Title Consumer perspectives on household food waste reduction campaigns

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Highlights

- Expert opinions are dominant in previous food waste reduction campaign design
- Social marketing and co-design processes allow the inclusion of the views of the consumers
- Extensive formative research addressed the discrepancy between expert and consumer views

Abstract

Food waste places pressure on the environment, costing communities and households substantial amounts of money. Yet, many previous studies rely on expert opinions to inform campaign design. To effect change, researchers and practitioners need to be open to different ways of thinking, including the views of the consumers. This paper extends research pathways traditionally applied in social marketing and co-design processes to consumers in the context of household food waste reduction. To offer a fresh perspective on current practice, we conducted a mixed-method formative research study as follows: co-design (Study 1; $N = 21$), an online survey (Study 2; $N = 414$), and a fridge audit (Study 3; $N = 197$). Addressing a gap in previous expert-led campaigns, our study incorporates consumer views on food waste campaigns suggesting they prefer: (a) targeting leftover-reuse behaviour, (b) using technology and avoiding door-knocking as a campaign strategy and (c) a focus on reducing fruit and vegetable waste. This study demonstrates the value of applying social marketing and the co-design process to the issue of household food waste. A point of difference associated with the social marketing approach employed in this study is the active participation of the consumers in campaign development. This paper offers rich information for researchers and/or practitioner to uptake thus, actualise verified consumer expectation and potentially benefit campaign effectiveness.

Keywords: Food waste, consumer behaviour, campaign development, codesign, social marketing

1. Introduction

Households are major contributors to food waste in Australia (Baker, Fear, & Denniss, 2009; Bio Intelligence Service, 2011). Estimates show that an average household will dispose of AU\$3,800 worth of food annually (RaboDirect Financial Health Barometer, 2017). Waste indicates inefficiency in the use of food with a concurrent generation of preventable costs. Baker et al. (2009) reported that 85% of Australian householders reported feelings of guilt for food waste, identifying negative emotional aspects resulting from food waste for people involved. Reduction of food waste at the household level has the potential to generate positive change at multiple levels (individual, community, global) (Dietz, Gardner, Gilligan, Stern, & Vandenberg, 2009).

Given the complexity of the food waste problem, and the multiple factors involved at a household level there is an increasing need for collaborative knowledge drawing on the expertise of multiple disciplines (Aschemann-Witzel et al., 2017). Of particular importance is the understanding of households and individual consumers' perspectives and the barriers and drivers of their food waste behaviours. Social marketing is a discipline that specialises in understanding consumer behaviour and motivations; it has a proven track record of effective consumer-driven behaviour change strategies with a dominant focus on the attainment of individual behavioural change (Carins & Rundle-Thiele, 2014; Kubacki, Rundle-Thiele, Lahtinen, & Parkinson, 2015). The overarching objective of this research is to enhance the implementation of food waste reduction campaigns with rich consumer insights that can be gained from application of the social marketing approach and tools. Specifically, this research aims to discover insights from an end-consumer perspective by understanding:

RQ1. Which food waste reduction behaviours consumers would like to change?

RQ2. Which campaign strategies consumers prefer?

RQ3. Which food items consumers can waste less?

2. Social Marketing and co-design

Given that the main agents in food waste behaviour change are individual consumers and households, the apparent lack of consumer insights and perspectives in past studies is surprising. Of the published studies on food waste behaviour identified in our narrative review (Kim, Knox, & Rundle-Thiele, 2019), only two had some form of consumer insight (Dai et al., 2015; Devaney & Davies, 2017); the rest of the campaigns were designed solely based on experts' opinion (Schanes, Dobernig, & Gözet, 2018). This lack of inclusion of an end-user perspective in program planning suggests an important gap in the food waste reduction literature, which this research aims to fill.

Social marketing is a discipline specialising in promoting voluntary behaviour change in targeted audiences (i.e. consumers) through the application of commercial marketing tools, techniques and thinking, to deliver societal and individual benefit (Fridinger, 1999; Hastings, MacFadyen, & Anderson, 2000; Kerr, Hammerschmidt, & Himebaugh, 1999; Stead, Gordon, Angus, & McDermott, 2007). A consumer-oriented approach contrasts with other perspectives and focuses program planning, implementation and evaluation on the needs and wants of the target audience (Trischler, Pervan, Kelly, & Scott, 2017).

In this research we draw on the unique strength of the social marketing approach, directly involving target consumers in program design through application of the co-design process. Co-design is an action of empowering consumers to develop new ideas during the product/campaign design process (Dietrich, Rundle-Thiele, Schuster, & Connor, 2016; Sanders & Stappers, 2008). In contrast to expert-designed questions (as often happens in focus groups), co-design enables consumers to be a part of the campaign design team, recognising that people are 'experts of their own experiences' (Dietrich et al., 2016). These insights are particularly important when designing for sustainable behaviour (Daae, Goile, Seljeskog, & Boks, 2016) and realistic and sustained behavioural change (Baldassarre, Calabretta, Bocken, & Jaskiewicz, 2017). This research outlines application of the co-design process, demonstrating the rich insights that can be gained for taking a consumer-oriented approach to inform future food waste reduction campaigns.

3. Review of published food waste campaigns

In reviewing past food waste reduction studies, it is important to consider three main campaign components: targeted behaviours, the campaign strategy, and the types of foods in focus. Here we give a narrative review of these three components as presented in a selection of published food waste reduction campaigns (Schanes et al., 2018; Kim et al., 2019).

3.1. Selection of a target behaviour

Food waste behaviour occurs at every step of the consumer food journey, from planning, shopping, cooking to recycling and disposal (Sobal & Bisogni, 2009). Considering this journey, we propose a novel conceptual framework. An effective food waste reduction campaign should consider modifiable food-waste reduction behaviours across two overarching categories: “Consume less” (Pathway A) and “Reuse more” (Pathway B) (see Figure 1).

Figure 1 Framework for understanding of food waste reduction behaviour

Pathway A involves reducing waste through food provisioning and consumption behaviours where careful planning of shopping and meals ideally result in only purchasing food items needed, efficient cooking and eating of what was purchased (Stancu, Haugaard, & Lähteenmäki, 2016), and thus, minimisation of food disposal (Romani, Grappi, Bagozzi, & Barone, 2018). Pathway B involves effective reusing of food items, which otherwise would be thrown away, for example, as a resource for a next-day-meals (leftover-reuse) (Waste and Resources Action Programme, 2015), gardening (composting) or source-separation for

recycling (Lea & Worsley, 2008). Therefore, consumers who engage in both behaviours (consuming less and reusing more) would be practising enhanced sustainability, through reductions in overall food waste.

Based on a narrative review of selected published studies that focused on campaigns to target household food waste (Kim et al., 2019), previous studies have typically targeted behaviours that decrease consumption rather than reusing behaviours. Thus, the most commonly studied food waste reduction behaviours were: source-separation (Bees & Williams, 2017; Bernstad, 2014; Bernstad, Jansen, & Aspegren, 2013; Bernstad, la Cour Jansen, & Aspegren, 2012; Chen et al., 2017; Dai et al., 2016; Ganglbauer, Fitzpatrick, & Comber, 2013; Nomura, John, & Cotterill, 2011; Rousta, Bolton, Lundin, & Dahlén, 2015; Xu, Lin, Gordon, Robinson, & Harder, 2016), followed by composting (Bench, Woodard, Harder, & Stantzios, 2005; Read, Gregory, & Phillips, 2009), leftover-reuse (Waste and Resources Action Programme, 2007, 2010) and food-sharing (Jagau & Vyrastekova, 2017). In regard to Pathway A, planning and disposing behaviours were studied (Farr-Wharton, Foth, & Choi, 2014; Morone, Falcone, Imbert, & Morone, 2018; Shearer, Gatersleben, Morse, Smyth, & Hunt, 2017). Since the targeted behaviour has a significant impact on the subsequent campaign strategy selection, a clear and careful selection of modifiable behaviour is vital. Despite consumers being the major agent of behaviour change in all mentioned studies, the involvement of consumers in the selection of the target behaviour for the campaign design was not mentioned in any of the studies included in our narrative review. We aim to address this gap with RQ1.

3.2. Selection of a campaign strategy

Our review showed that an information-education focus dominated previous food waste reduction campaigns; this focus was present in 19 of 32 past campaigns reviewed (Dai et al., 2016; Jagau & Vyrastekova, 2017; Nomura et al., 2011). This technique was effective when person to person interaction was implemented together with in person door-knocking activities (Bernstad et al., 2013; Dai et al., 2016; Xu et al., 2016). For example, a house visit via door-knocking to ‘distribute informative flyers’ successfully increased source-separation behaviour (Bernstad, 2014; Dai et al., 2016). Another strategy was the provision of infrastructure and involved installation of community waste stations/bins to reduce organic food waste among households (for example, Xu et al., 2016). This strategy (e.g. provision of garden bins) was successful when the campaign targeted composting behaviours (e.g. Bench, Woodard, Harder, & Stantzios, 2005). Interestingly, there was limited use of technology in

past campaigns (Jagau & Vyrastekova, 2017; Waste and Resources Action Programme, 2007, 2010). Technology, when it was used, was largely secondary to the main intervention, used to increase promotional effect (Young, Russell, Robinson, & Chintakayala, 2018) or to add extra benefits to overall campaign effectiveness (e.g. provision of website in addition to the main ‘Home visit’ campaign) (Devaney & Davies, 2017). Ambiguity in the involvement of consumers in identifying the most engaging (from a consumers’ perspective) campaign strategy was apparent across reviewed studies; none mentioned gaining consumer views when deciding on the campaign strategy to be applied. This is the second gap that this study aims to fill in RQ2.

3.3. Selection of a target food

Food waste includes several food categories: fruit and vegetables, meat and fish, dairy and bakery products, cooked (leftover) meals, and packaged food. However, previous household food waste campaigns reviewed did not clearly state which types of food waste they targeted. As each type of food is treated differently, arguably different tactics could be applied to reduce each type of waste (Visschers, Wickli, & Siegrist, 2016). For example, plant-based food waste (i.e. fruit and vegetables) require different storing and reuse tactics when compared to meat and fish. Depending how an individual consumes each type of food, it could turn into waste or not. To unpack this, first, we need to understand which food categories are most commonly wasted. According to previous studies, the most frequently wasted foods at the household level are fruits and vegetables, followed by commercially prepared food that is bought but not consumed (Baker et al., 2009; Leal Filho & Kovaleva, 2015; NSW Environment Protection Authority, 2015; Quested, Marsh, Stunell, & Parry, 2013).

Understanding existing food items in households could further reduce food waste. Previous studies showed the possibility of food waste occurring if the food that already exists is purchased by underestimating inventory (Bell, Corsten, & Knox, 2011; Chandon & Wansink, 2006; Stefan et al., 2013). A list of available food items offers an opportunity for consumers to waste less, and reflects consumers’ food preferences (Devine, Connor, Bisogni, & Sobal., 1998) as one’s food choice pattern is led by their food preferences (Sobal & Bisogni, 2009). There is potential for future studies to identify which food items consumers can waste less. This study will address this gap by identifying food items ready-for-use within households.

In summary, our review of published food waste reduction campaigns indicates limited engagement of consumers in the campaign design process, despite them being the main agent of proposed behaviour change. Therefore, there are important gaps in knowledge about which behaviours, strategies and foods consumers would like to target in their attempt to reduce food waste within their households. Arguably, targeting campaign elements that consumers are interested in engaging in, should result in more effective and sustained behaviour change strategies. Table 1 summarises the research questions and the three studies that address those questions.

Table 1 Summary of research questions

Overall research gap	Research question	Study 1: Co-design sessions	Study 2: Strategy testing survey	Study 3: Fridge audit survey
Limited consumer engagement in food waste campaign design, specifically selecting target behaviour, campaign strategy and food items for focus	RQ1. Which food waste reduction behaviours do householders prefer to change?	✓	✓	
	RQ2. What campaign strategies do consumers prefer?	✓	✓	
	RQ3. Which food items can consumers waste less?	✓	✓	✓

To address the research gaps identified, we conducted three studies over a one year period following ethical clearance by Human Research Committee.

Study 1) used co-design sessions to gain insights into which behaviours, strategies, and food waste types consumers would like to address,

Study 2) conducted an online survey to validate and quantify the findings of study 1 on a more diverse consumer sample, and

Study 3) used an online survey and a fridge audit to objectively record ready-for-use food items that consumers could waste less.

4. Study 1. Co-design

The purpose of Study 1 is threefold; one is to evaluate previous food waste reduction campaigns, the second is to gain new campaign ideas from a consumer-perspective, and third is to identify the most wasted food categories. By doing so we are able to discover the most modifiable behaviour and campaign strategy that consumers could engage with, along with food items that offered a potential focus. Knowledge gained from this study informed the development and design of studies 2 and 3.

4.1. Method

A co-design process was adopted to address the research questions following the best practice in co-design studies (Trischler, Dietrich, & Rundle-Thiele, 2019). Two co-design sessions were conducted within one local community in Australia. A convenience sample of community members ($n = 21$) were recruited via an email invitation, from emails supplied by a local council. The respondents were 14 female and 7 male residents. Participants received a small gift as a token of appreciation. Co-design sessions took between 45 and 60 minutes. The format of co-design sessions started with sensitisation including a word association exercise (Sinopalnikova, 2004), followed by a facilitated discussion to capture reactions to examples of previous food waste campaign elements including three commonly used past campaign strategies: online recipes to encourage reuse of food (WRAP, 2007;2009; Lim et al., 2017; Young et al., 2018), installation of waste bins (Bench et al., 2005; Kawai et al., 2016; Xu et al., 2016), and door-knocking to provide information (Bernstad et al., 2013; Dai et al., 2015; Read et al., 2009). During the discussion, a question “What did you throw out the most in the past two weeks?” was asked. Participants were then asked to work collaboratively to brainstorm their own campaign ideas in small groups of 3 to 4 participants. They were provided with large sheets of butchers’ paper and coloured pens to summarise their campaign ideas. Diagrams (see Figure 2 for examples) were collected for analysis and voice recordings of the facilitated discussion sessions were collected, and later transcribed.

Thematic analysis was used to identify themes and patterns through a deductive approach. Data were analysed at a semantic level following established guidelines (Braun & Clarke, 2006; Patton, 1990). To ensure the validity of the analysis, this study followed the five steps of thematic analysis (Braun & Clarke, 2006) and two researchers re-read data to triangulate their interpretation and achieve stronger reliability in coding and analysis (Fereday & Muir-Cochrane, 2006).

Figure 2 Examples of new intervention ideas created by participants

4.2. Results and discussion

4.2.1. Behaviour to be targeted

Consumers reported a range of barriers and motives for food waste reduction. We grouped those according to behavioural focus on either: consuming less or reusing more (see Table 2). Time and kitchen skills were the barriers to food waste reduction behaviour across behavioural foci. For example, the participants reported lack of time hindered them to consume less (write shopping list) as well as reuse more (cook leftovers). Kitchen skills including storing and cooking (Stefan, van Herpen, Tudoran, & Lahteenmaki, 2013) also stopped them from consuming less and reusing existing food. Saving money (Graham-Rowe, Jessop, & Sparks, 2014) and actualising social responsibility (Setti, Falasconi, Segrè, Cusano, & Vittuari, 2016) were key motivators across all behaviours. Associations between key barriers and motivations were observed. For example, perceived financial benefits from buying in bulk appeared to encourage food waste, while financial benefit from not wasting food motivated less food waste.

Table 2 Barriers and motivations according to related behaviours

Behaviours	Category	Key theme	Qualitative comments
Consuming less (Pathway A)			
Provisioning (Planning, purchasing, cooking/eating)	Barriers	Kitchen Skills	“...I’d buy veggies then go out for dinner and the veggies would go soft...” (Session 2, line 28)
		Quantity	“Buying too much and then you can’t cook and everything goes in the bin.” (Session 1, line 81)
		Time	“..I just don’t have time, but I know it’s something I should make time for.” (Session 2, line 38)
		Occasions	“When you have dinner parties and cook a lot and waste it, or buffets. “ (Session 1, line 82)
		Lack of guilt	“It’s that attitude where if I eat at a restaurant, I’ve paid my money for a meal and that’s not my problem anymore. I’ve made that exchange, so I walk away.” (Session 1, line 85)
		Marketing plot	“It’s also what was said about encouraging the supermarkets and encouraging bulk.” (Session 1, line 85)
	Motivation	Saving money	“Cost... it’s mainly cost for me...” (Session 2, line 58)
		Social responsibility	“caring about the environment or not being careless.” (Session 1, line 141)
Disposing	Barriers	Easiness	“I think when we talk about barriers, it’s easy to put things in bins; it’s a lack of a barrier in some ways that’s the problem. Bins are large capacity and rarely full.” (Session 2, line 39)
		Habituation	“The main thing for my friends who don’t do it is that it has to be done on a daily basis” (Session 2, line 36)
	Motivation	Saving money	“The less you waste, the more you’re getting for your dollar, because you’re actually consuming more and not disposing of as much. (Session 2, line 50)
		Social recognition	“...you can be labelled as a good family.” (Session 1, line 154)
		Hygiene	“Nicer house... Cleaner.. Smell... Less risk of bacteria... Hygiene.” (Session 1, line 186)
Reusing more (Pathway B)			
Leftover-reuse	Barriers	Cooking skills	“I have no idea how to cook for two people, so it just ends up being too much. “ (Session 1, line 208)
		Time	“Will I need to spend an extra 30 minutes cooking so I don’t have any waste?” (Session 1, line 136)
	Motivation	Saving money	“Not buying what you don’t need and throwing it out.” (Session 2, line 50)
		Social responsibility	“People out there don’t have food, so that’s my motivation for reduction in wastage of food.” (Session 2, line 58)
Composting/recycling	Barriers	Time	“Composting bins? Lots of digging involved.” (Session 2, line 90)
		Hygiene	“I think it’s gross.” (Session 1, line 99) “...if your kitchen is starting to smell... this is the worst.”
		Space	“There’s no room. Personally, I wouldn’t want a worm farm on a little balcony or in a house. I just wouldn’t.” (Session 1, line 97)
	Motivations	Social responsibility	“Setting a good example [for] kids.” (Session 2, line 42)
		Family gathering	“it’s something we can do as a family.” (Session 2, line 56)

The general discussion covered resourcing behaviours, including leftover-reuse, composting, and recycling rather than consuming less behaviours. Of those, most participants recalled behaviours relating to cooking skills. Only a minor group of participants mentioned composting as a behaviour they would like to engage with. For the majority, composting was not convenient due to the absence of a space (to keep the extra bin; and garden to install a compost bin). Therefore, leftover-reuse behaviour increasing efficiency of food management was identified as a key behaviour most participants would prefer to increase (Secondi, Principato, & Laureti, 2015).

4.2.2. Preferred strategies

Participants created simple, accessible, and rewarding campaigns to reuse foods that are already available (see Table 3 for new campaign ideas). Heavy emphasis on the use of technology was observed. For example, the participants wanted to create a smart phone app or website that is easy to use and contains various cooking recipes, which can assist the target audience to perform leftover-reuse behaviour. Campaigns created by participants incorporated ‘reward’.

Table 3 Six new campaign ideas delivered by the participants

Objective	Targeted behaviour	Campaign strategy	Targeted barrier/motivator
Reuse more	Leftover-reuse	Use of phone-applications to indicate how you saved, records fridge (Creation of a ‘no-food-waste’ online community)	Save money, Time/easiness
	Leftover-reuse	Personal communication - Nutritionists help you in building the pack (at woolies, coles)	Save money, time
	Source-separation	Use of website to educate children (Incorporate this into school activity)	Save money, time
	Source-separation	Signage on yellow bins + Personal communication	Time/easiness
	Composting	Online purchasing system and provision of a personal waste consultant	Save money
To increase awareness	Awareness	Car stickers for waste savers	Social responsibility

From the discussion, it was clear that the participants preferred to be engaged with online recipes much more than installations of bins and door-knocking campaigns. The majority of comments for ‘online recipes for leftover-reuse’ campaigns were positive, and these solutions were viewed as resolving ‘lack of time’ and ‘lack of cooking skills’ which

were both key barriers to left over reuse. Whereas, campaigns that installed waste bins for composting behaviour were more controversial. Key barriers such as hygiene and cost issues (that is to buy extra equipment) generated resistance to adopting composting behaviour. The matter of “*What to do next?*” with the produced compost failed to offer a clear benefit for households without a garden. Therefore, the participants mentioned that they would compost only if ‘I am not the one who has to touch and deal with it after collecting in my house’. Door-knocking to inform the audience about food waste reduction tactics was dismissed by all participants, who indicated they did not want strangers knocking on their door and invading their privacy.

4.2.3. Food type focus

Responses to the question “What did you throw out the most in the past two weeks?” revealed that fruit and vegetables were most frequently wasted, followed by grain/bread, cooked meals or leftovers, and chicken bones. Only a few participants claimed not to throw any food away.

Summary. As opposed to the behavioural foci of previous campaigns, participants expressed willingness to enhance leftover-reuse behaviour by having easy access to online recipes, given the lack of time and cooking skills. Concern over confidence in handling food resources emerged. Co-design discussions suggested that campaigns targeting leftover-reuse behaviour through recipes may assist individuals to reduce food waste by provisioning for eating using food already available within the household. Participants dismissed door-knocking which was prominent in previous campaigns due to privacy and many were not supportive of composting due to hygiene and lack of space. The food category of fruit and vegetables were reported to be frequently wasted by the majority of participants. However, a wider sample was needed to gain confidence in the findings. Study 2 was conducted to verify and quantify Study 1 findings on a representative Australian sample.

5. Study 2. Online survey

An online survey was conducted with new respondents to verify and quantify the results of Study 1. This survey quantified commonly waste food items and collected quantitative data in response to two alternate strategies, namely left-over re-use (most preferred) and door-knocking (least preferred strategy).

5.1. Method

A quasi-experimental survey was conducted to test how consumer attitudes and intentions towards food waste behaviour would change as a result of exposure to one of two food waste strategies. Specifically, the design was a 2 (before/after) x 2 (strategy) mixed design. A convenience sample of 414 consumers living in Australia was randomly assigned to one of two strategies: Strategy 1 portrayed an online leftover-reuse recipe strategy ($n = 204$), or Strategy 2 portrayed door-knocking ($n = 210$) (see Figure 3). On a five-point scale, the respondents were asked to rate their level of agreeableness after reading the assigned campaign strategy scenario. Each scale was developed based on the interest and engagement scales (Mazer, 2012; 2013). To assess applicability of campaign strategy scenario, the respondents were asked to select Yes/No for the question “Imagine yourself involved in this scenario. Do you think it would be applicable to you?”. of the survey included 31 questions including most commonly waste food items, barriers and motivations to reduce waste, and

1st Scenario: A pair of university/local volunteers wearing branded tabard will knock on your door and talk about food waste behaviour with you for 5 – 10 minutes. You will receive A2 size posters and hand size stickers that contains all information on how to reduce food waste at your house.

2nd Scenario: You open up to the website/Smartphone app called ‘Love Food Hate Waste’. From this website, you will be able to watch videos of nutrition-qualified recipes for leftovers and information on step-wise manual to reduce food waste at your house.

demographic items.

Figure 3 Scenarios of two strategies

Of the respondents, 208 (65.8%) were female and 107 (33.9%) were male. Almost half of sample were age 45 years and over. Approximately 64 percent of the respondents reported having a private garden.

5.2. Results and discussion

The first half of the survey aimed to validate which food was most commonly wasted and the barriers and motivations to reduce food waste. The frequency and percentage of respondents who reported discarding (throwing away) each type of food category is illustrated in Table 4.

Table 4 Descriptive statistics of wasted food

Reported types of food wasted	%
We don't throw away ANY food	32.3
Fruit and Vegetables	27.5
Bread and other bakery products	15.2
Cooked Meals	13.6
Milk and Dairy products	5.4
Packaged Food	4.1
Meat and Fish	1.9

One in three survey respondents reported that they did not throw any food away. Supporting study 1 findings, fruit and vegetables were the most frequently wasted food category in households followed by bakery items and cooked meals leftovers (Table 4).

More than half of householders surveyed nominated that they throw food away because the food has passed its best before or use by date, indicating that storage tips and hints may assist to motivate food waste reduction. Inedible food waste and forgotten food items were frequent reasons for food to be disposed. Consistent with Study 1 findings, a lack of cooking skills (i.e. ruined food and other cooking problems) were common reasons attributed to food waste in households. Cost and time savings were the most endorsed motivators for reducing household food waste, followed by social concerns such as guilt.

The second half of the survey assessed campaign strategy preferences. The level of interest and engagement in campaign scenarios were the dependent variables (DVs). Independent variables (IVs) were campaign strategy types (online leftover-reuse recipe/door-knocking) and time (before/after exposure). T-tests and chi-square tests were performed. An independent groups *t*-test was conducted to understand whether there was a significant difference in respondents' post-campaign interest and engagement towards door-knocking ($n = 166$) and online leftover-reuse recipe ($n = 150$) campaign scenarios. Levene's test indicated unequal variances ($F = 5.51, p = .019$), thus, degrees of freedom were adjusted. The result indicates that the respondents found the online leftover-reuse recipe campaign scenario ($M = 3.61, SD = 0.83$) significantly more interesting compared to the door-knocking campaign scenario ($M = 2.95, SD = 1.03$), $t(309) = -6.323, p < .001, d = .707$.

Equal variances were not assumed for the results of the *t*-test on engagement ratings after reading two scenarios (Levene's test $p < .05$). Scores on the level of engagement were higher for respondents who received the online leftover-reuse recipe ($M = 3.57, SD = 0.75$) campaign scenario when compared to the door-knocking ($M = 3.08, SD = 1.08$), $t(294) = -4.702, p < .001, d = .528$) scenario.

A chi-square test was conducted to verify the existence of a relationship between two variables; types of campaign and the scale of applicability. A significant relationship was found between types of campaign and the scale of applicability, $X^2(1, N = 316) = 10.6, p = .001$. Figure 4 illustrates applicability of campaign by its number of responses.

Figure 4 Applicability of campaign

As shown in Figure 4, 114 out of 166 respondents thought that the door-knocking campaign would not be applicable to them. On the other hand, the applicability of the online leftover-reuse recipe campaign was close to equal across the respondents. These results demonstrate heterogeneity in preferences for households.

Summary. Consistent with Study 1 findings, lack of cooking skills (i.e. ruined food and other cooking problems) were verified as common reasons for food waste. Cost was the key motive for reducing food waste. Respondents rated the example online leftover-reuse recipe campaign scenario more interesting and easier to engage with compared to the door-knocking campaign scenario. Fruit and vegetables were rated the most frequently wasted food category. These findings suggest that a food waste reduction campaign using online recipes which increases the level of confidence in cooking and outlines the value in terms of money saved could leverage leftover-reuse of fruit and vegetables behaviour, thus, reducing food waste at a household level. Given the important insight these findings have on informing campaign design, study 3 sought to identify ready-for-use food items through objective reporting to help develop recipes.

6. Study 3. Fridge audit survey

To complement the findings of study 2, study 3 aimed to identify fruit and vegetable items that were available within households that could be used to prevent food waste. A fridge audit was conducted to capture items present in the household fridge. This additional data collection was necessary as recipes to re-use produce would require more than fruits and vegetables. Thus, we aimed to list food items that households could waste less by combining commonly available fruit and vegetable items with other food items commonly found in households. This additional quantitative study is invaluable as it reflects study 1 and 2 findings: the recipe only requiring a list of ready-to-use food items could motivate a reduction in food waste by saving money and eliminate barriers (e.g. lack of cooking skills).

6.1. Methods

This cross-sectional study consisted of two components: (a) a questionnaire ($N = 197$) and (b) fridge photo audit ($n = 25$). The survey link was distributed to residents in Australia through social media channels including e-bulletins, websites, Facebook and direct email. The link was available for one month.

To identify the most wasted food items, one open question of ‘Please think about the last time you threw out food; what did you throw away?’ was asked. Multiple responses from each participant were then coded into seven food product categories used in Study 2, namely: 1) fruit and vegetables, 2) bread and other bakery, 3) milk and dairy, 4) meat and fish including bones, 5) packaged food, 6) cooked meals/leftovers, and 7) I don’t remember/we don’t throw away any food.

Identification of common food items in participants’ refrigerators was achieved two-ways; 1) a check-list inventory of 74 fruit and vegetable items and 2) photographs of household refrigerators (Figure 5). The check-list inventory asked respondents to tick all fruit and vegetable items that they already have in their fridge. Respondents were asked to upload a photograph via survey link. Photographic data were examined, and recognisable items were coded and tabulated by trained researchers. To validate the photo data, the survey also had free text responses asking participants to describe the contents of the fridge, which were content analysed for thematic patterns.

Figure 5 Example fridge photos

Demographic and shopping behaviour questions, including frequency of food shopping, who normally shops for food, and the source of food shopping were included. Open-ended items allowed respondents to describe their favourite home cooked meal, and to make comments regarding disposal of food waste.

Three quarters of respondents identified themselves as the main shopper for their household and 71% preferred to shop from a variety of retail outlet types rather than a single outlet. On average, respondents shopped for food 2.6 times per week. Almost half of the data were collected from people who were aged between 25 and 45 years old.

6.2. Results and discussion

Study three survey responses support study 1 and 2 findings. Respondents most frequently threw away fruit and vegetables ($n = 83$), followed by cooked meals/leftovers ($n = 33$), meat and fish ($n = 32$), bread and bakery products ($n = 27$), milk and dairy ($n = 7$), and packaged food ($n = 5$).

Within the food category of fruit and vegetables, the checklist inventory revealed carrots, onions, apples, potatoes and tomato were most commonly available in respondents' fridges (see left column in Table 5 to see Top 10 items common fruit and vegetable items). Seasonal variation was evident. Fridge photographs indicated that households have a range of other common food items on hand including dairy products, condiments, and eggs (see right column in Table 5 to see Top 10 other common food items).

Table 5 Top 20 common items in households

Top 10 fruit and veg. items reported in checklist	% of respondents (n = 197)	Top 10 other common ingredients observed in fridges photo	% of fridges (n = 25)
Carrot	92.9	Eggs	72
Onions	85.8	Yoghurt	64
Apples	82.2	Mayonnaise	64
Potatoes	81.7	Milk	56
Tomato	80.7	Butter / Margarine	56
Lettuce	77.7	Soy Sauce	52
Bananas	77.2	Cheese	48
Cucumber	63.9	White Wine	48
Capsicum	60.4	Fruit Juice	44
Sweet potato	57.8	Soft drink	40

Summary. Fruit and vegetables were the most commonly waste food item among various food categories in households. The top 10 most commonly available seasonal items that could be used were identified as carrot, onions, apples, potatoes, tomato, lettuce, bananas, cucumber, capsicum, and sweet potato. Fridge photos identified a further top 10 food items that could be combined with the fruit and vegetable list. Through objective reporting, the study identified ‘a typical fridge’. This investigation extends consumer insights found in Study 1 and 2. Findings have potential to benefit future campaigns delivering a clear focus for leftover-reuse.

7. General Discussion

Despite efforts in food waste reduction (Schanes et al., 2018; Kim et al., 2019), consumer household food waste continues to be a prominent issue that negatively impacts society. Addressing a major gap in past food waste studies, namely lack of consumer input into past campaigns, this research uncovers insights into which behaviours, strategies and food items could be the area of focus for a household-level food waste campaign. Our main findings enabled us to identify incongruence between expert and consumer expectations. This provides a fresh perspective for researchers and practitioners in the food waste area. Further, this new knowledge is potentially valuable in designing consumer-oriented campaigns, which meet the needs and wants of the major agents of behaviour change, the consumers. In a cross-disciplinary collaboration, the researchers draw on social marketing framework (a discipline specialising in understanding and influencing consumer behaviour change), to successfully demonstrate the use of the co-design process in application to food waste.

7.1. Target behaviour

Leftover-reuse was the behaviour that consumers wanted to address the most, which happened to be least practiced in previous food waste reduction campaigns (Waste and Resources Action Programme, 2015; Young et al., 2018). Other behaviours commonly used in past campaigns gained less consumer acceptance. In particular, composting behaviour (Harder & Woodard, 2009; Nye & Burgess, 2008) was perceived as creating an unhygienic environment, taking extra space, cost, and producing product (compost) that consumers cannot use (due to lack of garden). As the behavioural focus shapes campaign strategy, our finding indicates the importance of capturing consumer perspectives prior to behaviour selection.

This paper offers a conceptual food waste behavioural framework to offer a new way of thinking about food waste behaviour. Previous studies have largely focussed on *reducing food waste*, which is negatively framed. Morton et al. (2011) found that highlighting possible losses (negative framing) undermined effective action in a climate change context. In their study, stronger intentions to act pro-environmentally were observed when positive framing was used. Therefore, negative –framing could hinder progress in the field. Given consumers are the main food waste contributors, and they are the ones who suffer the most from their behavioural consequences; thus, they offer the greatest potential to benefit from changing their own behaviour. Re-framing (e.g. consume less and re-use more) could result in positive

changes given the linked to immediate short-term benefits for consumers such as saving money. An examination of positive and negative framing on rates of behavioural change offer an opportunity for future research.

7.2. Campaign strategy

Consumers wanted to engage with simple, easy, and accessible campaigns and preferences for technology as a campaign strategy were revealed. The willingness to incorporate technology was evident in both studies 1 and 2. Noticeably, consumers designed a campaign using a smartphone app to directly change food waste behaviour (in study 1) and consumers favoured online leftover-reuse recipes over door-knocking campaign strategies (in study 2). Technology has previously been incorporated an add-on campaign tool rather than a core campaign strategy (Devaney & Davies, 2017; Ganglbauer et al., 2013). The use of technology to educate consumers (e.g. posting food waste information on social media platforms) could be problematic if assumptions are made that people will reduce food waste solely on the basis of being fully informed about the environmental benefits of doing so.

Door-knocking was not a preferred campaign strategy among Australian households surveyed. This finding contrasts with previous interventions which focused on personal interaction through door-knocking activities and effectively encouraged source-separation behaviour and reduced food waste within targeted populations (Anna Bernstad, 2014; Dai et al., 2016; Xu et al., 2016). Such results add to our argument on the benefit of engaging consumers in campaign design to avoid costly failures that could arise from replication of approaches applied in other geographic areas. Current findings further advanced understanding of how to engage households to transition towards sustainable practices by examining factors facilitating and preventing changes to food waste behaviours.

7.3. Food focus

Consistent with previous findings (Baker et al., 2009; Quested, Marsh, Stunell, & Parry, 2013), fruit and vegetables were the food category that households wasted the most. Since all food categories (i.e. bakery vs meat) require different tactics to prevent waste, selection of food items for campaign focus is essential. Published studies do not typically focus on one food category (Schanes et al., 2018; Kim et al., 2019). Thus, we investigated ready-to-use items within the fruit and vegetable food category as well as other common food items to identify campaign recipe ingredients. The top 20 common food items that consumers can

waste less were identified. Our findings suggest recipes requiring existing fruit and vegetables and other complementary food items could minimise key barriers (lack of cooking skills) and maximise key motivation (saving money); thereby assisting leftover-reuse behaviour and resulting in reduced food waste (David, Rundle-Thiele, & Pallant, 2019)

8. Limitations and future research

Generalisability of the results is a limitation and the co-design study (study 1) may not represent the wider population in Australia. However, study 2 aimed to overcome limits of Study 1 involving a larger sample size (e.g. 316 responses). Study 2 relied on self-reported data. Gram (2010) argued that self-reporting can be problematic due to requiring respondents to recall their behaviour. If possible, future research should monitor actual waste behaviours (i.e. waste weight) to obtain the most accurate indication of food waste. Lastly, our paper presents information on consumer evaluations of two campaigns, but a high liking by consumers does not necessarily mean a high uptake or influence of the program. The approach reported in this study offers a future research opportunity.

9. Conclusion

A point of difference associated with the social marketing approach employed in this study is the active participation of the consumers in campaign development. Current best practice for behaviour change campaigns is to involve the consumers in behaviour change campaign design (National Social Marketing Centre, 2017). As the absence of consumer focus was detected in past studies, the current study applied a sequential mixed-method design to obtain insightful consumer perspectives into: target behaviour, campaign strategy and foods that could be wasted less. As a result, we gained new knowledge to guide campaign development on leftover-reuse behaviour through food recipes and use of technology. Based on our findings, this paper offers rich information for researchers and/or practitioner to immediately uptake thus, actualise verified consumer expectation and potentially benefit campaign effectiveness.

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