Refill at home for fast-moving consumer goods: Uncovering compliant and divergent consumer behaviour

Catriona Tassell [*], Marco Aurisicchio

Dyson School of Design Engineering, Imperial College London, Imperial College Rd, South Kensington, London SW7 9EG, United Kingdom of Great Britain and Northern Ireland

ARTICLE INFO

ABSTRACT

Context and problem: Consumers of fast-moving consumer goods have become accustomed to a culture of convenience and disposability, cultivating practices that are at odds with recycling, reusing, and reducing. Through the concept of refill, the fast-moving consumer goods industry is moving beyond the disposability and recyclability of packaging and products to consider longer term, more durable reuse solutions. If practised as intended, reuse has the capacity to lower the intensity of materials used compared to disposal or recycling. However, research on actual reuse behaviour is sparse, and new work is necessary to explore how consumers handle material resources in reuse offerings.

Method: In-depth interviews with 26 consumers were conducted where the behaviour chain method was used to elicit and map resource journeys for 48 refill at home cases.

Results: Consumers of refill at home offerings were found to display both compliant behaviour and a range of divergent resource handling behaviours, which either increased or decreased the impact of reuse. The behaviours were structured in a framework consisting of six reuse resource handling behaviour types and 17 sub-types, which operate alone or in combination. Whilst consumers displayed many instances of compliant behaviour, overall divergent behaviours were more common, like using multiple reusable products for the same purpose or using single-use products in parallel. Interestingly, consumers of refill at home offerings with a service engaged in compliant behaviour in the majority of the instances. Consumers were found to employ divergent behaviours even at the end of life, often recycling non-recyclable reusable components and occasionally disposing of recyclables in residual waste.

Conclusions: The resulting framework of resource handling behaviours provides a more nuanced understanding of reuse in practice than previously offered. The behaviour chain method was found to have the structural and analytical rigour to dissect difficult-to-predict and complex journeys.

1. Introduction

The linear 'take-make-waste' approach, where consumers frequently buy and dispose of goods (Strasser, 2003) and have become accustomed to 'as new' products (Bocken et al., 2018) has heavily influenced the modern throwaway consumer culture. In line with this approach, single-use disposable fast-moving consumer goods (FMCGs) are still the norm, thrown away regularly and sent to landfills or incinerated. The circular economy, described as "an industrial system that is restorative or regenerative by intention and design" offers an opportunity to prevent these outcomes (The Ellen McCarthur Foundation, 2013). In a circular economy, waste and pollution are designed out, products and materials kept in use and natural systems regenerated, reducing energy use and emissions along the entire supply chain (The Ellen McCarthur Foundation, 2013).

Circular strategies, such as recycling and reuse, rely on business implementation and consumer adoption. Whilst FMCGs are increasingly associated with recycling to combat the industry's heavy reliance on materials like plastic and aluminium, reuse is now gaining traction as it can extract higher value from materials before they become waste in comparison to recycling (Rizos et al., 2017). According to the waste hierarchy, a framework ranking waste management strategies in relation to environmental impact, reuse sits above recycling, (energy) recovery, and disposal, and below reduction (UK Government, 2011). In

reuse, less processing is needed for value to be recaptured than recycling and recovery (Blomsma and Brennan, 2017; The Ellen McCarthur Foundation, 2013). Whereas reuse refers to behaviours *in use*, recycling, (energy) recovery, and disposal refer exclusively to *end of life* behaviours. Alongside optimising reuse through prolonging the reuse cycle, it is necessary to combine reuse with additional strategies and ensure recyclability at the end of life.

With respect to prolonged reuse, life cycle analyses show that FMCG reuse offerings need to be used a certain number of times to counter the impact of materials that are often heavier and more durable (e.g. the environmental impact of multi-use stainless steel cups is lower than single-use take-away cups when used more than 140 times) (Changwichan and Gheewala, 2020; Hait and Powers, 2019; Hocking, 1994; Woods and Bakshi, 2014). Whilst business-to-business reuse offerings operate in more easily controlled environments (e.g. CauliBox rent food containers and hot drinks cups for use in workplace canteens), with a higher likelihood that an optimum number of reuse cycles are achieved, business-to-consumer reuse offerings (e.g. KeepCup sell hot drinks cups that consumers refill with hot drinks at home or on the go) are less predictable.

Regarding recycling, many FMCG reuse products are made from materials that are difficult to recycle via mainstream systems. There are, however, a small number of take-back schemes, particularly for consumable components (e.g. razor blade cartridges, toothbrush heads, and refill pouches), where consumers can deposit items for specialist recycling. Durable components (e.g. razor or toothbrush handles and drinks bottles), however, currently lack easy-to-access recycling infrastructure when thrown away (Muranko et al., 2021). Without such infrastructure, reusables can drop to the lowest rungs of the waste hierarchy: that is incineration or landfill. Whether or not recycling schemes exist, they are ultimately reliant on consumer engagement and compliance. If consumers do not comply, then even recyclables can find their way into the least preferred waste streams.

The Ellen MacArthur Foundation (2019) framework divides business-to-consumer FMCG reuse into four models: *refill at home*, *refill on the go*, *return from home*, and *return on the go*. In *refill at home* and *refill on the go*, users refill their reusables either at home (e.g. consumers refill the head of a Gillette razor in the bathroom) or using a refill point outside of the home (e.g. consumers refill an Ecover dish wash bottle in the refill station of a supermarket). In *return from home* and *return on the go*, reusables are either collected directly from users' homes (e.g. consumers return milk bottles to Milk & More on their doorstep) or returned to a drop off point for collection (e.g. consumers return refillable SodaStream gas canisters to partner stores). Whereas in *return from home* and *return on the go*, providers operate services to retrieve reusables at the end of use and to prepare them for replenishment, re-circulation, and reuse, in *refill at home*, consumers are responsible for these tasks. Overall, *refill at home* is easier to implement for a wider range of FMCG categories and products and requires less infrastructural transformation, making it the mainstream model. Given the ease of implementation and the potential for short-term impact, refill at home is very significant and needs to be better understood.

In refill at home, consumers retain more control over resources and dictate how they are used, resulting in greater potential to alter the capacity of reuse to reduce environmental impact. It is, therefore, imperative to understand actual consumer behaviour for business-to-consumer refill at home FMCGs. This will help to gauge the extent to which consumers comply with or diverge from expected behaviours, altering the reduction in impact associated with reuse.

The aim of this research is to understand how consumers carry out compliant and divergent reuse behaviour for refill at home FMCGs across the journey of purchase, use, and disposal.

The findings introduce a structured set of compliant and divergent refill at home behaviour types for FMCGs, followed by an explanation of how they function in consumer reuse journeys and a discussion on what strategies could be employed to facilitate better reuse with the goal of reducing impact.

A number of key terms used throughout the paper are defined below:

- Resource handling behaviour (RHB) – When consumers interact with and manage the different physical components of a FMCG reuse offering (e.g. razor handle or blade cartridge).
- Compliant behaviour – When consumers carry out behaviours that reflect what is intended by the provider and expected of the reuse offering.
- Divergent behaviour – When consumers carry out behaviours that deviate from what is intended by the provider and expected of the reuse offering.
- Refill – The act of replenishing the durable component to continue reusing it (e.g. refilling a razor handle with a blade cartridge).
- Refill at home – Reuse model where the consumer refills at home using refills purchased independently or via subscription (Ellen MacArthur Foundation, 2019). It includes refilling both reusable products (e.g. razor handle) and packaging (i.e. containers).
- Offering – What providers offer and consumers engage with. An offering can be differentiated according to a range of factors, such as whether it is a single product or a set of products, and it operates with a service or without. Further, offerings exist at different levels of the waste hierarchy in the form of disposables, recyclables and reusables.
- Single-use – Disposable or recyclable FMCG offerings used once before being thrown away (e.g. coffee pods) or more than once but not designed for reuse in that they cannot be replenished (e.g. disposable razors).
- Service – Marketable and intangible component of a reuse offering fulfilling a consumer need (e.g. a subscription service that automatically sends toothbrush heads to the consumer at regular intervals), typically offered along with a tangible product (e.g. toothbrush) (Tukker and Tischner, 2006).

2. Literature

2.1. Frameworks of reuse models

Whilst the Ellen MacArthur Foundation (2019) framework of reuse models has become most prevalently used, the literature presents a range of frameworks of FMCG reuse models (Table 1). These span high-level breakdowns, distilling FMCG-wide types of reuse into a smaller number of models (e.g. Ellen MacArthur Foundation, 2019; Greenwood et al., 2021; Zeeuw van der Laan and Aurisicchio, 2019), through to detailed lists of category-specific reuse models (e.g. for food and beverages; Mansour et al., 2019). Various approaches to modelling reuse are outlined in Table 1, with any models that represent types of refill at home highlighted in grey to convey the meaning and definition of this reuse type in comparison to others.

The role of consumer behaviour in these frameworks and models is given varying degrees of importance. Many of the models refer to behaviour through action verbs like 'self-dispense', 'top-up', and 'create', which describe consumers' interaction with the function of the product, packaging, or system (Lofthouse et al., 2009; Mansour et al., 2019). However, in other cases, behaviour is given greater consideration and emphasis through elements like the division of responsibility between different stakeholders (*consumer* or *company*; Tassell and Aurisicchio, 2020), the ownership of resources (*consumer* or *business*; Greenwood et al., 2021), and the type of interaction a consumer has with a resource (*exclusive* or *sequential*; Muranko et al., 2021). In comparison, Zeeuw van der Laan and Aurisicchio's (2019) approach is mostly centred on behaviour, identifying four archetypal roles, *keep*, *bring*, *consign*, and *abandon*, based on what the consumer must do to make an obsolete resource recoverable. Other components that are also dissected include the sales model (e.g. *subscription*; Mansour et al., 2019), delivery logistics (e.g. *door to door*; Mansour et al., 2019), and location where reuse takes place (e.g. *at home* and *on the go*; Ellen MacArthur Foundation,

Table 1
FMCG reuse modelling.

Authors	Framework of reuse models
(Greenwood et al., 2021)	*Consumer owned – Single use* (1) Used once only and then disposed of/recycled *Consumer owned – Repurpose* (2) Repurpose – Single-use with a secondary purpose* *Consumer owned – Refill* (3) Original packaging topped up from single use packaging at home, (4) Original packaging – on the go, (5) Consumer's container – on the go *Business owned – Return (Renting)* (6) Single company ownership – at home/on the go, (7) Collective ownership – at home/on the go
(Muranko et al., 2021)	*Exclusive reuse* (1) Exclusively reused products, (2) Exclusively reused products with reuse-enabling infrastructure, (3) Reuse-enabling infrastructure for exclusively reused products *Sequential reuse* (4) Sequentially reused products with reuse-enabling infrastructure, (5) Sequentially reused products
(Tassell and Aurisicchio, 2020)	(1) Consumer replenishes/reconditions, (2) Consumer replenishes at home via service, (3) Consumer replenishes on the go via service, (4) Consumer brings and company replenishes/reconditions via service, (5) Company replenishes for consumer via service
(Zeeuw van der Laan and Aurisicchio, 2019)	(1) Keep, (2) Bring, (3) Consign, (4) Abandon
(Ellen MacArthur Foundation, 2019)	(1) Refill at home, (2) Return from home, (3) Refill on the go, (4) Return on the go
(Mansour et al., 2019)	(1) Refillable home dispenser, (2) Door-to-door delivery, (3) Auto-dispensed returnable store refills, (4) Store manual refill system rental, (5) Store manual refill system, (6) Canteen returnable containers, (7) Catered refill service, (8) On-the-go container subscription, (9) Create your own drink, (10) Automated zero-waste system, (11) In-store container sale and auto refill, (12) Zero-waste store, (13) Container sale and refill station, (14) Deliver your container, (15) On-the-go refill station
(Lofthouse et al., 2009)	(1) Lightweight self-contained refill delivered through dispenser, (2) Self-dispense, (3) Original packaging swapped for new product, (4) Deposit system, (5) Top-up card, (6) Dispensed concentrate, (7) Dispensed product, (8) Concentrate mixed in original packaging

*Only model based on unintended actual consumer behaviour.

▌ Models highlighted in grey represent types of refill at home.

2019; Greenwood et al., 2021; Tassell and Aurisicchio, 2020). Whilst these components influence behaviour, they are often not considered from a behavioural point of view, instead serving the purpose of facilitating industry to identify, design, and implement potential reuse models.

These components of reuse models help capture the design intent of reuse and structure understanding. However, they do not capture the lived reality of reuse, when consumers are faced with the roles assigned to them in reuse models. Furthermore, previous models of FMCG reuse, including the four archetypal consumer roles identified by Zeeuw van der Laan and Aurisicchio (2019), are predominantly based on how consumers are expected to behave, in particular at the pivotal point determining whether reuse will take place. Muranko et al. (2020) call these pivotal points *ultimate circular behaviours*, described as 'the end-goal behaviour that a circular system is set out to achieve'. For example, in the four Ellen MacArthur Foundation (2019) models, these are *refill* and *return*. There is a need to consider what a reuse framework based on actual behaviour looks like. Further, this framework should consider whether behaviours beyond ultimate circular behaviours play a significant role in determining the success of reuse as a sustainable and circular consumption strategy.

Building on the Ellen MacArthur Foundation (2019) framework of reuse models, Greenwood et al. (2021) move a step beyond solely using expected behaviours to model reuse, incorporating elements of actual behaviour too, sourced as secondary data when reviewing the literature. In addition to the refill at home model put forward by Ellen MacArthur Foundation (2019), they include a variant that shows consumers carry out behaviours that are not necessarily expected of them by repurposing single-use items. Whereas their other five models of reuse fall under 'reuse as defined by regulations', Greenwood et al. (2021) distinguish the repurposing of single-use as being defined by 'willingness to engage' (Fig. 1). Here, consumers are shown to exhibit a positive resource handling behaviour without being prompted, extending the life of a resource otherwise destined to be thrown away. Greenwood et al. (2021) use the literature on the reuse of single-use FMCGs, like Shipton's (2003) study on the spontaneous and creative reuse of packaging, to highlight the role of the consumer (e.g. their ethical viewpoint), material association, context, and relationship with waste processing, as influential factors in this process. This represents one additional form of 'willingness to engage' in reuse that transcends what industry conceives of as reuse. Further research is needed to determine whether there are other similar cases where consumers go beyond what is officially defined as reuse in refill at home. Additionally, at the other end of the spectrum, this knowledge could be extended to understand what constitutes
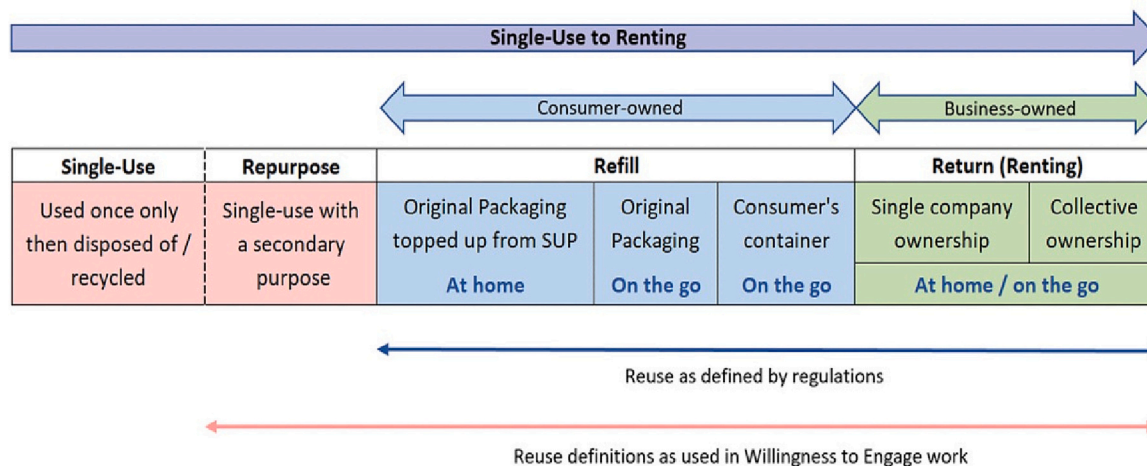
Fig. 1. Greenwood et al.'s (2021) ordering of reuse from single-use to return.

*un*willingness or divergent ways of engaging in reuse as expected for refill at home.

2.2. Divergent reuse behaviour

When moving beyond reuse frameworks to consider the broader body of literature on reuse behaviour, scattered insights are found into consumers' handling of reusable products that can be used to identify divergent behaviours. For example, through a survey conducted at Allegheny College, Choate et al. (2014) found that even when students own and use a durable water bottle, they may still continue to purchase and consume disposable bottled water, sometimes even as their main source of water. It is important to highlight these potentially negative types of resource handling to find ways to prevent them. Indeed, as a follow-up study, also conducted at Allegheny College, Bethurem et al. (2021) tested various interventions, finding that disposable bottled water usage reduced following a series of awareness campaigns, and the use of water refill stations increased by 46 % after 28 new bottle refill points were introduced.

Other interventions have resulted in mixed success, like providing students with a free reusable bottle. On the one hand, this has been found to reduce the purchase of disposable bottled water (Santos and Van Der Linden, 2016). On the other hand, however, it has encouraged ownership of multiple bottles, increasing the use of resources (Bethurem et al., 2021). Although these findings are specific to water bottles and more easily managed environments like a university campus, they highlight the contextual need to understand a greater range of FMCG-wide divergent reuse resource handling behaviours. This will help foresee unintended consequences as consumers transition, like the continued use of disposable bottled water (Choate et al., 2014) or ownership of multiple reusable bottles (Bethurem et al., 2021).

2.3. Compliant reuse behaviour

The broader body of literature on how to increase consumer engagement and generate compliance shows that the majority of research uses a narrow lens to explore reuse without considering any unintended consequences of transition. When using experimental quantitative approaches, there is little scope to account for variance in behaviour that sits outside of fixed study variables used to test hypotheses. For example, Ertz et al. (2017) seek to understand the relationship between theory of planned behaviour (TPB) and consumption of food refill containers, finding context and motivation to be important predictors of behaviour alongside TPB constructs. The outcome variables considered simplify behaviour into two types, namely, consumption of single-use containers versus refill containers, with no room for divergence. Poortinga and Whitaker (2018) test whether environmental messaging, provision of alternatives, and financial (dis)incentives increase the use of reusable hot drinks cups, finding the measures to be additive when deployed in conjunction. Again, in their study, there are two outcome variables considered, namely, consumption of single-use versus reusable hot drinks cups. The success of refill is framed by its consumption at the point of purchase, side-lining impact factors across the consumer journey, like longer-term continued reuse, replacement behaviour, or defaulting to single-use.

Research has also investigated pre-purchase attitudes to refill. Miller et al.'s (2011) study tests the effect of information provision on consumers' consideration of reusable nappies at the cost of convenience. Their findings show that information can increase consumers' intention to consider using reusables. However, intention to use is different from actual use, where feelings of inconvenience are most likely to emerge and divert consumers from continued compliant reuse. Similarly, Kunamaneni et al. (2019) and Bashir et al. (2020) use focus groups to understand consumer perceptions, beliefs, and attitudes towards refill solutions for home and personal care products, using the insights to suggest design and policy directions that will encourage consumers to transition to reuse. Although these kinds of qualitative methods capture wider consumer variations in opinion, they do not capture the lived reality of reuse during or post transition. Furthermore, each study focuses on specific categories or products with little cohesive understanding of how consumers are currently reusing FMCGs across the market.

3. Methodology
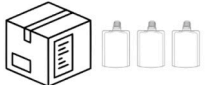
To collect data on real consumer journeys for business-to-consumer FMCG refill at home offerings, in-depth interviews with consumers were conducted. Research on actual consumer behaviour for FMCG reuse is still emergent so qualitative research was selected for its capacity to shed light on this relatively unexplored topic (Tashakkori and Teddlie, 1998). Interviews offer the ability to uncover individuals' experiences and learn about the significance or meaning of those experiences (Mears, 2012). The intention was to allow for genuine and open variation in participants' descriptions of their experiences rather than to be influenced by others in a focus group or to provide consumers with a set of predefined answers in a questionnaire. Ethical clearance was applied for and granted by Imperial College London's Science, Engineering and Technology Research Ethics Committee (SETREC) (number: 21OC6661).

3.1. Identifying refill at home offerings to study in interviews

To start with, the definition of refill was extended from its previously limited conception, which tends to refer to filling a container with a substance (often a liquid), to include other types of durable FMCG products with replenishable components (e.g. refilling a razor handle with a blade cartridge or a nappy with a liner) (Lofthouse et al., 2009; Muranko et al., 2021). To compile a set of business-to-consumer refill at home offerings that could be presented to prospective interviewees, the reuse literature was reviewed (see Section 2) along with visiting relevant

Table 2
List of refill at home offering types presented to prospective interviewees. All reusable products are consumer owned.

Mode	Offering number and description	Fast-moving consumer goods
Non-service	1. Reusable razor handle with removable blade refill cartridge or single blades that the consumer purchases when they run out	
	2. Reusable manual or electric toothbrush handle with removable refill brush heads that the consumer purchases when they run out	
	3. Reusable packaging for home and fabric care (i.e. laundry wash, surface cleaner, dish wash), personal care (i.e. hair wash, hand wash, body wash, shaving gel, deodorant) or beauty (i.e. make-up) filled at home using a pouch, self-owned bulk dispenser, concentrate solution or other refill mechanism that the consumer purchases when they run out	
	4. Reusable food storage container (instead of purchasing items in disposable packaging) filled at home by the consumer (e.g. by buying in bulk)	
	5. Reusable water jug with a replaceable and/or reusable filter	
	6. Reusable coffee pod for an at-home machine refilled with coffee purchased by the consumer	
	7. Reusable water bottle filled with water or other beverages	
	8. Reusable hot drinks cup filled with coffee or other beverages	
	9. Reusable nappy cleaned by the consumer for reuse	
Service	10. Reusable goods coming with a subscription service that supplies refills (i.e. razor handle and blade cartridges, toothbrush handle and brush heads, laundry wash bottle and laundry wash, deodorant case and deodorant, water jug and filter) at specified intervals	
	11. Reusable goods (i.e. packaging for laundry wash, dish wash, surface cleaner, hair wash, body wash, and shaving gel products) coming with a home delivery service (not available in store) that supplies refills	
	12. Reusable goods coming with an in use service (i.e. toothbrush with digital application) that provides information on product use and re-purchase	

online shops (e.g. Peace With the Wild and Plastic Freedom) and carrying out online searches in English using combinations of key-word strings for the model ("reuse", "reusable", "refill at home", "refill", "refillable", "replenish", "replenishable") and category and product (e.g. "grooming", "razor" and "beverage", "bottle"). Types of refill at home were only considered if currently available to UK based consumers.

Hybrid refill offerings (e.g. water bottles, hot drinks cups, and nappies), which can be refilled at home or on the go, were deemed relevant for inclusion in this study because they are often filled prior to leaving the home. Furthermore, compared to strict refill-on-the-go offerings, which require consumers to visit specific refill points, hybrid offerings provide greater flexibility much like mainstream refill at home offerings.

Refill at home offerings with services (i.e. product service systems) and without services were also deemed relevant for inclusion in this study. Whereas refill on the go, return from home, and return on the go only operate via services, refill at home is unique in that although it predominantly operates as a non-service, it offers the option to have a service too. Integrated services, like subscription, are a more recent addition to refill at home but have grown rapidly. Given that services alter the consumer journey, and that the aim was to understand how consumers carry out compliant and divergent reuse behaviour for refill at home FMCGs across the journey, these types of offering were included for comparison.

Based on these specifications, 12 refill at home offering types (non-service: 9, service: 3) were identified and selected (Table 2). A subset of the refill at home offerings included services spanning the different stages of consumption, with subscription services at the point of purchase, delivery services post-purchase and repurchase services during use. Though the services in these refill at home offerings address mainly *refill*, some brands also offer direct-to-consumer or third-party take-back services for *recycling* refill at home offering components.

In the products studied, there were refill at home offering types that have been available for a long time (e.g. refillable razors), are being revived (e.g. refillable nappies and water bottles) and are newer solutions (e.g. refillable coffee pods). In general, whilst many of these offerings respond in varying degree to the need to design more sustainable solutions for disposable products (e.g. offerings 3, 4, 5, 6, 7, 8 and 9 in Table 2), not all refill at home offering types have necessarily been developed with sustainability in mind (e.g. offerings 1, 2, 10 and 12 in Table 2). However, all the offerings studied provided insights into RHB for refill at home FMCGs, intended to be kept and reused and holding the capacity to counter the overconsumption and fast disposal associated with single-use.

Each refill at home offering has a generic set of components, typically including a reuse facilitator, a refill facilitator, and a consumable (Fig. 2). The reuse facilitator aids use of the consumable (e.g. hand wash bottle, razor handle, or water bottle) and is intended to be kept in use. Sometimes, this is purchased with the consumable (e.g. hand wash bottle containing hand wash), whereas at other times it is empty and ready to be filled (e.g. water bottle). The refill facilitator contains the consumable (e.g. hand wash refill pouch containing hand wash, blade cartridge containing blades) and enables the refill to take place. If the consumable is used up, the refill facilitator is left empty at the end of the refill process (e.g. the refill pouch becomes empty when the hand wash has been transferred to the reuse facilitator), whereas if the consumable wears and tears, the refill facilitator and the consumable remain as one unit (e.g. the blade cartridge and blades stay together during and after use). Some refill at home offerings comprise a smaller number of these components. For example, a water bottle is often offered by itself as a reuse facilitator without specific refill and consumable components.

3.2. Pre-screening interview participants

Following the identification of the refill at home offerings, a pre-screening questionnaire was developed to recruit participants for the interviews.

For each FMCG refill at home offering type, the pre-screening questionnaire collected information on each participant's level of experience, from having considered or considering it to using or having used it (example question in Appendix A). Further, participants were asked to specify the exact products and brands that they had experience of. The initial recruitment invitation was broad, seeking any consumers with FMCG refill experience, but it became more specific as participants were recruited. In particular, callouts via the recruitment agency's social media platforms were employed to identify consumers with experience of less common refill at home offerings (e.g. nappies).

After being piloted on a convenience sample of five participants, who provided feedback on whether the language and visuals were relatable, an updated version of the pre-screening questionnaire was distributed via a specialist consumer recruitment agency. Using this distribution channel enabled the recruitment of a diverse sample of UK-wide consumers. During the pre-screening questionnaire, demographic information on gender, age, area of residence, ethnicity, employment status, and
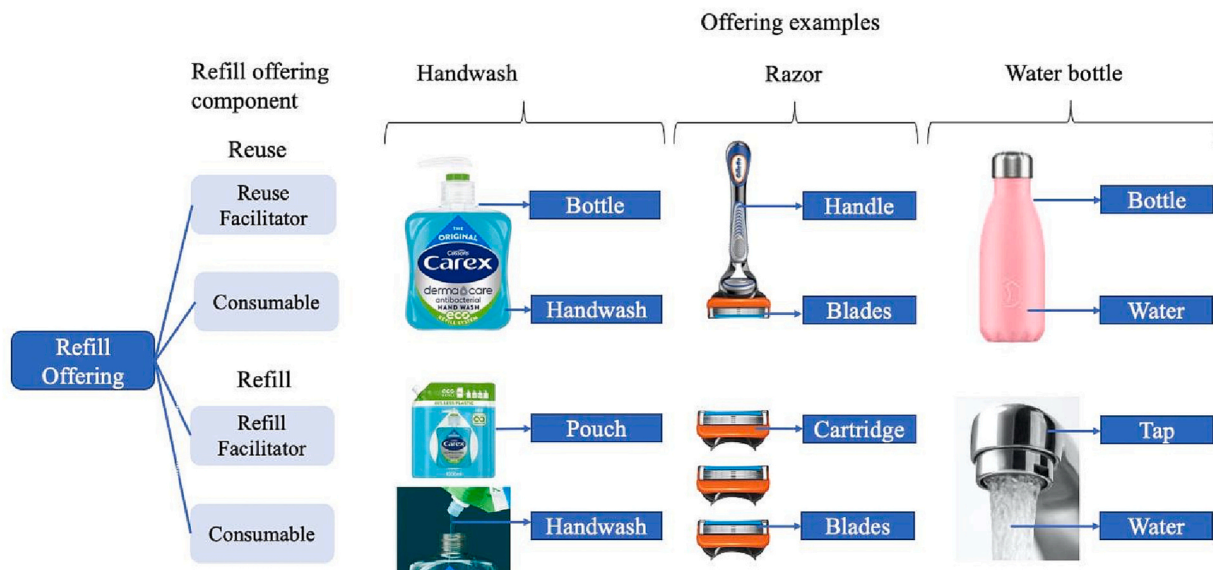

Fig. 2. Breakdown of the components in a FMCG refill at home offering.

level of education was collected.

3.3. Selecting interview participants

If the participants' pre-screening answers met the criteria to discuss their journey for at least one refill at home offering, their motivation to participate in the research and the applicability and legitimacy of their responses were investigated through a subsequent telephone screening. A team of trained project coordinators and managers from the recruitment agency carried out this further screening. This ensured that each participant had genuine relevant experience and had correctly interpreted the refill at home offerings within the research scope. Participants who passed the pre-screenings were selected to cover all of the refill at home offering types presented in Table 2. Once selected, participants were emailed an invitation to participate in an interview scheduled at their convenience. Participants were offered £40 to thank them for taking part.

Out of the 26 participants interviewed, 15 were female and 11 male. Participants spanned a range of ages between 18 and 65, though more were in the 18–30 (6) and 31–40 (10) brackets. Although participants were situated across the United Kingdom, Greater London was most heavily represented (11). Appendix B provides additional information on participants' ethnicity, employment status, and level of education, highlighting participants' diversity.

3.4. Planning and conducting in-depth interviews supported by consumer journey models

The interviews covered between one to three cases of refill at home offerings depending on the time required to report a case and the cases that participants had experience with. Overall, twenty-six interviews were conducted, covering 48 refill at home cases split between non-services (31) and services (17). Appendix C includes the final spread of refill at home offering types and brands investigated.

Prior to the interviews, participants were provided with an information sheet detailing the purpose of the study and outlining their level of involvement, privacy guarantees, and rights. They were also asked to sign a consent form, giving permission to record the interviews for transcription. Additionally, at this stage, the intended behaviour chain (Appendix D) for their refill at home offering was emailed to each participant so that they could gain familiarity with the intended structure of their journey (see Section 3.5 for more information on the behaviour chain method, how it was used to map actual journeys, and for subsequent analysis) (Muranko et al., 2020).

The interviews were conducted via Microsoft Teams. Teams provide an encrypted, secure audio and video communication platform that can be easily accessed from home using a link provided by the researcher. It also allowed the researcher to share their screen and use Miro, an online collaborative whiteboard platform, to present a model of their journey to participants.

One researcher conducted the interviews for consistency in delivery. Each interview lasted approximately 1–1.5 h. The interviews were semi-structured (interview guide sheet in Appendix E) with an open approach to consider naturally emerging topics outside of the set questions.

- *Starting the interview.* Participants were provided with a description of FMCGs, followed by a short warm-up discussion of how they generally purchase, use, and dispose of FMCGs and the types of FMCGs refill they aimed to cover in the interview.
- *Sampling behaviour in the interview.* Whilst an investigation of behaviour change was not in scope (i.e. behaviour change from single use to reuse or reverse), given that reuse products require to be kept and used repeatedly, behaviour was sampled within a timeframe as opposed to an instant. This timeframe extended from when the participant first purchased and started using the reuse offering,

up until the time of the interview if the participant was still using it or up until when they stopped using it.

- *Supporting behavioural understanding in the interview.* Using models of their journeys based on the behaviour chain method, participants were guided to discuss their practices for each refill at home offering (Muranko et al., 2020). Throughout the interview, the researcher populated the behaviour chain with digital notes based on each participant's discussion of their experience. This helped capture step-by-step information on behaviours across the journey from start to finish and provided a final summary for participants to confirm data accuracy or make adjustments upon completion. In this way, the behaviour chain was used as a tool to facilitate discussion and elicit information with more focus. However, participants were also made aware that their journeys may differ from the behaviour chain presented and were encouraged to discuss these points where applicable to capture authentic experiences outside of the assumed structure.

The interview structure, including the software and materials used, was trialled on the same convenience sample of five people who piloted the pre-screening questionnaire. During testing, a second more senior researcher was present to enable a reflection on the study design and execution, confirming its ability to gain a rapport with participants and access detailed and meaningful information on RHB for FMCGs refill.

3.5. Transcribing and mapping the interview data

The interviews were transcribed using an external service. Each interview led to approximately 11,500 words of transcript. Once the interviews had been transcribed, the researcher started to familiarise themselves with the data. At this point the data were used to map the interaction between the consumer and each component in a refill at home offering by applying the behaviour chain method in more detail in Miro (Muranko et al., 2020). Whilst traditional consumer journey mapping (CJM) does not instruct on how best to map consumer behaviour and assumes all consumers experience the same touchpoints equally (Rosenbaum et al., 2017), the behaviour chain method enables a structured, analytical, and predictive approach to scoping behaviours (Muranko et al., 2020). Further still, whilst CJM predominantly focuses on creating and delivering positive consumer experiences (Lemon and Verhoef, 2016), the behaviour chain method considers how consumer behaviour affects the optimum flow of resources needed for a circular economy to operate efficiently. Given that correct resource handling in FMCG reuse (i.e. reusing a sufficient number of times) is critical to offset environmental impact compared to single-use alternatives (Changwichan and Gheewala, 2020; Muranko et al., 2021), the behaviour chain method was deemed to be the most appropriate means to make observations on how consumers handle resources for FMCG refill at home offerings.

The primary refill at home offering that each participant reported on was mapped along with any other offerings they used to meet the related need. For example, the behaviour chain in Fig. 3 shows that the consumer uses four refillable razors along with disposables. Fig. 3 also highlights the key attributes of the behaviour chain that helped in mapping, analysing, and understanding the data. For example, behaviours were mapped across different *consumption stages,* such as post-acquisition and pre-utilisation (Fig. 3: A). Whilst *macro, meso* and *micro* levels are commonly used to understand different levels in a system (e.g. institutions/ policy, groups, and individuals; Ghisellini et al., 2016), in zooming in on the individual, Muranko et al. (2020) use these units to break down behaviour at incrementally more detailed levels. The data from the interviews enabled a series of actions to be distilled at a *macro level* to capture the essence of each consumption phase (e.g. consider, Fig. 3: B). Whilst the interviews further enabled behaviours to be broken down at a *meso level* (e.g. choose Gillette, Fig. 3: C), the level of depth required to understand behaviour at a *micro level* (e.g. look at razors - pick up razor - put down razor, etc.) was not achievable in the
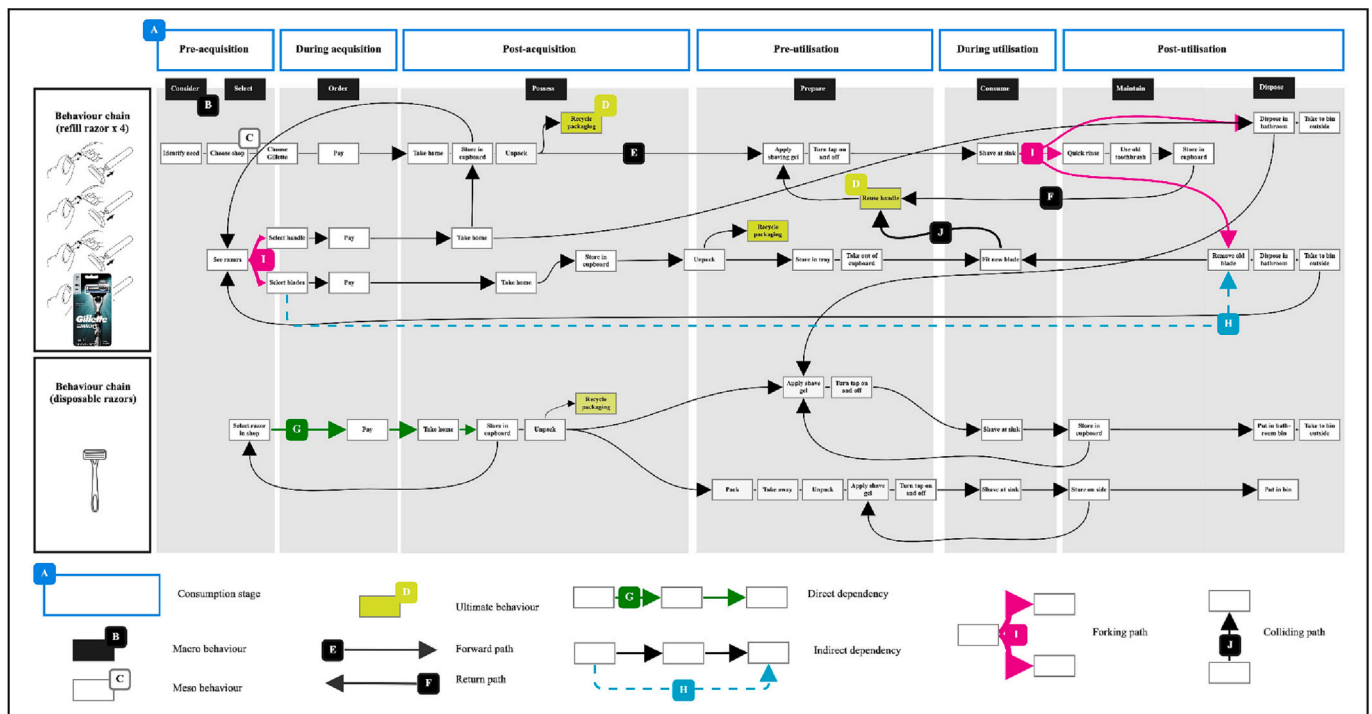
Fig. 3. Example behaviour chain produced from interview data showing a razor journey with key attributes of the chain highlighted.

time allocated for interviews, nor deemed necessary for the purpose of the study. Some of the behaviours are categorised as *ultimate circular behaviours* or 'end-goal behaviour(s) that a circular system is set out to achieve', namely reuse for the razor handle and recycling for the packaging (Fig. 3: D) (Muranko et al., 2020). The *direction* of each path indicates whether consumers are on a *forward path* towards the goal (Fig. 3: E) or on a *return path* to prepare to repeat the behaviours (Fig. 3: F), crucial in indicating how and where reuse takes place. Most behaviours have a *direct dependency* on the next behaviour in the chain, such as selecting, paying, taking home and storing a razor (Fig. 3: G). However, there are also instances where this dependency is *indirect* and a causal link exists between two behaviours that are not consecutively linked, such as changing the razor blade cartridge in post-utilisation when more have been purchased during-acquisition (Fig. 3: H). Paths can also *fork* when a behaviour prompts several subsequent behaviours, exemplified by either buying replacement blade cartridges or buying a new razor handle and blade cartridges (Fig. 3: I). Finally, refill at home offerings comprise multiple components that can flow through some phases of consumption *independently* as parallel paths, eventually *colliding* when the consumer connects the refill facilitator and consumable (e.g. blade cartridge containing blades) to the reuse facilitator (razor handle) (Fig. 3: J).

3.6. Analysing the behaviour chains and structuring emerging insights

Once mapped in detail, the 48 behaviour chain cases were used to investigate how consumers handle the resources in FMCG refill at home offerings using Braun and Clarke's (2006) six-stage approach to carry out a thematic analysis, including (1) becoming familiar with the data presented in the behaviour chains, (2) generating initial codes, (3) searching for themes, (4) reviewing themes, (5) defining and naming themes, and (6) producing the report. In generating the initial codes, a deductive approach was used whereby moments in the behaviour chains were grouped by the waste hierarchy constructs of reduce, reuse, recycle and dispose (UK Government, 2011). Instances where these constructs occurred were tagged with a short description of what was happening in terms of resource handling. During this process, variants of behaviour

emerged that did not neatly fit the waste hierarchy constructs offered. For example, whilst some consumers reused within the remit of the term, reuse was also carried out in different ways, such as purchasing and using more than one reuse facilitator. Therefore, a new code, 'increase', was inductively generated, reflecting instances where the consumer did the opposite of 'reduce'. Other instances where waste hierarchy behaviours were carried but not necessarily as intended included consumer recycling of non-recyclables. In these instances, information provided by the brands was used to classify correct and incorrect behaviours. Once all 48 cases had been analysed in this way, the tags were compared across the chains and grouped into common RHB themes and sub-themes (referred to as types and sub-types to better describe behaviour in subsequent sections). The descriptions for each individual tag were then synthesised to reflect the cases in each group and organised in a table, from those representing a reduction in resource use to those representing an increase in resource use. Conversations with a more senior researcher during each stage helped to review, define and name themes and sub-themes. Whilst in many of the cases the basic behaviours listed in the table could be used individually to describe resource handling, there were also cases where the behaviours overlapped and were practised concurrently. This reinforced the value in looking at combinations of behaviours, relaying the complexity of resource handling across a journey rather than at specific moments in time.

During data analysis, some of the RHBs were observed to occur frequently across cases, whilst others were observed infrequently. Furthermore, differences in the prevalence of RHBs for refill at home offerings with and without services were noted. In order to offer transparency, give precision to statements, enable patterns in the data to emerge with greater clarity, and increase the meaning of key findings, the distribution of RHBs and RHB combinations in the dataset is presented in graphical form alongside the qualitative findings (Monrouxe and Rees, 2020; Neale et al., 2014). Each case was coded according to a scheme including both the basic RHBs and the RHB combinations. Whilst this shows the distribution of behaviours across the dataset, no inferences can be drawn about the prevalence of the identified behaviours beyond the sample.

4. Results

4.1. Resource handling behaviour framework

Alongside reuse as intended, the analysis of the behaviour chains led to the identification of multiple basic divergent behaviours, which were organised in the framework in Fig. 4. The framework presents six RHB types (e.g. RHB 1) and 17 RHB sub-types (e.g. RHB 1a, 1b, 1c, 1d and 1e), structured according to whether they theoretically reduce or increase resource use.

RHBs 1, 2, 3, 4 and 5, shown in the upper part of the framework, operate when a refill at home offering is *in use* (Sections 4.1.1 to 4.1.5). For example, RHB 3, *reuse with multiple reusable products*, characterises consumers who own more than one reusable product like durable hot drinks cups.

Some *in use* RHBs were found to commonly co-exist. For example, RHB 3 and RHB 4 were found to be concurrently adopted by consumers as when in a journey, a consumer owns and uses multiple durable hot drinks cups (RHB 3) and temporarily pauses use of the durable hot drinks cups to use a single-use disposable or recyclable cup (RHB 4). Hence, the basic divergent behaviours are also combined to describe more complex behaviours that represent further divergence from each of the fundamental RHBs. Following a description of each of the basic

RHBs that were found to operate alone, the combinations identified in the data are presented to capture the intricacies and lived reality of these behaviours.

RHB 6, shown in the lower part of the framework, operates at the *end of life*. Given that all the components of any refill at home offering will eventually reach the end of life, RHB 6 co-exists with RHBs 1, 2, 3, 4, and 5 and with the in use RHB combinations.

4.1.1. In use: resource handling behaviours

4.1.1.1. Reuse as-is (RHB 2). This behaviour type is the baseline. It occurs when the consumer is compliant, that is, they use a refill at home offering as intended with no attempt to either increase or decrease resource use. Compliant use of a refill at home offering occurs when the consumer purchases and uses the reuse facilitator along with its other components for a number of cycles so that, in theory, the environmental impact is lower than that of the single-use offering it replaces.

The cases exhibiting this behaviour are based on different configurations of components. Refill at home offerings with a reuse facilitator, a refill facilitator and a consumable were common in razors (i.e. handle, blade cartridge, and blades) and toothbrushes (i.e. handle, head, and bristles) but also in deodorants (i.e. case, refill unit, and deodorant).

Other refill at home offerings consisted of either a reuse facilitator

Resource handling behaviours - In use		
RHB type	**RHB sub-type**	**Description**
1. Reuse with fewer components or repurposed components	1a	Moving away from a refill at home offering without replacing it
	1b	Repurposing a reuse facilitator
	1c	Using a refill facilitator as a reuse facilitator
	1d	Using a single-use recyclable as a reuse facilitator
	1e	Using a consumable for longer
2. Reuse as-is	2	Using a refill at home offering as-is
3. Reuse with multiple reusable products	3a	Using multiple refill offerings for the same purpose
	3b	Replacing a refill at home offering with another refill offering
4. Reuse along with recyclable or disposable products	4a	Using a refill at home offering with single-use recyclable offerings
	4b	Using a refill at home offering with single-use disposable offerings
	4c	Pausing a refill at home offering temporarily to use a single-use recyclable offering
	4d	Pausing a refill at home offering temporarily to use a single-use disposable offering
5. Abandon reuse for a disposable product	5	Replacing a refill at home offering with a single-use disposable offering
Resource handling behaviours - End of life*		
6. Recycle/ Dispose reuse components	6a	Recycling a recyclable refill at home offering component
	6b	Disposing of a disposable refill at home offering component
	6c	Recycling a disposable refill at home offering component
	6d	Disposing of a recyclable refill at home offering component

* Can apply selectively to any reuse from 1 to 5

Fig. 4. Resource handling behaviour (RHB) framework for refill at home FMCGs.

and refill facilitator only, as in water jugs (i.e. jug, refill filter), or a refill facilitator and consumable only, as in hand wash (i.e. stand-alone hand wash refill pouch), though the latter were often used with previously owned single-use products as reuse facilitators.

4.1.1.2. Reuse with fewer components or repurposed components (RHB 1). This behaviour sits above *reuse as-is*. It occurs when the consumer reduces the number of reuse components needed.

In RHB 1a, *moving away from a refill at home offering without replacing it*, the consumer's needs change (e.g. a razor is no longer needed following the decision to stop shaving), stemming the flow of refill facilitators and consumables. For example, Participant 11, in relation to their decision to stop shaving, stated "when I didn't shave I didn't get [blade cartridges]", ultimately leading to a complete reduction.

RHB 1b, *repurposing a reuse facilitator*, was only found to operate in combination with other RHBs and is therefore discussed in Section 4.1.2.

RHB 1c, *using a refill facilitator as a reuse facilitator,* is when the consumer decides to purchase the refill facilitator but not the reuse facilitator (e.g. laundry wash bottles). For example, Participant 20, in relation to using laundry wash directly from the refill pouch to reduce the number of components used, stated: "for these ones I don't put it into any other packaging. That's because—actually it works quite—like it works fine. Like I didn't need that extra step".

For RHB 1d, *using a single-use recyclable as a reuse facilitator*, the consumer diverts single-use packaging (e.g. hand wash, dish wash, or laundry wash bottles) from the waste stream and refills them like reuse facilitators. For example, Participant 20 discussed transferring dish wash liquid from a refill pouch into an "old bottle, which… was just like a standard Fairy bottle from Tesco".

Finally, in RHB 1e, *using a consumable for longer*, the consumer extends the lifetime of a consumable (e.g. razor blades, toothbrush heads, or hand wash). For example, Participant 10, in relation to adding water to hand wash when it is "nearly empty", stated: "I take the top off and stick a little water in and shake it up and keep using that until it's finished".

4.1.1.3. Reuse with multiple reusable products (RHB 3). This behaviour sits below *reuse as-is*. It occurs when the consumer uses more reuse components than intended for reuse to take place.

RHB 3a, *using multiple refill offerings for the same purpose*, is when the consumer has more than one refill offering to meet the same need (e.g. water bottles or hot drinks cups). These products are often used in sequence within different contexts of use. For example, Participant 8 noted "funnily enough I've got two actually, two bamboo mugs, one I take to work, and obviously one I have [at home]". They are, however, also used in sequence within the same context, where a preferred refill offering is used more frequently, reducing the number of times that less preferred refill offerings are used. For example, despite participant 10 having "two other plastic [water bottles] that actually are secure and safe", they primarily use their newest double walled metal bottle because they "like it cold".

RHB 3b, *replacing a refill at home offering with another refill offering*, involves the consumer discarding one refill at home offering in favour of another of the same type (e.g. razors). For example, Participant 14 commented that they "actually replaced [an old reusable razor] with something that is going to be doing exactly the same job" and, once replaced, stated: "the [old] handle itself I had to throw away". Consumers replace refill at home offerings either in quick succession or over more prolonged periods of time. Despite RHB 3b representing a horizontal shift in terms of waste hierarchy constructs in that consumers continue to reuse rather than moving down the hierarchy to single-use recyclables or disposables, reuse components are still cycled at a faster pace, reaching end of use or end of life faster than desired.

In contrast to RHB 3, which characterises situations where the use of reuse components increases because of the uptake of other refill offerings, RHBs 4 and 5 characterise situations where an increase in resources occurs through the uptake of single-use recyclable and disposable offerings.

4.1.1.4. Reuse along with recyclable or disposable products (RHB 4). This behaviour sits below *reuse with multiple reusable products*. RHB 4a is *using a refill at home offering with single-use recyclable offerings* (e.g. water bottles). For example, Participant 3, in relation to a reusable water bottle, stated "I buy the 5 litre [recyclable] water bottles for consumption. So I refill [my reusable bottle] from that" and for a shampoo bar in a refillable tin "I mix it with other normal shampoos and conditioners or hair masks. But they're just the ones in bottles". RHB 4b is *using a refill at home offering with single-use disposable offerings* (e.g. razors). For example, Participant 13, in relation to using a reusable razor and a disposable razor, stated: "I still have some disposable razors… they're in my bathroom".

Further, RHBs 4c and 4d are *pausing a refill at home offering temporarily to use a single-use recyclable offering* or *a single-use disposable offering* (e.g. hot drinks cups). RHBs 4c and 4d are particularly relevant to hybrid refill at home offerings that also act as refill on the go offerings. For example, reflecting on the moments when they use disposable hot drinks cups instead of their reusable one, Participant 13 stated "It happened last weekend… I just used the coffee shop provided one".

4.1.1.5. Abandon reuse for a disposable product (RHB 5). *Abandon reuse for a disposable product* sits below all the other in use RHBs and represents situations where the consumer breaks away from refill entirely. Unlike RHB 1a, where there is no replacement, in RHB 5, consumers switch to a single-use offering (e.g. nappies). For example, Participant 6, after using reusable nappies, stated that "[disposables] came in for convenience".

4.1.2. In use: resource handling behaviour combinations

Analysis of behaviour chains showed that in use RHBs can operate alone or as a combination of RHBs, representing further divergence. These combinations are described below.

4.1.2.1. RHB 3 combinations. RHB 3 combinations describe variants of *reuse with multiple reusable products*. These consumers make reuse more erratic and increase resource impact. In RHB 3&4, it is common for consumers to own multiple reusables (e.g. toothbrushes, razors, bottles, and hot drinks cups) as well as to use them with recyclable (3a&4a) or disposable (3a&4b) products, which they use concurrently. Additionally, they replace one refill with another refill, rather than continuing to use the one they already own as well as temporarily pause refill for recyclable (3b&4c) or disposable (3b&4d) products. For example, Participant 6 stated that they "still can't work out whether it's cheaper to or better to buy the throwaway razors or the ones where you replace the blades only" and has "both types running in parallel now" but also mentioned that they have multiple reusable razors, of which they "only use one or two out of the four" (3a&4b). The continuous and difficult to predict flow of resources resulting from RHB 3 combinations makes them particularly problematic.

4.1.2.2. RHB 5 combination. The RHB 5 combination describes a variant of *abandon reuse*. In RHB 5&1, alongside abandoning reusables in place of disposables (e.g. nappies), the consumer was found to divert abandoned reuse facilitators from the waste stream by repurposing them (e.g. using nappies for another purpose) (5b&1b). For example, Participant 1 discussed having "friends who worked in charity stores who explained that even things like nappies, as long as they were clean and in good condition, could be [reused]" and so they "made use of them in that regard".

4.1.3. The distribution of in use RHBs and RHB combinations in the dataset

The behaviour chain cases were coded according to the type of in use RHBs and RHB combinations, highlighting differences in the distribution of the behaviours in the dataset (Fig. 5). In many instances, participants did reuse as-is (RHB 2). However, cumulatively, divergent RHBs were more common, particularly those that increased resource use, including reuse with multiple reusable products (RHB 3), variants of reuse with multiple reusable products (RHB 3 combinations) and reuse along with recyclable or disposable products (RHB 4).

During the analysis, a difference in the distribution of RHBs and RHB combinations between cases of service and non-service refill at home offerings was also noted (Fig. 6). Most significantly, refill at home offerings with services displayed compliant behaviour (RHB 2) in the majority of instances. There were also marginally more instances of behaviour that reduced resource use in refill at home offerings with services compared to non-services.

4.1.4. End of life: resource handling behaviours

Whereas RHBs 1, 2, 3, 4 and 5 relate to resource handling in use, RHB 6 considers the moment when the components of a refill at home offering reach the end of life. Given that all the components will ultimately reach this point, RHB 6 forms an inevitable extension of all the in use RHBs. RHB 6a is *recycling a recyclable refill at home offering component*, whereas RHB 6b is *disposing of a disposable refill at home offering component*. These indicate instances where consumers recycle and dispose of components correctly. For example, Participant 9 stated that they disposed of their reusable toothbrush handle "in the bin" because they "haven't found a way of disposing of them more responsibly".

RHB 6c is *recycling a disposable refill at home offering component*, whereas RHB 6d is *disposing of a recyclable refill at home offering component*. These indicate instances where consumers recycle and dispose of components incorrectly, including wish-recycling of components that are not recyclable (e.g. hot drinks cups, razor handles, blade cartridges, and refill pouches) and disposal of components that are recyclable. For example, in misreading product signs, Participant 12

stated that they put both their reusable electric toothbrush handles and brush heads "in the plastic recycling".

Both compliant and divergent end of life RHBs are positioned in the framework as increasing resource use. Despite correct recycling being a circular strategy and offering a better solution than incineration or landfill, it still requires more processing than the baseline of reuse, reinforcing the need to encourage consumers to prolong life in use.

4.1.5. The distribution of end of life RHBs in the dataset

When components (i.e. reuse facilitator, refill facilitator, and consumable) reached the end of life, more were recycled than disposed of in the dataset studied (Fig. 7). However, recycling was most often carried out incorrectly (6c in Fig. 7). This indicates that even though the components of refill at home offerings are increasingly sent for recycling, these behaviours are not compliant in many instances. Disposal was only occasionally carried out incorrectly (6d in Fig. 7) but this still played a role in divergent end of life behaviour.

5. Discussion

5.1. The RHB framework

We are in a period of transition where refill at home offerings are being introduced into the FMCG market at an increasingly rapid rate. Different types of refill offering have been presented in a number of frameworks that help distinguish models and identify their key components (Ellen MacArthur Foundation, 2019; Greenwood et al., 2021; Lofthouse et al., 2009; Mansour et al., 2019; Muranko et al., 2021; Tassell and Aurisicchio, 2020; Zeeuw van der Laan and Aurisicchio, 2019). However, more technical elements overshadow the role of behaviour. When the role of behaviour is included, it is based on how consumers and other stakeholders are expected to behave. Only the framework Greenwood et al. (2021) present includes a divergent variant of reuse that describes actual consumer behaviour as opposed to intended. The continued use of disposables (Choate et al., 2014) and the

Resource Handling Behaviour Key
1 - Reuse with fewer components or repurposed components
2 - Reuse as-is
3 - Reuse with multiple reusable products
4 - Reuse along with recyclable or disposable products
5 - Abandon reuse for disposable product

Resource Handling Behaviour Combination Key
3& - Variants of *reuse with multiple reusable products*
5& - Variants of *abandon reuse*

Fig. 5. Instances of in use RHBs and RHB combinations in the dataset.

Resource Handling Behaviour Key
1 - Reuse with fewer components or repurposed components
2 - Reuse as-is
3 - Reuse with multiple reusable products
4 - Reuse along with recyclable or disposable products
5 - Abandon reuse for disposable product

Resource Handling Behaviour Combination Key
3& - Variants of *reuse with multiple reusable products*
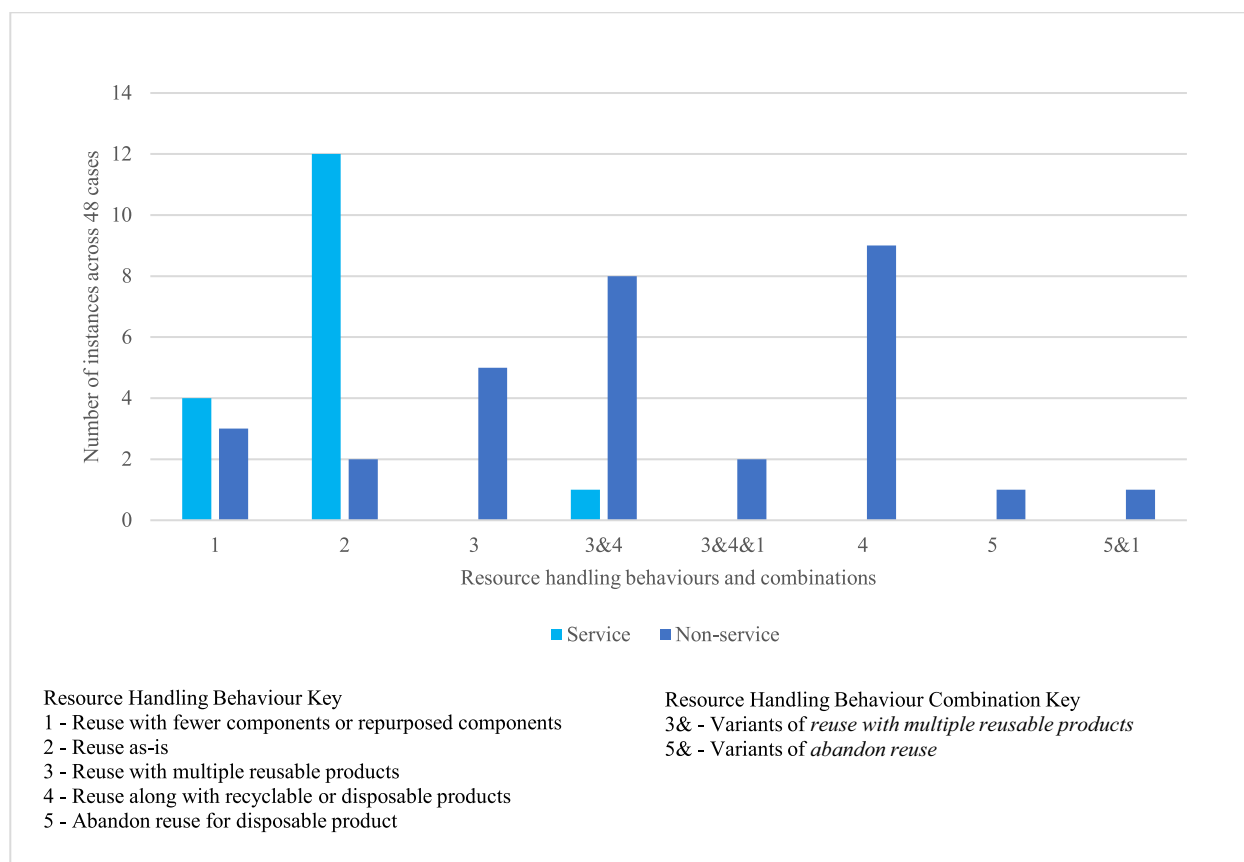5& - Variants of *abandon reuse*

Fig. 6. Comparing instances of RHBs and RHB combinations for refill at home service (31) and non-service (17) cases.

possession of multiple reusables (Bethurem et al., 2021) are examples of divergent behaviour identified in the literature for specific products and in specific contexts. These hinder the assumed capacity for reuse to reduce resource use. However, there is little structure in these emergent insights.

The RHB framework responds to this gap by identifying six RHB types and 17 RHB sub-types, divided across the in use and end of life stages. These more realistically depict how refill at home is operating from consumer behaviour and resource handling perspectives in instances where the consumer reduces, maintains, or increases resource use. Different types of consumer behaviour are represented through the RHBs and the framework can be used to profile consumers based on the RHBs carried out. There are consumers who follow instructions, are happy with the performance of a refill at home offering, and commit to reuse as is intended (RHB 2). There are also consumers who repurpose and reuse single-use components and push the boundaries to reuse in less impactful ways through using consumables for longer (RHB 1). At the other end of the spectrum, there are consumers who do not necessarily engage with reuse as a sustainable option, using more reusable products than necessary or replacing them in their search for the right one (RHB 3), using multiple reusables alongside single-use products (RHB 3 combinations), and falling back to single-use practices when convenient (RHB 4) or preferred (RHB 5). These behaviours result in the purchase, use, and disposal of an abundance of resources. Impactful RHBs were found to be associated with refill at home offerings that have been developed with sustainability in mind (e.g. durable hot drinks cups and refillable packaging for home care products), as well as with offerings that have not (e.g. refillable razors and toothbrush handles). This highlights the need for market-wide interventions to optimise reuse.

5.2. Intervention strategies and actions to improve refill at home

Based on the RHBs, six high-level intervention strategies (IS) aimed at reducing impactful divergent behaviours and increasing reuse as-is for refill at home offerings are proposed. Specific actions (A) to enact the strategies are also provided based on concepts and proposals that emerged in the literature (e.g. incentivising reuse through financial rewards (A) can *make reuse easy and appealing compared to single-use recyclables or disposables* (IS4)). Further research to determine the factors influencing divergent behaviour would help expand on these actions, and identify which strategies and actions are best placed to address divergent behaviours and reduce impact (further discussed in Section 5.4).

IS1: Promote responsible consumption of reusables. In RHB 3, consumers buy too many reusable products despite being increasingly aware of products' environmental credentials and willing to change brands to those committed to lowering environmental impact (Nielsen, 2014). Whilst messages about recycling are increasingly used in advertising and printed on packaging, helping consumers to make better informed choices, information on waste reduction through keeping and reusing products is non-existent. In order to make decisions that have the capacity to achieve this, consumers need information on the credentials of new reusable products (A) and education on the impact of overconsuming reusables (A). Given that FMCGs are often purchased quickly and habitually, tangible information on the benefits of keeping and reusing, rather than replacing an already owned reusable could make shopping behaviour slower, more considered and less impulsive. It would also respond to the European Commission's (1993) Fifth Environmental Action Programme (FEAP) goal to "help consumers to make informed choices on the basis of safety, quality, durability, and general environmental implications".

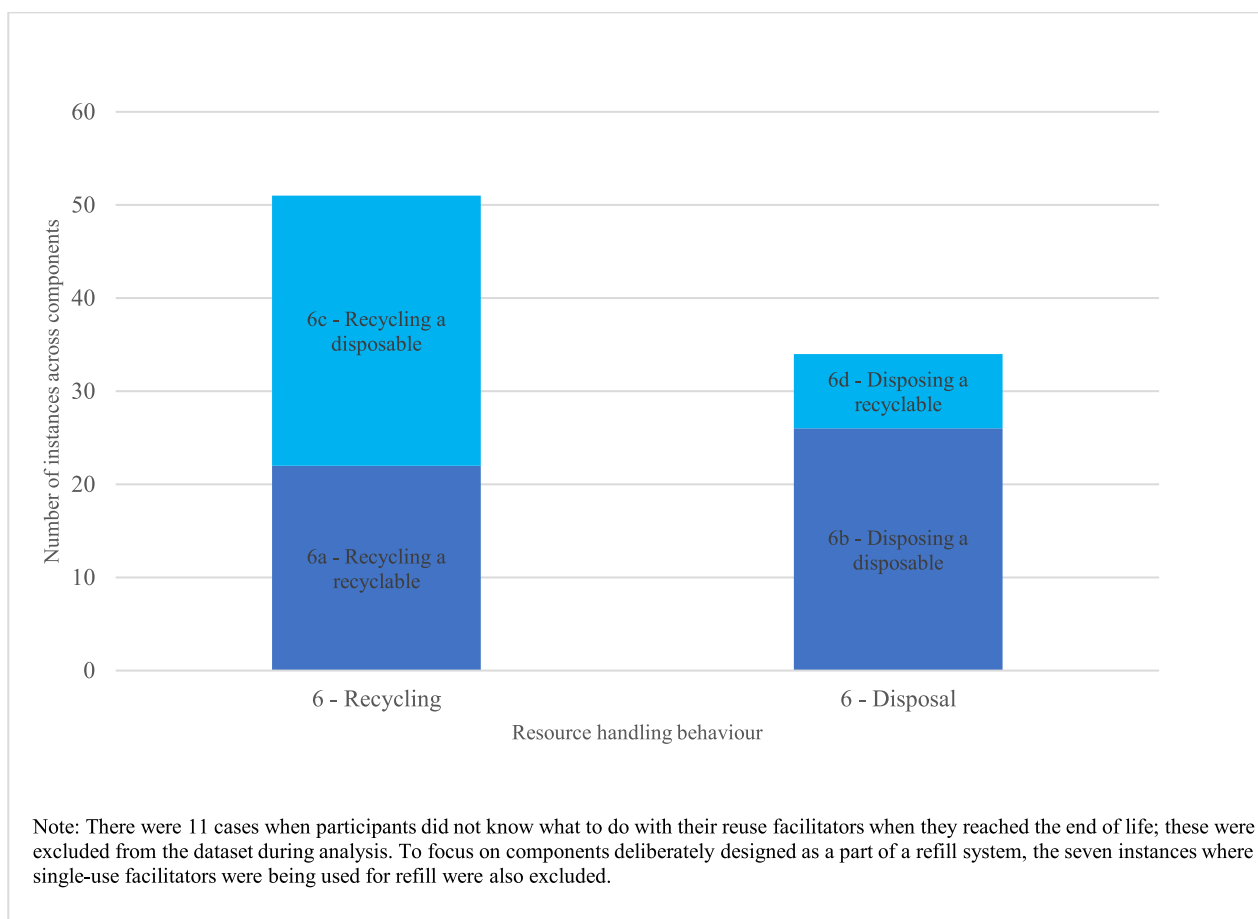*IS2: Discourage early disposal of reusables and capture residual value if*

Note: There were 11 cases when participants did not know what to do with their reuse facilitators when they reached the end of life; these were excluded from the dataset during analysis. To focus on components deliberately designed as a part of a refill system, the seven instances where single-use facilitators were being used for refill were also excluded.

Fig. 7. Instances of end of life RHB in the dataset.

disposal is inevitable. RHB 3b hints at premature disposal, that is, when reuse components are thrown away before their intended design lifetime. In particular, components from a current refill at home offering will be discarded in favour of a new one when consumers replace it or abandon it for a single-use recyclable or disposable offering. In these situations, it is important that consumers are educated on components' intended lifetime and the implications of early disposal to help emphasise value and encourage prolonged reuse (A). Further, consumers should be provided services to intercept reusables for continued reuse and encouraged to return them (A). Whilst these services currently exist in other product categories (e.g. mobile phones; Ongondo and Williams, 2011), they have not yet been implemented for refill at home FMCGs.

IS3: Use services to reduce overconsumption. In the non-service cases, RHB 3 and 4 were common and consumers used other reusable and single-use products. However, consumers using refill at home offerings with subscription services reported to rarely undertake divergent behaviour. This is likely to be the result of removing consumer autonomy during purchase. With subscription, consumers are provided with what they need, when they need it conveniently (A). This contrasts with non-service refill at home offerings, where consumers are presented with a range of products when shopping, resulting in a greater likelihood of them (impulsively or decisively) selecting something other than what is needed to keep the original reuse facilitator in operation.

In theory, then, subscription services for refill at home could hold the key to prolonging the life of a reuse facilitator. However, other known hurdles would need to be overcome, like acquiring and retaining sign-ups in the first place (Chen et al., 2018). Consumers would also need to be persuaded to sign up for a time equal to the intended life of the refill at home offering (A), therefore making a long-term commitment. If

subscription services are cancelled early, before the end of intended component life, take-back schemes could operate to intercept reuse components (A).

Product-oriented services, where the business model still relies on the sale of products but with a facilitating service (Tukker, 2004), as in subscription services for FMCG refill at home offerings, complement certain product types more effectively than others. For example, FMCGs that are used for personal care are more suited to consumer ownership, and get replenished on a more predictable basis, like razors and toothbrushes. However, Tukker (2004) also suggests that other types of service, such as use-oriented product renting and sharing, could enable higher impact reduction in comparison. Innovative ways of implementing these services for types of reusable FMCG less reliant on consumer ownership should, therefore, also be considered (A).

IS4: Make reuse easy and appealing compared to single-use recyclables or disposables. RHBs 4 and 5 indicate that the transition to reuse is not a clean one in that most consumers do not exclusively replace single-use disposable or recyclable products with reusable ones. There is a continued abundance of convenient single-use FMCGs on the market that are often cheaper and more accessible than reusables. In this context, consumers need to be incentivised to reuse (A), such as offering financial rewards to consumers who reuse, and disincentivised to abandon reuse (A). In Poortinga and Whitaker's (2018) study, adding a charge for disposable cups was found to be more effective than offering a discount on reusable hot drinks cups. These kinds of initiatives would be most effective if enforced through policy. Further, retailers could make it easier for consumers to discover and purchase refill at home offerings (A), like increasing in-store availability and positioning them in prime locations on shop shelves. Indeed, in their study on reusable containers, Ertz et al. (2017) highlight that the external environment influences

consumer's ability, stressing the importance of creating situations that facilitate consumption of reusable containers and complicate recourse to single-use ones.

IS5: Support recycling of reusables. In RHB 6d, consumers were found to dispose incorrectly regardless of the existence of recycling infrastructure. However, recycling reuse facilitators, refill facilitators, and consumables made from difficult to disassemble multi-materials is not always possible (Muranko et al., 2021). To dispose of these components correctly, consumers are sometimes given access to specialist recycling schemes and expected to exert additional effort to ensure that the resources involved find their way to facilities outside of the doorstep recycling infrastructure. Effort has, however, previously been highlighted as a key factor responsible for the accumulation of valuable resources in landfills (Muranko et al., 2021; Tassell and Aurisicchio, 2020; Zeeuw van der Laan and Aurisicchio, 2019).

Consumers need to be incentivised to carry out the necessary effort to recycle (A), but ultimately, providers also need to make recycling schemes more widely accessible (A), and re-design refill at home offerings to enable end of life circularity via existing easy-to-access infrastructure (A) (e.g. modular parts that can be easily deconstructed for further reuse and recycling; Bakker et al., 2014; Bocken et al., 2016).

IS6: Support disposal of reusables. Whereas in RHB 6d consumers were found to dispose of the recyclable components of refill at home offerings as waste, in RHB 6c they were also found to wishfully recycle disposables in the hope that something might be recoverable. Consumers might be motivated to do this to chase the positive emotions that have been found to be associated with recycling behaviour (Sun and Trudel, 2017; van Doorn and Kurz, 2021), not realising that they are contaminating the waste stream. There is also the possibility that consumers are simply unsure whether something is recyclable, preferring to recycle just in case.

In the same way that communication, such as labels, can increase recycling rates for single-use packaging (Nemat et al., 2019), consumers need to be made aware of how to dispose of reuse components adequately at the end of life through information on products, at recycling sites, in retailer shops, and on local authority websites (A). Campaigns could also be used to educate consumers on the implications of waste stream contamination (A).

5.3. Behaviour chains

In introducing the behaviour chains method, Muranko et al. (2020) list a range of attributes described as 'inherent features of consumer behaviour in reuse systems'. Among them, *ultimate circular behaviours* are listed as 'the end goal that the circular system is set out to achieve'. In refill at home, this refers to the point at which a consumer uses the reuse facilitator again, like refilling a durable bottle with a beverage or refill solution. Although this attribute helps in understanding how to theoretically devise a compliant consumer journey, it does not account for divergent behaviours that either prevent the ultimate end goal from being carried out or, more commonly, operate alongside them, increasing the intended impact. In mapping actual consumer FMCG refill at home journeys, the current research moves from intention to real-world behaviour, using the behaviour chain method to identify types of divergent consumer behaviour that hold the key to developing and implementing targeted interventions.

5.4. Limitations and future research

RHB framework. Despite uncovering a range of RHBs, there may be additional behaviours that were not captured in the framework. For example, replacing a refill at home offering with a single-use disposable offering was an identified behaviour, but replacing with a single-use recyclable was not. Some RHBs that were identified may also be under-represented, like abandoning reuse for single-use. This is likely due to the fact that the majority of participants had current experience with refill at home offerings.

The framework describes *how* consumers are handling reuse components. Future work could also explore *why* consumers handle reuse components as described by the six RHBs identified. Previously identified factors that may give insight into why consumers carry out divergent RHBs include someone's level of environmental consciousness and their willingness to change (Bashir et al., 2020) as well as the degree to which the desired behaviour is a social norm (Ertz et al., 2017; Vaughan et al., 2007). Vining and Ebreo (1992) exemplify the influence of external factors on divergent end of life behaviour, finding that recycling rates grow in response to the increased availability of local recycling facilities. Further work to determine a wider range of internal and external factors influencing the divergent behaviours would help to identify different types of intervention with greater potential for success. Additionally, the behaviour chain method could be used to trace the root behaviours responsible for causing the diversion, enabling targeted interventions at specific points in a consumer journey.

Refill at home offerings studied. As the research included a wide range of FMCGs and was led by the product experiences of participants who responded to the pre-screening, certain refill models and product categories were more heavily represented than others. For example, water bottles, hot drinks cups, razors, and toothbrushes featured more than nappies, coffee pods, and water jugs. The majority of cases are refill at home offerings without services. Although the range of product types enabled a broader exploration of FMCGs, which the literature often fails to do, extending the number of product types that appear less would lead to more definitive comparisons and product-specific insights. Future research could also target consumers of refill at home offerings with a smaller pool of users, like nappies, with the intention of understanding and growing this market. Similarly, razor and toothbrush subscription services predominantly populate the group of refill at home offerings with a service, making the observations on the potential for services to increase reuse compliance for refill at home less generalisable across product and service types.

Online interviews. The interviews were conducted online because of COVID-19 restrictions. This required participants to have internet access and a certain level of computer literacy. However, it also gave participants greater flexibility to decide when to carry out the interviews. They joined the interviews from the comfort of their own homes, increasing willingness to participate and making them feel at ease during the conversation. Furthermore, it enabled a UK-wide sample that was less reliant on convenience sampling based on the researchers' location. Convenience sampling may not have been sufficient to identify an extensive range of reuse RHB types. Despite seeming to reach a level of saturation in the RHBs identified, with analysis of later interviews reinforcing previously identified RHBs, it is possible that the data did not cover every possible occurrence.

Participant selection. Participants from a range of different backgrounds were recruited to enable a broad understanding of the current situation. The offerings and brands brought forward by participants ranged from sustainably marketed to non-sustainably marketed. However, future research could profile participants according to their level of pro-environmental behaviour or other factors (e.g. age group) to compare different types of consumers or refill at home offerings and understand whether certain behaviour types, like the ones that lead to an increase in reuse, are unique or universally experienced. Similarly, comparisons could be made between different countries, especially in locations where refill already makes up a higher proportion of the market share, to help understand whether different stages of transition to refill alter results or whether there are cultural influencers at play.

Retrospective data collection. Finally, the interviews collected information directly from consumers but relied on self-reported data. Therefore, there is a risk of information inaccuracy, either intentionally to make answers more desirable, or unintentionally when communicating past experiences that were difficult to remember. Given that the interviews were able to capture insights into behaviours where reuse

and other socially desirable actions, like recycling, were not carried out as expected, this does not appear to have affected the data. However, although most experiences were current (i.e. consumers reported on refill at home offerings they were currently using), there were also instances where consumers reflected on previous experiences. In particular, this was the case for nappies, a product type that is only used for a set period when caring for a baby. Therefore, some cases relied more heavily on memory than others. Memory also played a stronger role for certain components of refill at home offerings and stages in the behaviour chain. For example, whereas the refill facilitator and consumable are purchased on a more regular basis and are, therefore, more likely to have been recently experienced, purchase of the reuse facilitator will either be a one-off or a less frequently experienced behaviour. FMCGs are also framed by repetitive behaviours or behaviours that are carried out to meet immediate needs (e.g. buying a single-use bottle of water in a shop to quench thirst), and may therefore be performed on a subconscious level. The interview questions and the behaviour chain method helped break down journeys in a granular way, requiring participants to think deeply rather than sweeping over more meso-level behaviours. However, a longitudinal study using creative ways to capture actual behaviour as it happens would help address these potential issues.

6. Conclusions

To understand how consumers carry out compliant and divergent reuse behaviours related to refill at home FMCGs, the RHB framework was developed. Moving beyond existing reuse modelling, which is heavily based on what is expected of consumers, the RHB framework is the first effort to characterise actual consumer behaviour.

There were many instances where consumers reused as intended (RHB 2), complying with the way in which refill at home offerings work. However, the instances where consumers displayed divergent behaviour were more common and took various forms. Most significantly, consumers reused with fewer components or repurposed components (RHB 1); reused with multiple reusable products including using recyclable and disposable products (RHB 3 and combinations); and reused along with recyclable and disposable products (RHB 4). The range of possible RHBs and combinations reflect the complexity of divergent behaviour. The research shows that refill at home offerings, rather than replacing existing recyclable and disposable products, are often overconsumed or used concurrently, risking to increase the impact on resource usage. This result suggests the need to promote responsible consumption of reusables (IS1) and to make reuse easy and appealing to consumers compared to single-use recyclables or disposables (IS4). It also shows that refill at home offerings are sometimes consumed with the intent to reduce the baseline impact on resource usage, potentially inspiring better designs of future FMCG reuse offerings.

At the end of life, the components put through the recycling infrastructure were often non-recyclable; less components were put through the disposal infrastructure but occasionally these were also incorrectly placed in residual waste bins (RHB 6). These results reinforce the need to support the recycling and disposal of reusables (IS5, IS6) to reduce waste stream contamination. To ensure that the life of reusables is not reduced in length, the research also highlighted the importance of discouraging early disposal (IS2).

Consumers' repeated use of refill at home FMCGs is seemingly influenced by the availability of services. Divergent behaviours that increased resource use substantially affected refill at home offerings without a service, whereas consumers of offerings with services, particularly subscription, were compliant in the majority of instances. This result suggests that services could be used to reduce overconsumption (IS3).

The results extend the application and validation of the behaviour chain method to elicit and model actual consumer reuse behaviour. Previously, the capacity of the behaviour chain method had only been

tested on expected consumer journeys using providers' information (Muranko et al., 2020). Behaviour chains were found to be a valuable tool for mapping actual consumer behaviour, capable of systematically identifying compliant and divergent patterns of behaviour across less predictable journeys than previously analysed.

Declaration of competing interest

Acknowledgments

Appendix A. Supplementary information and data

References

Bakker, C., Hollander, M.den, Hinte, E.van, Zijlstra, Y., 2014. Products That Last: Product Design for Circular Business Models. Marcel den Hollander.

Bashir, H., Jørgensen, S., Pedersen, L.J.T., Skard, S., 2020. Experimenting with sustainable business models in fast moving consumer goods. J. Clean. Prod. 270, 122302 https://doi.org/10.1016/j.jclepro.2020.122302.

Bethurem, M., Choate, B., Bramwell, S., 2021. Stop piling on: assessing efforts to reduce single-use water bottles at allegheny college. Sustain. 13 https://doi.org/10.3390/su13168864.

Blomsma, F., Brennan, G., 2017. The emergence of circular economy: a new framing around prolonging resource productivity. J. Ind. Ecol. 21, 603–614. https://doi.org/10.1111/jiec.12603.

Bocken, N., Miller, K., Evans, S., 2016. Assessing the environmental impact of new Circular business models. In: "New Business Models" - Exploring a Changing View on Organizing Value Creation. Toulouse, France.

Bocken, N.M.P., Schuit, C.S.C., Kraaijenhagen, C., 2018. Experimenting with a circular business model: lessons from eight cases. Environ. Innov. Soc. Trans. 28, 79–95. https://doi.org/10.1016/j.eist.2018.02.001.

Braun, V., Clarke, V., 2006. Using thematic analysis in psychology. Qual. Res. Psychol. 3, 77–101. https://doi.org/10.1191/1478088706qp063oa.

Changwichan, K., Gheewala, S.H., 2020. Choice of materials for takeaway beverage cups towards a circular economy. Sustain. Prod. Consum. 22, 34–44. https://doi.org/10.1016/j.spc.2020.02.004.

Chen, T., Fenyo, K., Yang, S., Zhang, J., 2018. Thinking inside the subscription box: new research on e-commerce consumers [WWW Document]. URL. Think. Insid. Subscr. box New Res. e-commerce Consum. https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/thinking-inside-the-subscription-box-new-research-on-ecommerce-consumers. (Accessed 22 July 2022).

Choate, B., Davis, B.Y., Verracchia, J., 2014. Campus bottled water bans, not always the solution. Int. J. Sustain. High. Educ. 19, 987–997. https://doi.org/10.1108/14676371311312905.

Ellen MacArthur Foundation, 2019. In: Reuse - Rethinking Packaging. Ellen MacArthur Found, pp. 1–43.

Ertz, M., Huang, R., Jo, M.S., Karakas, F., Sarigöllü, E., 2017. From single-use to multi-use: study of consumers' behavior toward consumption of reusable containers. J. Environ. Manag. 193, 334–344. https://doi.org/10.1016/j.jenvman.2017.01.060.

European Commission, 1993. Fifth environment action programme - towards sustainability. Off. J. Eur. Communities. https://wayback.archive-it.org/12090/20230310090849/https://ec.europa.eu/environment/archives/action-programme/env-act5/pdf/5eap.pdf, 2002.

Ghisellini, P., Cialani, C., Ulgiati, S., 2016. A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems. J. Clean. Prod. 114, 11–32. https://doi.org/10.1016/j.jclepro.2015.09.007.

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

Hait, A., Powers, S.E., 2019. The value of reusable feminine hygiene products evaluated by comparative environmental life cycle assessment. Resour. Conserv. Recycl. 150, 104422 https://doi.org/10.1016/j.resconrec.2019.104422.

Hocking, M.B., 1994. Reusable and disposable cups: an energy-based evaluation. Environ. Manag. 18, 889–899. https://doi.org/10.1007/BF02393618.

Kunamaneni, S., Jassi, S., Hoang, D., 2019. Promoting reuse behaviour: challenges and strategies for repeat purchase, low-involvement products. Sustain. Prod. Consum. 20, 253–272. https://doi.org/10.1016/j.spc.2019.07.001.

Lemon, K.N., Verhoef, P.C., 2016. Understanding customer experience throughout the customer journey. J. Mark. 80, 69–96. https://doi.org/10.1509/jm.15.0420.

Lofthouse, V.A., Trimingham, R.L., Bhamra, T.A., 2009. Investigating consumer perceptions of refillable packaging and assessing business drivers to their use. Packag. Technol. Sci. 335–348.

Mansour, N., Ceschin, F., Harrison, D., Long, Y., 2019. Mapping & classifying business models to replace single-use packaging in the food & beverage industry : a strategic design tool. Learn. Netw. Sustain. 418–423.

Mears, C., 2012. No title. In: Arthur, J., Waring, M., Coe, R., Hedges, L. (Eds.), Research Methods and Methodologies in Education. SAGE, London, pp. 170–175.

Miller, J., Bennett, C., Cumming, G., 2011. Potentially changing health behaviour using nappy "nudges". Br. J. Midwifery 19, 246–251. https://doi.org/10.12968/bjom.2011.19.4.246.

Monrouxe, L.V., Rees, C.E., 2020. When I say … quantification in qualitative research. Med. Educ. 54, 186–187. https://doi.org/10.1111/medu.14010.

Muranko, Z., Aurisicchio, M., Baxter, W., Childs, P., 2020. Behaviour chains in circular consumption systems: the reuse of FMCGs. In: IS4CE2020 Conference of the International Society for the Circular Economy. Exeter, UK.

Muranko, Ż., Tassell, C., van der Laan, A.Z., Aurisicchio, M., 2021. Characterisation and environmental value proposition of reuse models for fast-moving consumer goods: reusable packaging and products. Sustain 13, 1–35. https://doi.org/10.3390/su13052609.

Neale, J., Miller, P., West, R., 2014. Reporting quantitative information in qualitative research: guidance for authors and reviewers. Addiction 109, 175–176. https://doi.org/10.1111/add.12408.

Nemat, B., Razzaghi, M., Bolton, K., Rousta, K., 2019. The role of food packaging design in consumer recycling behavior-a literature review. Sustain 11, 1–23. https://doi.org/10.3390/su11164350.

Nielsen, 2014. Global consumers are willing to put their money where their heart is when it comes to goods and services from companies committed to social responsibility – Nielsen [WWW document]. URL. https://www.nielsen.com/us/en/press-releases/2014/global-consumers-are-willing-to-put-their-money-where-their-heart-is/. (Accessed 6 September 2020).

Ongondo, F.O., Williams, I.D., 2011. Mobile phone collection, reuse and recycling in the UK. Waste Manag. 31, 1307–1315. https://doi.org/10.1016/j.wasman.2011.01.032.

Poortinga, W., Whitaker, L., 2018. Promoting the use of reusable coffee cups through environmental messaging, the provision of alternatives and financial incentives. Sustain 10. https://doi.org/10.3390/su10030873.

Rizos, V., Tuokko, K., Behrens, A., 2017. The Circular Economy A Review of Definitions, Processes and Impacts Vasileios, Reserach Report.

Rosenbaum, M.S., Otalora, M.L., Ramírez, G.C., 2017. How to create a realistic customer journey map. Bus. Horiz. 60, 143–150. https://doi.org/10.1016/j.bushor.2016.09.010.

Santos, J.M., Van Der Linden, S., 2016. Changing norms by changing behavior: the Princeton drink local program. Environ. Pract. 18, 116–122. https://doi.org/10.1017/S1466046616000144.

Shipton, J., 2003. The spontaneous re-use of packaging: designing for creative consumption and dispossession. In: 5th European Academy of Design Conference, pp. 1–12.

Strasser, S., 2003. The alien past: consumer culture in historical perspective. J. Consum. Policy 26, 375–393. https://doi.org/10.1023/a:1026331225908.

Sun, M., Trudel, R., 2017. The effect of recycling versus trashing on consumption: theory and experimental evidence. J. Mark. Res. 54, 293–305. https://doi.org/10.1509/jmr.15.0574.

Tashakkori, A., Teddlie, C., 1998. Mixed methodology: combining qualitative and quantitative approaches. Appl. Soc. Res. Methods Ser. 46.

Tassell, C., Aurisicchio, M., 2020. The evolution of reuse and recycling behaviours : an integrative review with application to the fast-moving consumer goods industry. Int. Soc. Circ. Econ. 1–8.

The Ellen McCarthur Foundation, 2013. Towards the Circular Economy Vol. 1: An Economic and Business Rationale for an Accelerated Transition.

Tukker, A., 2004. Eight types of product-service system: eight ways to sutainability? Experiences from suspronet. Bus. Strateg. Environ. 260, 246–260.

Tukker, A., Tischner, U., 2006. Product-services as a research field: past, present and future. Reflections from a decade of research. J. Clean. Prod. 14, 1552–1556. https://doi.org/10.1016/j.jclepro.2006.01.022.

UK Government, 2011. Guidance on Applying the Waste Hierarchy. Department for Environment Food and Rural Affairs.

van Doorn, J., Kurz, T., 2021. The warm glow of recycling can make us more wasteful. J. Environ. Psychol. 77, 101672 https://doi.org/10.1016/j.jenvp.2021.101672.

Vaughan, P., Cook, M., Trawick, P., 2007. A sociology of reuse: deconstructing the milk bottle. Sociol. Rural. 47, 120–134. https://doi.org/10.1111/j.1467-9523.2007.00432.x.

Vining, J., Ebreo, A., 1992. Predicting recycling behavior from global and specific environmental attitudes and changes in recycling opportunities. J. Appl. Soc. Psychol. 22, 1580–1607. https://doi.org/10.1111/j.1559-1816.1992.tb01758.x.

Woods, L., Bakshi, B.R., 2014. Reusable vs. Disposable cups revisited: guidance in life cycle comparisons addressing scenario, model, and parameter uncertainties for the US consumer. Int. J. Life Cycle Assess. 19, 931–940. https://doi.org/10.1007/s11367-013-0697-7.

Zeeuw van der Laan, A., Aurisicchio, M., 2019. Archetypical consumer roles in closing the loops of resource flows for fast-moving consumer goods. J. Clean. Prod. 236, 117475 https://doi.org/10.1016/j.jclepro.2019.06.306.