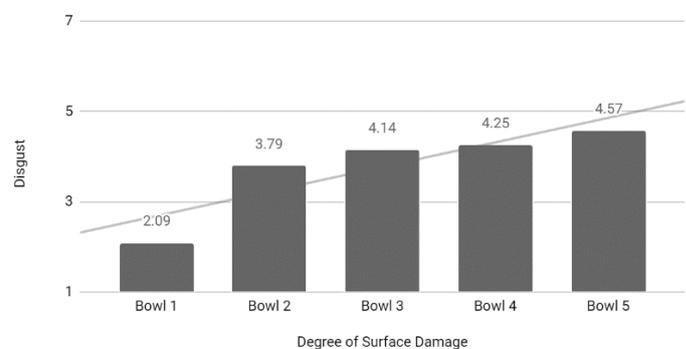


Figure 4: Combined disgust measure questionnaire results, Study 1

#### Perception Measures

1 = Negative perceptions, 7 = Positive perceptions

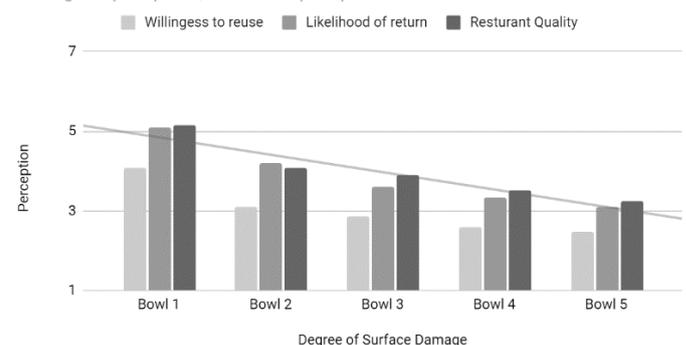


Figure 5: Perception measures questionnaire results, Study 1

## 5 Study 2 – In-Person Exploratory Interviews

### 5.1 Overview

The purpose of study 2 is to understand the reasoning and rational behind the findings in Study 1 through in-person interviews. This allowed perceptions to be evaluated in a more qualitative manner, adding an exploratory element to this work, and ensuring that these findings are not constrained to the selected measures in Study 1. Furthermore, the in-person nature of this study allowed participants to physically evaluate the bowl using all their senses (as they would in real life), ensuring that this research is not just limited to visual stimuli via digital images.

### 5.2 Method

Study 2 used the same bowls as study 1, but in just 2 conditions: brand new (control) and highly used (test), see Figure 6. Participants were randomly assigned to each of the conditions and were not told the nature of their condition. N=22 Adult participants, all students at the Dyson School of Design Engineering. The study took 24 minutes to complete on average, and participants were compensated with £10 vouchers for their time.

Upon entering the test room, participants were first briefed on the procedure. Then, participants were asked to complete a consent form and worksheet (including the exact same questions as Study 1). The bowl was hidden under a box and participants were instructed to only reveal the bowl after reading the scenario (in the worksheet) to prevent premature evaluations. The interview commenced on completion of the worksheet. An interview guide was followed. Questions were carefully written to prevent suggestive language and included references to the participants' worksheet answers. For example, "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?" or "If I told you that 67 people had eaten out of this bowl, how would that change your perception of the packaging?" (See /Appendix for a full list of questions). Finally, participants were shown the opposite condition to their own and were debriefed regarding the purpose of the interview. A more informal approach was taken here to try and capture nuanced perceptions through a more natural, conversational tone (van Enk, 2009). Notes were taken during the interviews to capture key quotes and insights.

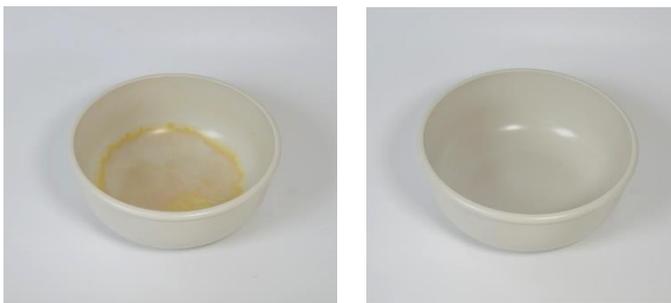


Figure 6: Highly Used vs. Brand new Vytal bowls, use in the Study 2 interviews.

### 5.3 Results & Discussion

Interview notes were analysed using a discovery-oriented, thematic analytic approach (Braun and Clarke, 2006). Emerging themes were identified by iterative reading, revealing 4 key trends.

#### 5.3.1 Packaging Invisibility

When asked how they evaluated price, it was expected that participants would factor in the condition of the bowl into their decision. However, participants rarely mentioned signs of use when considering what price they would pay - almost all

answers were regarding the food portion and quality. "I based the price on the average cost of lunch around campus, and the food in the picture looked good" (Samantha). "It looks like quite a big bowl, so probably big portions too" (Martin). Many participants also mentioned the quality of the bowl, remarking its sturdiness compared to flimsy single-use containers. From the language of the answers given, packaging seems to be a facilitator and is rarely seen as a part of the transaction. The contents seem to overshadow the packaging, reducing its importance in the user experience. This follows findings by Shaddy and Fishbach (2018) which showed that people want to invest resources in goals rather than means. This also provides a possible explanation to why the willingness to pay measure did not correlate with bowl age in Study 1.

#### 5.3.2 Sharing with Strangers

When told that 67 strangers had eaten out of the bowl before (which was true for the used bowl), participants unanimously answered that this would not bother them, citing that it is a social norm to share dishes in the context of a restaurant. "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" (Oriane). A few participants even said that the knowledge of the previous uses would improve the experience for them. "If people have used this bowl before and haven't died, it gives me confidence that I'll be fine" (Jacob). This suggests that people are not bothered by the idea of sharing packing with strangers but cannot look past the prominent and unappealing signs of use. However, when participants were told that users could take the bowls home for up to 2 weeks, this new piece of information alone created imagined contaminations. "They could have done anything with this bowl, they could have used it as a dog bowl" (Jordan).

#### 5.3.3 Feeling, Not Logic

When asked if lab testing to certify the bowl's hygienic condition would change their perceptions, participants mostly answered that it would not. The answers suggested that participants' method of evaluating the cleanliness of the bowl came primarily from sensory analysis i.e., touching, smelling, and looking closely. "No, that wouldn't change anything, I know it's clean" (Freyja). This will inevitably depend on the individual, but these findings suggest that instinctive 'feel' for how clean the bowl is overrides logical thinking. Furthermore, this shows that participants in the 'used bowl' condition were able to correctly classify the surface damage as superficial. However, this did not prevent feelings of disgust. Many participants who thought the bowl was clean still found the sight of the stain repulsive. "The stains are still very disgusting to me for some reason" (Jordi). This further supports the notion that the problem of reusable packaging ageing is a behavioural issue.

#### 5.3.4 Recognisable Damage

When asked about the nature of the scratches and stains on the inside of the bowl, participants generally had a good idea of where they came from. They correctly identified that the damage most likely resulted from metal cutlery being used too firmly and staining foods such as curries being left in the bowl for long periods of time. Furthermore, some participants said that they recognised such staining from their own Tupperware, which remained stained 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" (Hannah). 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.

Table 2: Summary of selected design interventions following the 8 Decontamination strategies.

Strategy	Strategy Description	Idea Title	Idea Description
Reframe	Alter how the user thinks about the contaminated target	Battle Scars	Reframe the scratches and stains as battle scars earned from fighting plastic waste.
Withdraw	Move the user to another situation	Controlled allocation	Allocate damaged bowls in a controlled way to certain users.
Condemn	Make the act of contaminating punishable	Condition Tracking	Track bowl damage and punish it via a financial penalty.
Restore	Bring the target back to an uncontaminated state	Surface Scraping	Remove stains and scratches by cutting away a thin layer of the surface plastic.
Protect	Prevent object-level changes	Durable Materials	Select a more durable plastic for the bowl that is resistant to scratching/staining.
Block	Prevent user contact with the contaminant	Opaque Spray	Restaurants cover the stains/scratches with an opaque soluble paint before filling.
Remove	Eliminate the contaminant altogether	Decommission guide	Guidelines could be given to restaurants on the exact condition bowls should be removed.
Conceal	Disguise or cover the contaminant	Colourful Patterns	Add bright colours to the bowl to overpower the aesthetic of stains/scratches.

## 6 Study 3 – Design Interventions

### 6.1 Overview

Studies 1 & 2 highlighted the difficulties of implementing reusable packaging at scale due to signs of use. The purpose of Study 3 is to explore possible solutions to this problem in a proactive and creative way. This study will serve as a starting point for future work into reusable packaging designs that consider signs of use more heavily.

### 6.2 Method

Ideas were generated through 2 collaborative brainstorming sessions with 6 participants in each. These sessions were based on common design brainstorming techniques, following 3 key rules: aim for sheer quantity, defer judgment about the quality of ideas, and encourage new and wild ideas (Wilson, 2013). The 8 decontamination strategies outlined in section 2 of this paper formed a theoretical framework around which ideas could be generated in a structured fashion (Baxter et al., 2017b). Participants were given a short presentation prior to the brainstorm to ensure they fully understood the problem area, goals, and decontamination framework. 156 ideas were generated, of which 8 of the best solutions were extracted by combining and critiquing through discussion.

### 6.3 Results & Discussion

See Table 2 for a summary of the results. Each idea will now be explained in more depth.

#### 6.3.1 Reframe: Battle Scars

Through marketing and language on the app, the bowl damage could be reframed as ‘battle scars’ earned from fighting plastic waste. The more damage a bowl has, the more single-use plastic it has prevented which should be celebrated, not avoided. This could be clearly communicated via a count of ‘single-use plastics prevented’ on the app, creating a sense of pride and responsibility in being a part of the circular economy, prompting users to be more lenient with the condition of the bowl.

#### 6.3.2 Withdraw: Controlled Allocation

Certain bowls could be given to certain customers based on the condition of the bowl. For example, new users might always get a pristine bowl on their first use to prevent a bad first

experience, or the system could ensure that users never get 2 highly used bowls in a row. In the Vytal system, users have a transaction history and bowls have digital IDs, so this would be easily implementable.

#### 6.3.3 Condemn: Condition Tracking

Due to scannable QR codes on each bowl, restaurants could track bowl condition 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 and punished via a financial penalty. Social penalties could also be used, such as a star rating. This would create a deterrent to treating the bowl roughly, preventing surface damage.

#### 6.3.4 Restore: Surface Scraping

As the scratches and stains are only surface level, there could be a revitalisation process when the bowls 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, revealing fresh plastic underneath that would minimise feelings of disgust and avoidance. This process could be repeated several times and would prolong the operational lifetime of the bowl.

#### 6.3.5 Protect: Durable Materials

The bowl could be redesigned with the known causes of damage in mind at the materials level. Through plastic selection, additives, and surface coatings, the bowl could be hardened against scratching and staining, increasing the average number of use cycles before the bowl reaches a ‘used’ state.

#### 6.3.6 Block: Opaque Spray

To hide existing damage from users, restaurants could spray the bowls with a food safe, opaque coating before filling it with food. This would create a barrier between the user and the contaminant, reducing the impact of surface damage on perceptions. This coating would only come off during the intense heat of a commercial dishwasher.

#### 6.3.7 Remove: Decommission Guide

Currently, individual restaurants decide when a bowl is at its end of life, evaluating it in a non-structured way. To prevent premature disposal, a ‘decommission guide’ could be issued to

restaurants. This could include images that show at what exact condition a bowl should be removed from the system. This point of damage would need to be carefully selected through case-specific user research.

### 6.3.8 Conceal: Colourful Patterns

The white bowls used in this paper create a clear contrast in colour for the stains to show up. This could be concealed with a bright and colourful pattern on the surface of the bowl to overpower the aesthetic of the surface damage. These patterns could be made by local artists and potentially divert attention away from the damage. This is a common method used in bus and train seats to reduce the effect of prolonged use.

## 7 General Discussion

### 7.1 Theoretical Implications

This research has shown that signs of use significantly affect user perceptions and thus pose a serious threat to the success of reusable packaging in the mass market. These findings follow previous work on contaminated interactions (Baxter et al. 2017a), showing that contamination operates within the circular economy, and extending this work to the context of reusable packaging through a contemporary real-world example. Through qualitative and quantitative methods, this research has shown that users devalue reusable containers as their age increases. Furthermore, these negative perceptions of the packaging product were also shown to contaminate perceptions of the restaurant quality and packaging brand, giving reusable packaging businesses another direct incentive to address this issue. This also builds on previous work into willingness to use reusable packaging (Greenwood et al. 2021), exploring more deeply the effects of signs of use. Study 1 showed that the answer to willingness to use is often not a binary one, but rather a scale of declining perceptions as reusable containers become more and more aged. Although users may be 'willing' to use an aged container, they may have an inferior user experience and choose to not engage in future reusable packaging systems as a result.

### 7.2 Managerial Implications

The most notable finding from study 1 was the post hoc analysis that revealed a clear separation in perceptions between bowl 1 and bowls 1, 2, 3, and 4; suggesting that perceptions are dichotomised – the containers are either in a state of 'clean' or 'dirty' with no middle ground. Designers therefore have 2 options for the future: either they take steps to maintain the bowl in a 'clean' state through preventative and revitalisation methods, or they attempt to change the social norms surrounding the idea of packaging surface damage. Businesses have significant influence through the design of the product, the surrounding service, the marketing, and the messaging to prescribe how we think about packaging in a long-term sustainable way. Furthermore, the cultural groundwork for such a norm already exists to some extent, Study 2 revealed that many consumers already view these surface imperfections as 'normal'. Catalysed by the powerful environmental benefits of reuse, a business-driven cultural shift in packaging perceptions is highly feasible. In the not-too-distant future, we could all be using packaging that more closely resembles the battered tiffin box of Figure 1 in the name of sustainability.

### 7.3 Limitations & Further Research

There were some methodological limitations due to the experimental nature of this research. Participants did not eat of the bowl, but instead saw a clean, empty bowl: digitally in Study 1 and physically in Study 2. Perhaps the results would differ if the experimental interaction was closer to reality. Some participants reported confusion as they had not actually used

the bowl themselves and therefore found it difficult to imagine how they 'would' feel. An ideal method would involve the same questionnaire and interview carried out in a real-world reusable packaging system to gain more realistic results.

Secondly, there was no correlation between the self-report measures and the perception measures in Study 1. However, individual differences may play a larger role than this research suggests. A more concentrated study could focus on this variable with a greater sample size. Packaging design is also closely related cultural factors and packaging perceptions have been shown to vary significantly when comparing participants from a western to an eastern cultural background (Ertz et al., 2017). Therefore, a one size fits all approach may not be favourable. Further research is required to understand how culture and personality impact packaging perceptions.

Thirdly, this research was also constrained by the use of a single stimuli. The Vytal bowls used in studies 1 and 2 are a specific application of reusable packaging. Different materials and designs, such as steel Tupperware, may yield different results to the current polypropylene bowl. Furthermore, this research was also constrained to the context of takeaway food packaging. Perceptions are likely to vary with product intimacy (Abbey et al., 2015), for example disgust may be lower in context of shampoo packaging as it is not being ingested. These contextual variables must be considered if the current findings are to be transferrable to other applications.

## 8 Conclusion

The key objective of reusable packaging is to reduce plastic waste by refilling a single container multiple times. However, if the container is not used enough times, then it may not reach its break-even point with single-use alternatives and thus would be environmentally worse off. Durable containers, such as the bowl used in this study, have the physical ability to complete thousands of uses (just like restaurant dishes) and have a staggering potential to cut our plastic waste. But as of yet, this has not been achieved at scale due to premature disposal – partly due to contaminated interactions arising from signs of use. This simple and inevitable weakness of reusable packaging is seldom mentioned in literature or considered in the design process, potentially due to the novelty and complexity of implementing reusable systems when compared to the simplicity of single-use. This work therefore offers a first look into the effects of signs of use but must be extended through further research and implementation of the design interventions.

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## 10 Appendix

### 10.1 Study 1 Questions

#### 10.1.1 Questionnaire

- How would you rate the quality of the restaurant? (1 - Low Quality to 7 - High Quality)
- How much would you be willing to pay for this meal? (In £)
- How likely are you to return to this restaurant in the near future? (1 – Extremely Likely to 7 – Extremely Unlikely)
- How likely are you to use reusable takeaway packaging again following this meal experience? (1 – Extremely Likely to 7 – Extremely Unlikely)
- How does the condition of the bowl make you feel? (using Argo et al. (2006)'s disgust scale averaging answers of single words such as Disgusted, Revolted, Unclean, Gross on a scale of 1 - Not at all to 7 - Very)
- Imagine that you returned this bowl to the restaurant who washed and returned it to service. Would you be willing to eat out of this bowl again? (Yes/No)

#### 10.1.2 Self-Report Measures

##### Disgust Sensitivity

1 – Never to 5 – Always for the following statements:

- I think that disgusting items could cause me illness/infection
- I avoid disgusting things
- I feel repulsed
- I become disgusted more easily than other people
- Disgusting things make my stomach turn

##### Environmental Identity

1 - Strongly Disagree to 7 – Strongly Agree for the following statements:

- I think of myself as an environmentally-friendly consumer
- I think of myself as someone who is very concerned with environmental issues
- I would be proud to be seen as having an environmentally-friendly lifestyle
- The issue of climate change is important to me personally
- I view plastic waste as a significant environmental problem

##### Reuse Behaviour

1 – Never to 5 – Always for the following statements:

- I use reusable products (e.g. coffee cup, water bottle, shopping bag)
- I do not throw away plastic bottles. Instead, I wash and refill them with water
- I bring a reusable coffee mug every time I purchase coffee
- I bring reusable grocery shopping bags every time I do grocery shopping

- I do not purchase individual size disposable water bottles. Instead, I use a reusable bottle for water

## 10.2 Study 2 Interview Questions

Follow up questions were added with each participant based on their unique responses. An agile approach was taken to quickly adjust questions wording to maintain relevance to each participant's answers.

- 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?
  - Optional follow-up question:
  - Why would you not be willing to pay more?
- You said you were X disgusted by the state of the bowl, why did the bowl make you feel this way?
  - Optional follow up questions:
  - How did the stains/scratches make you feel?
  - What do you think about the cleanliness of this bowl?
- What is your opinion of the idea of reusable packaging for takeaway food following this experience? Do you think it is a good idea?

- Optional follow up question:
- What is your opinion of the reusable packaging start up, BowlCycle following this experience?
- You said you would/wouldn't be willing to eat out of this bowl again, why did you choose this answer?
- If I told you that 67 people had eaten out of this bowl, how would that change your perception of the packaging?
  - Optional follow up question:
  - Hundreds of people share and reuse restaurant bowls and plates. Does reuse bother you in that context?
- (Extremely aged bowl only)
  - What do you think might have caused the scratches/stains?
  - 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?

## 10.3 Tables

**Table 1:** 8 Decontamination design intervention strategies from Baxter et al. (2017b)

Strategy	Description	Example Activities
Change meaning	Alter how the user thinks about the contaminated target	Branding, educating, or reframing of interaction
Withdraw	(Help) move the user to another situation	Engage with equivalent products, services, and environments or disengage altogether
Condemn the contaminator	Make the act of contaminating punishable	Establish social norms, terms of use or fines for misuse that carry social or financial burden
Restore the target object	Bring the target back to an uncontaminated state	Clean, air out, or otherwise purify the object
Protect the target object	Prevent object-level changes	Design for technical durability or script desired behaviour
Block the contaminant	Prevent contact with the contaminant	Create a barrier between the user and the contaminant
Remove the contaminant	Eliminate the contaminant altogether	Remove specified touchpoints or offenders
Conceal the contaminant	Disguise or cover the contaminant	Add some stimuli of proportional power that conceals the contaminant

**Table 1:** 8 Decontamination design intervention strategies from Baxter et al. (2017b)