



HORIZON-CL6-2021-CIRCBIO-01

Innovative solutions to over-packaging and single-use plastics, and related microplastic pollution (IA)

BUDDIE-PACK

Business-driven systemic solutions for sustainable plastic packaging reuse schemes in mass market applications

Starting date of the project: 01/09/2022

Duration: 42 months

= Deliverable: D2.2 =

Guidelines for the Design of Reusable Plastic Packaging (RPP) to Minimise Concerns about Contamination

Due date of deliverable: 31/08/2024

Actual submission date: 05/09/2024

Responsible Work Package: WP2: Social and behavioural innovation

Responsible Task Leader: University of Sheffield (USFD)

Revision: V1.3

Dissemination level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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DOCUMENT HISTORY

Document version	Date	Change
V1.0	12/07/2024	Initial version
V1.1	31/07/2024	Comments from reviewer
V1.2	27/08/2024	Suggestions following review by IPC addressed. Sent for review by full WP2 team on 16/08/2024 and final edits made on 27/08/24.
V1.3	30/08/2024	Final version agreed following review from IPC.

DOCUMENT APPROVAL

Reviewers		Validation date
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DOCUMENT DATA

Keywords	Consumers, barriers, contamination, design, packaging
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Delivery date	05/09/2024

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Acronym description

GA	Grant Agreement
WP	Work Package
RPP	Reusable Plastic Packaging

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Executive Summary

Evidence suggests that concerns about contamination significantly affect consumers' willingness to use reusable packaging and containers, particularly when these items show signs of prior use, such as scratches or staining. Research conducted our team and others has highlighted that these visible signs of wear can undermine the appeal of reuse systems, especially for food and drink containers (e.g. Baird et al., 2022; Collis et al., 2023). The model of contaminated interactions outlines three types of contamination concerns that can be triggered by signs of prior use: (i) hygienic contamination, where consumers fear a threat to their health; (ii) utility contamination, where the functionality of the object is questioned; and (iii) territorial contamination, where discomfort arises from the idea that someone else has used the object (Baxter et al., 2016).

Although such concerns may be unfounded (e.g., when packaging is cleaned to high standards), our previous research suggests that they may still pose a barrier to consumers engaging with reuse systems (Hoseini et al., 2024). Our research conducted within the Buddie-Pack project further suggests that simply providing information designed to reassure consumers about the cleanliness of containers is insufficient to increase willingness to engage with these systems (Pott et al., 2024). We are also conducting an additional study to explore the views of kitchen staff on using reusable packaging for raw meat in food service kitchens, where end-consumers are not directly involved in the decision-making process. However, recruitment for this study has been challenging, and we have not yet gathered sufficient data to draw conclusions.

This report provides an overview of the literature on contamination concerns and how it relates to different product types and contexts. We then explore how to minimise these concerns. Our specific recommendations are to consider colours that are unlikely to show signs of prior use (e.g., darker colours that do not show food stains) and materials that are resistant to scratching. The aim is to reduce visual 'cues' that might trigger contamination concerns, thereby enhancing consumer acceptance and engagement with reuse systems.

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1. Introduction

The success of reuse systems, once implemented, depends on people being willing to use them (Greenwood et al., 2021; Hoseini et al., 2024). However, people may be reluctant to reuse items, especially if they exhibit signs of wear and tear—something that may be inevitable if containers are used the required number of times for a reuse system to confer environmental benefit. For example, Baird et al. (2022) developed a paradigm to identify people's thresholds with respect to their willingness to reuse containers for food and drink. The paradigm used a sequence of 100 images of a bowl (similar to that used by Vytal prior to the Buddie-Pack project) from perfectly clean through to significantly stained. By asking participants to indicate whether they would be willing to eat from each bowl, the paradigm identified the point at which people became unwilling to use the bowl—termed their threshold. Despite finding variations in people's thresholds for reuse, the results indicated that people are generally unwilling to consume food or drink from containers that show any sign of prior use. These findings were supported by Collis et al. (2023) who gave participants the opportunity to physically interact with bowls that showed signs of previous use.

2. Concerns about contamination

A key explanation for the finding that people are generally unwilling to consume food or drink from containers that show any sign of prior use is that people view signs of previous use as an indication of potential contamination. Baxter et al. (2016) proposed a model of contaminated interactions, outlining three potential types of contamination that might arise from indicators of previous use:

- **Hygienic contamination** refers to contamination that poses a threat to a person's health (e.g. the belief that pathogens are present).
- **Utility contamination** refers to concerns about reduced functionality of an object (e.g., a reusable carrier bag might have become torn, or a bowl might be cracked).
- **Territorial contamination** is the concern about the object having been touched or used by someone else (e.g., a warm seat on a bus, or the smell of a previously owned jumper).

This multi-dimensional model explains how an object's interaction history - such as signs of previous use - can alter its perceived value, often leading to negative associations that result in avoidance or discomfort, whether related to (actual or perceived) health risks, reduced functionality, or territorial concerns. These concerns can significantly impact an individual's willingness to engage with reuse systems (Argo et al., 2006; Collis et al., 2023) and undermine their environmental benefit (Hoseini et al., 2024).

The extent to which these concerns impact consumer behaviour also appears to vary depending on the type of product. For example, Abbey and colleagues (2015) found that items closely associated with personal hygiene or ingestion, such as electric toothbrushes, are more likely to be rejected by consumers than less intimate items like laptops. Similarly, White and colleagues (2016) demonstrated that superficial damage to packaging reduced consumers' intent to purchase, particularly when the contents are intended for ingestion (e.g. food). These findings suggest that contamination concerns are especially pronounced for packaging that holds consumable products and may lead users to reject otherwise functional and sustainable solutions, like reusable packaging, in favour of single-use alternatives that are perceived as "cleaner" or "safer".

3. Psychological strategies to minimise concerns about contamination

If reuse systems are to be successful, strategies are therefore needed to manage potential concerns about contamination. Given that contamination concerns may affect user engagement to a greater degree for food

products than for other items, our research has focused on understanding concerns in this context and trying to address them.

We have been running an interview study to understand the perspectives of owners, managers, and kitchen staff in the food service industry regarding the use of reusable packaging for raw meat. This study is expected to provide valuable insights into the practical challenges and concerns faced by professionals in this field. However, we have only recruited two participants to date, as recruiting businesses to participate has proven to be particularly challenging. This ongoing research highlights the difficulties in engaging businesses in studies like this and underscores the need for broader participation to fully understand the barriers and develop effective strategies for promoting the use of reusable packaging in the food service industry.

We also followed the suggestions of Baird et al. (2021) and Hubbub (2022) who suggested that people's concerns about contamination in a takeaway food and drink context might be addressed by offering reassurance that reusable containers go through a robust washing process. Providing such information has intuitive appeal as a strategy for reducing concerns and is used in related areas (e.g., Food Hygiene Rating Schemes).

The Buddie-Pack team (Pott et al., 2024) therefore conducted an experiment to investigate whether information about cleaning (i) reduced concerns about contamination and (ii) increased willingness to reuse bowls that show signs of prior use. Participants were UK university students recruited from the research platform Prolific. They were asked to imagine that they were buying "lunch-to-go" from a local cafe that had implemented the Vytal scheme allowing customers to have their food served in a reusable container, which they then returned after use. Participants were shown images of the reusable bowls and asked how willing they would be to use each bowl. Prior to doing so, however, a subset of participants were shown information about how the bowls are cleaned (under the auspices of evaluating posters designed to promote the scheme), so that we could evaluate the effect of information about cleaning on contamination concerns and willingness to use the reusable bowls.

We hypothesised that participants who viewed bowls which had varying levels of staining, would exhibit heightened concerns about hygiene, utility and territory contamination compared to participants who had not seen any bowls. As expected, participants who viewed bowls were more concerned about potential contamination, particularly hygiene and utility, compared to those who did not view the bowls. However, participants who received information about cleaning were significantly less concerned about hygiene contamination than participants who did not receive the information. Despite this reduced concern, information about cleaning did not increase participants' overall willingness to use the reusable bowls, with results showing that participants were generally unwilling to use bowls that showed signs of prior use.

These findings are directly relevant to the business-to-consumer use cases in Buddie Pack that use RPP to deliver food, specifically reusable containers for takeaway food and pre-packed food in supermarkets. They may also apply to the use of RPP for raw meat in food service kitchens and reusable catering trays in nursing homes and schools, where the appearance of reusable packaging could raise hygiene contamination concerns and hinder engagement with the system due to food safety issues. Concerns about hygiene contamination are less likely to be a barrier in use cases involving household products like laundry detergent, where the container's appearance is not directly tied to the safety of the product (Abbey et al., 2015), though signs of wear could potentially elicit utility contamination concerns in this context.

The finding that providing information about cleaning did not increase participants' willingness to use the reusable bowls is consistent with other evidence which suggests that information and education alone is not sufficient to reduce concerns about reuse systems and increase willingness to engage with them. For example, Matthews and Webb (2023) ran a series of online studies designed to alleviate concerns about the digital tracking of reusable containers, but found that providing information about safety and data privacy did not increase willingness to use such systems. Likewise, Tonikidou and Webb (2024) examined whether providing consumers with information

about the environmental benefits of using reusable packaging would influence their willingness to adopt such systems. Despite increasing participants' awareness of the environmental impact of reuse systems, the study found no significant change in their willingness to engage with reuse systems or their attitudes towards them. Indeed, there is a growing body of evidence which suggests that interventions targeting knowledge and beliefs may not be effective ways to change behaviour (Albaraccin et al., 2024; Whitmarsh, Pootinga, & Capstick, 2021).

4. Design strategies to minimise concerns about contamination

Given the apparent limitations of psychological strategies, design strategies that address the physical attributes of reusable containers may offer a more effective approach to minimising contamination concerns. The goal of these design strategies is to create containers that are less likely to show signs of prior use, thereby reducing cues to contamination.

○ 4.1. Materials and colours

One potential design strategy is the use of materials and colours that are resistant to staining and wear. The bowls used in the Vytal scheme for takeaway food which formed the basis of several of our studies (e.g., Baird et al., 2022; Collis et al., 2023; Hoseini et al., 2024; Pott et al., 2024) were relatively light in colour (off-white) and therefore more prone to staining, particularly from foods containing ingredients like tomato or turmeric and when the food was reheated in the bowl (Hoseini et al., 2024). To address this issue, one design recommendation is to use darker colours for reusable containers, which are less likely to show food stains. For example, Echo's redesign of the Vytal food bowl for the Buddie-Pack project utilises a dark grey colour, which is less likely to reveal signs of staining. However, it is important to note that darker-coloured materials may present their own challenges, such as making moulding defects or scratches more visible. This trade-off between hiding stains and revealing other signs of wear is an area that requires further study in terms of consumer acceptance.

In addition to colour, the choice of material may also be important. For example, RECOUP (2023) suggest that Tritan is less susceptible to surface scratching than PET and polypropylene, making them more suitable for reusable containers that need to maintain a clean appearance over multiple uses.

○ 4.2. Functional design considerations

Beyond material choice, other functional design considerations can help reduce contamination concerns. For example, ensuring that containers are easy to clean and maintain may alleviate some concerns about hygienic contamination. Containers with smooth surfaces, minimal crevices and easy to clean designs can help prevent the build-up of food residues and stains that might otherwise trigger contamination concerns.

Finally, the durability of the container should be a key consideration in its design. Containers that are resistant to cracking, warping or other forms of damage are less likely to exhibit signs that could trigger utility contamination, thereby increasing consumer confidence in their functionality.

5. Conclusions

D2.2 has focused on how to design RPP to minimise concerns about contamination. Our specific recommendations are that packaging be designed in a way that is unlikely to show signs of previous use (e.g., use darker colours, materials that are resistant to scratching etc.).

We do, however, want to end by acknowledging that considerations with respect to minimising concerns about contamination need to be balanced against other, potentially more important considerations that shape the design of reusable packaging. These include for example; weight, stackability, aesthetics, and food safety which has been studied in WP3 – Materials and processes for manufacturing reusable plastic packaging (for overviews, see D1.3: Technical and economic specifications of reusable plastic packaging; see also Recoup’s report ‘Reusability by design’, 2023). It is also important to note that the design of reusable packaging and containers is just one of a myriad of factors that can influence consumers’ engagement with reuse systems (for an overview, see D2.1: Consumer interaction with reuse systems) and so those designing and operating reuse systems should consider where their efforts and resources would best be focused to maximise uptake and engagement. Finally, we echo RECOUP’s assertions that “*When designing reusable packaging the needs of stakeholders throughout the supply chain must be considered, these include but are not limited to packaging manufacturers, brands, retailers, consumers, waste management companies and service providers*” and that “*Consideration of how elements such as standardisation and use of technology for reusable packaging throughout the supply chain will no doubt have a key role to play in the scale up of reuse.*”

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