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# Can social media be a tool for reducing consumers' food waste? A behaviour change experiment by a UK retailer

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ABSTRACT

This paper reports on a landmark study to field-test the influence of a large retailer to change the behaviour of its millions of customers. Previous studies have suggested that social media interaction can influence behaviour. This study implemented three interventions with messages to encourage reductions in food waste. The first was a social influence intervention that used the retailer's Facebook pages to encourage its customers to interact. Two additional information interventions were used as a comparison through the retailer's print/digital magazine and e-newsletter. Three national surveys tracked customers' self-reported food waste one month before as well as two weeks after and five months after the interventions. The control group included those who said they had not seen any of the interventions. The results were surprising and significant in that the social media and e-newsletter interventions as well as the control group all showed significant reductions in self-reported food waste by customers over the study period. Hence in this field study, social media does not seem to replicate enough of the effect of 'face-to-face' interaction shown in previous studies to change behaviour above other factors in the shopping setting. This may indicate that results from laboratory-based studies may over-emphasise the effect of social media interventions.



## 1. Introduction

This study explores whether social media can be used to influence the behaviour of a large retailer's customers on food waste reduction in the household. Behaviour change approaches on environmental issues have tended to focus around central and local government initiatives. Typical activities include the provision of infrastructure (e.g., household recycling bins), legal structures (e.g., vehicle emission related taxes), incentives (e.g., such as renewable energy technology subsidies) and related information campaigns to change attitudes and behaviour (Auld et al., 2014). These all try to shift consumers to more sustainable lifestyles.

Companies also influence behaviour through the marketing of products to customers with declared green criteria (Shrum et al., 1995). What has emerged more recently is that companies are starting to influence the behaviours, habits, practices and actions beyond the traditional company-customer relationship (Morgan, 2015). This extension of the relationship from company to consumer focuses on encouraging consumers to reduce the environmental impact of product use within in their homes.

Company goals of influencing the way their products and services are consumed can be motivated by two broad perspectives. The first is that progressive companies found that for consumer goods the results of environmental lifecycle assessments often showed the 'use' phase having the highest environmental loads (Girod et al., 2014). Greenhouse gas emissions and product disposal are often more significant in this part of the lifecycle phase. Secondly, governments have seen that branded product companies have a closer relationship with, and hence potentially higher influence on, consumers than governments do with their citizens (Goworek et al., 2013). Therefore, companies are increasingly being coerced by government and quasi-autonomous non-governmental organisations (quangos) to be involved in cross-industry 'partnerships' and voluntary agreements, and to play a leading role in reducing the environmental impact of the use phase of their products and services (Bocken and Allwood, 2012; Spaargaren and Mol, 2008).

However, influencing the use phase means companies are entering the realm of asking their customers to consume less or at least consume differently, which is difficult for companies with a high volume economic business model. Indeed, the financial incen-

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tives especially for retailers point to increasing sales quantity, not reduction. There are, however, incentives for companies in that by encouraging consumers to reduce their environmental impacts in the use phase may result in stronger customer brand loyalty by aligning companies with the green intentions of their customers. This may be an effective mode of building brand loyalty because research has shown that consumer green attitudes are no longer a niche issue with European consumers and that the majority of consumers now have green attitudes (EC, 2014).

In this paper, we report on a field experiment with the UK supermarket Asda (part of Walmart) to reduce food waste generated by its customers through a number of behaviour change interventions. More specifically, a number of different mechanisms were employed with the aim to induce behaviour change, ranging from more traditional interventions such as information provided in magazines and e-newsletters, to the use of social media. It has been argued that social media approaches are more effective than conventional interventions, as they have the potential to replicate face-to-face interactions (Goldsmith and Goldsmith, 2011). Following social influence theory, face-to-face interactions can be seen as a crucial element of effective behaviour interventions (Abrahamse and Steg, 2013). Given that face-to-face interactions are extremely cost-, time- and resource-intensive, it is difficult to scale up these types of interventions to the level of a national supermarket with a customer base of tens of millions of people. In this context, social media interventions such as Facebook could be a promising alternative. This study aimed to test a large retailer's use of social media as a tool for reducing food waste in the home.

The remainder of this article is structured as follows. In the next section, we present environmental and socioeconomic challenges linked to the generation of food waste, with particular emphasis on household food waste and the potential roles played by major retailers in this context. Next, we review social influence theory as the analytical lens employed in this study. In the following section, we explain and justify the research design, including a description of the case organisation as well as the three behaviour interventions that were applied. We then present our findings, comparing the effectiveness of the three intervention types in terms of frequency and quantity of food waste and uncovering similarities and differences in their performance with regard to different sociodemographic factors. Before concluding, we present and discuss implications derived from this study.

## 2. Background

### 2.1. Food waste

After being largely ignored in the 1990s and early 2000s when recycling boomed, more recently there has been an increase in the focus placed on food waste (Metcalfe et al., 2012), arguably due to the increasing awareness of food waste levels and associated impact. It is estimated that one-third of edible food produced for human consumption is lost or wasted globally each year (Goebel et al., 2015; Graham-Rowe et al., 2014). In the United Kingdom alone 15 million tonnes of food and drink are thrown away annually (WRAP, 2013a). However it is not solely the amount of food wasted that has increased interest in this waste stream but the impact it has economically, socially and environmentally.

According to Graham-Rowe et al. (2014), food waste exacerbates escalating food prices globally which causes food to be less attainable to the world's poorest, increasing the number of malnourished people and demonstrating the direct social impact of food waste. The associated economic impact of buying food that is never eaten and thrown away (Graham-Rowe et al., 2014) costs the average UK household £470 a year, growing to £700 for a family with children (WRAP, 2013a). Possibly the most damaging impact of vast levels of food waste is the corresponding environmental effect. For example, production of food that is consequently wasted magnifies the pressure for diminishing forests that are inevitably altered for agricultural land (Graham-Rowe et al., 2014). Additionally, the disposal of food and drink to landfill adds to the avoidable release of gases like methane (Graham-Rowe et al., 2014) and $CO_2$ emissions (Goebel et al., 2015). Ultimately, it has become clear recently that minimising food waste is crucial for obtaining a sustainable food system as it has serious economic, social and environmental repercussions (Goebel et al., 2015).

This paper particularly focuses on 'avoidable' household food waste as Lebersorger and Schneider (2011) state the greatest potential for reduction of food waste in the developed world is with retailers, food services and in particular, consumers. 'Avoidable' household food waste is defined as "food and drink thrown away because it is no longer wanted or has been allowed to go past its best" (WRAP, 2013a, p.23).

In the UK, food waste derived from households accounts for 7 million tonnes of total food and drink wasted each year (WRAP, 2013a). UK households throw away approximately a third of the food they purchase for consumption (Evans, 2011) with the average annual household waste consisting of 17% food waste (Defra, 2015). However, much of the environmental impact associated with household food waste stems from the production and supply of the food wasted rather than the disposal of food. 4.2 tonnes of $CO_2$ eq. is avoided by preventing waste compared to 0.5 tonnes of $CO_2$ eq. avoided by treating waste (Quested et al., 2011). Thus, much of the work being carried out to reduce household food waste has focused on targeting the behaviours that create or exacerbate food waste.

There is a growing literature on the drivers of food waste (Priefer et al., 2016; Thyberg and Tonjes, 2016). According to Quested et al. (2011), household food waste transpires from the interaction of multiple behaviours called 'specific food behaviours'. These behaviours relate to planning, storing, preparing and consuming food (Quested et al., 2011). However, other studies have found it is more than just specific food waste behaviours that exacerbate household food waste. Goebel et al. (2015) argue that consumer expectations around availability, variety, and freshness cause food waste along the supply chain and in households. Conversely, a study by Evans (2011) argues that targeting the attitude and behaviour of consumers is illogical because there is no evidence to suggest consumers are careless or callous about the food they throw away. Instead, just targeting consumer behaviour continues to individualise responsibility and away from government and companies. Metcalfe et al. (2012) concur with this notion by stating that food waste is not caused by irrational excess that can be cut through everyday behaviours and practices.

However, it is our contention that we should be focusing on changing consumers actions that lead to environmental harm (Young and Middlemiss, 2012). This takes a multitude of interventions from many stakeholders with much focused on influence from local or national government on households (Schmidt, 2016). In this paper we examine if retailers can use social media as a tool to trigger changes to reduce food waste from households.

### 2.2. Retailers and food waste

Retailers produce less the 3% of food waste in the UK (Defra, 2015) and some research has been produced on this (Eriksson et al., 2016; Scholz et al., 2015). But due to their pivotal place in the supply chain, retailers can produce significant reductions by working with their suppliers and influencing their customers. Much retailer activity in the UK on food waste has been coordinated by the past quasi-autonomous non-governmental organisations (quango)

now independent Waste and Resources Action Programme (WRAP) using multi stakeholder 'Courtauld' agreements (WRAP, 2015b). This is a voluntary industry agreement to help UK consumers cut down food waste in households using WRAP and retailer's campaigns. The campaigns have focused around shopping smarter (using shopping lists), storing products better, planning meals, using up food that could be thrown away and composting food waste where possible. However, it has recently been argued that social influence interventions are typically more effective when compared to mere information provision (Abrahamse and Steg, 2013; Goldsmith and Goldsmith, 2011), and could therefore be seen as a promising avenue in this context.

### 2.3. Social influence

Consumers' food waste behaviours are complex due the interaction of multiple household activities and influencing these is key (Quested et al., 2013). Social influence theory could be one route where individuals learn from each other leading to attitudinal and behaviour change (Goldsmith and Goldsmith, 2011). Trying to harness this for pro-environmental behaviour change could be the key for households to reduce their impacts on the natural environment.

The results of the meta-analysis of intervention experiments by Abrahamse and Steg (2013, p.1774) found that the social influence approaches that were most effective were:

1. "Block leaders and social networks", for example recyclers encouraging their neighbours. This relies on the notion that people are more likely to take act if information is provided by someone in their social network. The stronger the ties in the network the more likely the information will affect behaviour.
2. "Public commitment making", for example signing a community pledge to conserve water. Publically binding someone to a behaviour has been linked to the need for consistency and social pressure to adhere to the commitment.
3. "Modelling", for example a couple showing their neighbours how to compost. People are more likely to commit to something if they see other people undertaking the behaviour.

The factor in common with these approaches is the 'face-to-face' interaction which accentuates these influences (Abrahamse and Steg, 2013). Note too that "...the type of target group and the type of behaviour did not significantly affect the observed effect size of social influence approaches compared..." (Abrahamse and Steg, 2013; p.1783).

Within this research we were particularly interested in using success of 'face to face' interaction as an intervention on food waste with Asda as shown by Quested et al. (2013). It is, however, challenging to scale up this sort of intervention to a national level without significant investment of resources. Goldsmith and Goldsmith (2011) suggest that online social networks could replicate face to face social influence, which could be an easier route for the influence millions of householders on environmental issues. The reasons for this online influence over behaviour is that people are spending increasing amounts of time on social media and that opinion leaders that are influence in person are also influential through social media and to many more people (Goldsmith and Goldsmith, 2011). While they made this assertion theoretically, to date there has been no empirical testing of the efficacy of such an approach. One study that has attempted to address this was the use of Twitter on the issue of climate change (Williams et al., 2015), while another study did so through Facebook (Robelia et al., 2011). What was found was that users tended to segregate into likeminded communities and were influenced by them but this make it is less likely for them to influence non-advocates. But the social influence mechanism could be through existing face to face networks that are used online for spreading messages (Bond et al., 2012). However, in other subjects social media tools like Facebook have been successfully used to influence social networks such as in health behaviour change (Laranjo et al., 2014) as well as in the conventional marketing of products (Seng Chew and Keat Leng, 2014).

## 3. Methods

In our study we aimed to test a large retailer's use of social media as a tool for reducing food waste in the home. We were particularly interested in Facebook due to its dominance of social media and if successful, this could provide the ability to apply intervention strategies at a much bigger scale and accelerating behaviour change on environmental issues. Hence our research question is: *Will a social influence intervention approach be effective at encouraging behaviour change on social media compared to information interventions and a control group*?

This study was the result of an on-going collaboration between university researchers and employees of Asda. The aim of the project was to develop and test scientifically rigorous field-based interventions to determine the extent to which a company could impact the behaviours of consumers while simultaneously contributing to scientific knowledge. This dual approach between researchers and practitioners is known as co-production (Clark and Dickson, 2003). In conducting the research we, as researchers, deliberately influenced and changed decisions, actions and processes within the company. In turn, employees in Asda provided data, helped shape and implement interventions, and facilitated data collection to fit the activities of the company for maximum effect.

With any co-production approach, it is important that researchers maintain a good standard of research ethics when receiving funding from and working with companies. The researchers and Asda employees complied with the University Research Ethics Policy and work was conducted that was consistent with the British Psychological Society's Code of Human Research Ethics. While we acknowledge that the discussion of the ethics of co-funded research is important, a full discussion of the issues are outside the scope of this article (see Somerville (2002) for lessons from drugs research).

### 3.1. The case organisation

The research for this study was conducted with Asda. Founded in the 1960s, Asda is one of Britain's leading retailers. It has over 180,000 employees serving customers from 600 stores, including 32 Supercentres, 409 Superstores, 27 Asda Living stores, 148 Supermarkets, 3 Home Shopping Centres and 14 Petrol Filling Stations. Asda serves over 18 million shoppers a week in store and its growing home shopping business at Asda became part of Walmart in 1999 (Asda, 2013).

Concerning sustainability, Asda takes the lead from their parent company, Walmart. This project was started following customer surveys of Asda's customers that revealed that customers not only want Asda to reduce food waste in its own and supply chain practices but also help them in this context (Asda, 2013). Hence, their customers gave the supermarket the permission to influence behaviour in the home but only on food related issues.

### 3.2. Food waste interventions

Three one-off interventions were deemed practical and effective for impacting and measuring behaviour. These interventions were designed following a qualitative feasibility assessment of a range of intervention types was conducted against Asda's customer

communication channels (magazine, social media, e-newsletter, in-store radio, in-store posters, on products, national media advertising or through local community initiatives). The intervention approaches were discussed within the research team and Asda's sustainability and marketing teams and a shortlist of interventions was developed. This shortlist was then circulated by Asda to gain insight internally and externally. Factors included in the decision-making process included cost of the interventions, agreeability of the category teams, and the availability of communications teams in Asda to participate and implement the interventions. Following this process three interventions were signed off utilising Asda's communication channels with two information interventions following Asda's normal communication strategies. It was anticipated that the behaviour change would be from the social influence intervention, which tailored the 'face to face' interaction to social media. This was explained earlier in the paper in Section 3. The messaging in all three interventions was consistent with that from WRAP's 'Love Food Hate Waste' campaign covering shopping smarter (using shopping lists), storing products better, planning meals and using up food that could be thrown (WRAP, 2015a). Each of the interventions are now discussed in turn.

#### 3.2.1. Information intervention 1: Asda magazine

Asda Magazine is distributed to 1.9 million readers every month. It is made available to customers in Asda stores as well as online; thus, it can be read both physically and remotely. This intervention consisted of publishing a featured article that provided expert tips to cut down household food waste.

The feature was published on page 47 of the October 2014 monthly issue of Asda magazine (shown in Fig. S1 in the electronic Supplementary materials) and provided tips for reducing the waste of specific foods. Tips included storage advice, recipe inspiration and methods to use up leftovers. This feature specifically highlighted methods to make the most of the highest commonly wasted foods based on data from WRAP (Pocock et al., 2008) and the Everyday Expert Panel. Food covered in the article comprised of: 1) Fruit and vegetables; 2) Meat and fish; 3) Bread and baked goods; 4) Dairy items; 5) Cooked rice and pasta.

#### 3.2.2. Information intervention 2: Asda e-newsletter

The Asda e-newsletter is circulated every two weeks and has a readership of 1.4 million customers. This intervention was circulated once in conjunction with the social media campaign. The e-newsletter had two specific features addressing household food waste. The first feature, like the social media campaign, discussed using leftovers to reduce food waste and consisted of a web link connecting customers to the social media campaign encouraging them to share ideas for reducing food waste (see Fig. S2 in the electronic Supplementary materials). The second feature highlighted correct storage as a method of keeping food fresh and preventing waste, and provided a link for purchasing food storage items.

#### 3.2.3. Social influence intervention: Asda Facebook pages

This intervention was designed utilise the success of the interaction element of 'face to face' interaction from previous social influence interventions (Abrahamse and Steg, 2013). The aim was to facilitate discussion among customers on Asda's Facebook site which has 1.4 million 'likes'. Utilising Asda's social media group, this intervention consisted of posting a 'leftovers' campaign on Facebook (shown in Fig. S3 in the electronic Supplementary materials). This campaign asked Asda customers to submit their favourite recipes that involved using leftover food and directed users to a website providing 'Love Food, Hate Waste' tips from WRAP on reducing food waste at home (LoveFoodHateWaste, 2015). The objective of this intervention was to encourage the use of leftover food to cut down waste within households and to promote discussion of this issue between Asda consumers.

### 3.3. Measures

An online questionnaire was used to measure changes from the intervention at Time 1 (one month before intervention), Time 2 (two weeks after intervention) and Time 3 (five months after intervention). Participants were recruited from Asda's existing customers that had signed up to complete market research (panel of 30,000 customers, see https://pulse.asda.com). Questions were designed by the research team to measure behaviours. Edits to the questions were suggested by Asda's customer insight team and final questions agreed as outlined below. Raw data collected by Asda were given to the research team to analyse. At the start of the questionnaire, participants were asked if they had seen the print magazine, e-newsletter or Facebook page without mentioning food waste. If respondents indicated they had seen an intervention their answers were coded as such. All participants answered the same set of questions.

The main limitation of our study was that we relied on self-reported food waste behaviour from customers, which is known to be a pragmatic but relatively imprecise measure of actual waste behaviour compared to compositional food waste analysis (Graham-Rowe et al., 2014). In an ideal world we would have analysed the contents of household waste bins as in other studies with smaller samples (Hanssen et al., 2016; WRAP, 2013b), but doing this for up to 10,000 people over a year was financially impossible. Other measurement tools such as interviews and food diaries are discussed by other authors (Langley et al., 2010; Sharp et al., 2010) but these too show mixed results. However, there would have been a real risk of discouraging mainstream customers (as opposed to highly motivated green customers) to engage in the project if we used highly intensive data collection methods for the participants. In order to minimize sampling bias, we therefore decided to conduct online questionnaires, which have been successfully used in other household waste studies (Dhokhikah et al., 2015; Graham-Rowe et al., 2015; Liu et al., 2015). Overall, we still think our methods and results are valid and appropriate for this study.

#### 3.3.1. Food waste behaviour

The degree to which consumers had engaged in food waste behaviours was measured using two items, including frequency and quantity. Frequency of waste was measured by asking consumers "How regularly do you think food is thrown away in your household (e.g. as a result of cooking too much or food spoiling)?" Responses were given on a five-point Likert scale (1 = Never, 5 = Most mealtimes). The quantity of foods wasted was measured by asking, "Over the past week have you thrown out any of the following items? Please select all that apply". Participants indicated the types of foods wasted from nine product categories including: fruit, vegetables, salad, bakery, dairy, meat and poultry, seafood, drinks, and other. These were summed to provide an index of food quantity wasted. These questions were developed from previous research by WRAP (2013a) and quality checked through discussions with researchers at WRAP and Asda's Insight team.

## 4. Results

To determine the impact the interventions had on consumer behaviour, data were analysed using repeated measures analyses of variance (ANOVA) and post-hoc tests. The protocol for carrying out the statistical analysis tests as well as the interpretation of the

**Table 1**
Sample size of each intervention group.

| Intervention Group | Sample Size (N) |
|---|---|
| None | 469 |
| E-Newsletter | 105 |
| Facebook | 510 |
| Magazine | 327 |
| E-Newsletter & Facebook | 134 |
| E-Newsletter & Magazine | 116 |
| Facebook & Magazine | 250 |
| All Interventions | 107 |

results were conducted according to Field (2013) and Pallant (2007) using IBM SPSS Statistics 22 software.

### 4.1. Participants

The baseline and follow-up surveys were sent to 20,000 customers from Asda's Everyday Expert panel. A total of 7990 customers responded to the baseline (Time 1) survey, 5388 responded to the first follow-up (Time 2) and 4398 responded to the second follow-up survey (Time 3). After removal of cases with missing responses from one or more surveys, the final sample included 2018 matching responses across all three surveys. All analyses reported in relation to the survey and demographics refer to the participants who responded to all three surveys. The median age range of participants was 50–59 years, and ranged from 16 to 70+ years. Approximately 58.4% of participants were female. The sample size for each intervention group is shown in Table 1.

### 4.2. Food waste behaviour

A one-way repeated measures ANOVA was conducted to compare scores on the frequency and quantity of food waste at Time 1 (1 month prior to the intervention), Time 2 (2 weeks following the intervention) and Time 3 (five-month follow-up). The means and standard deviations for frequency quantity are presented in Table S2 in the electronic Supplementary materials. For food waste frequency there was a significant effect for time, Wilks' Lambda = 0.99, F (2, 2008) = 4.78, $p < 0.01$, multivariate partial eta squared = 0.01. For food waste quantity there was a significant effect for time, Wilks' Lambda = 0.99, F (2, 2009) = 13.65, $p < 0.001$, multivariate partial eta squared = 0.01 (Figs. 1 and 2).

Results showed that those who were not exposed to any of the interventions reported a reduced food waste quantity over the course of the study period. There was a significant difference for the no intervention condition from Time 1 (M = 1.27, SD = 0.1.42) to Time 3 (M = 1.14, SD = 1.31); t (2.32, $p = < 0.05$).

Those participants who were exposed to the electronic newsletter showed a significant difference in their frequency of food waste from Time 2 (M = 2.47, SD = 0.910) to Time 3 (M = 2.41, SD = 0.910); t (2.19, p = < 0.05). There was not a significant reduction in frequency of food waste as compared to the baseline levels at Time 1. Customers who were exposed to the electronic newsletter also showed a reduced food waste quantity over the course of the study period. There was a significant difference for the electronic newsletter condition from Time 1 (M = 1.43, SD = 1.34) to Time 3 (M = 1.16, SD = 1.26); t (2.29, $p = < 0.05$).

Those customers who viewed the Facebook intervention also showed a significant difference in their frequency of food waste from Time 2 (M = 2.47, SD = 0.91) to Time 3 (M = 2.41, SD = 0.91); t (2.19, $p = < 0.05$). Much like the electronic newsletter, however, this was not a significant reduction in frequency of food waste as compared to the baseline levels at Time 1. Participants who viewed the Facebook intervention also demonstrated a significant change in their reported quantity of food waste from Time 2 (M = 1.36, SD = 1.49) to Time 3 (M = 1.17, SD = 1.33); t (3.47, $p = < 0.05$). The quantity of food waste reduction slowed, but was still significantly different at Time 3 (M = 1.17, SD = 1.33) when compared to their initial food waste quantity at Time 1 (M = 1.28, SD = 1.36); t (1.99, $p = < 0.05$).

Customers who were exposed to the magazine (found online and in-store) showed a reduction in reported food waste from Time 2 (M = 1.29, SD = 1.44) to Time 3 (M = 1.16, SD = 1.38); t (2.06, $p = < 0.05$). This difference was not significant when compared to the baseline at Time 1.

We also tested the results for those participants who were exposed to more than one intervention. Those who were exposed to both the electronic newsletter and the Facebook interventions reported a significant difference in the quantity of food waste from

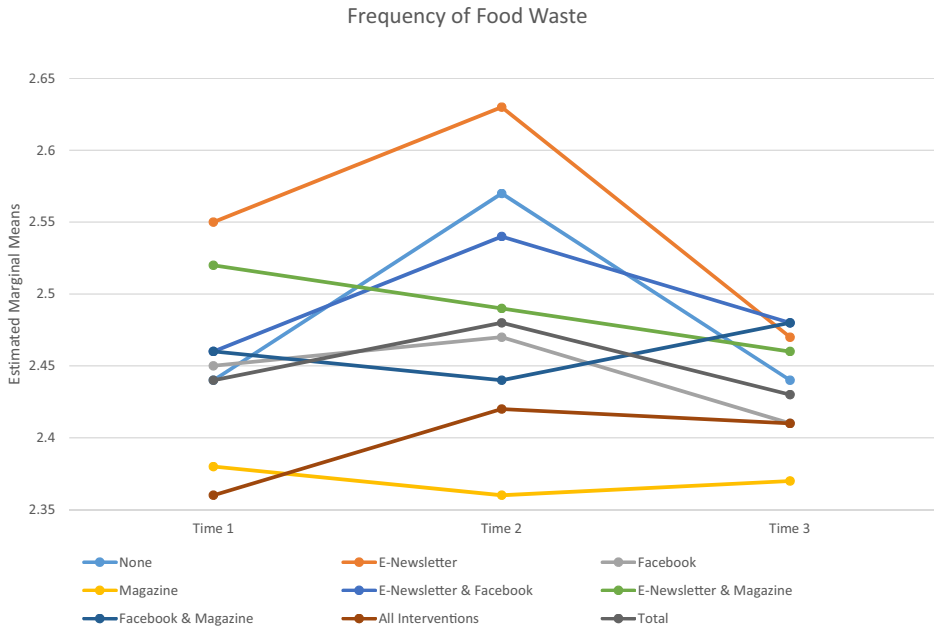


**Fig. 1.** Means of Frequency of Waste.

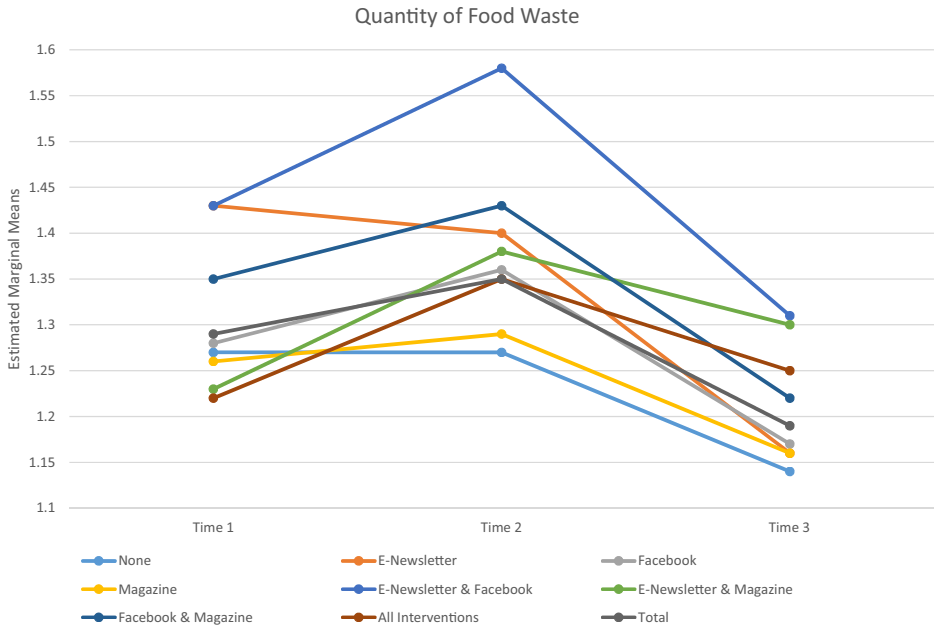


**Fig. 2.** Means of Quantity Waste.

Time 2 (M = 1.58, SD = 1.63) to Time 3 (M = 1.31, SD = 1.49); t (2.47, $p = < 0.05$). The change, however, was not significantly different from Time 1 to Time 3.

Customers who were exposed to both the Facebook intervention and the magazine also showed a significant difference in the quantity of food waste that they reported. There was also a change for this group from Time 2 (M = 1.43, SD = 1.31) to Time 3 (M = 1.22, SD = 1.24); t (3.20, $p = < 0.05$). The difference was not, however, significant across Time 1 and Time 3.

### 4.3. Further analyses

In order to further interrogate our data, we also examined the results as they related to different categories of food waste. As shown in Fig. 3, approximately one third of respondents reported throwing away salad or bakery items and one quarter had thrown away fruit and vegetables.

In order to examine how the interventions affected different types of waste categories, we conducted further ANOVA tests on the four categories of waste that together accounted for 75% of all food waste reported by the respondents: salad, bakery, fruit and vegetables. The quantity of food waste category or type was captured in the survey, however, the frequency of waste was not. The following results therefore show the quantity of food waste for each of the four categories.

A one-way repeated measures ANOVA to compare scores on the quantity of food waste for each category at Time 1 (1 month prior to the intervention), Time 2 (two weeks following the intervention) and Time 3 (five-month follow-up). The means and standard deviations are presented in Table S3 in the electronic Supplementary materials.

For quantity of salad wasted there was a significant effect for time, Wilks' Lambda = 0.99, F (2, 1694) = 10.35, $p < 0.01$, multivariate partial eta squared = 0.01. For quantity of bakery goods wasted, there was a significant effect for time, Wilks' Lambda = 0.99, F (2, 1694) = 4.95, $p < 0.01$, multivariate partial eta squared = 0.01. There was no significant effect for the quantity of fruit or vegetables wasted.

Posthoc paired samples *t*-tests showed that for those who were not exposed to any of the interventions there was a reported reduction in salad waste over the course of the study period. There was a significant difference for the no intervention condition from Time 1 (M = 0.32, SD = 0.47) to Time 3 (M = 0.25, SD = 0.46); t (2.12, $p = < 0.05$). Salad waste was also reduced for those in the E-News condition from Time 1 (M = 0.40, SD = 0.49) to Time 3 (M = 0.21, SD = 0.41); t (3.38, $p = < 0.001$). For those in the Facebook condition there was also a reduction in food waste from Time 1 (M = 0.34, SD = 0.47) to Time 2 (M = 0.25, SD = 0.43); t (3.03, $p = < 0.01$); and from Time 1 (M = 0.34, SD = 0.47) to Time 3 (M = 0.24, SD = 0.43); t (3.27, p = < 0.01).

For bakery goods only one result was significant, with those who were exposed to the magazine intervention showing a significant difference in the quantity of bakery goods wasted between Time 2 (M = 0.33, SD = 0.47) to Time 3 (M = 0.25, SD = 0.43); t (2.52, p = 0.05).

Taken together these results suggest that the differences found in the overall results may be in a large part due to the waste of salad goods by consumers.

## 5. Discussion

This study aimed to test a large retailer's use of social media as a tool for reducing food waste in the home. It has been asserted that face-to-face interactions are an important element of behaviour change interventions (Abrahamse and Steg, 2013; Goldsmith and Goldsmith, 2011), however, creating face-to-face interventions on a large scale is a problem due to the intensity of cost, time and resources required. In this study we wanted to see if using a social media tool could replicate the influence of face-to-face interactions to influence behaviour at a much larger scale than limited resources would otherwise allow. Using Asda's customer base as the study site, we tested the intervention on a large-scale field-based sample of UK customers.

From a methodological point of view, we have to be careful as that the repeated use of the online survey was not the cause of the influence on reported food waste behaviour rather than the designed interventions. With our large sample size of 2018 and

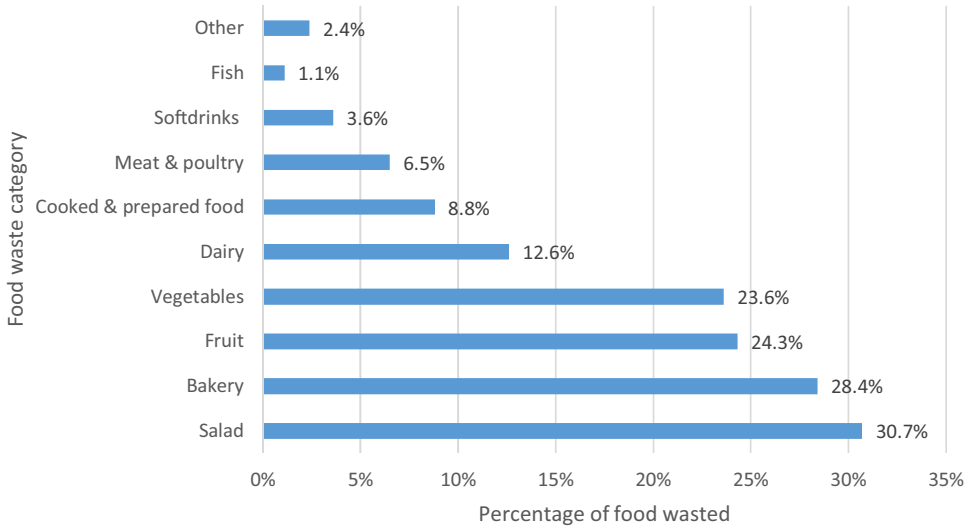


**Fig. 3.** Relative percentage of food wasted by category at Time 1.

wide variety of respondents' backgrounds, we feel this is unlikely and has not been reported elsewhere (Dhokhikah et al., 2015; Graham-Rowe et al., 2015; Liu et al., 2015). However, other more invasive methods of data collection discounted by this project such as food diaries are used as tools to influence food waste behaviour (Quested et al., 2013).

Results showed that the social media intervention did not perform differently to the information interventions or control group, which all showed a significant reduction in self-reported food waste by customers. There were no socio-economic trends from the data that could have helped explain factors in other research (Quested and Luzecka, 2014). The results of this study therefore contribute to the existing literature in four ways.

First, field results show that social media such as Facebook cannot replicate enough of the interaction shown by face to face social influence interventions to change reported behaviour more than the control group (those that did not see the interventions). This challenges the enthusiasm expressed by previous studies (Collins et al., 2010; Goldsmith and Goldsmith, 2011; Laranjo et al., 2014; Seng Chew and Keat Leng, 2014) for online social networks as a behaviour change tool. Indeed, our findings demonstrate that although participants engaged in the Facebook initiative they did not outperform the control group on any of the measures of food waste behaviour reduction. Perhaps this is the nature of the topic (reducing food waste) which is contrary to what is mainly discussed on the social media site, i.e. promoting the consumption of products. Another way to look at this result is that social media tool should be classified as an information intervention as it is not displaying the elements of the face-to-face influence of the other physical face-to-face interventions. Further research could focus on how this face-to-face influence could be incorporated into behaviour change interventions to millions of customers by a retailer without spending a huge amount of money.

Secondly, our results demonstrate the necessity of field-based research in fully understanding how interventions affect consumers in a real life setting. Indeed, our field study tested these interventions in a supermarket and consumer environment where there were many competing modern life distractions for the consumer. Findings from previous social influence intervention studies (Abrahamse and Steg, 2013) have most often been based on laboratory results that effectively eliminate other distracting factors. Thus, our work suggests that these laboratory findings may not work as effectively in the field and this points to the requirement for further field tests to explore how competing demands and 'noise' impacts on the efficacy of planned interventions. Further research could combine social laboratory and field-based experiments to identify factors that are effective.

Our work makes a third contribution in that it extends the method of co-production (Clark and Dickson, 2003) where practitioners and researchers work together in the study. Researchers and practitioners worked closely together throughout all stages of this research and in doing so we have demonstrated how this method can influence the decisions, actions and processes in an organisation and hence have a tangible impact. It is time intensive and requires much pragmatism on both sides to overcome differences perceptions of time scales and quality of evidence. We argue that co-production is an effective mechanism to ensure the dual benefit of scientific advancement and practical contribution.

Finally, our work confirms that the most frequently wasted food items of salad, fruit, bakery and vegetables are still relevant today and confirms WRAP's research (WRAP, 2013a). There seems a real issue of differences in what consumers think they consume of these products and hence buy and what they actually consume. More research could be done here to add to sociology research on eating and cooking (Evans, 2011).

## 6. Conclusions

To the best of our knowledge, this is the first study to implement and measure the impact of food waste reduction interventions that have potential to reach up to 18 million supermarket customers. This is important for the research area of behaviour change interventions as it shows how effective interventions are or not in the noise of real life such as in a competitive supermarket environment. Whilst theoretically sound and performing better than information interventions under laboratory conditions, our field-based results show that social media interventions did not perform differently from the other intervention types. Crucially, none of the three interventions we tested in the field managed to perform better than the control group.

Our study illustrates both the potential and the limitations of large retailers' attempts to bring about incremental change in the behaviour of their mainstream customers (Ganglbauer et al., 2013). For more significant change society needs appropriate infrastruc-

ture and legal changes to help leading companies to enhance their efforts to manage sustainable behaviours. Even large retailers are limited in their reach and only one out of a wide range of actors that have the potential to shape their customers' behaviour. In addition, companies are unlikely to go into areas that will reduce profitability or competiveness such as reducing consumption. Ultimately, wider governance solutions, for example at the sector-level and/or including a stronger role of government actors, may be required to achieve effective reductions in food waste.

Our study looked at food waste without judgement of the different products wasted. One area that perhaps needs clarity is how to avoid any rebound effect. Changing behaviour on food waste for example, may lead to consumers spending money on activities that have higher environmental implications (such as greenhouse gases) than the original target behaviour (Chitnis et al., 2013). On the issue of food waste, this may mean reductions in, for example salad and consumers spending financial savings for example on meat products. Meat products have the highest level of greenhouse gas emissions in food products (Barrett and Scott, 2012), hence the intervention could have increased greenhouse gas emissions overall. We recommend that food waste reduction initiatives should probably be aimed at products with higher greenhouse gases.

Future research on reducing food waste is needed especially around how companies shape the social practices of cooking and eating in the home as shown by Evans (2011). Working with companies on managing the sustainable lifestyles of their consumers is important and further research on the effectiveness of these interventions should be a focus of researchers.

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## Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.resconrec.2016.10.016.

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