



Food waste interventions: Experimental evidence of the effectiveness of environmental messages

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ABSTRACT

Given the need to reduce food waste, information-based intervention campaigns that present messages to individuals are crucial and likely part of the solution. However, the subject matter of these messages has been under scholarly debate. Although empirical evidence is lacking, scholars and practitioners have recently focused on environmental messages even though, traditionally, others have advocated for taste- or financially-oriented messages. With two experiments, totaling 1,656 participants, we contribute to the resolution of this debate. We examined how environmental and taste-oriented messages affect behavioral intentions to reduce food waste and to plan meals (Experiment 1) and how environmental and financially-oriented messages affect interest in food waste reduction efforts (Experiment 2). In Experiment 1, we found that a message linking meal planning to tackling climate change elicited more future meal planning intentions and more general intentions to reduce food waste than the control condition. We also found that an environmental message was more effective in increasing general intentions to reduce food waste and as effective in increasing future meal planning intentions, than a message that linked meal planning to tasty food. In Experiment 2, we found that an environmental message promoted more interest in food waste reduction efforts than no message and was as effective as a message that conveyed the financial burden of food waste. We discuss implications for future intervention campaigns and research.

1. Introduction

Food waste is one of the key contributors to greenhouse gas emissions and thus one of the main obstacles to overcome in efforts to tackle climate change (Clark et al., 2020; Rosenzweig et al., 2020). Given that households are responsible for the majority of post-farm-gate food waste in the UK (WRAP, 2020) and Europe (Stenmarck et al., 2016), it is perhaps not a surprise that governments and institutions are conducting a wide range of different interventions with the aim to persuade individuals to waste less food. Examples of such campaigns are *Love Food Hate Waste* (2022b) in the UK (and other countries), *Stop Wasting Food* (2022) in Denmark, and *Save The Food* (ad Council, 2016) in the US (for an overview, see Zamri et al., 2020). Although a range of different intervention-types exist, most of these campaigns are information-based campaigns that aim to change behavior through awareness-raising

messages (Hebrok and Boks, 2017; Reynolds et al., 2019; Stöckli et al., 2018). Given the prevalence of information-based campaigns, understanding the effectiveness of different types of messages has been an important area of research in order to maximise the likelihood of success in tackling food waste (Kim et al., 2020; Närvänen et al., 2018).

To date, researchers have examined different ways of reducing food waste via different routes. On the one hand, research has indicated that the household's financial position, or wealth, predicts household food waste (Abeliotis et al., 2014; Graham-Rowe et al., 2014; Neff et al., 2015; Rispo et al., 2015) and it has been assumed, therefore, that monetary savings may be a motivator to reduce food waste (Quested et al., 2013; Stancu et al., 2016). On the other hand, based on the finding that people throw away food due to a perception of being unpalatable (Aschemann-Witzel et al., 2015), researchers often suggest that effective interventions need to focus on persuading others that (leftover) food is

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still acceptable to eat. To encourage leftover usage and thus reduce food waste, [Porphino et al. \(2016\)](#), for example, pointed out that interventions may need to focus on the taste of leftovers, aiming to increase leftover usage. Similarly, [Young et al. \(2017\)](#) demonstrated that repeated stimuli associated with the taste of food may be part of the solution to reduce food waste among consumers. In another intervention study conducted in University canteens, [Whitehair et al. \(2013\)](#) showed that a taste-focused message was effective in reducing food waste. Therefore, it is not surprising that real-life interventions have often focused on financial savings ([van der Werf et al., 2021](#)) as well as the taste of food ([Love Food Hate Waste, 2022a](#)) in an attempt to persuade people to reduce food waste.

More recently researchers have started to suggest that environmental messages, those that associate climate change with food waste, may be effective in reducing food waste, particularly when used in combination with additional interventions ([Chen, 2019](#); [van Geffen et al., 2020](#)). To date, however, limited empirical evidence exists for the effectiveness of environmental messages in reducing food waste, possibly due to the assumption that personal or financial factors matter more than environmental factors for behavior change ([Quested et al., 2013](#); [Stancu et al., 2016](#)). In one of the few existing studies, [Minton et al. \(2020\)](#) found that images linking food waste to climate change were particularly beneficial to promote food waste reduction efforts of religious individuals. More recently, [Nisa et al. \(2022\)](#) presented participants with differing combinations of stimuli and found that a combination of six environmental messages may be promising in reducing food waste. However, given that participants were presented with a bundle of pictures comprising very different messages, it is challenging to disentangle which of these, if any, had the strongest effect, or whether it was the sheer number of messages that elicited the effect. More importantly, to design the most effective information-based campaigns, the key question is whether environmental messages can be as effective, or potentially more effective, in reducing food waste, compared to traditional messages that promote the financial burden and taste of (leftover) food – unfortunately, to date, we do not have an answer to that question.

Although there is some evidence to the contrary ([Chen and DeSalvo, 2022](#); [Ferguson and Ashworth, 2021](#); [Kesenheimer and Greitemeyer, 2020](#)), research in the area of general environmental psychology suggests that environmental messages can be effective in promoting environmental behaviors ([Chan, 1998](#); [Joshi and Rahman, 2016](#); [Scannell and Gifford, 2013](#)). [Marks et al. \(2016\)](#) note that environmental messages are important to building environmental awareness and biospheric attitudes and other scholars have found that highlighting the negative consequences of climate change may be an effective way to motivate particular groups of individuals to engage in pro-environmental behavior ([Kapeller and Jäger, 2020](#)). [Terrier and Marfaing \(2015\)](#), for instance, demonstrated in their study that hotel guests are more likely to act pro-environmentally (by re-using towels more often) after having been exposed to environmental commitment messages. In a more recent study, [Wolstenholme et al. \(2020\)](#) examined the effect of messages related to the environment, health, environment and health, or no message on meat consumption and pro-environmental behavior over a 5-week period. They not only found that environmental messages were most persuasive in reducing meat consumption but also that this effect endured over time.

Environmental messages have also been successful in priming environmental goals and thus fostering environmental behavior ([Unsworth et al., 2021](#); [Unsworth and McNeill, 2017](#)). In their study, [Tate et al. \(2014\)](#) found that presenting participants with environmental messages activated environmental goals and thus elicited subsequent pro-environmental behavior in a task. Similarly, priming environmental goals with images has been found to increase environmental consciousness and the willingness to pay for environmental protection ([Bimonte et al., 2020](#)). Overall, environmental messages have been found to be important for promoting various environmental behaviors, ranging from recycling ([Evison and Read, 2001](#); [Li et al., 2021](#)) and a

reduction of energy use ([Toledo, 2016](#); [Xu et al., 2015](#)) to a decline of meat consumption ([Laestadius et al., 2016](#); [Wistar et al., 2022](#)).

Thus, both the preliminary evidence from the food waste literature and the broader literature on environmental psychology seems promising for the use of environmental messages. However, it is insufficient from a practical perspective as we do not know how it compares to traditional taste or financially-oriented messages. To design effective interventions, therefore, the question remains: Are messages that associate food waste with its effect on the environment as effective as, or perhaps more effective than, messages that promote the taste or cost of food for reducing food waste? We believe that answering this question is particularly important when one considers that Love Food Hate Waste project of WRAP uses both environmental messages ([Love Food Hate Waste, 2022b](#)) alongside taste-focused messages ([Love Food Hate Waste, 2022a](#)). Hence, a better understanding of the impact of each message is crucial for the success and future design of such intervention campaigns. Knowledge of whether environmental messages are as (or more) effective than traditionally applied messages will open more avenues for practitioners to use in efforts to tackle food waste. Additionally, a better understanding of the different messages will help to amend current intervention designs, thereby aiding their effectiveness.

In this paper, we aim to enhance this understanding (a) by examining how an environmental and a taste-oriented message can affect an individual's intention to reduce food waste and to engage in meal planning (Experiment 1) and (b) by investigating how an environmental and a financially-oriented message can alter behavior (Experiment 2). For the experiments reported here, we define an environmental message as one that associates food waste reductions (or a behavior correlated with food waste reduction such as meal planning; [Bretter et al., 2022](#)) with a positive environmental impact. A taste-oriented message, in contrast, associates with food waste reductions (or a behavior correlated with food waste reduction such as meal planning; [Bretter et al., 2022](#)) by enhancing one's pleasure (through tasty meals). Finally, we define a financially-oriented message as one that associates food waste reductions (or a behavior correlated with food waste reduction such as meal planning; [Bretter et al., 2022](#)) with improving one's financial situation.

In line with the literature on environmental psychology and the evidence from the food waste literature, we test the hypotheses in Experiment 1 that an environmental message is more effective than no message (H_{1a}) and at least equally effective as a taste-oriented message (H_2).

H1a. *Messages that associate food waste with its impact on the environment are more effective than no message in affecting intentions for food waste and meal planning behavior.*

H2. *Messages that associate food waste with its impact on the environment are at least as effective as taste-oriented messages in affecting intentions for food waste reduction and meal planning behavior.*

Experiment 1 will therefore test whether messages can alter intentions. Yet, it is of practical importance to also examine whether messages can alter individual actions; not just intentions. Similar to Experiment 1, we will thus test whether an environmental message is more effective than no message in influencing individual interest in food waste reduction efforts in Experiment 2 (measured via a quasi-behavioral index; H_{1b}), but we will also test whether such environmental messages are at least as effective as financially-oriented messages in such influence (H_3).

H1b. *Messages that associate food waste with its impact on the environment are more effective than no message in affecting citizens' interest in food waste reduction efforts.*

H3. *Messages that associate food waste with its impact on the environment are at least as effective as financially motivated messages in influencing citizens' interest in food waste reduction efforts.*

Our experiments therefore directly respond to a call made by various scholars to further examine more intervention studies in an attempt to better understand how to reduce food waste (Schmidt, 2016; Schmidt and Matthies, 2018; Stöckli et al., 2018). More importantly, however, they will examine the effectiveness of messages currently applied in food waste reduction campaigns and thus will offer valuable insights for practitioners. In the following sections, we will elaborate on our experimental designs, analyses and results before we discuss our findings, their implications and offer our concluding remarks.

2. Method

2.1. Overview of studies

We conducted two experiments. The purpose of Experiment 1 was to test H_{1a} and H_2 , namely that environmental messages are at least as effective as taste-oriented, compared to the control condition, in promoting meal planning intentions and intentions to reduce food waste. The aim of Experiment 2 was to examine whether an environmental message can change behavior by using a quasi-behavioral measure (H_{1b}). Additionally, we will also test the hypothesis (H_3) that environmental messages are at least as effective as financially-oriented messages. As elaborated more in the respective sections of the experiments, we collected the data via Qualtrics and distributed the experiment via Prolific. Prolific is a large, ethical survey panel, often used in research (e.g., Bretter, Unsworth and Robinson, 2022), where potential participants can sign up if they are interested in participating in academic work. We chose Prolific because the quality of the data, compared to other panel providers has been shown to be superior (Peer et al., 2017). We calculated the minimum sample size for both experiments via G*power (Faul et al., 2007). Based on our experimental designs, we used a small effect size of $f = .12$ (see Bretter et al., 2023), $\alpha = .05$, Power = .80, and number of experimental groups = 3 as input variables for the calculation in an ANOVA design. The resulting minimum sample size for both experiments was therefore 675 participants.

2.2. Experiment 1

2.2.1. Procedure, participants, and measures

This experiment followed a single-factor design with three conditions. In the first condition, participants were shown a message that highlighted the benefits of meal planning for tackling climate change. The exact wording of the message was “Meal planning. Because how you fix the dinner can help to fix the climate crisis.”. In the second condition, participants read a message that links meal planning to tasty food. The exact wording was “Meal planning. Because it is like planning a holiday for your tongue.” Both messages were developed in collaboration with WRAP and their partnering PR agency Kindred. In the control condition, participants only answered questions related to our measures (see below).

Given that meal planning tends to be a habitual behavior (Russell et al., 2017), current meal planning habits will likely influence our results. Further, the extent to which the individual places value on the environment per se may also influence our results (i.e., biospheric values; De Groot and Steg, 2008; van Geffen et al., 2020). We therefore needed to control for these habits and values, and thus our experiment consisted of two measurement points, one week apart. In the first survey, we measured demographic information, current meal planning behavior and values (see measures below). In the second, one week later, we conducted the manipulations and measured our dependent variables (i.e., intentions to reduce food waste; future meal planning intentions).

We conducted the experiment via Qualtrics and collected the data via Prolific. Participants were paid for each time point as compensation for their time in line with the ethical principles of Prolific. Across both waves, 753 participants participated in our experiment and were randomly allocated to one of our three conditions. The sample

characteristics are presented in Table 1.

At time point one, we measured participants' current meal planning habits with five items (e.g., “Making a meal plan for the week ahead”; see Bretter et al. (2022)) on a 5-point scale from (1) = “Never” to (5) = “At every opportunity”, asking about past behavior (“How often did you do each of the following in the last two weeks?”). The scale showed acceptable reliability ($\alpha = .73$). We measured participants' biospheric values on a 7-point Likert scale from (1) = “Not important to me at all” to (7) = “Very important to me” following the procedure by de Groot and Steg (2008). This allowed us to control for the perceived importance of the environment to the individual and thus to examine whether our effects go above and beyond biospheric values. The scale showed acceptable reliability ($\alpha = .90$).

At the second time point, we measured our dependent variables with the following scales. Participants' intention to reduce food waste was measured using 3 items adapted from Bretter et al. (2022) on a 5-point

Table 1
Demographic Information.

Demographic information	Experiment 1 (N = 753)	Experiment 2 (N = 903)		
Gender	Female	71.7%	48.9%	
	Male	27.4%	49.8%	
	Other/prefer not to say	1.0%	0.2%	
Ethnicity	White	88.4%	68.7%	
	Mixed	2.7%	10.2%	
	Chinese	0.7%	0.2%	
	Asian (other)	4.8%	1.4%	
	Black	1.9%	10.1%	
	Other/Prefer not to say	1.6%	9.4%	
Age	18–24 years	11.2%	53.0%	
	25–34 years	33.0%	32.8%	
	35–44 years	21.8%	8.4%	
	45–54 years	17.7%	3.5%	
	55–64 years	11.7%	2.1%	
	65 years and over	4.6%	0.2%	
Education	National Vocation Qualification	4.0%	3.0%	
	GCSE or similar	13.4%	6.0%	
	A-Level	21.0%	13.4%	
	Undergraduate degree	40.4%	43.1%	
	Postgraduate degree	18.7%	24.3%	
	PhD	1.9%	1.6%	
	Other	0.7%	8.7%	
Living situation	I live on my own	15.4%	13.1%	
	My partner and I live together (no children)	25.9%	14.7%	
	I live with my children (no partner)	6.2%	1.3%	
	My partner and I live with our children	30.7%	8.4%	
	I live in a shared house/with friends	5.4%	8.0%	
	I live in student halls of residence	1.5%	3.1%	
	I live with my parents/another family	13.5%	49.8%	
	Other living arrangements	1.3%	1.6%	
	Annual Gross Income	< £7,000	3.3%	17.2%
		£7,000- £14,000	8.2%	21.7%
£14,001- £21,000		8.9%	14.4%	
£21,001- £28,000		11.4%	10.0%	
£28,001- £34,000		10.4%	6.1%	
£34,001- £41,000		9.7%	5.0%	
£41,001- £48,000		8.5%	3.8%	
£48,001- £55,000		8.6%	2.9%	
£55,001- £62,000		6.4%	2.1%	
£62,001- £69,000		3.6%	1.7%	
£69,001- £76,000		4.0%	1.2%	
£76,001- £83,000		1.9%	0.7%	
> £83,000		7.4%	1.9%	
Prefer not to say/Don't know	7.7%	11.5%		

scale from (1) = “Never” to (5) = “At every opportunity”. Participants were asked “How often do you intend to do the following in the next two weeks?” and “Trying to minimize my food waste” represents an example item. This scale showed acceptable reliability ($\alpha = .88$). Using the same response options and question, we measured participants’ future meal planning intentions with the same 5-items used at the first time point. The scale showed acceptable reliability ($\alpha = .71$).

2.2.2. Results

To analyze the data, we conducted a one-way multivariate analysis of covariance (MANCOVA) using our experimental conditions as the independent variable, future meal planning intentions and intentions to reduce food waste as the dependent variables, and current meal planning behavior as the covariate. Multivariate tests revealed an effect of our manipulation across both dependent variables ($F(4, 1496.00) = 3.57; p = .007; \eta^2 = 0.01$). Subsequent between-subject tests for each variable showed an effect of our manipulation on both participants’ intention to reduce food waste ($F(2, 749) = 5.25; p = .005; \eta^2 = 0.01$) and future meal planning intentions ($F(2, 749) = 3.94; p = .020; \eta^2 = 0.01$).

Participants showed higher intentions to reduce food waste in the environmental condition ($M = 4.29; SE = .04$), compared to both the taste-oriented condition ($M = 4.15; SE = .04; p = .016$) and the control condition ($M = 4.08; SE = .06; p = .003$). The difference between the taste-oriented and the control condition was non-significant ($p = .339$).

Further, participants demonstrated higher future meal planning intentions in the environmental condition ($M = 3.74; SE = .03$), compared to the control condition ($M = 3.59; SE = .04; p = .006$), but not compared to the taste-oriented condition ($M = 3.67; SE = .03; p = .123$). Again, the difference between the taste-oriented and the control condition was non-significant ($p = .141$).

The results of the multivariate tests ($F(4, 1494.00) = 3.09; p = .015; \eta^2 = 0.01$) and the between-subject tests for intentions to reduce food waste ($F(2, 748) = 4.33; p = .014; \eta^2 = 0.01$) and future meal planning intentions ($F(2, 748) = 3.52; p = .030; \eta^2 = 0.01$) remained unchanged when we controlled for the perceived importance of the environment for the individual by adding biospheric values as a covariate, indicating additional robustness of our findings.

A graphical illustration of these effects can be found in Fig. 1. Importantly, our results still stand, once we control for multiple comparisons using the Bonferroni adjustment.

2.2.3. Discussion

In this experiment, we have demonstrated that a message linking

meal planning to tackling climate change elicits higher future meal planning intentions as well as higher general intentions to reduce food waste, compared to the control condition, thus supporting H_{1a} . We have also revealed evidence suggesting that an environmental message seems to be more effective in increasing general intentions to reduce food waste and as effective in increasing future meal planning intentions, compared to a message that links meal planning to tasty food, thus supporting H_2 . Although our findings seem robust because of the unchanged results after controlling for biospheric values, interventions using environmental messages may only be considered successful if they can change behavior. The aim of Experiment 2 was therefore to examine whether an environmental message can change behavior by using a quasi-behavioral measure (H_{1b}). Additionally, we also tested the hypothesis (H_3) that environmental messages are at least as effective as financially-oriented messages, thus scrutinizing the assumption that financial factors may be more motivating to reduce food waste than environmental factors (Quested et al., 2013; Stancu et al., 2016).

2.3. Experiment 2

2.3.1. Participants, procedure and measures

As in Experiment 1, we conducted the experiment on Qualtrics and recruited participants via Prolific. We recruited 903 participants who were paid as compensation for their time in line with the ethical principles of Prolific. The sample’s characteristics can be found in Table 1.

For methodological rigor, it was important that, as in Experiment 1, these messages were roughly equal in length and had the same grammatical structure with the only difference being the message focus (environmental vs financial). Hence, we refrained from including further information in those messages such as the carbon emissions due to food waste (in the environmental condition) or the amount of money wasted (in the financial condition). In the first condition (environmental condition), we presented participants with an image and a message that linked food waste to climate change (i.e., “Wasting food feeds climate change”). In the second condition, the image and message linked food waste to a financial burden (i.e., “Wasting food feeds your shopping bill”). In the control condition, participants did not see any message. Please see the appendix for the images/messages.

Upon entering the survey, and before seeing the manipulation, we obtained demographic information, measured participants’ biospheric values ($\alpha = .87$) and current meal planning behaviors ($\alpha = .67$) using the scales from Experiment 1. After the manipulation, we included our quasi-behavioral measure. More specifically, we measured participants’ interests in food waste reduction efforts by showing them a list of ‘tips,

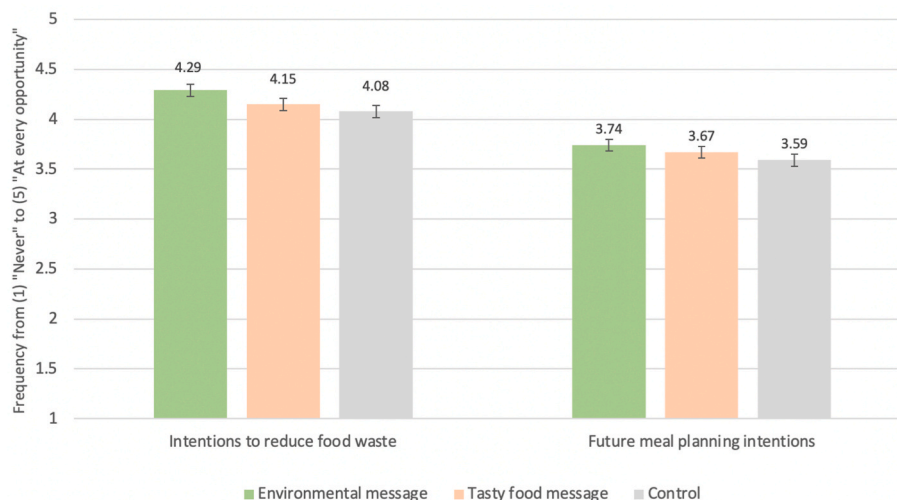


Fig. 1. Intentions to reduce food waste (left) and future meal planning intentions (right) per experimental condition. Error bars represent ± 1 SE.

tricks, and further information that might be of interest to them. This list included 8 items such as a storage guide, a template for meal plans or shopping lists. Participants could click on each of those points to receive more information, if they were interested. However, they could also decide to skip this section and finish the experiment. We then counted how many of the overall 8 points each participant had shown interest in. The higher the number of points a participant got in this test (i.e., the more boxes were ticked), the greater their interest in receiving more information on food waste reduction efforts.

2.3.2. Results

Using the manipulation as the independent variable and our quasi-behavioral index as the dependent variable, we conducted an Analysis of Variance (ANOVA). Between-subject tests showed a main effect of our manipulation on our quasi-behavioral index ($F(2, 900) = 5.62; p = .004; \eta^2 = 0.01$). Participants were more interested in food waste reduction efforts in the environmental ($M = 2.83; SE = 0.10; p = .016$) and in the financial condition ($M = 2.95; SE = 0.09; p = .001$), compared to the control condition ($M = 2.49; SE = 0.09$). The difference between the environmental and financial conditions was non-significant ($p = .430$). Therefore, our findings indicate that an environmental message fosters more interest in food waste reduction efforts, compared to the control condition, thus supporting H_{1b} . The environmental message also elicited no less participant engagement than the financially motivated message, thus supporting H_3 . Importantly, these effects remained when we controlled for participants' perceived importance of the environment (i.e., biospheric values) and current meal planning behaviors ($F(2, 898) = 6.23; p = .002; \eta^2 = 0.01$), demonstrating the robustness of our findings.

3. General discussion

3.1. Summary of findings

In this paper, we examined the effectiveness of environmental messages on food waste intentions and behavioral effort. In our first experiment we compared a message that associated meal planning with climate change to one that associated it with preparing tasty food and to a control. In support of our hypothesis, we found that an environmental message, compared to no message, increased respondents' stated intentions to plan meals and to waste less food. Further, compared to the tasty food message, we found an environmental message was more effective in increasing general intentions to reduce food waste and as effective in increasing future meal planning intentions. In Experiment 2, we explored the effect of an environmental message compared to a financial message and a control condition on interest in food waste reduction efforts. In support of our hypotheses, we found that an environmental message promoted more interest in food waste reduction efforts than no message; and that such an environmental message is as effective as a message that conveys the financial burden of food waste.

3.2. Implications for research and practice

Our findings are aligned with – and extend – the literature on food waste (e.g., Principato et al., 2021; Schanes et al., 2018; Secondi et al., 2015) and environmental psychology in several ways and thus have multiple implications. Our results fit well with the findings obtained in several studies that suggest environmental messages are effective in promoting general environmental behavior (e.g., Spence et al., 2014; Wolstenholme et al., 2020; Zhang et al., 2020). Moreover, they are also aligned with preliminary evidence that suggests environmental messages may be effective in promoting a reduction of food waste (Graham-Rowe et al., 2019; Nisa et al., 2022). Therefore, our findings indicate that information-based intervention campaigns that utilize environmental messages increase engagement with the campaign and increase intentions to reduce food waste, at least in the short term. Importantly, our findings also imply that environmental messages used

in such campaigns are at least as effective as messages related to the taste of food or to the financial burden of food waste.

Based on our results, we thus scrutinize the assumption that financial factors may generally be *more* motivating to reduce food waste than environmental factors (Quested et al., 2013; Stancu et al., 2016); instead, our results show that they are equally effective. Importantly, however, we do not suggest that environmental messages are the only way forward. Given that individuals often react differently to messages that are aligned with their pre-existing belief structures (Schultz and Zelezny, 1999), different messages may work better for different individuals (see also limitation and future directions). Hence, we argue that intervention campaigns should use a myriad of message frames to resonate with more individuals (Jenkins et al., 2022; Roodhuyzen et al., 2017). As environmental beliefs become more embedded across society, such environmental messages are likely to become more and more important. Therefore, at a practical level, our findings here show that environmental messages may be an effective frame that can be used in these campaigns. The finding that environmental messages are as effective in reducing food waste as frequently-used frames such as those used in taste- or financial-oriented campaigns is a positive one for policy-makers and practitioners who can add these into their repertoire.

Our findings are also aligned with results obtained in a recent study by Bretter et al. (2022). In particular, the authors put forward a new construct, 'Responsibility', which refers to individuals' motivation to act for the benefit of others (including the environment) and which was associated with participants' intention to reduce food waste. Aligned with their study, our findings suggest that environmental messages that may be tapping into the construct of 'Responsibility' can increase participants' intention to reduce food waste and to plan future meals. Accordingly, policymakers and practitioners may be able to increase the effectiveness of their intervention campaigns by using environmental messages that similarly tap into 'Responsibility'.

In general, our experiments also show that any of the tested message frames, be it focused on the environment, taste or financial, does not *reduce* participants' short-term intentions or their interest in food waste reduction efforts, compared to no message. As different messages may resonate with different audiences (Kusmanoff et al., 2020), efforts should be made to target particular messages to section of the audience with whom they would resonate. We believe this is a natural next step for both theory and practice.

3.3. Limitations and future directions

Although we believe that our findings are robust, we feel the need to make readers aware of several limitations. Importantly, these relate to the generalizability of our results, not to their validity. First, we have focused on messages in information-based intervention campaigns. Although these are the most common types of intervention in food waste reduction (Stöckli et al., 2018), there are also others such as technology or policy-based approaches (Hebrouk and Boks, 2017; Reynolds et al., 2019; Stöckli et al., 2018). Accordingly, we do not suggest that information-based intervention campaigns are the most effective way to reduce food waste (Osbaldiston and Schott, 2012); previous research has suggested that a comprehensive campaign may work best if it is not solely based on one intervention-type, but rather on a combination of different types (Kollmuss and Agyeman, 2002). Neither do we suggest that each intervention-type always needs to incorporate environmental messages. Instead, we argue that, where messaging is required, environmental messages are considered alongside the traditional alternatives (e.g., financial and taste-oriented messages).

Second, even though we have shown that environmental messages, compared to no message, can increase participants' intention to reduce food waste and to plan meals, we are cautious to suggest that these outcomes will always translate into a reduction of food waste. Although our manipulations changed individual responses on scales relating to these outcomes, scale responses may not translate into action (Kormos

and Gifford, 2014; Schläpfer et al., 2004), partially because of desirability bias (Krumpal, 2013). This concern is somewhat ameliorated by Experiment 2 which used a quasi-behavioral measure, however future research needs to further examine whether such manipulations and campaigns can causally affect actual behavior change.

Third, research suggests that messages are more likely to resonate with individuals when they are aligned with their pre-existing belief structures (Arpan et al., 2013; Bretter and Schulz, 2023; Cheng et al., 2011; Schultz and Zelezny, 1999). We had a very large and diverse sample and we controlled for biospheric values in both studies, however we are still cautious to suggest that environmental (or other) messages will work reliably across different contexts. Rather, messages of information-based intervention campaigns may need to be aligned with the values of the target audience. We suggest further research examines which groups of individuals resonate with environmental, tasty, or financial messages.

4. Conclusions

Based on the notion that financial concerns are predominant in food waste (Abeliotis et al., 2014; Graham-Rowe et al., 2014; Neff et al., 2015; Rispo et al., 2015) or that individuals throw away food in anticipation of insufficient taste (Aschemann-Witzel et al., 2015), scholars have advocated for food waste intervention campaigns to incorporate taste-oriented (Porpino et al., 2016; Whitehair et al., 2013) or financially-oriented messages (Quested et al., 2013; Stancu et al., 2016). Yet, scholars suggested more recently that intervention campaigns would benefit from environmental messages that associate food waste with climate change (Nisa et al., 2022). However, to date there was insufficient evidence on the potential of environmental messages to reduce food waste and on how environmental messages compare to the more traditional taste- and financially-oriented messages. In this paper, we aimed to close this gap and, in doing so, found that environmental messages work at least effectively as taste-oriented (Experiment 1) and financially-oriented messages (Experiment 2), compared to the control group, in eliciting higher intentions to reduce food waste and to plan meals (Experiment 1) as well as to increase participants' interest in food waste reduction efforts (Experiment 2).

Appendix

Messages Experiment 1

Environmental message: Meal planning. Because how you fix the dinner can help to fix the climate crisis.

Taste-oriented message: Meal planning. Because it is like planning a holiday for your tongue.

Messages Experiment 2

Environmental message.



Financial message.

As environmental concerns become more widespread across society, we expect that more environmental messaging will occur. Our research therefore provides much needed evidence that, for interventions requiring direct communication with citizens, incorporating appropriate environmental messages has the potential to increase engagement and should be strongly considered as part of a wider strategy for businesses in their efforts to contribute to a more sustainable society (Russell et al., 2023).

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CRediT authorship contribution statement

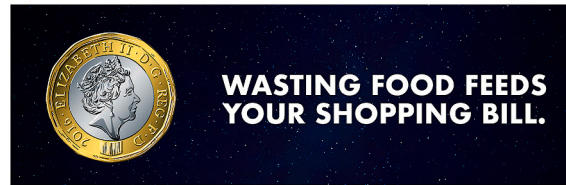
Christian Bretter: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing, Visualization. **Kerrie L. Unsworth:** Conceptualization, Methodology, Formal analysis, Writing – review & editing, Supervision, Funding acquisition. **Sally V. Russell:** Conceptualization, Methodology, Supervision, Funding acquisition. **Tom E. Quested:** Conceptualization, Methodology, Writing – review & editing, Supervision. **Gülbanu Kaptan:** Conceptualization, Methodology, Writing – review & editing, Supervision, Funding acquisition. **Aggelina Doriza:** Methodology, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.



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