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Don't put all your eggs in one basket: Testing an integrative model of household food waste

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ABSTRACT

Scholarly investigations into household food waste have advanced our knowledge of its determinants by focusing on food management behaviors (FMB) and by using the theory of planned behavior (TPB). Drawing on literature from environmental psychology, we created and tested a comprehensive framework that not only encompasses TPB and FMB, but also individual goals and values, which, we argue, can advance understanding of why people waste food. Using a two-wave survey design with a quasi-representative sample of the UK population ($N = 1{,}336$ participants), we tested our framework with Structural Equation Modelling (SEM). Broadly, results indicated support for our framework in that individual values were associated with short-term cognitions and participants' goals, particularly the goal to behave responsibly, which were in turn associated with FMB and intentions; these, finally, were associated with self-reported food waste. Overall, our results indicate that food waste is the result of different cognitive and behavioral processes.

1. Introduction

Food waste is one of the major contributors to global greenhouse gas emissions and therefore a key obstacle to tackling climate change (Clark et al., 2020; Rosenzweig et al., 2020; Vermeulen et al., 2012). Approximately 931 million tonnes of food waste are generated globally (United Nations Environment Programme, 2021) and more than 9.5 million tonnes of food waste occur annually in the UK alone (WRAP, 2020c). A large proportion of this food waste is generated by households: in the UK, 70% of post-farm-gate food waste (i.e., excluding agricultural food waste) comes from households (WRAP, 2020c). Around the world, for countries with accurate data, more food waste comes from households than from either the retail or food service sector (United Nations Environment Programme, 2021). Such waste is financially costly (FAO, 2014) and generates significant greenhouse gas emissions (FAO, 2011a; Munesue et al., 2015) but is also avoidable (Farr-Wharton et al., 2014). This issue is not new (see FAO, 2011b, 2013; WRAP, 2009) but there is still an obvious need to reduce household food waste (see also Project DRAWNDOWN, 2021).

A quick look at the literature shows that there is a large number of studies examining food waste behavior, so why does this need still exist? We argue that this previous work has tended to be too focused on one theory or framework, whether that be short-term cognitions (e.g., Russell et al., 2017) or behaviors (for a review, see Hebrok and Boks, 2017). Such detailed work is a necessary and important first step but we believe that an integration of those different factors is required before we can move forward. Moreover, this integration highlights the predominant focus on proximal antecedents – those attitudes, emotions and behaviors occurring at the time or shortly before food waste occurs. But interventions directed towards such proximal factors are extremely difficult to implement, requiring changes to the individual's home or constant usage of a message or tool. Long-term cognitions can solve this problem – if values or medium-term goals are found to be related to food waste then targeted interventions will be more effective. For example, interventions can frame the benefits of a reduction in food waste in line with a particular value-orientation, thus appealing to individuals with this specific values. Goals represent longer-term cognitive processes that affect behavior (Locke and Lathan, 1990; Osbaldiston and Sheldon,

Abbreviations: FW, food waste; FMB, food management behavior; TPB, theory of planned behavior.

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2003) and the broader literature on environmental behavior has emphasised their importance, whether they be personal values (e.g., Gatersleben et al., 2014; Steg et al., 2014) or medium-term goals (e.g., Unsworth & McNeill, 2019). Thus, there are both theoretical and practical reasons to investigate the effect of long-term cognitions on food waste.

Therefore, rather than isolating short- and long-term perspectives to understand food waste, we argue for a comprehensive framework that integrates the Theory of Planned Behavior (TPB), Food Management Behaviors (FMB), medium-term goals and values. In this way, our research significantly advances current understanding by illustrating that food waste is the result of these two sets of proximal factors underpinned by individual goals and values. Examining these concepts in a single study helps to generate a more holistic understanding of food waste behavior (for calls to better understand food waste behavior, see Aschemann-Witzel et al., 2015, 2018; see also Porpino, 2016; Reynolds et al., 2019) and it also allows us to examine interdependencies across these factors.

Examining the interplay of different constructs has crucial implications for policies and interventions. For example, if we find that a particular goal is positively associated with one FMB (e.g., planning routines), but negatively associated with another FMB (e.g., saving leftovers), interventions that aim to make this goal salient may be less useful in reducing food waste because of the promoting some behaviors that reduce food waste (e.g., planning) while simultaneously impeding other such behaviors (e.g., saving leftovers). Similarly, previous research has examined the impact of the individuals' intention to reduce waste on food waste separately from the impact of FMB on food waste (see Stancu et al., 2016; Stefan et al., 2013). While we agree with scholars on the negative association between intention and food waste, we argue that we also need to examine the association between intentions and FMB to create a more holistic understanding. For example, the effect of intentions may be completely mediated via FMB, in which case behavioral interventions may be most cost effective; partially mediated via FMB, in which case either cognitive or behavioral interventions may be used; or have separate, unique effects to FMB, in which case both cognitive and behavioral interventions will be required. The difference here is that behavioral interventions have the primary goal of changing a particular behavior such as teaching individuals how to store food so it lasts longer or how to use leftovers to make another meal (see van der Werf et al., 2021) whereas a change of attitudes or intentions, for example, are the primary focus of cognitive interventions. By solely focusing on the established link between intentions and food waste for interventions without considering the effects of intentions on FMB, scholars may have potentially omitted important interdependencies that are crucial for the effectiveness of interventions. It is because of these, and other, potential interdependencies that we see the need to create a holistic framework to better understand food waste and thus design better interventions.

The remainder of the paper is structured as follows. In the next section, we will bring together our integrated model by elaborating on the existing literature on TPB, FMB, individual values, and personal goals. Then, we will describe our data collection and analyses before we elaborate in detail on our results. We then discuss our results with specific reference to practical implications before we offer our concluding remarks and point the reader to future research directions.

2. Literature review

2.1. Theory of planned behavior

The Theory of Planned Behavior (TPB) is one of the most frequently applied frameworks to study food waste (Schanes et al., 2018). Through the lens of TPB, food waste reduction is the result of short-term cognitive processes, namely intentions, attitudes to reduce food waste (i.e., the extent to which the individual favours a reduction in food waste), subjective norms (i.e., the perceived social pressure to reduce food waste), and perceived behavioral control to reduce food waste (i.e., PBC; see Ajzen, 1991). Research has largely supported the association of TPB-related mechanisms with food waste (see, for example, (Barone et al., 2019; Graham-Rowe et al., 2015; Russell et al., 2017; Visschers et al., 2016). We therefore hypothesize that:

Hypothesis 1: Attitudes, subjective norms and perceived behavioral control will be positively associated with intentions to reduce food waste.

Hypothesis 2: Intentions to reduce food waste will be negatively associated with actual food waste.

Nonetheless, researchers have also highlighted weaknesses with TPB (e.g., Visschers et al., 2016), including reverse causality between behavior and attitudes (van Wee et al., 2019) and the need to include additional variables to account for complex behavior (for related debates, see Blake, 1999; Godin et al., 2005; see also Sheeran, 2002). These findings demonstrate that behavior is more multifaceted than originally proposed by the TPB. This seems particularly relevant for a behavior as complex as food waste, due to its tendency to be affected by various situational and habitual factors (see also Hebrok and Boks, 2017; Reynolds et al., 2019) as well as by various behaviors simultaneously (Quested et al., 2013). Accordingly, we see a need to examine food waste more comprehensively than purely relying on TPB.

2.2. Food management behaviors

An alternative approach to studying food waste that has emerged in the literature is a behavioral one. FMBs are defined as the proximal behaviors that lead directly to reduced food waste, such as planning meals, making shopping lists, correctly storing and cooking food as well as eating leftovers (see Quested et al., 2013). Considering the frequency with which individuals engage in FMB, it is perhaps not a surprise that, instead of consciously performing FMB, individuals may do so both consciously, driven by their intentions, and habitually (Aydin and Yildirim, 2021; Darnton et al., 2011).

Given the complexities accompanying habitual processes and their potential to predict – and to reduce – food waste, FMB have been central to several scholarly investigations (for reviews, see Hebrok and Boks, 2017; Principato et al., 2021). Stancu et al. (2016), for example, found that, in addition to TPB-related constructs, shopping and leftover-usage routines were directly related to food waste (see also WRAP, 2014a). Similarly, Stefan et al. (2013) found that planning and shopping routines predict food waste. Other researchers, in contrast, did not find an effect of planning routines on food waste and instead pointed to the use of leftovers (Schmidt and Matthies, 2018; van Geffen et al., 2017) or to not using food by the product dates (Bravi et al., 2020) as the main contributors to food waste. On balance, we propose FMB engagement is associated with food waste and is likely to mediate the short-term cognitions indicated by TPB. Therefore, we hypothesize:

Hypothesis 3: Intentions to reduce food waste will be associated with food management behaviors.

Hypothesis 4: Food Management behaviors will be associated with actual food waste.

Nonetheless, as with TPB, we believe the current understanding of FMB is insufficient for understanding food waste; in this case it is because the determinants of why individuals engage or don't engage in particular FMB have not been understood. Instead, research has focussed on *which* FMB are associated with food waste rather than *when* and *why* individuals engage in them. By integrating them with cognitive processes, we build on the current understanding of FMB by examining the motivations of enacting them.

Research into other pro-environmental behaviors suggests that long-

term cognitive processes such as goals play an important role (Unsworth et al., 2021). As noted earlier, the more proximal perspective of TPB and FMB may have resulted in missed opportunities for both knowledge and practice. We, in contrast, aim to integrate the short-term cognitive processes represented by TPB with longer-term cognitive processes such as values and medium-term goals, to examine how they are related to behavior (i.e., food waste and FMB), thereby providing a more holistic understanding of food waste behavior.

2.3. Goals, values and medium-term goals

2.3.1. Overview of goals

Goals are defined as "internal representations of desired states, where states are broadly construed as outcomes, events, or processes" (Austin and Vancouver, 1996, p. 338). Thus, a person's goals represent cognitive processes that generate motivation to achieve that desired state (Locke and Lathan, 1990; Osbaldiston and Sheldon, 2003). Goals can vary in their level of abstractness ranging from very specific micro-tasks such as washing your teeth in the morning, through daily tasks that you might see on a to-do list, to more general medium-term goals such as being healthy, and finally to very abstract long-term goals such as a value of altruism (see Austin and Vancouver, 1996). Research on goals in environmental psychology has been extensive (for a review, see Gifford and Nilsson, 2014; Steg et al., 2015; Unsworth et al., 2021) and clearly demonstrates the effects of very long-term goals (i.e., values; Steg et al., 2011) and medium-term goals (Unsworth et al., 2013; Unsworth and McNeill, 2017). Therefore, in this study we examine both of these. Values refer to a (sometimes) idealised end state (see also Maslow, 1970); medium-term goals, in contrast, refer to objectives set by an individual to reach that state, making them more proximal to actual behavior than values (see Emmons, 1989; for a discussion, see Jolibert and Baumgartner, 1997) but still significantly more abstract than TPB cognitions.

2.3.2. Medium-term goals

To date, only a few studies have examined the impact of medium-term personal goals on food waste and these have been focused only on competing goals – that is, goals that conflict with the intention to reduce food waste. Both van Geffen et al. (2017) using focus groups and Barone et al. (2019) in a temporally-lagged survey have shown that goals of eating healthily, avoiding illnesses, and being a good provider are negatively related to the intention to reduce food waste.

Although the findings from those studies are certainly valuable, focusing only on the limited set of competing goals may be neglecting important information. Research on multiple goals has shown that a complex set of different goals may exist in a particular situation that are related to an individual's behavior (see Unsworth et al., 2014). Rather than examining a few goals based on a pre-selection process that may lead to omitted variable bias (Cinelli and Hazlett, 2020), we therefore see the need to consider a broader range of goals that may affect food waste both positively and negatively for a more comprehensive understanding. Moreover, by integrating goals with personal values (see below) and TPB we can examine interdependencies across these factors, thereby providing us with a more nuanced understanding of food waste.

Nonetheless, there is a very broad range of goals that have been identified in the literature, such as spending as much time as possible outside the kitchen (WRAP, 2014b), having a wide range of products available (Barone et al., 2019), having tasty food (van Geffen et al., 2017), and being frugal (Unsworth and McNeill, 2017). Our aim is to integrate these and identify overarching goal frames that are meaningful for food waste; as such, we cannot specify *a priori* the particular goal constructs that will emerge. Therefore, in line with the literature on personal goals, we simply hypothesize:

Hypothesis 5a: Medium-term, personal goals will be associated with intentions to reduce food waste.

Hypothesis 5b: Medium-term, personal goals will be associated with food management behaviors.

2.3.3. Individual values

Values may be understood as deep-rooted belief structures that act as principles of guidance to select or evaluate incoming information, individuals, or behavior (De Groot and Steg, 2008; Schwartz, 1992, 2006). Values influence what individuals believe and the way they act, not only generally (for reviews, see Sagiv et al., 2017; Schwartz, 2011) but also pro-environmentally (see Clayton et al., 2015; Klöckner, 2013; Steg et al., 2014; Stern et al., 1999). Although there are different value-orientations (see Schwartz, 1992), two have been predominantly applied in the literature on environmental behavior: altruistic (i.e., self-transcendent) and egoistic (i.e., self-enhancement) values (see De Groot and Steg, 2007). Considering that individuals high in altruistic values are generally understood to act for the benefit of others including the environment, it is perhaps not surprising that altruistic values (but not egoistic values) have been linked to green behaviors such as recycling (Evans et al., 2013), green electricity purchasing and carbon tax support (Hartmann et al., 2017).

More recently scholars have included a third dimension, a biospheric value orientation, that gives worth to nature per se (see De Groot and Steg, 2008; Steg and De Groot, 2012; Stern et al., 1998; Stern, 2000). Although often correlated with altruistic values, biospheric values are distinct from altruistic values in that they prioritize non-human aspects of altruism (De Groot and Steg, 2007). Biospheric values have also been linked to a range of environmental behaviors, including environmental purchasing (Nguyen et al., 2016), meat consumption and energy efficiency (Van der Werff et al., 2013) as well as energy-saving behaviors (Bouman et al., 2020).

The importance of individual values in predicting various environmental behaviors has been firmly established in the field of environmental psychology. However, to the best of our knowledge, there are no empirical studies that examined the relationship between values and food waste behaviors. Given the evidence that individual values ultimately determine actions, this is somewhat surprising. We see a need to incorporate values into our framework because of their potential to explain short-term cognitive processes such as beliefs and attitudes (e.g., TPB; see Schwartz, 1992) and medium-term processes such as personal goals thereby influencing food waste. Given that personal values are relatively stable over the short to medium term (Schwartz, 1994), research suggests that they are not directly linked to behavior, but rather will act through mediators such as attitudes, norms, or goals (Roos and Hahn, 2017; Steg et al., 2014; Stern et al., 1999). Accordingly, we propose that values, understood as stable belief-structures, affect both short-term cognitive processes such as norms, attitudes, and intentions as well as long-term cognitive processes such as goals and FMB.

Hypothesis 6a: *Altruistic values will be negatively associated with food waste, mediated by personal goals, attitudes, subjective norms, intentions, and food management behaviors.*

Hypothesis 6b: *Egoistic values will be positively associated with food waste, mediated by personal goals, attitudes, subjective norms, intentions, and food management behaviors.*

Hypothesis 6c: *Biospheric values will be negatively associated with food waste, mediated by personal goals, attitudes, subjective norms, intentions, and food management behaviors.*

2.4. The proposed framework

During our review, we have identified the need to amalgamate TPB and FMB with factors that have been firmly established in the field of environmental psychology such as individual values (see Clayton et al., 2015; Klöckner, 2013; Steg et al., 2014; Stern et al., 1999) and personal goals (van Geffen et al., 2017; Barone et al., 2019). A single framework that integrates these constructs allows us to examine interdependencies

that may be missed otherwise, thereby creating a more holistic understanding of the psychological determinants of food waste. Underpinned by personal values, our framework views food waste as a result of two distinct, yet intertwined, pathways: short-term and long-term cognition. We see the former as cognitive processes that influence behavior in the immediate future. These are thus shaped by constructs such as attitudes or norms that, despite being influenced by values, tend to be salient temporarily. We understand long-term cognition, in contrast, as processes that are rather stable over longer periods of time. They comprise constructs that tend to be more rigid such as medium-term personal goals and values. Both short-term and long-term cognition are therefore thought to affect food waste but through different pathways. A graphical illustration of the proposed simplified framework can be found in Fig. 1.

3. Method

3.1. Procedure

We conducted the online survey using Qualtrics. The survey was administered to the same individuals in two separate waves in March 2021 (at the end of the Covid-19-related lockdown; see Section 5.6) with a time lag of two weeks in between. We measured participants' values, goals, and TPB-related constructs (i.e., subjective norms, attitudes, perceived behavioral control, and the intention to reduce food waste) in the first wave while the second focused on participants' food management behaviors (FMB), self-reported food waste, and their demographic information (for measures, see below and Appendix A). Each survey took roughly 10 min to complete and participants were paid an equivalent of £7.50 per hour.

3.2. Participants

We recruited participants from the UK population for two reasons. First, according to the latest United Nations Environmental Program Report (2021), the UK is one of the countries that waste the most food (in the high confidence category). A better understanding of the psychological and behavioral processes underpinning food waste behavior in the UK may thus not only lead to more successful interventions but these may also have a stronger practical impact on reducing food waste. Second, we worked alongside WRAP, a global NGO based in the UK specialized in food waste. Hence, we wanted to collect data in a country where we can make the best use of WRAP's extensive knowledge in understanding food waste.

As indicated before, we used a two-wave study design. In the first wave, 1498 participants participated in the study. Two weeks later, we invited all of those to participate in the second part of our study and 1336 participants agreed to participate (= 89.2%), thus representing our final sample. This between-wave attrition was due to the unwillingness of first-wave participants to participate in the second wave and is common in multi-wave study designs. To exclude the possibility of a systematic reason for participants' unwillingness to participate in the second wave, we conducted independent t-tests to compare the responses provided by participants who agreed to participate in both waves with those who only participated in the first wave for values, goals, and TPB-related constructs. The results show no significant differences and are reported in the Supplemental Materials. The distribution of participants in the first survey was representative of the UK population across gender, age, and ethnicity, however due to between-wave attrition, we conducted chi-square tests on the second wave respondents using the UK population estimates as expected values. We found no differences for gender ($\chi^2 = 0.395$; df = 1; $p = .530$) or ethnicity ($\chi^2 = 1.91$; df = 4; $p = .752$). For the age groups, however, our chi-square test revealed a difference between observed and expected age distribution ($\chi^2 = 116.44$; df = 5; $p < .001$) where individuals in the age categories 45–64 years were over-represented while those in the 65 years or over category were under-represented suggesting that our sample was only approaching representativeness due to between-wave attrition. Table 1 shows the demographic information of our final sample and how this compares to the UK population in terms of age, gender, and ethnicity.

3.2.1. Measures

The full list of measures, their scales, and sources, can be found in Appendix A.

In the first questionnaire, we measured participants' values, goals, subjective norms, attitudes, perceived behavioral control (PBC), and their intention to reduce food waste. For the value measure, we used the 13-item measure developed by de Groot and Steg (2008) to capture participants' biospheric, egoistic, and altruistic values on a 7-point Likert scale from *1* = "*not important to me*" to *7* = "*very important to*

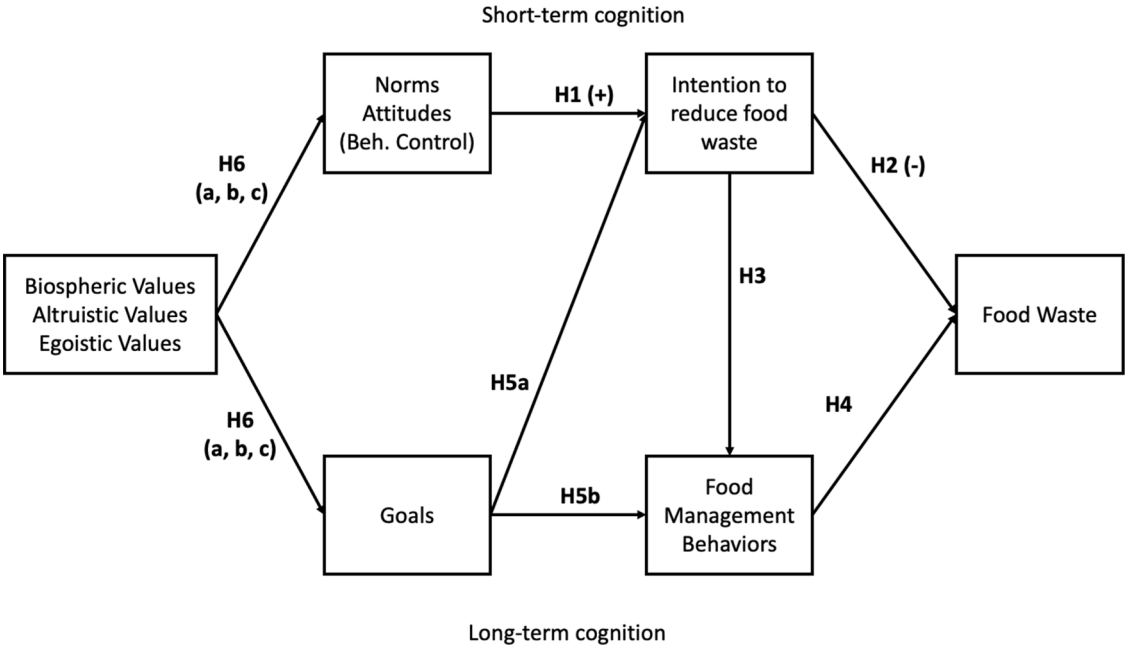

Fig. 1. Conceptual Model.

Table 1
Sample demographics.

Demographic information	Final sample (N = 1336)	UK population
Gender		
Female	49.9%	50.6%
Male	49.4%	49.4%
Other/ prefer not to say	0.7%	–
Ethnicity		
White	84.9%	86%
Mixed	2.4%	2.2%
Chinese	0.5%	0.7%
Asian (other)	7.3%	6.8%
Black	3.7%	3.3%
Other/ Prefer not to say	1.3%	–
Age		
18–24 years	9.1%	10.2%
25–34 years	16.5%	14.4%
35–44 years	17.4%	13.6%
45–54 years	18.9%	14.2%
55–64 years	23.7%	13.2%
65 years and over	14.4%	19.7%
Education		
National Vocation Qualification	4.8%	–
GCSE or similar	14.1%	–
A-Level	22.2%	–
Undergraduate degree	37.4%	–
Postgraduate degree	17.1%	–
PhD	3%	–
'None of the above'	1.3%	–
Adults in the household		
1	17.6%	–
2	57.6%	–
3	14.3%	–
4	6.7%	–
5	2.7%	–
6	0.4%	–
8	0.3%	–
9	0.1%	–
Annual Gross Income		
< £7000	4.0%	–
£7000- £14,000	9.1%	–
£14,001- £21,000	10.5%	–
£21,001- £28,000	11.3%	–
£28,001- £34,000	10.3%	–
£34,001- £41,000	10.3%	–
£41,001- £48,000	6.6%	–
£48,001- £55,000	7.3%	–
£55,001- £62,000	6.2%	–
£62,001- £69,000	3.7%	–
£69,001- £76,000	3.3%	–
£76,001- £83,000	3.1%	–
> £83,000	6.4%	–
Prefer not to say / Don't know	7.9%	–
Religion		
Christian	37.1%	–
Muslim	3.4%	–
Hindu	1.1%	–
Jewish	0.9%	–
Sikh	0.3%	–
Buddhist	0.7%	–
Other	1.3%	–
None	53.0%	–
Prefer not to say	2.2%	–

me". Further, using three-, four-, and one-item measures (adapted from Russell et al., 2017), we assessed participants' perceived behavioral control to reduce food waste, their food waste attitudes, and their subjective norms, respectively, on a 5-point Likert scale (for scale points, see Appendix A). The intention to reduce food waste was measured by three items on a 5-point Likert scale from *1* = "*Strongly disagree*" to *5* = "*Strongly agree*", adapted from Stancu et al. (2016).

In contrast to these rather specific constructs, individual goals that may affect food waste via distinct behaviors seem to be multifaceted. Accordingly, we preferred not to rely on only one scale but instead to take a more exploratory approach and use multiple goal scales from not only the literature on food waste but also from the more general environmental literature. This approach allowed us to explore broader, underlying factor structures. We therefore created a scale by adapting six items from Unsworth and McNeill (2017), six items from van Geffen et al. (2017), two items from Barone et al. (2019), five items from WRAP (2014b), and, finally, adding two items ourselves. We asked participants how important each of these 21 goals was to them measured on a 5-point Likert scale from *1* = "*Not important at all*" to *5* = "*Very important*" (see Appendix A).

In the second questionnaire, administered to the same individuals two weeks after the first, we measured participants' food waste, their FMB, and demographical information. In line with the food waste literature, we measured self-reported food waste separately for four food categories: bread, chicken, potatoes, and milk. We adapted a scale previously used by WRAP (2020b) ranging from 0 to 100% for each of those four food categories on a slider where 0 represented 'None of the food was wasted (was all used up and eaten)' and 100 represented 'The whole amount was wasted (uneaten and thrown away)'. As with goals in the first part of the survey, we took a more exploratory approach to measure participants' FMB in the second part. Rather than focusing on only a few FMB, we adapted a list of 23 FMB produced by WRAP (2020a) allowing us to explore underlying factor structures. On a 5-point Likert scale from *1* = "*Never*" to *5* = "*At every opportunity*", we asked participants how frequently they have performed each of these FMBs in the last two weeks (see Appendix A).

3.3. Data analysis

Before analyzing the data using SEM, we needed to examine the underlying factor structures for our goal and FMB measures. Considering the size of our sample, we randomly split our sample in half (approximately 50% sample split), to conduct an exploratory factor analysis (EFA) with one half ($n_1 = 687$) and a confirmatory factor analysis (CFA) with the other ($n_2 = 649$), effectively treating them as two different samples. We then added the resulting goal- and FMB-related factors to the combined dataset to conduct our analysis using SEM. The EFAs were conducted in SPSS version 27 while the CFAs and the SEM were conducted in R 4.0.5.

4. Results

4.1. Goals

We conducted the EFA with all 21 goal items and varimax rotation for one half of our overall sample. Extraction was based on Eigenvalues > 1. Although the results of the EFA revealed a six-factor structure, the CFA showed that the final three factors were not sufficiently stable (see Supplemental materials). Given that only the first three factors showed acceptable reliabilities and variance extracted (see Supplemental materials), we only report those in the following. We report the full EFA and CFA in the Supplemental materials. Table 2 shows the results of the EFA

Table 2
EFA factor loadings: Goals.

Items	Responsibility	Pleasure	Convenience
Protecting the environment.	**.730**	.141	−0.055
Being a good citizen or neighbor.	**.689**	.036	.019
Ensuring social justice by not buying more than my household needs.	**.805**	.045	−0.078
Having a great experience when eating food.	.089	**.789**	.046
Having a great experience when cooking and preparing food.	.142	**.719**	−0.198
Having tasty food.	.117	**.551**	.070
Having food that is quick to prepare.	.035	−0.070	**.787**
Having convenient food.	−0.167	−0.023	**.751**

Table 3
CFA results: Goals.

Latent Factor	Indicator	B	SE	Z	β	δ	α	AVE
Responsibility	Protecting the environment.				.77	.41***	.76	.52
	Being a good citizen or neighbor.	1.15	.08	14.37	.72***	.48***		
	Ensuring social justice by not buying more than my household needs.	1.08	.08	13.93	.69***	.52***		
Pleasure	Having a great experience when eating food.				.74	.46***	.66	.47
	Having a great experience when cooking and preparing food.	1.22	.14	8.73	.70***	.51***		
	Having tasty food.	0.46	.05	10.06	.49***	.76***		
Convenience	Having food that is quick to prepare.				.92	.16	.74	.62
	Having convenient food.	0.72	.27	2.70	.64**	.59**		

Note. $\chi^2 = 68.07$; df = 17; $p < .001$; RMSEA = 0.068; SRMR = 0.041; CFI = 0.96; TLI = 0.93.

with the remaining three factors that comprise 8 goals. The first factor, which we labeled 'Responsibility', was related to the notion of ensuring social justice and protecting the environment and comprised five goals. The second, which we call 'Pleasure', related to the enjoyment of food and consisted of three goals. Finally, the third factor, 'Convenience', consisted of two goals and related to spending as little time as possible with food.

Having excluded the last three factors due to their instability (see Supplemental Materials), we conducted a second CFA with only the first three factors. We therefore assigned the 8 goals to their three respective factors, using the second half of our sample. The results are presented in Table 3. Importantly, the measurement model had acceptable fit indices ($\chi^2 = 68.07$; df = 17; $p < .001$; RMSEA = 0.068; SRMR = 0.041; CFI = 0.96; TLI = 0.93). As indicated in the EFA, the goals loaded strongly on their pre-assigned factors ($\lambda > 0.48$; $p < .001$) which, in turn, had acceptable reliabilities ($\alpha > 0.65$). Initially, though, it seemed that Pleasure did not reach the initial threshold of sufficient average variance extracted (AVE) of > 0.5, to establish divergent validity (see Fornell and Larcker, 1981). In such cases, Fornell and Larcker (1981) proposed another test for divergent validity. More specifically, the AVE needs to be larger than the square of the correlation between the factors. Considering that, for the CFA sample, the highest correlation among the factors is between Responsibility and Pleasure ($r = 0.342$; $r^2 = 0.117$) and that the lowest AVE was 0.47 (see AVE for Pleasure in Table 3), we can establish sufficient divergent validity for the three factors.

4.2. Food management behaviors

As with our goal measures, we conducted an EFA with all 23 FMB and varimax rotation for half of our overall sample. Extraction was based on Eigenvalues > 1. As with our goals, the EFA indicated five underlying factors, whereas the CFA showed that two of those factors were insufficiently stable and thus needed to be removed (see Supplemental Materials). The full EFA and CFA can also be found in the Supplemental Materials. Table 4 indicates the EFA results for the remaining three factors. Five items loaded cleanly onto 'Planning', three onto 'Using Label Information', and two onto 'Labeling'.

To examine that each factor captures unique variance, we conducted a second CFA with these three factors with the other half of our overall sample. We assigned each of the 10 FMB to their respective factors.[1] Given its theoretical relevance to food waste, we also included one of our items referring to leftover usage in this and all subsequent models. The results, illustrated in Table 5, show acceptable fit indices ($\chi^2 = 183.28$; df = 39; $p < .001$; RMSEA = 0.076; SRMR = 0.053; CFI = 0.95; TLI = 0.93). All three factors have acceptable reliabilities ($\alpha > 0.68$) and each FMB loads strongly onto its pre-assigned factor ($\lambda > 0.59$; $p < .001$). Importantly, divergent validity is supported as each factor meets the threshold of AVE > 0.5 (see Fornell and Larcker, 1981).

Accordingly, the analysis with the 23 FMB revealed three distinct factors: Planning, Using label information, and Labeling (and leftover usage as an extra single-item factor[1]). Alongside the three goal-related factors (i.e., Responsibility, Pleasure, and Convenience), we will examine the three FMB factors in our SEM model. As we are aware that practitioners might be interested in a frequency table that shows the number of participants per FMB that chose each of the five response options, we provided such a table in Appendix B.

4.3. Structural equation modeling

Having revealed three goal-related factors (i.e., Responsibility, Pleasure, and Convenience) and four FMB-related factors (i.e., Planning,

[1] Although the EFA did not reveal leftover usage as a factor, we included an item referring to leftover usage in the CFA and in the subsequent SEM model due to its theoretical significance to food waste.

Table 4
EFA factor loadings: FMB.

Items	Planning	Using Label Information	Labeling
Checking what you have in the cupboards before shopping.	**.773**	.241	.045
Checking what you have in the fridge before shopping.	**.773**	.261	−0.043
Managing cupboards (i.e., what there is and when to use it by).	**.420**	.354	.346
Making a shopping list.	**.609**	.005	.093
Checking what you have in the freezer before shopping.	**.787**	.177	.122
Checking labels for best before dates.	.228	**.799**	.091
Checking labels for use-by dates.	.204	**.816**	.067
Checking labels for where and how long to store items.	.160	**.680**	.236
Labeling products to show the date it was opened.	.047	.159	**.755**
Labeling products to show when you put it in the freezer.	.107	−0.007	**.755**

Using label information, Labeling, and Saving leftovers) based on EFA and CFA, we created an SEM with our overall sample ($N = 1336$ participants). The means, standard deviations and correlations can be found in Table 8. The model is graphically illustrated in Fig. 2. Our model starts with our three value groups (i.e., biospheric values, altruistic values, and egoistic values) which are thought to underpin both the three goal-related factors as well as subjective norms and attitudes as part of TPB-related constructs. These TPB-related constructs alongside perceived behavioral control (PBC) underpin participants' intention to reduce food waste which in turn is associated with self-reported food waste (alongside PBC, see TPB). Further, the three goal-related factors load both onto the three FMB-related factors and, again, on participants' intention to reduce food waste. Finally, the FMB-related constructs also load on self-reported food waste. Importantly, given the skewness of our food waste measure (see Table 7), we conducted the CFA and SEM with a log-transformed measure. As a robustness check and for transparency purposes, we report the CFA and SEM results without the log transformation in the Supplemental Materials.

Following best practice (for guidance, see Ullman and Bentler, 2012), we conducted an analysis of the measurement model before adding the structural paths. The results can be seen in Table 6. First, the model fit indicators suggest an acceptable fit ($\chi^2 = 2657.11$; df = 931; $p < .001$; RMSEA = 0.037; SRMR = 0.047; CFI = 0.93; TLI = 0.91). Second, all scales show an acceptable reliability ($\alpha > 0.63$) while all factors load moderately to strongly onto their pre-assigned factors ($\lambda > 0.39$; $p < .001$). Importantly, seven constructs reach the threshold of AVE > 0.5 to establish divergent validity (see Fornell and Larcker, 1981). For the remaining constructs we compared their squared correlations with their AVE (see Fornell and Larcker, 1981): As shown in Table 7, the highest correlation coefficient among the constructs that do not meet the above threshold of AVE (i.e., egoistic values, attitudes, PBC, responsibility, and pleasure) is between responsibility and attitudes ($r = -.37$; $r^2 = 0.14$). Considering that PBC has the lowest AVE according to Table 5 (AVE = 0.40), our results support divergent validity for our constructs.

The results of the structural model are summarized in Table 8 and graphically illustrated in Fig. 2. Overall, the data show acceptable fit with the model ($\chi^2 = 3419.32$; df = 987; $p < .001$; RMSEA = 0.043; SRMR = 0.068; CFI = 0.90; TLI = 0.89) and explain 19% of the variance in food waste, 14% of 'Planning', 9% of 'Using labels', 15% of 'Labeling' and 14% of leftover usage. Partially supporting H_{6a}, H_{6b}, and H_{6c}, participants' values were related to all three goal-related constructs as well as subjective norms and food waste attitudes. The medium-term goals, in turn, were associated with all FMB-related constructs, supporting H_{5b}. Although no directions were hypothesized (we did not pre-specify either the goal nor the FMB factors), we found both facilitative effects -

Table 5
CFA results: FMB.

Latent Factor	Indicator	B	SE	Z	β	δ	α	AVE
Planning	Checking what you have in the cupboards before shopping.				.87	.25***	.86	.56
	Checking what you have in the fridge before shopping.	0.95	.04	26.78	.85***	.28***		
	Managing cupboards (what there is and when to use it by).	0.80	.05	17.29	.63***	.59***		
	Making a shopping list.	0.79	.05	16.32	.60***	.64***		
	Checking what you have in the freezer before shopping.	1.07	.04	24.22	.79***	.36***		
Using Label Information	Checking labels for best before dates.				.87	.24***	.84	.65
	Checking labels for use by dates.	1.02	.04	24.53	.88***	.23***		
	Checking labels for where and how long to store items.	0.87	.05	18.59	.68***	.54***		
Labeling	Labeling products to show the date it was opened.				.73	.47***	.69	.54
	Labeling products to show when you put it in the freezer.	1.25	.16	7.92	.74***	.45***		
Saving leftovers[i]	Saving leftovers to use another day.					–	–	–

Note. $\chi^2 = 183.28$; df = 39; $p < .001$; RMSEA = 0.076; SRMR = 0.053; CFI = 0.95; TLI = 0.93.

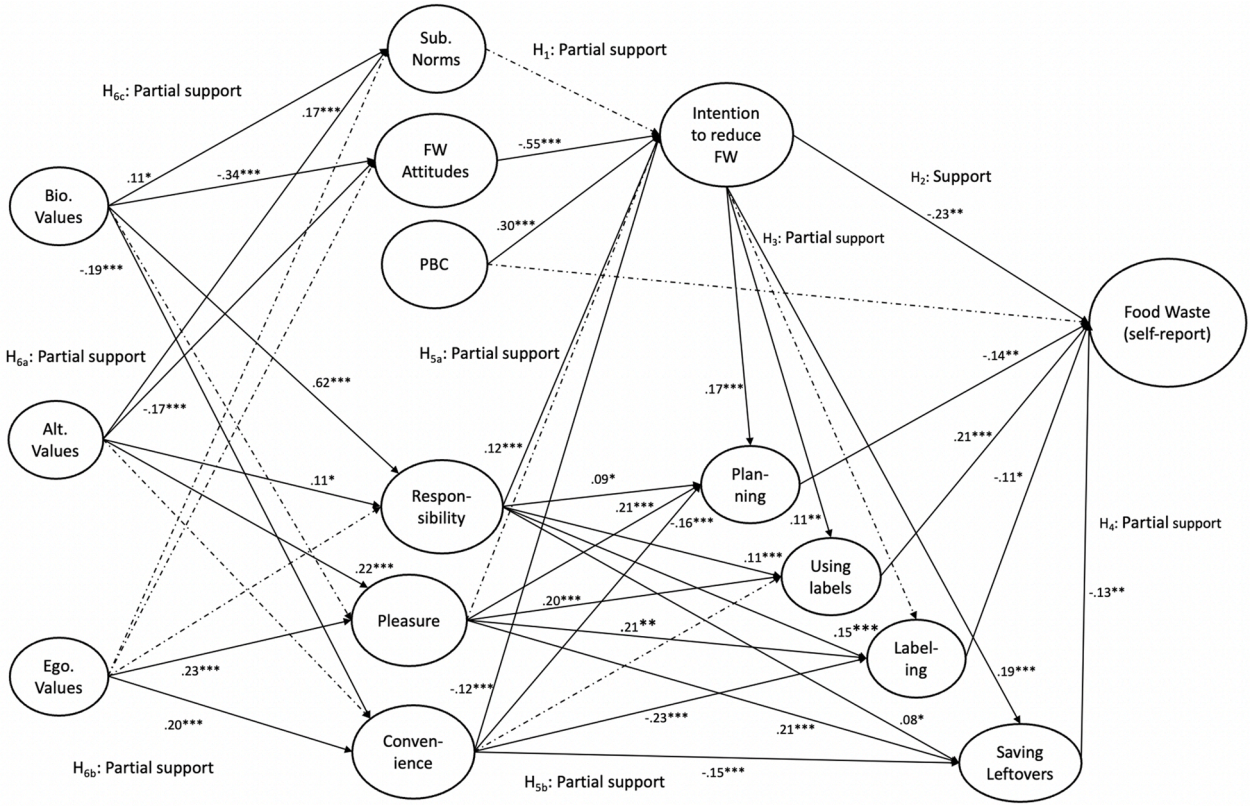

Fig. 2. SEM Model with standardised coefficients. Dashed lines represent non-significant paths. ***$p < .001$; **$p < .01$; *$p < .05$.

participants' frequency of planning was positively associated with their goal to behave responsibly and their goal of having pleasure with food – and inhibitive effects - the goal of having convenient food was negatively associated with planning activities. Planning, Labeling, and using leftovers were negatively associated with food waste; and, interestingly, using label information was positively associated with food waste, thus partially supporting H_4. Broadly aligned with TPB, participants' intention to reduce food waste was related to their food waste attitudes and their PBC (but not with subjective norms), thereby partially supporting H_1. The goal to behave responsibly also had a positive association with the intention to reduce food waste while the goal of having convenient food had a negative correlation, partially supporting H_{5a}. In partial support of H_3, participants' intention to reduce food waste was positively associated with using label information, planning behaviors and leftover usage. As expected, food waste per se was negatively associated with the intention to reduce food waste (supporting H_2). For transparency purposes, we would like to highlight that in the non-transformed model (see Supplemental Materials), 'Planning' and 'Labeling' were not significantly (or only marginally) correlated with self-reported food waste, whereas PBC was significantly correlated.

5. Discussion

5.1. Summary of results

This study aimed to create a more complete understanding of household food waste by amalgamating the proximal indicators of Theory of Planned Behavior (TPB, Ajzen, 1991), and Food Management Behaviors (FMB) with longer-term cognitions, namely values and personal goals (see Figs. 1 and 2). Importantly, we used a survey design across two waves and a sample that is approximating representativeness of the UK population. Based on the large range of possible goals and FMB that might be relevant, we used exploratory and confirmatory factor analyses to reveal three underlying goal factors (the goal of behaving responsibly, the goal of getting pleasure from food, and the goal of having convenient food) and four behavioral factors (planning, using label information, labeling, and saving leftovers). As expected, participants' values were associated with the three overarching goals (H_6) which, in turn, were associated with the four overarching FMB categories (H_{5b}). Importantly, values were also related to TPB-related constructs (H_6) in the expected directions. In addition to participants' intention to reduce food waste (H_2), leftover and label usage as well as their planning and labeling behaviors were directly associated with (log-transformed) self-reported food waste (H_4) whereas the three overarching goals were related to the log-transformed measure of food waste indirectly via intentions (H_{5a}) and FMB. Participants' intentions were also related to their engagement with planning behaviors, using labels, and saving leftovers (H_3). In the following sections, we discuss our findings in more detail. In summary, we believe our integrative study makes three strong contributions: (1) We demonstrate the importance of values in underpinning proximal food waste cognitions and behaviors, thus highlighting the embeddedness and difficulty in changing these; (2) We identify medium-term "triggers" of food management behaviors and food waste that are both independent of proximal cognitions and malleable yet long-lasting (see Austin and Vancouver, 1996) and thus make for promising interventions; and (3) We aid future research through the identification of the three FMB factors and the three personal goal factors for which the short scales we developed may now be used.

5.2. Theory of planned behavior

In addition to other important factors such as goals or values that captured unique variance our study largely supported TPB in partly explaining self-reported food waste as both perceived behavioral control (PBC) and participants' intentions were associated with our self-report food waste measure. Food waste attitudes had the largest association with participants' intention to reduce food waste alongside a positive

Table 6
CFA of the measurement model.

Latent Factor	Indicator	B	SE	Z	β	δ	α	AVE
Biospheric values	Preventing pollution: Protecting natural resources.				.87	.25***	.91	.73
	Respecting the earth: Harmony with other species.	1.06	.03	39.81	.85***	.28***		
	Unity with nature: Fitting into nature.	1.08	.03	36.54	.81***	.34***		
	Protecting the environment: Preserving nature.	1.06	.02	45.25	.89***	.19***		
Altruistic values	Equality: Equal opportunity for all.				.75	.44***	.82	.55
	A world at peace: Free of war and conflict.	0.89	.04	24.59	.72***	.48***		
	Social justice: Correcting injustice; care for the weak.	1.08	.04	27.14	.79***	.38***		
	Helpful: Working for the welfare of others.	0.90	.04	23.59	.69***	.53***		
Egoistic values	Social Power: Control over others; dominance.				.65	.58***	.76	.41
	Wealth: Material possessions; money.	0.90	.06	15.82	.53***	.72***		
	Authority: The right to lead or command.	1.38	.06	21.53	.78***	.39***		
	Influential: Having an impact on people and events.	1.34	.06	17.63	.65***	.57***		
	Ambitious: Hard-working; aspiring.	0.92	.06	14.83	.53***	.72***		
Food waste attitudes	I think food waste is… (very bad/ very good)				.74	.46***	.77	.46
	I think food waste is… (very harmful/ very beneficial)	1.06	.05	20.11	.63***	.60***		
	I think food waste is… (very unpleasant/ very pleasant)	1.24	.06	21.21	.69***	.53***		
	I think food waste is… (very unsatisfying/ very satisfying)	1.04	.05	20.98	.66***	.56***		
Perceived behavioral control	How much control do you have over whether you reduce food waste in your household?				.87	.24***	.64	.40
	How difficult would it be to reduce food waste in your home?	0.55	.05	10.74	.39***	.85***		
	It is mostly up to me to reduce food waste in my home.	0.97	.06	15.08	.65***	.59***		
Subjective norms	If I wasted less food, people who are important to me would…					–	–	–
Intention to reduce food waste	I try to minimize food waste in my home				.70	.51***	.81	.60
	I intend to minimize food waste in my home	1.23	.05	25.43	.82***	.33***		
	I plan to minimize food waste in my home	1.22	.05	24.07	.79***	.37***		
Log Food waste	Bread				.65	.58***	.77	.46
	Milk	1.18	.12	9.67	.71***	.50***		
	Chicken	0.93	.09	9.71	.69***	.53***		
	Potatoes	0.89	.09	10.47	.68***	.54***		
Goal: Responsibility	Protecting the environment.				.84	.29***	.75	.49
	Being a good citizen or neighbor.	0.94	.05	21.17	.63***	.60***		
	Ensuring social justice by not buying more than my household needs.	0.89	.04	20.93	.65***	.58***		
Goal: Pleasure	Having a great experience when eating food.				.71	.49***	.64	.46
	Having a great experience when cooking and preparing food.	0.79	.06	14.13	.71***	.50***		
	Having tasty food.	0.36	.03	11.34	.45***	.80***		
Goal: Convenience	Having food that is quick to prepare.				.65	.58***	.73	.62
	Having convenient food.	1.44	.13	10.94	.89***	.21**		
FMB: Planning	Checking what you have in the cupboards before shopping.				.86	.27***	.84	.54
	Checking what you have in the fridge before shopping.	0.94	.03	36.57	.84***	.30***		
	Managing cupboards (what there is and when to use it by).	0.74	.03	22.29	.59***	.66***		
	Making a shopping list	0.82	.04	22.79	.59***	.65***		
	Checking what you have in the freezer before shopping.	1.06	.03	33.77	.79***	.37***		
FMB: Using Label Information	Checking labels for best before dates.				.86	.25***	.82	.62
	Checking labels for use by dates.	1.00	.03	33.01	.85***	.28***		
	Checking labels for where and how long to store items.	0.86	.03	24.96	.66***	.56***		
FMB: Labeling	Labeling products to show the date it was opened.				.70	.50***	.68	.54
	Labeling products to show when you put it in the freezer.	1.32	.10	12.68	.76***	.44***		
FMB: Saving leftovers[i]	Saving leftovers to use another day.					–	–	–

Note. $\chi^2 = 2657.11$; df = 931; $p < .001$; RMSEA = 0.037; SRMR = 0.047; CFI = 0.93; TLI = 0.91.

Table 7
Means, standard deviations, and correlations ($n = 1336$).

Construct	M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Biospheric values	5.38	1.23	1														
2 Altruistic values	5.64	1.09	.62***	1													
3 Egoistic values	3.56	1.04	.08**	.11***	1												
4 Attitudes	1.70	0.50	−0.38***	−0.32***	−0.04	1											
5 Intention	4.47	0.56	.32***	.26***	−0.02	−0.53***	1										
6 PBC	3.83	0.78	.16***	.08**	−0.01	−0.21***	.34***	1									
7 Subjective norms	4.02	0.66	.27***	.25***	−0.03	−0.43***	.35***	.14***	1								
8 Food waste	7.36	11.48	−0.07	.03	.06	.10**	−0.25***	−0.18***	−0.08*	1							
9 Responsibility	3.41	0.93	.53***	.44***	.09***	−0.37***	.37***	.19***	.22***	−0.10**	1						
10 Pleasure	3.99	0.64	.15***	.20***	.19***	−0.21***	.19***	.11***	.16***	−0.07	.26***	1					
11 Convenience	3.30	0.94	−0.08**	−0.01	.16***	.08**	−0.19***	−0.10***	−0.08**	.13***	−0.11***	−0.13***	1				
12 Planning	3.65	0.87	.14***	.11***	.01	−0.21***	.25***	.11***	.16***	−0.13***	.22***	.20***	−0.17***	1			
13 Using Label Inf	3.51	0.96	.13***	.16***	.06*	−0.14***	.17***	.07**	.15***	.01	.21***	.16***	−0.03	.46***	1		
14 Labeling	1.89	1.09	.13***	.10***	.05*	−0.16***	.16***	.13***	.06*	.00	.22***	.16***	−0.20***	.33***	.31***	1	
15 Saving leftovers[i]	3.69	1.19	.16***	.12***	.02	−0.22***	.26***	.11***	.17***	−0.18***	.19***	.22***	−0.18***	.36***	.22***	.21***	1
16 Log Food Waste	0.65	0.50	−0.13**	−0.02	.09*	.16***	−0.31***	−0.19***	−0.14***	.75***	−0.13**	−0.09*	.18***	−0.19***	.02	−0.05	−0.22***

Note. M= mean; SD= standard deviation.

Table 8
SEM regression results.

Latent construct	Predictor	β	SE	z
Intention	Subjective norms	.05	.01	1.77
	Attitudes	−0.55***	.04	−13.92
	PBC	.30***	.02	8.99
	Goal: Responsibility	.12***	.02	3.59
	Goal: Pleasure	.03	.02	0.92
	Goal: Convenience	−0.12***	.02	−4.21
Log Food Waste	Intention	−0.23***	.04	−4.53
	PBC	−0.09	.02	−1.77
	FMB: Planning	−0.14**	.02	−2.70
	FMB: Using Label Information	.21***	.02	4.10
	FMB: Labeling	−0.11*	.02	−2.25
	FMB: Saving leftovers	−0.13**	.01	−2.84
Goal: Convenience	Biospheric values	−0.19***	.03	−3.64
	Egoistic values	.20***	.03	5.42
	Altruistic values	.09	.04	1.76
Goal: Responsibility	Biospheric values	.62***	.04	13.56
	Egoistic values	.03	.03	1.15
	Altruistic values	.11*	.04	2.45
Goal: Pleasure	Biospheric values	.02	.03	0.45
	Egoistic values	.23***	.03	5.90
	Altruistic values	.22***	.04	3.80
FMB: Planning	Intention	.17***	.07	4.80
	Goal: Convenience	−0.16***	.04	−4.79
	Goal: Responsibility	.09*	.04	2.39
	Goal: Pleasure	.21***	.05	5.47
FMB: Using Label Information	Intention	.11**	.08	3.06
	Goal: Convenience	.00	.05	0.02
	Goal: Responsibility	.11**	.04	2.89
	Goal: Pleasure	.20***	.05	5.13
FMB: Labeling	Intention	.07	.07	1.81
	Goal: Convenience	−0.23***	.04	−5.93
	Goal: Responsibility	.15***	.04	3.52
	Goal: Pleasure	.21***	.04	4.76
FMB: Saving leftovers[i]	Intention	.19***	.09	5.97
	Goal: Convenience	−0.15***	.05	−4.91
	Goal: Responsibility	.08*	.05	2.40
	Goal: Pleasure	.21***	.06	5.92
Attitudes	Biospheric values	−0.34***	.02	−6.93
	Egoistic values	.02	.02	0.69
	Altruistic values	−0.17**	.02	−3.39
Subjective norms	Biospheric values	.11*	.04	2.52
	Egoistic values	−0.03	.03	−0.95
	Altruistic values	.17***	.04	3.54

Note. $\chi^2 = 3419.32$; df = 987; $p < .001$; RMSEA = 0.043; SRMR = 0.068; CFI = 0.90; TLI = 0.89.

influence of participant's perceived behavioral control. The more they thought of food waste as something bad, and the more they saw themselves as in control of their food waste, the greater they intended to reduce food waste. In contrast to TPB, subjective norms did not correlate with participants' intention to reduce food waste. Considering that we are not the first to report a non-significant correlation between subjective norms and intention to reduce food waste (see Visschers et al., 2016), one possible explanation may suggest that food waste, because it is often invisible to others even within the same household, is rather driven by attitudes than subjective norms. This line of reasoning seems to be aligned with studies that found attitude-based intentions to perform a behavior to be better predictors of the behavior, compared to norm-based intentions (Sheeran et al., 1999).

Another possible explanation refers to our main contribution, that is, the integration of TPB, values, goals, and FMB. It seems that the inclusion of three goals and value-orientations, particularly 'Responsibility' as additional predictors of participants' intention to reduce food waste and altruistic (and biospheric) values as predictors of subjective norms may have captured some variance that would have been attributed to subjective norms, thereby reducing the effect of subjective norms. In other words, our results suggest that it may not be subjective norms that affect the intention to reduce food waste but rather a mix of values and

goals.

5.3. Food management behaviors

Using EFA and CFA with 23 FMB, we have revealed four underlying factors: Planning, Using label information, Labeling, and saving leftovers. The results showed a positive relationship between the usage of label information (i.e., checking labels for dates) and food waste as well as a negative relationship between saving leftovers, planning, and labeling behaviors and self-reported food waste. Although our findings for leftover usage (see Stancu et al., 2016), planning routines (see Stefan et al., 2013; Stancu et al., 2016), and checking label information (Davenport et al., 2019; Thompson et al., 2020) seem to be in line with the literature (WRAP, 2014a), it is important to note that the effect sizes seem to be significantly smaller. As already pointed out above, this may refer to the integration of TPB, values, goals, with FMB. To date, most studies have investigated the impact of FMB onto food waste via main effects only, rather than via mediations. In such studies (see Stancu et al., 2016, Stefan et al., 2013), food waste was regressed onto participants' intention to reduce food waste separately from FMB. In our framework, however, FMB mediated the effect of participant's intention to reduce food waste besides the direct effects of FMB and intention onto self-reported food waste. Additionally, FMB were predicted in our framework by participants' goals (see Section 5.4) which also may have captured variance that would have been allocated to FMB if our goals had not been included. Accordingly, our results may suggest that the correlation between FMB and self-reported food waste may be smaller than previously anticipated because of an interplay of goals and behavioral intention. Alternatively, our small correlations may be due to the way we measured self-reported food waste, given that this is inherently sensitive to the response options available.

Interestingly, though common in the literature, our analysis did not reveal any underlying factors related to shopping behavior. One possible explanation for this may be that such factors did not capture sufficient unique variance once our four FMB were accounted for. Consequently, our findings may suggest that routines related to these four factors may be more important in predicting self-reported food waste for our sample than shopping routines. A second explanation might be that shopping routines are very multi-faceted and thus we have not included enough of such behaviors in our list of FMBs to extract a factor that sufficiently relates to such behavior.

These results point to important implications for interventions aimed at reducing food waste. We found that intentions to reduce food waste was positively associated with some FMBs that are negatively associated with food waste (e.g., planning or saving leftovers), while it is also positively associated with FMB that are positively associated with food waste (i.e., Using labels). This interdependency suggests that interventions aimed at increasing participants' intention to reduce food waste may have some undesired effects (i.e., increasing food waste through increasing label usage) that need to be considered when designing interventions. Moreover, our findings, particularly the *partial* mediation of intentions on food waste via FMBs, show that the most promising interventions may be both cognitive (i.e., focused on attitudes and intentions) and behavioral (i.e., focused on behaviors per se). The indirect effect of intentions through FMBs is expected and hypothesized, however the direct effect suggests an alternative decision-based approach to reducing food waste. For example, some decisions involving food waste (e.g., "Do I eat this apple or put it in the compost?") do not involve a food-management behavior (as defined in this survey), but instead represent a direct effect of intentions. Thus, the inclusion of both cognition and behavior in the same study allows us to highlight new potential interventions.

5.4. Goals

As with FMB, we extracted three goal-related factors from a pool of 21 goals: Responsibility, Convenience, and Pleasure. It is important to recall that we did not pre-select these factors. Instead, we were interested in those factors that capture sufficient unique variance from a list of goals that were thought to influence behavior (see Appendix A). Unsurprisingly, the most important of those seems to be the participant's goal to act responsibly as it is not only associated with their intention to reduce food waste but also with all four FMBs. It is important to note that this construct seems to encompass an ethical component as it is comprised of the goal of 'being a good person' and taking care of others, including the environment. It is also important to point out that this concept has very little to do with the ascription of responsibility to food waste (see Graham-Rowe et al., 2014; Welch et al., 2021). Although it is expectedly related to biospheric values (see Section 5.5), the goal of responsibility seems to reflect an individuals' motivation to act for the 'greater good' and thus appears to represent a novel concept in the food waste literature.

The goal of convenience seems to refer to the subjective importance of having quick food to focus the attention on other things that matter more. Our results show that, aligned with the literature (see Aschemann-Witzel et al., 2018; Parizeau et al., 2015), convenience negatively correlates with FMB (planning, labeling, saving leftovers) and participants' intention to reduce food waste.

In contrast, the goal of Pleasure requires more elaboration. In this paper, the construct of Pleasure relates to enjoyment of food-related activities. The more participants want pleasure from food, the more they engage in planning, using labels, labeling behaviors and saving leftovers. Nonetheless, to the best of our knowledge, this is the first study that shows that pleasure with food may indirectly correlate with self-reported food waste via using labels and leftover usage.

Interestingly, our factor analysis has not revealed goals traditionally thought to be related to food waste such as a healthy diet (see Conrad et al., 2018) or monetary concerns (Barone et al., 2019), despite a few of our goal items that specifically referred to those goals (see Appendix A). One explanation might be that these goals, as noted in the literature (Quested et al., 2013) are multi-faceted and thus our items, although they captured part of the goals, did not capture their full complexity. For example, people try to save money for a myriad of reasons; because they may want to increase their spending power in other areas or because they are motivated by the idea of thrift, among other reasons (Quested et al., 2013). Our items, as can be seen in Appendix A, rather relate to the concept of thrift and hence may have missed other nuances of the concept.

Importantly, our integrative study has shown that possible interventions could work at both cognitive and behavioral levels, rather than having to choose one or the other. We found that the 'Responsibility' goal was related to both intentions and behaviors. Thus, priming this goal may not only generate short-term cognitions (e.g., affecting intentions, which then have a knock-on effect to behavior) but it appears to also operate as a more automatic, non-conscious driver of FMBs. Nonetheless, such interventions also need to take the different relationships to FMBs we found in our results into consideration. Although priming this goal (i.e., 'Responsibility') may increase planning behaviors that reduce food waste, the same intervention may also increase behaviors that have been shown to accelerate food waste (e.g., labeling; see our results in Section 4.3 Structural Equation Modeling), thereby leading to a mix of behaviors in which the benefit of one may be diminished by the negative consequences of the other. It is these interdependencies that we have uncovered that are crucial to consider in future interventions to successfully reduce food waste.

5.5. Values

Our results show that, as expected, biospheric values are positively correlated with subjective norms and negatively correlated with food waste attitudes. Specifically, the more important biospheric values were to participants, the less they saw food waste as beneficial and the more

they believed their social environment approved of food waste reduction. Such findings are in line with the general literature in environmental psychology (relatedly, see Feinberg and Willer, 2013; Wesley Schultz and Zelezny, 1999) and suggest that altruistic and biospheric values underpin how individuals think and engage with food waste. Egoistic values, in contrast, do not seem to be related to subjective norms and attitudes, neither positively nor negatively. Given the inherent focus on the self (Schwartz, 1992), it seems that individuals with an egoistic value orientation simply 'do not care enough' about food waste or subjective norms because such concepts do not affect them and may therefore be perceived as irrelevant. Therefore, our findings suggest that persuasive attempts to reduce food waste may be more challenging for individuals with an egoistic value orientation, because they may not see food waste as sufficiently relevant to themselves, leading to less engagement with FMBs and less intention to reduce food waste.

Biospheric and altruistic values, however, seem to be partly associated with our three goal-factors. Given the relationship of responsibility with caring about others and the environment, it is not a surprise that both biospheric and altruistic values have positive effects. Additionally, our results also show a negative relationship between biospheric values and Convenience, suggesting that individuals high in biospheric values see the time associated with preparing food as less of an issue. This finding is broadly aligned with research that suggests such individuals are willing to make a personal sacrifice in exchange for behaving pro-environmentally (Rahman and Reynolds, 2016).

5.6. Limitations

Although our study contributes to the literature in several ways, we see the need to elaborate on some considerations that are important for the interpretation of our results. First, given that our sample is drawn from the UK population, we do not suggest that our findings hold across countries and cultures. Despite the established influence of some of our constructs, we encourage future research to use our framework and conduct our study in different countries. Moreover, as elaborated above, although the sample of our first wave was representative of the UK population in terms of age, gender, and ethnicity, our final sample was merely 'approaching' representativeness due to between-wave attrition.

Second, as with a lot of food waste research, we recognise that our analysis was correlational and thus we cannot draw causal conclusions. Although integrative studies like ours are useful for identifying important factors that may help to reduce food waste, these factors need to be tested in interventions and/or experiments to establish causality. In addition, and again like much of the research into food waste, it is important to recall that our food waste measure was based on self-reported data. Given that self-report measures frequently underestimate food waste (van der Werf et al., 2020), it requires us to consider the possibility that our model may not represent the true pattern of variance.

Finally, we conducted the survey in March 2021, at the end of the Covid-19-related lockdown in the UK, which may have affected participants' responses to our questions. In particular, it may have influenced their engagement in some of the food management behaviors such as those related to shopping. Although this is speculative, we nevertheless encourage future researchers to repeat our study to examine the validity of our framework in a time after the pandemic.

5.7. Practical implications & conclusions

The aim of this study was to integrate known research findings on food waste from different areas (TPB and FMBs) with long-term cognitions. We hypothesized and found a complex array of interrelationships and shared pathways that allow us to provide both cautious advice as well as new ideas for interventions to practitioners. In essence, we believe future work needs to take these interdependencies into account when designing interventions, particularly noting that a change in one behavior may be accompanied by a (negative) change in another behavior. Intervention studies need thus to consider both cognitive and behavioral pathways as well as both positive and negative spillover effects. A simplistic intervention that focuses only on one aspect of this complexity will be unlikely to be effective. Thus, it is important that future interventions measure multiple FMBs to capture these spillover effects. To tackle food waste, our results imply that attempts merely focused on promoting engagement in FMB may be limited. Instead, our study suggests that efforts may be more promising when they are aligned with individual values and goals. However, further research is needed to examine whether such efforts only work if the goal to behave responsibly is important to the individual; or conversely, how individuals react to such efforts if they are not driven by the goal to behave responsibly. Similarly, communication strategies that are aimed at persuading individuals to reduce their food waste need to resonate with their values. Given that values differ between individuals, we recommend a targeted approach to communications, in which values and goals (especially responsibility) represent a central part of that targeting. Inherently, such approaches require practitioners to know the values and goals of their target groups before engaging with them. Thus, we recommend that practitioners first familiarise themselves with their target group via surveys, interviews and other engagement activities, before designing their interventions.

Drawing from a sample approximating representativeness of the UK population, the findings of our integrative study extend our current understanding of household food waste and indicate that self-reported household food waste appears to be the result of a complex chain of short- and long-term cognitive processes, underpinned by individual values. The former relates to self-reported food waste through the individuals' perceived control and their intention which, in turn, is driven by their attitudes and norms related to food waste (i.e., TPB). The latter, in contrast, relates to self-reported food waste through their engagement in FMBs which are not only associated with the person's intention to reduce food waste, but also by their goals (e.g., responsibility). Overall, our study demonstrates the complexity of understanding household food waste (see also Boutlet et al., 2021) given the interdependencies of values, goals, FMB and TPB.

5.8. Future research

Our results open various avenues for future research. First, for future interventions we believe it is necessary to further examine whether priming medium-term goals such as responsibility can indeed promote a reduction in food waste behavior. Our results have shown that goals are associated with both intentions and FMB, thus playing an important role in determining food waste. Experiments that test whether priming those goals can decrease food waste through such cognitive and behavioral mechanisms, and comparing these mechanisms, may be a valuable first step to designing more effective interventions. Importantly, in pursuing these avenues, researchers should measure a range of FMB and intentions to ensure interdependencies are not overlooked.

Second, our results demonstrate the importance of values in determining food waste through a range of mechanisms. Unlike previous research which focused on short-term cognitions and behaviors, our inclusion of longer-term constructs allows us to understand and predict different reactions to interventions. Hence, interventions to reduce food waste might be more successful in reducing food waste if they take individual values into account. Future research can, for example, examine whether individuals with a particular type of value orientation are more prone to responding to specific primes than individuals with other value-orientations. For example, the strong relationships between biospheric values or altruistic values and the responsibility goal suggests that priming a responsibility goal may not work for those people who are low in these values.

Third, we feel the need to stress that a single prime will most likely

not be sufficient to influence individual behavior. Research has shown that priming individuals works best if these primes are repeatedly conducted over time (see Steg and Vlek, 2009). Hence, we urge scholars to test such longitudinal intervention designs both in laboratory settings and in real-life rather than relying on cross-sectional data.

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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, Writing – review & editing, Supervision, Funding acquisition. **Sally V. Russell:** Conceptualization, Methodology, Writing – review & editing, Supervision, Funding acquisition. **Tom E. Quested:** Conceptualization, Methodology, Writing – review & editing, Supervision. **Aggelina Doriza:** Methodology, Writing – review & editing. **Gülbanu Kaptan:** Conceptualization, Methodology, Writing – review & editing, Supervision, Funding acquisition.

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.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.resconrec.2022.106442.

Appendix A

Wave	Construct	Scale	Item	Source
1	Biospheric values	1: "Not important to me"… 7: "Very important to me"	Preventing pollution: Protecting natural resources.	(de Groot and Steg, 2008)
			Respecting the earth: Harmony with other species.	(de Groot and Steg, 2008)
			Unity with nature: Fitting into nature.	(de Groot and Steg, 2008)
			Protecting the environment: Preserving nature.	(de Groot and Steg, 2008)
1	Altruistic values	1: "Not important to me"… 7: "Very important to me"	Equality: Equal opportunity for all.	(de Groot and Steg, 2008)
			A world at peace: Free of war and conflict.	(de Groot and Steg, 2008)
			Social Justice: Correcting injustice; care for the weak.	(de Groot and Steg, 2008)
			Helpful: Working for the welfare of others.	(de Groot and Steg, 2008)
1	Egoistic values	1: "Not important to me"… 7: "Very important to me"	Social Power: Control over others; dominance.	(de Groot and Steg, 2008)
			Wealth: Material possessions; money.	(de Groot and Steg, 2008)
			Authority: The right to lead or command.	(de Groot and Steg, 2008)
			Influential: Having an impact on people and events.	(de Groot and Steg, 2008)
			Ambitious: Hard-working; aspiring.	(de Groot and Steg, 2008)
1	Attitudes	1: "Very bad"… 5: "Very good"	I think wasting food is…	(Russell et al., 2017)
		1: "Very harmful"… 5: "Very beneficial"	I think wasting food is…	(Russell et al., 2017)
		1: "Very unpleasant"… 5: "Very pleasant"	I think wasting food is…	(Russell et al., 2017)
		1: "Very unsatisfying"… 5: "Very satisfying"	I think wasting food is…	(Russell et al., 2017)
1	Perceived behavioral control	1: "Very little"… 5: "Very much"	How much control do you have over whether you reduce food waste in your household?	(Russell et al., 2017)
		1: "Very difficult"… 5: "Very easy"	How difficult would it be for you to reduce food waste in your home?	(Russell et al., 2017)
		1: "Strongly disagree"… 5: "Strongly agree"	It is mostly up to me to reduce food waste in my home.	(Russell et al., 2017)
1	Subjective norms	1: "Completely disapprove"… 5: "Completely approve"	If I wasted less food, people who are important to me would…	(Russell et al., 2017)
1	Intention to reduce food waste	1: "Strongly disagree"… 5: "Strongly agree"	I try to minimize food waste in my home.	(adapted; Stancu et al., 2016)
			I intend to minimize food waste in my home.	(adapted; Stancu et al., 2016)
			I plan to minimize food waste in my home.	(adapted; Stancu et al., 2016)
1	Goals	1: "Not important at all"… 5: "Very important"	Spending as much time as possible on activities outside the kitchen.	(adapted; WRAP, 2014b)
			Having the highest quality food.	(adapted; WRAP, 2014b)
			Having a great experience when cooking and preparing food.	(adapted; WRAP, 2014b)
			Having a great experience when eating food.	(adapted; WRAP, 2014b)
			Having food that is quick to prepare.	(adapted; WRAP, 2014b)
			Having tasty food.	(adapted; van Geffen et al., 2017)
			Having convenient food.	(adapted; van Geffen et al., 2017)
			Having enough food.	(adapted; van Geffen et al., 2017)

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Wave	Construct	Scale	Item	Source
			Having cheap food.	(adapted; van Geffen et al., 2017)
			Not having too much food.	(adapted; van Geffen et al., 2017)
			Eating healthy food.	(adapted; van Geffen et al., 2017)
			Treating myself to "naughty" or "luxurious" food.	Developed
			Avoiding foodborne illnesses.	Developed
			Ensuring I can monitor the food intake for me or somebody in my household (e.g., for dieting or health reasons).	(adapted; Unsworth and McNeil 2017)
			Being frugal and thrifty.	(adapted; Unsworth and McNeil 2017)
			Protecting the environment.	(adapted; Unsworth and McNeil 2017)
			Ensuring social justice by not buying more than my household needs.	(adapted; Unsworth and McNeil 2017)
			Not standing out from the crowd.	(adapted; Unsworth and McNeil 2017)
			Being a good citizen or neighbor.	(adapted; Unsworth and McNeil 2017)
			Providing a large variety of foods at shared mealtimes so that everyone can eat what they like.	(adapted; Barone et al., 2017)
			Having products available to be prepared for unexpected guests or events.	(adapted; Barone et al., 2017)
2	Self-reported food waste	0–100%	Bread	(e.g., WRAP, 2020b)
			Milk	(e.g., WRAP, 2020b)
			Chicken	(e.g., WRAP, 2020b)
			Potatoes	(e.g., WRAP, 2020b)
2	Food Management Behaviors	1: "Never"… 5: "At every opportunity"	Checking what you have in the cupboards before shopping.	(e.g., WRAP, 2020a)
			Checking what you have in the fridge before shopping.	(e.g., WRAP, 2020a)
			Using random ingredients you happen to have to make a meal.	(e.g., WRAP, 2020a)
			Managing cupboards (i.e., what there is and when to use it by).	(e.g., WRAP, 2020a)
			Managing the fridge (i.e., what there is and when to use it by).	(e.g., WRAP, 2020a)
			Making a shopping list.	(e.g., WRAP, 2020a)
			Cooking creatively (trying new recipes).	(e.g., WRAP, 2020a)
			Thinking where to store items to keep them fresh for longer.	(e.g., WRAP, 2020a)
			Saving leftovers to use another day.	(e.g., WRAP, 2020a)
			Checking what you have in the freezer before shopping.	(e.g., WRAP, 2020a)
			Checking labels for best before dates.	(e.g., WRAP, 2020a)
			Checking labels for use by dates.	(e.g., WRAP, 2020a)
			Freezing items.	(e.g., WRAP, 2020a)
			Sticking to your shopping list/ not buying extra.	(e.g., WRAP, 2020a)
			Making a meal plan for the week ahead.	(e.g., WRAP, 2020a)
			Managing the freezer (i.e., what there is and when it was frozen).	(e.g., WRAP, 2020a)
			Batch cooking (e.g., making several portions to store for later).	(e.g., WRAP, 2020a)
			Checking labels for where and how long to store items.	
			Weighing/ Judging portions the number you are cooking for.	(e.g., WRAP, 2020a)
			Checking labels for portion size guidance (e.g., serves 2).	(e.g., WRAP, 2020a)
			Labeling products to show the date it was opened.	(e.g., WRAP, 2020a)
			Checking/ changing the fridge temperature.	(e.g., WRAP, 2020a)
			Labeling products to show when you put it in the freezer.	(e.g., WRAP, 2020a)

Appendix B

Food Management Behaviors	Never	Occasionally	Sometimes	Often	At every opportunity
Checking what you have in the cupboards before shopping.	38	137	227	576	358
Checking what you have in the fridge before shopping.	38	88	196	585	429
Using random ingredients you happen to have to make a meal.	173	321	404	326	112
Managing cupboards (i.e., what there is and when to use it by).	99	272	358	461	146
Managing the fridge (i.e., what there is and when to use it by).)	49	164	272	596	255
Making a shopping list.	85	164	212	438	437
Cooking creatively (trying new recipes).	202	354	379	299	102
Thinking where to store items to keep them fresh for longer.	138	234	293	456	215
Saving leftovers to use another day.	79	167	238	459	393
Checking what you have in the freezer before shopping.	97	166	264	503	306
Checking labels for best before dates.	54	160	231	592	299
Checking labels for use by dates.	48	182	213	573	320
Freezing items.	51	155	307	554	269
Sticking to your shopping list/ not buying extra.	190	276	320	411	139
Making a meal plan for the week ahead.	377	303	204	257	195

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Food Management Behaviors	Never	Occasionally	Sometimes	Often	At every opportunity
Managing the freezer (i.e., what there is and when it was frozen).	181	299	329	367	160
Batch cooking (e.g., making several portions to store for later).	327	316	288	272	133
Checking labels for where and how long to store items.	145	278	324	425	164
Weighing/ judging portions the number you are cooking for.	277	243	250	392	174
Checking labels for portion size guidance (e.g., serves 2).	411	359	267	232	67
Labeling products to show the date it was opened.	857	196	136	101	46
Checking/ changing the fridge temperature.	664	357	204	86	25
Labeling products to show when you put it in the freezer	699	215	159	145	118

Note. Frequency table showing the number of participants per respond option per food management behavior ($N = 1336$).

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