



Save near-expired food: Does a message to avoid food waste affect food purchase and household waste prevention behaviors?

Yi Zhang^{a,*}, Erica van Herpen^a, Ellen J. Van Loo^a, Mario Pandelaere^{b,c}, Maggie Geuens^c

^a Marketing and Consumer Behavior Group, Wageningen University & Research, Hollandseweg 1, 6706 KN, Wageningen, Netherlands

^b Department of Marketing, Virginia Polytechnic Institute and State University, 2016 Pamplin Hall, Blacksburg, VA, 24061, United States

^c Department of Marketing, Innovation and Organisation, Ghent University, Tweeckerkenstraat 2, 9000, Gent, Belgium

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ABSTRACT

Food waste, especially at the retail and consumer level, is a critical societal issue. Consumers' reluctance to purchase and consume near-expired food is a major contributor. Retailers have taken actions to promote near-expired food; however, it is unclear how their actions influence both purchase and consumption of near-expired food. This research examines one retail strategy aiming to reduce food waste—a message about food waste avoidance (without discounts). Specifically, four experiments ($N = 1196$) using various measurements of food waste prevention behaviors and one single-paper meta-analysis reveal that a message about food waste avoidance increases consumers' willingness to buy near-expired food through increased moral satisfaction. After purchasing near-expired food, consumers engage in more waste prevention behaviors for it than for other food regardless of whether consumers encounter the food-waste-avoidance message. In addition, we find indications that increased moral satisfaction deriving from the food-waste-avoidance message motivates consumers to conduct more household waste prevention behaviors for the purchased near-expired food. Together, these findings suggest that a message about food waste avoidance can be a potentially effective strategy to reduce the waste of near-expired food. This research extends our understanding of the purchase and consumption of near-expired food and supports retail messages about food waste avoidance to sell near-expired food.

1. Introduction

An astonishing 931 million tons of food were wasted in 2019 worldwide (UNEP, 2021). Retail and households account for a large proportion of this waste, 13% and 61%, respectively. Food waste refers to food that is intended and appropriate for human consumption but is not consumed by people (van Herpen and van der Lans, 2019). It aggravates economic, environmental, and societal problems by wasting money and precious resources (i.e., soil and water) and emitting greenhouse gas unnecessarily. Therefore, reducing food waste, especially at the retail and household level, is essential and has drawn much attention from society and research (Schanes et al., 2018).

A big cause of retail and household food waste is consumers' reluctance to buy and consume suboptimal food (Aschemann-Witzel et al., 2015; de Hooge et al., 2017). Suboptimal food is food that deviates from optimal food in cosmetic specifications (i.e., shape), date labeling (i.e., near-expired food), or packaging (i.e., damaged wrapper), but retains its

intrinsic quality and safety (van Giesen and de Hooge, 2019). The current study focuses on near-expired food. Consumers are reluctant to buy food approaching its expiration date (Aschemann-Witzel et al., 2018; de Hooge et al., 2017) because it is perceived to offer fewer product benefits compared with regular food, such as lower perceived freshness (Aschemann-Witzel et al., 2018).

Given consumers' resistance to buy and consume near-expired food, retailers have taken actions to promote near-expired food by offering discounts or conveying messages about the economic savings or environmental benefits of buying near-expired food (Kulikovskaja and Aschemann-Witzel, 2017). Prior research has shown that discounts are effective in selling near-expired food (Theotokis et al., 2012; Tsalis, 2020). However, it remains unclear whether communicating these discounts as an action to avoid food waste increases the purchase of near-expired food. Several studies show a positive influence on consumers' responses (Aschemann-Witzel et al., 2018; Aschemann-Witzel et al., 2019; van Giesen and de Hooge, 2019), while other studies suggest

* Corresponding author.

E-mail addresses: yi2.zhang@wur.nl (Y. Zhang), erica.vanherpen@wur.nl (E. van Herpen), ellen.vanloo@wur.nl (E.J. Van Loo), mpand@vt.edu (M. Pandelaere), Maggie.Geuens@UGent.be (M. Geuens).

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no such positive influence (Aschemann-Witzel, 2018).

Our contribution to prior research is threefold. First, prior studies have mostly focused on the effect of a message about food waste avoidance in combination with discounts for near-expired food. The effect of the food waste avoidance message, without price promotion, has not received systematic investigation, even though the message itself can offer unique benefits. For instance, communicating about near-expired food sold in the store can avoid a negative impact on store image (Aschemann-Witzel et al., 2020). Second, mechanisms explaining why a message impacts consumer behavior related to the waste of near-expired food are lacking in the literature but are important to be understood. By investigating the mediating role of moral satisfaction as the underlying mechanism for the first time, this research provides scientific support for the use of such a message in encouraging pro-environmental behaviors. In doing so, we add to prior research on the factors that can influence pro-environmental behavior. For readers who are interested in broader theories on pro-environmental behaviors, we refer to studies that introduce and/or review the roles of identity theory (Lou and Li, 2021; Stets and Biga, 2003), the theory of planned behavior (Ajzen, 1991; Graham-Rowe et al., 2015; Yuriev et al., 2020), and value theory (Schwartz, 1992). In addition, influential factors are also reviewed in the literature (White et al., 2019), such as moral motivations (Sachdeva et al., 2015), emotions (Brosch, 2021), and financial reasons (Clark et al., 2003). Third, how consumers subsequently treat purchased near-expired food at home has mostly been neglected in the literature. This is crucial as consumers may throw the purchased food in the bin at home. From this perspective, retailers may transfer the risk of food waste from stores to households. Thus, understanding consumers' responses to retailers' messages about food waste avoidance at both the purchase and consumption stages is necessary. To fill these gaps in prior literature, our research investigates the effect of a message about food waste avoidance on consumers' willingness to buy near-expired food in supermarkets and their waste prevention behaviors regarding this food at home.

1.1. Conceptual framework

Literature on prosocial and pro-environmental behaviors has documented that people acquire personal benefits in terms of moral satisfaction while contributing to good causes (Andreoni, 1990). Moral satisfaction refers to the good feeling that comes from performing moral behaviors. For instance, consuming ethical food (e.g., organic food) can increase the moral satisfaction that consumers feel about themselves, which enhances taste expectations and experiences (Bratanova et al., 2015). Likewise, using green products can give an improved consumption experience because prosocial behavior increases good feelings about oneself (Bodur et al., 2020). A message about food waste avoidance signals that buying near-expired food is a pro-environmental behavior. As such, this message may enhance consumers' moral satisfaction from buying near-expired food. According to the concept of self-enhancement, people desire to maximize and maintain positive self-views (Dufner et al., 2018; Sedikides and Gregg, 2008), as a consequence of which they pursue positive feedback and outcomes (Gaertner et al., 2012). As the moral satisfaction resulting from following up on a message about food waste avoidance engenders such positive self-views, consumers may be more willing to buy near-expired food. Therefore, we hypothesize that:

H1. A message about food waste avoidance increases consumers' willingness to buy near-expired food.

H2. The effect of the message on willingness to buy is mediated by an increased anticipated moral satisfaction obtained from buying near-expired food with the message.

Regarding the relationship between a message about food waste avoidance and household waste prevention behaviors at home with purchased near-expired food, we see three possibilities. First, the

message of food waste avoidance may increase household waste prevention behaviors. As mentioned, buying near-expired food with a message about food waste avoidance, compared to buying it without such a message, can boost consumers' moral satisfaction. The concept of self-enhancement (Dufner et al., 2018; Sedikides and Gregg, 2008) and the commitment and consistency principle predict that people tend to behave consistently with their self-image (Cialdini, 2007). This implies that after buying near-expired food, consumers may increase their waste prevention behaviors for this purchased food to maintain the positive self-view initially triggered by the waste-avoidance message.

Secondly, the message of food avoidance may decrease household waste prevention behaviors since consumers do not always extend their pro-environmental behaviors from supermarkets to in-home situations. The concept of moral licensing poses that people who initially behave morally may engage in immoral behaviors afterward (Blanken et al., 2015). This transition can be explained by moral credits: performing good behaviors, such as buying near-expired food, endows people with credits that can balance out subsequent immoral behaviors (Miller and Effron, 2010). In addition to moral credits, a message about food waste avoidance in the supermarket may remind consumers that this food will be wasted if not purchased. Consumers are thereby more likely to trivialize the possible waste of this food at home after reading the message (van Geffen et al., 2020). According to the mechanisms of moral credits and trivialization of food waste, after purchasing near-expired food with the waste-avoidance message, consumers may decrease their waste prevention behaviors for this food.

In addition, a third possibility is that the message does not influence consumers' household waste prevention behaviors at all because consumers continue to follow set food routines (Talwar et al., 2021). Food-related habits in planning, shopping, storing, and cooking play a key role in household food waste generation (Stancu et al., 2016). These habits are difficult to change because they are activated automatically by situational cues in the absence of conscious awareness (Gardner, 2015). From this perspective, a message about food waste avoidance does not alter consumers' behaviors at home concerning the purchased near-expired food.

Given the above arguments, a message about food waste avoidance may increase, decrease, or not influence consumers' waste prevention behaviors at home. Examining these three possibilities helps clarify the concern that retail may transfer the risk of food waste from the supermarket to the home by selling near-expired food to consumers. This concern arises from the fact that food is already close to expiration when consumers are persuaded to buy it by waste-avoidance messages, and it can be relieved if we find that the message does not decrease household waste prevention behaviors for the purchased near-expired food. Given the assumed positive influence of the message on willingness to buy, either a positive influence or no influence of the message on household waste prevention behaviors after having bought near-expired food can support a message about food waste avoidance to be an effective strategy of reducing food waste. Fig. 1 displays the conceptual framework.

2. Method

To test our expectations, we conduct four experiments. Experiments 1 and 2 examine the effect of a food waste message on the willingness to purchase near-expired food and on different waste prevention behaviors. The results suggest that the message increases consumers' willingness to buy near-expired food and does not influence waste prevention behaviors at home. Experiment 3 subsequently investigates moral satisfaction as a mediator of the positive effect of the message on willingness to buy and examines whether the absence of an effect of the message on waste prevention behaviors is due to the routine that consumers have on handling near-expired food. To do so, Experiment 3 also tests whether consumers treat near-expired food and non-near-expired food differently at home. Next, pre-registered Experiment 4 (https://aspredicted.org/R75_22V) aims to replicate mediating effects of

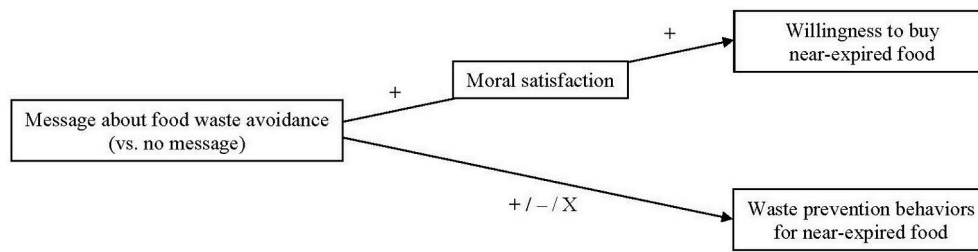


Fig. 1. Conceptual framework.

moral satisfaction and examines two other possible mediators for the effect of the message on waste prevention behaviors: moral credits and trivialization of food waste. The Social Sciences Ethical Committee of Wageningen University & Research approved this research.

2.1. Near-expired food stimuli

Across the four experiments, we use bake-at-home bread rolls as stimulus material for four reasons: (1) cereals, including bread, make up a large share of food waste (Eriksson et al., 2017); they contribute to 34% of the carbon footprint of food waste (FAO, 2013) and largely contribute to supermarkets’ environmental footprint (Brancoli et al., 2017), (2) expiration date is clearly communicated through date labels on the package, (3) waste prevention behaviors can be applied to prolong shelf life (e.g., freezing), and (4) bread is a commonly consumed product (See Appendix A for the stimuli).

2.2. Participants

Table 1 displays participants recruited for the four experiments. We used samples from the Netherlands and the United Kingdom because they are similar in food waste-related behaviors and norms (Masotti et al., 2019), and we were interested to know whether our findings could be replicated. An important inclusion criterion was that participants would consider buying bake-at-home bread rolls in real life. When participants were recruited from Prolific Academic – an online crowdsourcing platform serving as a participants pool for online social and economic experiments – the inclusion criteria included (1) not younger than 18 years old; (2) currently living in the Netherlands (Experiment 1, 3) or the United Kingdom (Experiment 2, 4); (3) fluent in Dutch (Experiment 1, 3) or English (Experiment 2, 4); (4) approval rate on Prolific Academic not lower than 95% (an indicator of whether the participant completed studies seriously); (5) not responded to a similar experiment previously (participants of Experiment 2 could not complete Experiment 4). The exclusion criteria are (1) not completing the whole experiment, (2) failing the attention check question (“This is an attention check. Please do not enter an answer here”), or (3) misconducting

the study according to participants’ comments.

2.3. Design, measures, and procedures

Table 2 summarizes the design and goals of the experiments. The experimental procedure was similar across the four experiments. After reading and accepting the consent form, the participants were randomly assigned to one of the two conditions (Experiment 1, 2, and 4) or one of the four conditions (Experiment 3). In all the conditions, participants were asked to imagine doing grocery shopping in a supermarket that they visited frequently, walking past the shelves of bread rolls, and seeing some bags of bread rolls. The best-before date of these bread rolls was in one day and the price was displayed as normal (no discount). Participants in the message condition additionally read a slogan in the supermarket: “Save near-expired food! Join the fight against food waste!” and saw a sticker with the text “prevent waste” on the package of the bread rolls (see Appendix A). In Experiment 3, participants in the message condition saw only a sticker with the text “prevent waste” on the food package. Food expiration was additionally manipulated by describing the bread rolls as either one day or nine days to the best-before date (see supplementary materials 4.1). Next, participants reported their willingness to buy the bread rolls. Moral satisfaction was measured in Experiment 3 and 4 (adapted from Bratanova et al. (2015)), and moral credit was measured only in Experiment 4 (adapted from Lin et al. (2016)). Next, participants were instructed to imagine – regardless of their willingness to buy – that they had bought one bag of bread rolls and had arrived home with their groceries. They reported their waste prevention behaviors for these bread rolls. In Experiment 4, participants also reported trivialization of food waste. Finally, participants answered several background and demographic questions. For the measures of willingness to buy, household waste prevention behaviors, mediators, and background questions, please see Appendix B.

Waste prevention behaviors were based on a pilot study (N = 61; see supplementary materials 1) and prior literature (Le Borgne et al., 2021; Romani et al., 2018; van Lin et al., 2020). These behaviors were chosen because consumers were likely to carry out one of these behaviors to prevent wasting bread. Although freezing sometimes is seen as a delay in

Table 1
Participants in the experiments.

	Experiments			
	1 N = 280	2 N = 201	3 N = 216	4 N = 499
Country	Netherlands	UK	Netherlands	UK
Source	University	Prolific	Prolific	Prolific
Age	46.37 (17.92)	30.75 (9.07)	26.68 (8.48)	41.51 (14.64)
Gender	72.5% female	81.6% female	56.5% male	68.3% female
Household size	2.45 (1.25)	2.91 (1.33)	2.62 (1.25)	2.66 (1.29)
Shopping frequency	4.72 (0.60)	5.25 (1.10)	4.54 (0.66)	5.44 (1.10)
Gluten intolerance	98.6% no	93.0% no	98.1% no	93.8% no
Bread liking	5.19 (1.39)	5.95 (1.00)	5.55 (1.23)	5.71 (1.01)
Freezing suitability	4.40 (1.83)	5.53 (1.46)	4.25 (1.85)	5.46 (1.32)
Suitable freezer	77.5% yes	90.5% yes	75.9% yes	88.4% yes

Notes. For age, household size, shopping frequency, bread liking, and freezing suitability, the table displays M (SD)¹¹.

Table 2
Design and goals of the four experiments.

	Experiments			
	1	2	3	4
Design (between-subjects)				
Message of food waste avoidance: no vs. yes	X	X		X
2 (message about food waste avoidance: no vs. yes) x 2 (food expiration: non-near-expired food vs. near-expired food)			X	
Goals				
1. Effects of message on willingness to buy	X	X	X	X
2. Effects of message on waste prevention behaviors at home	X	X	X	X
3. Whether near-expired and regular food are treated differently at home			X	
4. Moral satisfaction as a mediator for willingness to buy			X	X
5. Moral satisfaction as a mediator for waste prevention behaviors			X	X
6. Alternative mediators for waste prevention behaviors: moral credits, trivialization of food waste				X

Table 3
Overview of the main findings.

	Experiments			
	1	2	3	4
1. Message about food waste avoidance increases consumers' willingness to buy near-expired food (supporting H1)	X	X	X	X
2. The message does not influence consumers' waste prevention behaviors for the purchased near-expired food at home	X	X	X	X
3. Consumers treat near-expired food with more household waste prevention behaviors than regular food			X	
4. Mediation: The message boosts consumers' moral satisfaction, which in turn increases willingness to buy (supporting H2).			X	X
5. Mediation: The increased moral satisfaction derived from the message also induces more household waste prevention behaviors			X	X
6. Moral credits and trivialization of food waste do not mediate the effect of the message on household waste prevention behaviors				X

throwing food away (Evans, 2011), research in Austria and Netherlands has shown that less food is wasted when food is frozen than for its fresh equivalent (Janssen et al., 2017; Martindale and Schiebel, 2017). Because very different measures of waste prevention behaviors were used in previous projects (Goossens et al., 2019; Zorpas and Lasaridi, 2013) and no validated scale has been established, it is important to check our results with different measures. Therefore, in Experiment 2, we used open-ended questions because these could capture all possible behaviors participants would conduct with near-expired food.

The measurements of household behaviors in Experiment 2 included two writing tasks and one self-reported question. In the *first writing task*, we asked participants to think about what they would do with the ten purchased near-expired bread rolls and to write down their thoughts in detail. Two researchers who were blind to the experimental design independently read the responses and evaluated the extent to which these bread rolls would be wasted on a seven-point scale (1 = no waste, 7 = large waste; see supplementary materials 3.2 for an example). Their evaluations were highly correlated ($r = 0.74, p < .001$) and averaged into one measurement—projected food waste (cf. content analysis for open-ended questions coding (Woike, 2007)). In the *second writing task*, participants reported the number of bread rolls for which they would perform a specific action (i.e., eat it, put it in the cupboard). The two

¹ In Experiment 2, we also found that participants were concerned about food waste ($M = 5.66, SD = 1.02$). Random distribution between conditions was successful for all background questions ($ps > .101$) except freezing suitability in Experiment 2 and 4. Controlling for this did not influence result patterns (see supplementary materials 2.2, 3.1, 4.2, 5.1).

researchers coded categories of actions independently and discussed differences in coding until reaching agreement, ending up with four categories (see supplementary materials 3.2). Among these, we focused on household behaviors related to food waste: eating, freezing, and waste (Appendix C). The numbers of bread rolls in the three categories significantly deviated from a normal distribution and were therefore recoded into binary variables for further analyses. Next, in the *self-reported question*, participants were asked to estimate their consumption (“What percentage of the purchased bake-at-home bread rolls is likely to be eaten in the end?”, 0–100%), as another (inverse) indicator of food waste—estimated consumption (%). Together, projected food waste (first writing task), three categories of household behaviors (second writing task), and estimated consumption (%) made up the measurements of household behavior about food waste in Experiment 2.

Because eating and freezing stood out from participants' writings on handling near-expired food at home in Experiment 2, we focused on these behaviors in Experiment 3 and 4 and the meta-analysis.

3. Results

We provide an overview of the main findings in Table 3.

3.1. Willingness to buy

Across the experiments, T-tests, and ANOVA consistently showed that willingness to buy was significantly higher in the message condition than in the no message condition (Table 4a, 5a, 5b). Further, this positive effect was moderated by food expiration (Experiment 3). As expected, the message increased participants' willingness to buy near-expired food but did not influence their willingness to buy non-near-expired food². Meanwhile, participants were also less likely to buy near-expired food than non-near-expired food in general.

3.2. Household waste prevention behaviors

Across the experiments, T-tests, chi-square tests, and ANOVA consistently showed no significant differences between the two conditions except for one single case where the message increased accelerated consumption in Experiment 3 (Tables 4a, 4b, 5a, 5b). This effect was not moderated by food expiration (Experiment 3). In addition, participants displayed more immediate freezing and accelerated consumption but not more freezing by expiration for near-expired food than for non-near-expired food.

² Willingness to buy did not influence the results of waste prevention behaviors (see supplementary materials 2.3, 3.3, 4.3, 5.2).

Table 4a
Differences between conditions in Experiment 1, 2, 4.

	No message <i>M</i> (<i>SD</i>)	Message <i>M</i> (<i>SD</i>)	<i>t</i>	<i>df</i>	<i>p</i>	<i>d</i>
Willingness to buy						
Experiment 1 (<i>n</i> = 139 vs <i>n</i> = 141)	3.09 (1.62)	4.06 (1.73)	-4.81	278	<.001	0.57
Experiment 2 (<i>n</i> = 101 vs <i>n</i> = 100)	3.23 (1.64)	5.02 (1.63)	-7.79	199	<.001	1.10
Experiment 4 (<i>n</i> = 250 vs <i>n</i> = 249)	3.47 (1.65)	5.11 (1.60)	-11.26	497	<.001	1.01
Waste prevention behaviors						
<i>Experiment 1</i>						
Accelerated consumption	5.32 (1.62)	5.36 (1.51)	-0.20	278	.839	0.02
Consumption after best-before date	4.42 (1.83)	4.40 (1.74)	0.06	278	.952	<.01
Increased consumption	3.65 (1.97)	4.08 (1.83)	-1.90	275.81	.059	0.23
Shared consumption	4.37 (2.18)	4.17 (2.00)	0.79	278	.432	0.09
Freezing	4.15 (2.31)	4.58 (2.17)	-1.61	278	.109	0.19
<i>Experiment 2</i>						
Projected food waste	1.73 (0.86)	1.68 (0.64)	0.49	199	.623	0.07
Estimated consumption (%)	88.81 (20.44)	87.08 (25.40)	.533	199	.595	0.08
<i>Experiment 4</i>						
Accelerated consumption	5.38 (1.61)	5.20 (1.56)	1.29	497	.197	0.12
Freezing	5.73 (1.65)	5.92 (1.59)	-1.35	497	.177	0.12
Mediators (Experiment 4)						
Moral satisfaction	3.14 (1.32)	4.74 (1.25)	-13.95	497	<.001	1.25
Moral credits	2.72 (1.34)	3.78 (1.41)	-8.64	497	<.001	0.77
Trivialization of food waste	2.94 (1.16)	3.08 (1.11)	1.35	497	.176	0.12

Table 4b
Differences between conditions in Experiment 2 (second-writing task).

Category	Coding	No message (count)	Message (count)	χ^2	<i>df</i>	<i>p</i>
Eating	0	59	63	0.36	1	.549
	1	37	33			
Freezing	0	50	38	3.02	1	.082
	1	46	58			
Waste	0	92	93	0.15	1	.700
	1	4	3			

3.3. Mediation effect of moral satisfaction on willingness to buy (Experiment 3 and 4)

As Tables 4a, 5a, and 5b show, moral satisfaction was significantly higher in the message condition than in the no message condition. This positive effect was not moderated by food expiration (Experiment 3). Food expiration influenced moral satisfaction, though, suggesting that buying near-expired food relative to non-near-expired food caused higher moral satisfaction. Further, to test whether the effect of the waste-avoidance message on willingness to buy was mediated by moral satisfaction, we conducted a moderated mediation analysis (Process macro, model 59, 20,000 bootstraps) with food expiration as a moderator for all three paths (a, b, c) in Experiment 3 and conducted a mediation analysis (Process macro, model 4, 20,000 bootstraps) in Experiment 4. As Table 6 shows, in Experiment 3, the message positively affected moral satisfaction, and moral satisfaction positively influenced willingness to buy. This mediating effect was moderated by food expiration (*index* = 0.31, *SE* = 0.14, 95% CI [0.044, 0.615]). The mediation effect of moral satisfaction was not significant for non-near-expired food

Table 5a
Descriptives (*M* (*SD*)) in experiment 3.

	No message + Non-near-expired (<i>n</i> = 54)	Message + Non-near-expired (<i>n</i> = 54)	No message + Near-expired (<i>n</i> = 54)	Message + Near-expired (<i>n</i> = 54)
Willingness to buy	5.19 (1.56)	5.22 (1.70)	3.69 (1.79)	4.69 (2.05)
Immediate freezing	3.07 (2.00)	2.56 (1.54)	3.61 (2.13)	3.48 (2.12)
Accelerated consumption	4.04 (1.81)	4.52 (1.65)	5.13 (1.66)	5.56 (1.41)
Freezing by expiration	3.63 (2.12)	3.52 (2.08)	3.72 (1.96)	3.81 (2.16)
Moral satisfaction	2.96 (1.26)	3.97 (1.36)	3.13 (1.44)	4.62 (1.44)

(*indirect* = 0.10, *SE* = 0.06, 95% CI [-0.005, 0.249]) but was significant for near-expired food (*indirect* = 0.41, *SE* = 0.13, 95% CI [0.186, 0.696]). Experiment 4 subsequently successfully replicated the mediation effect of moral satisfaction for near-expired food (*indirect* = 0.41, *SE* = 0.05, 95% CI [0.317, 0.511]).

3.4. Mediation effects on waste prevention behaviors (Experiment 3 and 4)

We explored whether the relationship between message and household waste prevention behaviors was mediated by moral satisfaction, though the total effect of the message on household waste prevention behaviors was not significant. A total effect does not need to be significant for significant mediating effect(s) to occur (Rucker et al., 2011; Zhao et al., 2010). The total effect might have several mediators, in which the indirect effects via some mediators are positive while the indirect effects via other mediators are negative in similar magnitudes.

In Experiment 3, because food expiration did not moderate the effect of the message on waste prevention behaviors and we had no theoretical predictions about its influence, we include food expiration as a covariate in the mediation analysis (Process macro, model 4, 20,000 bootstraps). As Table 7 shows, in Experiment 3, the message positively affected moral satisfaction, and moral satisfaction increased immediate freezing, accelerated consumption, and freezing by expiration. The mediating effects of moral satisfaction were all significant. The direct effects of the message were all non-significant. In further exploration, we found that food expiration did not moderate these mediation effects (see supplementary materials 4.4). The mediation analyses in Experiment 4 (Process macro, model 4, 20,000 bootstraps) subsequently replicated the mediation effect of moral satisfaction on accelerated consumption but not on freezing because moral satisfaction did not influence freezing.

Table 5b
Differences between conditions in Experiment 3.

Variables	Effect	F	df1	df2	p	η_p^2
Willingness to buy	Message	4.58	1	212	.034	.02
	Food expiration	17.65	1	212	<.001	.08
	Message x Food expiration	3.95	1	212	.048	.02
	Message in non-near-expired	0.01	1	212	.914	<.01
Immediate freezing	Message in near-expired	8.51	1	212	.004	.04
	Message	1.48	1	212	.226	.01
	Food expiration	7.51	1	212	.007	.03
	Message x Food expiration	0.53	1	212	.467	<.01
Accelerated consumption	Message	4.14	1	212	.043	.02
	Food expiration	22.82	1	212	<.001	.10
	Message x Food expiration	0.02	1	212	.901	<.01
Freezing by expiration	Message	<.01	1	212	.974	<.01
	Food expiration	0.47	1	212	.493	<.01
	Message x Food expiration	0.13	1	212	.720	<.01
	Message	44.65	1	212	<.001	.17
Moral satisfaction	Food expiration	4.86	1	212	.029	.02
	Message x Food expiration	1.65	1	212	.201	<.01

Table 6
Mediating effects of moral satisfaction on willingness to buy.

Variables	Effect	b	SE	t	p
Experiment 3					
Moral satisfaction	Message	0.63	0.09	6.68	<.001
	Food expiration	0.21	0.09	2.21	.029
	Message x Food expiration	0.12	0.09	1.28	.201
Willingness to buy	Message	0.01	0.13	0.04	.965
	Moral satisfaction	0.37	0.08	4.39	<.001
	Food expiration	-1.23	0.33	-3.73	<.001
	Message x Food expiration	0.09	0.13	0.68	.499
	Moral satisfaction x Food expiration	0.18	0.08	2.08	.039
	Moral satisfaction for non-near-expired	0.20	0.13	1.56	.121
	Moral satisfaction for near-expired	0.55	0.11	4.81	<.001
Experiment 4					
Moral satisfaction	Message	0.80	0.06	13.95	<.001
Willingness to buy	Message	0.41	0.08	5.20	<.001
	Moral satisfaction	0.51	0.05	9.86	<.001

Because the total effect of the message on waste prevention behaviors was non-significant but a positive mediation path was identified via moral satisfaction, other mediators are yet to be discovered for the potentially negative mediation path that may offset the observed positive indirect effect. We explored two other potential mediators in Experiment 4: moral credits and trivialization of food waste. As Table 4a shows, moral credits were significantly higher in the message condition than in the no message condition, while trivialization of food waste was not significantly different between the conditions. Next, we included moral credits and trivialization of food waste together with moral satisfaction as mediators in the effect of the message on waste prevention behaviors (Process macro, model 4, 20,000 bootstraps). After including these two mediators (Table 7), the indirect effect of moral satisfaction became non-significant for accelerated consumption and became significant for freezing. The indirect effects of moral credits and trivialization of food waste were non-significant. Specifically, although the waste-avoidance message granted participants with moral credits, these credits did not influence accelerated consumption and freezing. In addition, the message did not influence the trivialization of food waste, even though trivialization influenced accelerated consumption positively and freezing negatively. Taken together, the results indicate that moral satisfaction mediates the effect of a message about food waste on household waste prevention behaviors, while two alternative mediators, moral credits and trivialization of food waste, can be excluded.

3.5. Meta-analysis

To provide stronger evidence for whether the message influences waste prevention behaviors at home, we conducted a meta-analysis of the four experiments using Multiple Contrast Standardized Meta-analysis (MCSM; McShane and Böckenholt (2021)). Results from the MCSM showed that the two conditions did not significantly differ in eating behavior (*Estimate* = -0.03, *SE* = 0.06, *z* = -0.49, *p* = .622) but significantly differed in freezing behavior (*Estimate* = 0.15, *SE* = 0.06, *z* = 2.46, *p* = .014). To further interpret these findings, we conducted equivalence tests and found that the effect of the message was small enough to be seen as null on eating behavior but was large enough to be seen as positive on freezing behavior (see supplementary materials 6.1). The results thus reveal that the message about food waste avoidance does not influence consumers' intended eating behavior but increases their intended freezing behavior with the purchased near-expired food.

In addition, to address the issue that Experiment 3 was underpowered (the minimal detectable effect size based on the sample size of Experiment 3 was $\eta_p^2 = 0.03$, which was higher than the observed effect sizes, $\eta_p^2 = 0.02$), we conducted a similar meta-analysis for willingness to buy across the four experiments. The results showed that the two conditions were significantly different in willingness to buy (*Estimate* = 0.82, *SE* = 0.14, *z* = 5.65, *p* < .001), suggesting that the message indeed increases consumers' willingness to buy (see supplementary materials 6.2).

Table 7
Mediating effects on household waste prevention behaviors.

Variables	Effect	<i>b</i>	<i>SE</i>	<i>t</i>	<i>p</i>	95% CI
Experiment 3						
Moral satisfaction	Message	0.63	0.09	6.67	<.001	
	Food expiration	0.21	0.09	2.21	.029	
Immediate freezing	Message	-0.29	0.15	-1.96	.051	
	Moral satisfaction	0.20	0.10	2.05	.042	
	Indirect effect	0.12	0.06			[0.002, 0.251]
	Food expiration	0.32	0.13	2.43	.016	
Accelerated consumption	Message	0.13	0.12	1.06	.291	
	Moral satisfaction	0.16	0.08	1.95	.053	
	Indirect effect	0.10	0.03			[0.001, 0.122]
	Food expiration	0.50	0.11	4.47	<.001	
Freezing by expiration	Message	-0.17	0.15	-1.09	.278	
	Moral satisfaction	0.26	0.10	2.54	.012	
	Indirect effect	0.16	0.03			[0.028, 0.309]
	Food expiration	0.04	0.14	0.31	.758	
Experiment 4						
<i>Mediator: Moral satisfaction</i>						
Moral satisfaction	Message	0.80	0.06	13.95	<.001	
Accelerated consumption	Message	-0.24	0.08	-2.84	.005	
	Moral satisfaction	0.18	0.05	3.26	.001	
	Indirect effect	0.14	0.05			[0.048, 0.242]
Freezing	Message	0.01	0.09	0.14	.892	
	Moral satisfaction	0.11	0.06	1.91	.057	
	Indirect effect	0.09	0.05			[-0.006, 0.184]
<i>Mediators: Moral satisfaction, moral credits, trivialization of food waste</i>						
Moral credits	Message	0.53	0.06	8.64	<.001	
Trivialization	Message	0.07	0.05	1.35	.176	
Accelerated consumption	Message	-0.25	0.08	-2.99	.003	
	Moral satisfaction	0.11	0.08	1.39	.164	
	Indirect effect	0.09	0.07			[-0.048, 0.231]
	Moral credits	0.11	0.08	1.41	.160	
Freezing	Indirect effect	0.06	0.04			[-0.027, 0.145]
	Trivialization	0.16	0.06	2.56	.011	
	Indirect effect	0.01	0.01			[-0.005, 0.033]
	Message	0.03	0.09	0.35	.725	
	Moral satisfaction	0.17	0.08	2.12	.034	
	Indirect effect	0.14	0.07			[0.005, 0.279]
	Moral credits	-0.11	0.08	-1.42	.156	
	Indirect effect	-0.06	0.04			[-0.147, 0.025]
Freezing	Trivialization	-0.20	0.06	-3.09	.002	
	Indirect effect	-0.01	0.01			[-0.040, 0.006]

4. Discussion

Our studies show that a message about food waste avoidance increases consumers’ willingness to buy near-expired food, and it does not come at the expense of negatively impacting waste prevention behaviors for this food at home. We show this in various measurements and a single-paper meta-analysis (which even identifies a positive influence on intended freezing behavior). As for the underlying processes, moral satisfaction mediates the positive effect of the message on willingness to buy, and we find indications that it also mediates the relationship between the message and household waste prevention behaviors. In addition, Experiment 3 shows that consumers are more likely to immediately freeze and accelerate the consumption of near-expired food than non-near-expired food but treat near-expired food and non-near-expired food equally in terms of freezing by the best-before date. This suggests that consumers may display more waste prevention behaviors towards near-expired food than regular food at the initial time of arriving home, regardless of the message.

4.1. Implications

To the best of our knowledge, this research suggests for the first time that a simple message about food waste avoidance can motivate consumers to purchase near-expired food, even in the absence of discounts that usually accompany such messages. Indeed, prior research has mainly taken this kind of message as a supplement for discounts offered for near-expired food (Aschemann-Witzel et al., 2019), but our findings

reveal that a waste-avoidance message has its own value in stimulating consumers to buy near-expired food. In line with this idea, van Giesen and de Hooge (2019) note that sustainability positioning without discounts can increase consumers’ purchase intentions of oddly shaped food (another type of suboptimal food). Moreover, where most prior research focuses on only purchase or consumption, our findings provide a comprehensive understanding of both purchase and consumption of near-expired food by uncovering the routine behaviors towards this food at home.

Our research also contributes to the literature on moral satisfaction. Prior research has shown that people feel good about themselves after doing something good (Andreoni, 1990; Bodur et al., 2020), which can impact subsequent experiences (Bratanova et al., 2015). Our findings extend this line of research by showing that this good feeling can also impact subsequent behaviors. Even though we still acknowledge the existence of moral licensing, where people sometimes conduct immoral behaviors after engaging in moral behaviors, consumers may realize that the goal of saving near-expired food is not complete unless the food is not wasted at home. In this case, moral satisfaction obtained from purchasing near-expired food may induce subsequent household waste prevention behaviors for this food.

The current research also provides insights into the effects of retail practices concerning food waste. As the main provider of food for households, food retailers are demanded to display their social responsibility by tackling food waste (Kulikovskaja and Aschemann-Witzel, 2017). Our findings identify a low-cost practice against the waste of near-expired food in supermarkets—messages about

food waste avoidance. Such messages increase consumers' willingness to buy near-expired food, and we find no evidence to suggest that the increased purchase increases household food waste. In contrast, our findings suggest that consumers tend to exhibit one waste prevention behavior (freezing) more. Together, this research provides empirical support for the use of messages about food waste avoidance in stores to sell near-expired food.

4.2. Limitations and future research

Some limitations exist in our research. First, most of the participants in this research were recruited from Prolific Academic. Though this crowdsourcing platform provides relatively higher-quality data than other such platforms (Peer et al., 2021), measuring purchase and household behaviors of near-expired food using hypothetical scenarios is challenging. The behavioral intentions measured in this research reflect consumers' willingness to act and exert effort in performing behaviors, but there might still be a gap between intentions and behaviors (Sheeran, 2002), as future research may examine further.

Second, we recruited participants from two countries – the Netherlands and the United Kingdom – that share similar food waste-related behaviors or norms (Masotti et al., 2019), but these norms can be different across other countries. Future research can investigate whether our findings can be generalized to different food waste-related cultures.

Third, because estimating food waste is rather inaccurate in a hypothetical scenario (Ammann et al., 2021), we measured self-reported waste prevention behaviors using Likert scales and open-ended questions instead of self-reported food waste as dependent variables. Both of these self-reported measures are not perfect. Open-ended questions can help capture all relevant behaviors but involve subjective interpretation during coding, while Likert scales can be more objective in analysis but require pre-defined items. Both measures are more easily influenced by social desirability than behavioral observations. Therefore, future research with observed food waste data or revealed behaviors could provide useful complementary evidence. Future research may also explore potentially relevant consumer characteristics, such as environmental awareness or food safety concerns, which may influence consumers' willingness to buy near-expired food and household waste prevention behaviors.

Appendix A. Stimuli



5. Conclusion

To conclude, this research demonstrates that a message about food waste avoidance without discounts increases consumers' willingness to buy near-expired food due to moral satisfaction. The message does not negatively impact consumers' waste prevention behaviors for this food at home. In addition, consumers exhibit more waste prevention behaviors towards this food than other food. These findings suggest that a retail message about food-waste-avoidance can be effective in reducing the waste of near-expired food.

Credit author statement

Yi Zhang: Conceptualization, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing, Visualization, Funding acquisition. **Erica van Herpen:** Conceptualization, Validation, Writing – review & editing, Supervision, Funding acquisition. **Ellen J. Van Loo:** Conceptualization, Validation, Writing – review & editing, Supervision, Funding acquisition. **Mario Pandelaere:** Conceptualization, Validation, Writing – review & editing, Supervision. **Maggie Geuens:** Conceptualization, Validation, Writing – review & editing, Supervision

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 link to the data is shared in the appendix.

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Appendix B. Measures

Measures
<p>Willingness to buy (absolutely not - absolutely yes; Experiment 1-4) Would you buy these bake-at-home bread rolls?</p> <p>Waste prevention behaviors (very unlikely – very likely; Experiment 1, 3, 4) How likely is it that you will conduct the following behaviors for the purchased bake-at-home bread rolls?</p> <p><i>Experiment 1</i></p> <ol style="list-style-type: none"> 1. Accelerated consumption: eat them as soon as possible 2. Consumption after the best-before date: eat them after the best-before date 3. Increased consumption: eat more of them in multiple dishes 4. Shared consumption: share them with others (e.g., roommates, neighbors) 5. Freezing: Freeze it <p><i>Experiment 3</i></p> <ol style="list-style-type: none"> 1. Immediate freezing: immediately freeze them when you get home 2. Accelerated consumption: eat them first instead of something else (e.g., previously bought food and stored food) 3. Freezing by expiration: freeze them if there are bake-at-home bread rolls left by the best-before date <p><i>Experiment 4</i></p> <ol style="list-style-type: none"> 1. Accelerated consumption: eat them as soon as possible 2. Freezing: freeze them if you do not immediately eat all of them <p>Mediators (Experiment 3–4) <i>Moral satisfaction</i> (strongly disagree – strongly agree; Experiment 3: $\alpha = .90$; Experiment 4: $\alpha = .92$)</p> <ol style="list-style-type: none"> 1. Buying the bread rolls feels like a morally right thing to do 2. Buying the bread rolls makes me feel like a better person 3. Buying the bread rolls feels like a personal contribution to a good cause <p><i>Moral credits</i> (strongly disagree – strongly agree; Experiment 4 only: $\alpha = .98$)</p> <ol style="list-style-type: none"> 1. Buying the bake-at-home bread rolls earns me credits as a moral person 2. Buying the bake-at-home bread rolls builds up my account of moral credits 3. Buying the bake-at-home bread rolls adds to my moral credits <p><i>Trivialization of food waste</i> (Experiment 4 only: 1 and 2 were reverse scored; $\alpha = .78$)</p> <ol style="list-style-type: none"> 1. If you do not eat all the bake-at-home bread rolls and throw some of them away, how problematic do you think it is? (very unproblematic – very problematic) 2. How guilty would you feel if you waste some of the bake-at-home bread rolls? (very unguilty – very guilty) 3. If you eat part of the bake-at-home bread rolls and waste the rest of them, how would you feel? (very uncomfortable – very comfortable) <p>Background questions</p> <p><i>Frequency of grocery shopping</i> (Experiment 1–4) How often do you shop for groceries? (1 = never, 2 = less than once a month, 3 = once a month, 4 = once a week, 5 = several times a week, 6 = every day)</p> <p><i>Gluten intolerance</i> (no/yes; Experiment 1–4) Do you have a gluten intolerance?</p> <p><i>Liking the bake-at-home bread rolls</i> (not at all – very much; Experiment 1–4) How much do you like bake-at-home bread in general?</p> <p><i>Suitability of freezing</i> (very unsuitable – very suitable; Experiment 1–4) Do you think the bake-at-home bread rolls are suitable for freezing at home?</p> <p><i>Having a suitable freezer at home</i> (no/somewhat/yes; Experiment 1–4) Do you have a suitable freezer to freeze your bake-at-home bread rolls?</p> <p><i>Waste concern</i> (Experiment 2 only; $\alpha = .89$)</p> <p>How concerned are you that food is wasted? (not concerned at all – very concerned) How worried are you that food is not eaten? (not worried at all – very worried) How uncomfortable do you feel about the possibility that food may be wasted? (very comfortable – very uncomfortable)</p>

Notes. All the measurements were on seven-point scales, except for the frequency of grocery shopping, gluten intolerance, and having a suitable freezer.

Appendix C. Waste prevention behaviors (the second writing task) in Experiment 2

Category	Rolls <i>M</i> (<i>SD</i>)	Coding remarks	Skewness (<i>SE</i>)	Kurtosis (<i>SE</i>)
Eating	6.28 (3.32)	Eating and sharing with others	-0.18 (0.18)	-1.36 (0.35)
Freezing	3.16 (3.33)	Storing in the freezer	0.48 (0.18)	-1.20 (0.35)
Waste	0.17 (1.00)	Throwing away and feeding animals	6.71 (0.18)	46.11 (0.35)

Notes: *M* and *SD* refer to the number of bread rolls assigned to each behavior. Many participants ($n = 70, 34.83\%$) indicated that all ten bread rolls would be eaten, thus we coded 0–9 rolls into 0 and 10 rolls into 1 for eating. Also, many participants indicated zero bread rolls in the freezing ($n = 88, 43.78\%$) and waste ($n = 185, 92.04\%$) categories, thus we coded 0 rolls into 0 and 1–10 rolls into 1 for these categories.

Appendix D. Data

For experimental materials and data, please see: <https://osf.io/y63rn/>

Appendix E. Supplementary materials

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jclepro.2022.135555>.

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