



Determinants of consumer food waste behaviour: Two routes to food waste



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ABSTRACT

Approximately one quarter of the food supplied for human consumption is wasted across the food supply chain. In the high income countries, the food waste generated at the household level represents about half of the total food waste, making this level one of the biggest contributors to food waste. Yet, there is still little evidence regarding the determinants of consumers' food waste behaviour. The present study examines the effect of psycho-social factors, food-related routines, household perceived capabilities and socio-demographic characteristics on self-reported food waste. Survey data gathered among 1062 Danish respondents measured consumers' intentions not to waste food, planning, shopping and reuse of leftovers routines, perceived capability to deal with household food-related activities, injunctive and moral norms, attitudes towards food waste, and perceived behavioural control. Results show that perceived behavioural control and routines related to shopping and reuse of leftovers are the main drivers of food waste, while planning routines contribute indirectly. In turn, the routines are related to consumers' perceived capabilities to deal with household related activities. With regard to intentional processes, injunctive norms and attitudes towards food waste have an impact while moral norms and perceived behavioural control make no significant contribution. Implications of the study for initiatives aimed at changing consumers' food waste behaviour are discussed.

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1. Introduction

Every year large amounts of the food available for human consumption are lost or wasted in the different stages of the food supply chain. Recent estimates suggest that globally food losses and waste amount to about 24 per cent of all food supplied for human consumption (Kummu et al., 2012). Food losses refer to those losses in production, post-harvest and processing of food, while food waste represents losses at the distribution and consumption stages (Gustavsson, Cederberg, Sonesson, van Otterdijk, & Meybeck, 2011; Kummu et al., 2012). In the higher income countries (e.g. in Europe), the biggest contributors to food waste are distribution and consumption (i.e. household level) while in the lower income countries (e.g. in Sub-Saharan Africa) it is the agricultural and post-harvest stages which account for much of the food loss generated (Kummu et al., 2012; Parfitt, Barthel, & Macnaughton, 2010).

At the household level, food waste in Europe is estimated to

represent more than 50 per cent of the total food waste (Kummu et al., 2012) and even up to 60 per cent of the total food waste throughout the different stages in the US (Griffin, Sobal, & Lyson, 2009). Studies in the UK showed that the amount of food and drink waste at the household level represents about 22 per cent (330 kg per household per year) of all purchased food and drink (WRAP, 2009). An overwhelming share of this waste, namely 65 per cent (215 kg per household per year), was avoidable, meaning that at some point prior to being discarded it was edible (WRAP, 2009). Lower levels of avoidable food waste were found in Denmark where an average household generates about 105 kg of avoidable food waste per year (EPA, 2012) and in Finland where the avoidable food waste represents about 63 kg of avoidable food waste per household per year (Koivupuro et al., 2012; Silvennoinen, Katajajuuri, Hartikainen, Heikkilä, & Reinikainen, 2014). The differences in amounts can also be due to differences in the methods used for estimation and definitions of food waste.

These large amounts of food waste have a severe negative environmental impact, but also social and monetary effects. First, food waste is associated with large emissions of greenhouse gases (Bio Intelligence Service, 2010; WRAP, 2009) and wasteful use of

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resources such as water, cropland, fertilisers or fossil fuels (Hall, Guo, Dore, & Chow, 2009; Kummu et al., 2012). Secondly, the global population is expected to increase in the coming years, which implies that higher constraints will be placed on the food available. The reduction of food waste is seen as a strategy to increase food supply in order to feed the increasing global population (Godfray, Beddington, Crute, Haddad, Lawrence, Muir, et al., 2010; Godfray, Crute, Haddad, Lawrence, Muir, Nisbett, et al., 2010). Therefore, wasting food has a negative societal impact as it contributes to the shortage of food and as such to an increased challenge of feeding the world's population. Finally, avoidable food waste is estimated to cost UK households up to £480 per year, representing roughly 15 per cent of their total expenditure on food and beverages (WRAP, 2009), while in US the estimates are at about \$936 used on food purchased but not eaten per household per year (Buzby & Hyman, 2012).

These negative impacts of food waste call for more attention towards means to reduce the amount of food waste generated. Prevention of food waste is found to be one of the most promising means to achieve environmental impact savings compared to other alternatives such as home composting or draining of moisture to reduce food waste (Gentil, Gallo, & Christensen, 2011; Matsuda, Yano, Hirai, & Sakai, 2012) as well as to improve food security for the growing population (Godfray, Crute, et al., 2010; Kummu et al., 2012). Moreover, prevention of food waste seems feasible as there appears to be a lot of potential for reduction in food waste and losses (up to 63%), especially at the consumption stage (Kummu et al., 2012). Waste reduction at the consumption level is critical as well because the environmental impact accumulates throughout the stages of the food life cycle (Williams & Wikström, 2011).

Even though avoiding food waste is suggested as the most promising initiative for decreasing the environmental impact of food waste, little is known about consumers' behaviour towards food waste and the determinants of consumer food waste. Compared to the body of literature aiming to estimate the amount of food waste and its consequences, studies on consumer behaviour towards food waste are scarce. Since prevention is seen as one of the most suitable ways to deal with the food waste issue and the consumption level has the highest potential for prevention, such research is highly relevant. Insight into the determinants of consumer food waste behaviour could provide a basis for efforts to promote food waste prevention at the household level. Although food waste has severe environmental consequences, consumers seem to be bothered by food waste because they see it as a waste of money rather than because it has negative effects on the environment (Brook Lyndhurst, 2007). In a study conducted by Watson and Meah (2013), consumers did not make any connection between food waste and environmental concerns such as greenhouse gas emissions, similarly only few mentioned social impact of food waste as a reason for feeling guilty about their food waste. However, household economic concerns such as time and money were related to people's aversion to waste food (Watson & Meah, 2013). It seems thus that consumers perceive food waste as food-related behaviour more so than as environmental behaviour. The present paper studies food waste from the perspective of food-related behaviour.

The objective of the present study was to examine determinants of household food waste with a focus on the avoidable part of the food waste defined as the food and drink which at some point prior to being thrown out was edible (WRAP, 2009). There is both theoretical and empirical support for the association between several psycho-social factors, such as attitudes, norms, perceived behavioural control or self-efficacy and food-related behaviour (AbuSabha & Achterberg, 1997; Ajzen, 1991); thus, the role of such factors will be accounted for in the present study. At the same time,

household food waste cannot be seen in isolation as it is embedded in the household food provisioning process, which includes many interrelated decisions (Jensen et al., 2012; Marshall, 1995; Munro, 1995). Therefore, in this study, household routines related to decisions in the food provisioning process (e.g. shopping, cooking) and households' perceived skills in dealing with these routines were considered as potential determinants of food waste behaviour in parallel to psycho-social factors.

2. Theoretical background and prior literature

Many studies of food-related behaviour have drawn on the Theory of Planned Behaviour (Ajzen, 1991) to explain behaviours of interest (Conner & Armitage, 2002). Recently, the framework was applied in a study of food waste behaviour (Stefan, van Herpen, Tudoran, & Lähteenmäki, 2013).

The Theory of Planned Behaviour posits that behavioural intention is the primary antecedent of behaviour (Ajzen, 1991). As consumers are generally waste averse (Bolton & Alba, 2012), there is reason to believe that intentional processes may drive their food waste behaviour. Further, according to the Theory of Planned Behaviour, behavioural intention is determined by consumers' attitudes towards the behaviour, their subjective norms and their perceived behavioural control. Attitudes towards the behaviour represent the general favourable or unfavourable evaluation of performing the behaviour, and more favourable attitudes towards the behaviour are expected to translate into stronger intentions to perform the behaviour (Ajzen, 1991). Subjective norms account for consumers' perceived social pressure to engage in the behaviour and are hypothesised to contribute to stronger intentions to perform the behaviour (Ajzen, 1991). The literature on social influence posits that there is an important distinction to be made between social injunctive and descriptive norms. The first ones refer to what is seen as commonly approved or disapproved behaviour in a culture, i.e. the shared beliefs of how one should behave, called the "ought" norms. The latter refer to what is commonly done, the so-called "is" norms (Cialdini, Reno, & Kallgren, 1990; Reno, Cialdini, & Kallgren, 1993). The subjective norms in the Theory of Planned Behaviour can be seen as a type of injunctive norms (Thøgersen, 2006) as they account for the perceived social pressure to undertake the behaviour. Prior evidence shows that subjective norms operationalized in line with the Theory of Planned Behaviour have a weak effect in applications of the theory (Armitage & Conner, 2001) and this is the case in relation to food waste behaviour as well (Stefan et al., 2013). Therefore, in the present study the norms were operationalised as injunctive norms. The final antecedent of intention included in the Theory of Planned Behaviour, perceived behavioural control, was added to extend the applicability of the theory to behaviours which are not under complete volitional control. This construct accounts for past experience as well as potential barriers or facilitators of the behaviour and represents the perceived ease or difficulty of engaging in the behaviour. It contributes to stronger intentions and in conditions of suboptimal volitional control, it adds to the prediction of behaviour (Ajzen, 1991). Prior literature provides some evidence that in the case of food waste behaviour, the perceived behavioural control can determine behaviour through food-related routines and not intentions (Stefan et al., 2013).

The additional role of moral aspects in the context of the Theory of Planned Behaviour has been studied in prior literature (e.g. Arvola et al., 2008; Chu & Chiu, 2003) as the framework allows the flexibility of examining the influence of additional relevant concepts to its original ones (Ajzen, 1991). Moral aspects have proved to be important in explaining consumers' food choice behaviour (Raats, Shepherd, & Sparks, 1995). In food waste behaviour the

moral aspects seem to be relevant as well as consumers feel guilty or bothered to some extent if they waste food (Brook Lyndhurst, 2007; Hamilton, Denniss, & Baker, 2005; Stefan et al., 2013).

While the factors considered above may have a role in explaining food waste behaviour through intentions, the present study considers a second route to food waste, the routine one. Food-related behaviours are interrelated and embedded in households' food provisioning process (Jensen et al., 2012; Sobal & Bisogni, 2009). Food waste behaviour, as the last step in the household food provisioning process (Munro, 1995), can be seen as a food-related behaviour interconnected with other food-related behaviours embedded in this process. Due to their repetitive nature, food-related behaviours can become routinized, leading as such to the facilitation of everyday life (Beharrell & Denison, 1995; Sobal & Bisogni, 2009; Thomas & Garland, 2004). As one of the main components in food choice processes (Furst, Connors, Bisogni, Sobal, & Falk, 1996; Sobal & Bisogni, 2009), routines are closely related to food choice scripts. The latter refer to the procedural knowledge that consumers have about food-related behaviours in specific situations, including their plans of how to act in a specific situation and the sequence of behaviour that they will undertake. Those food choice scripts that work for consumers become routines providing comfort and predictability (Jastran, Bisogni, Sobal, Blake, & Devine, 2009; Sobal & Bisogni, 2009). The importance of routines in consumer behaviour is recognised, and due to the interrelatedness of food-related behaviours these may be important in explaining food waste behaviour. Routines as conceptualised in the present study differ from habits in that they are not seen to be automatic responses to specific cues (Verplanken & Orbell, 2003).

Prior literature supports the importance of household food-related routines in understanding food waste behaviour (Brook Lyndhurst, 2007; Koivupuro et al., 2012; Stefan et al., 2013). As consumers' shopping behaviour seems to some extent to be routinized (Maubach, Hoek, & McCreanor, 2009) and purchasing too much food during the shopping trips is common (Brook Lyndhurst, 2007; Evans, 2012), such routines could contribute to increased food waste. On the other hand, cooking too much food seems to be a main driver of food waste in addition to the purchase of too much food, thus reuse of leftovers could contribute to lower levels of food waste (Brook Lyndhurst, 2007). Planning routines, such as planning meals in advance or checking inventories, can also contribute to lower food waste (Stefan et al., 2013). Moreover, planning routines could decrease the likelihood of underestimation of inventories and purchase of food already in stock at home (Bell, Corsten, & Knox, 2011; Chandon & Wansink, 2006), and could potentially contribute to stronger leftovers reuse routines.

Food-related routines are much influenced by the skills or confidence that consumers have in their ability to perform these activities. Theoretically, the impact of one's confidence to perform an action on the likelihood of performing it is supported when considering the role of self-efficacy in explaining behaviour (Bandura, 1977). There is also empirical evidence that for instance cooking skills have an impact on consumption (Hartmann, Dohle, & Siegrist, 2013) or that confidence in cooking has an influence on shopping (Winkler & Turrell, 2009). Moreover, lack of cooking skills has been shown to constrain people's food choices, such that low confidence in one's cooking skills was associated with unwillingness to experiment with cooking (Bava, Jaeger, & Park, 2008). Skills or one's ability to deal with food provisioning activities play an important role in food waste (Brook Lyndhurst, 2007; Watson & Meah, 2013).

Finally, socio-demographic factors may be associated with food waste behaviour. Larger households are found to waste more food (Koivupuro et al., 2012), and the same holds for households with higher incomes (Stefan et al., 2013). Age, however, is negatively

correlated with food waste amounts (Brook Lyndhurst, 2007; Stefan et al., 2013).

This study explored whether combining psychological factors with food-related routines provides a better model than the psychological one on its own. Therefore two competing models of the hypothesised relationships between the concepts were developed (see Figs. 1 and 2). The first model represents the intentional route to food waste; it was developed based on insights from the Theory of Planned Behaviour (Ajzen, 1991) considering the additional role of moral norms and accounts for the hypothesised impact of the psychological constructs on food waste. The second model includes the additional routine route to food waste. The hypothesised effects of the routines were developed based on prior literature regarding the role of routines in food choice and food waste in particular. Based on prior studies emphasising the importance of household food-related routines on food waste (e.g. Stefan et al., 2013), the combined model was expected to perform better in explaining the food waste behaviour than the psychological model. The two compared models are seen as reflecting different avenues for changing people's food waste behaviour, thus the results can provide useful insight for future attempts to reduce food waste.

3. Method

3.1. Participants and design

Data were collected by means of a web-based survey developed in the Qualtrics software; it was conducted in July 2012 in Denmark. All participants were recruited in collaboration with YouGov, a nationwide market research institute, from the institute's panel. As reward for their participation, the respondents received points that can be exchanged for products in the YouGov Panel Store.

The survey was targeted to Danes between the age of 18 and 74 who are responsible to some extent for cooking in their household. A link to the online survey developed by the authors was delivered to the YouGov market research institute. YouGov distributed the survey link through their recruitment system to individuals in the YouGov Panel who met the criteria for participating in the study. A total of 3303 individuals were invited to participate via email invitations, of which 1109 completed the survey, meaning a response rate of 34 per cent. Of these, 1062 respondents were within the target group and were responsible to some extent for cooking and shopping in their household. The sampling method employed by YouGov ensured that the sample contained a good variety of people in terms of age, gender and region. The sample contained slightly more females compared to the population (53% vs 50%), fewer respondents under 35 years old (22% vs 29%) and more respondents over 55 years (38% vs 31%). The prevalence of respondents in the 35–54-years interval was the same in the sample compared to the population (i.e. 40%), the same holds for the prevalence of respondents from different Danish regions (Capital 31%, Zealand 15%, South 23% vs 22%, Central 22%, North 10%). The socio-demographic characteristics of the final sample are presented in Table 1.

The questionnaire was developed in English, translated into Danish and then back-translated to ensure compatibility of terms. A pilot test including measures developed by the authors based on previous literature was conducted on a sample of 200 respondents from the YouGov Panel in April 2012.

After the pilot test, minor changes in wording were made to the questionnaire. Moreover, due to results of the pilot test showing that people at large have a negative attitude towards food waste, the decision to use unipolar scales rather than bipolar ones to measure attitudes in the main study was made, in an attempt to get a better distribution for this construct.

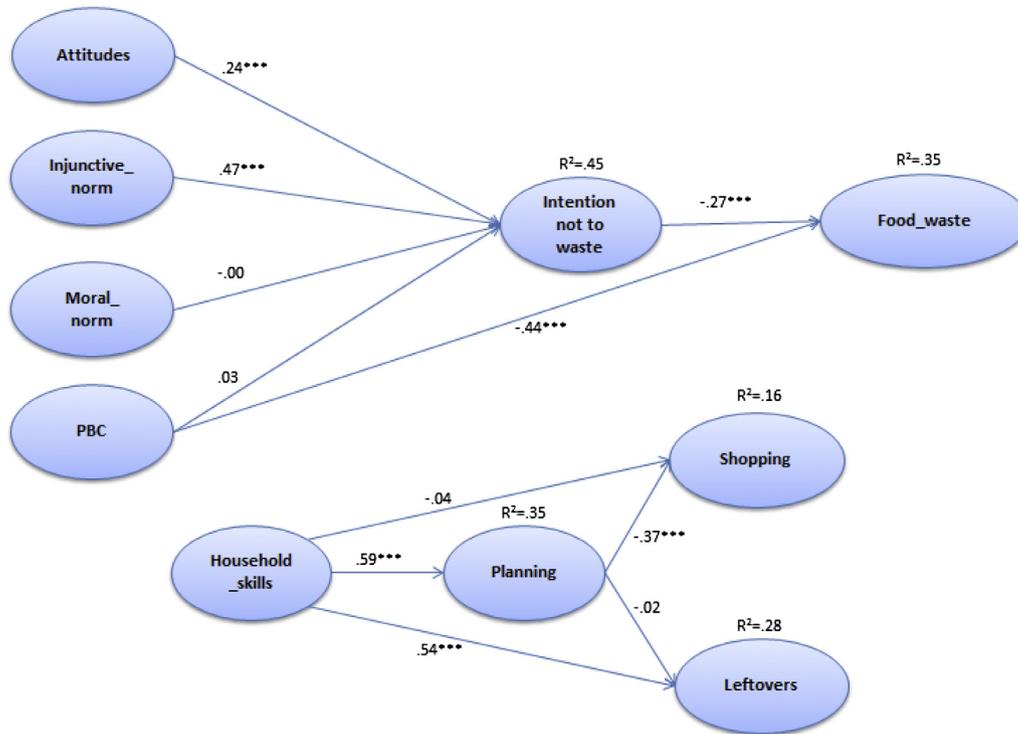


Fig. 1. The structural model of food waste behaviour: effects of psychological constructs. Note! The model allows covariation between Attitudes, Injunctive norm, Moral norm, Perceived behavioural control and Household skills (covariances between all of these are allowed). **Goodness of fit indices:** Chi-square = 1586.25, df = 413; p < .001; IFI = .92, CFI = .92, RMSEA = .05. ***p < .001; **p < .01; *p < .05. N = 1037 (due to exclusion of multivariate outliers). R² = Squared multiple correlations.

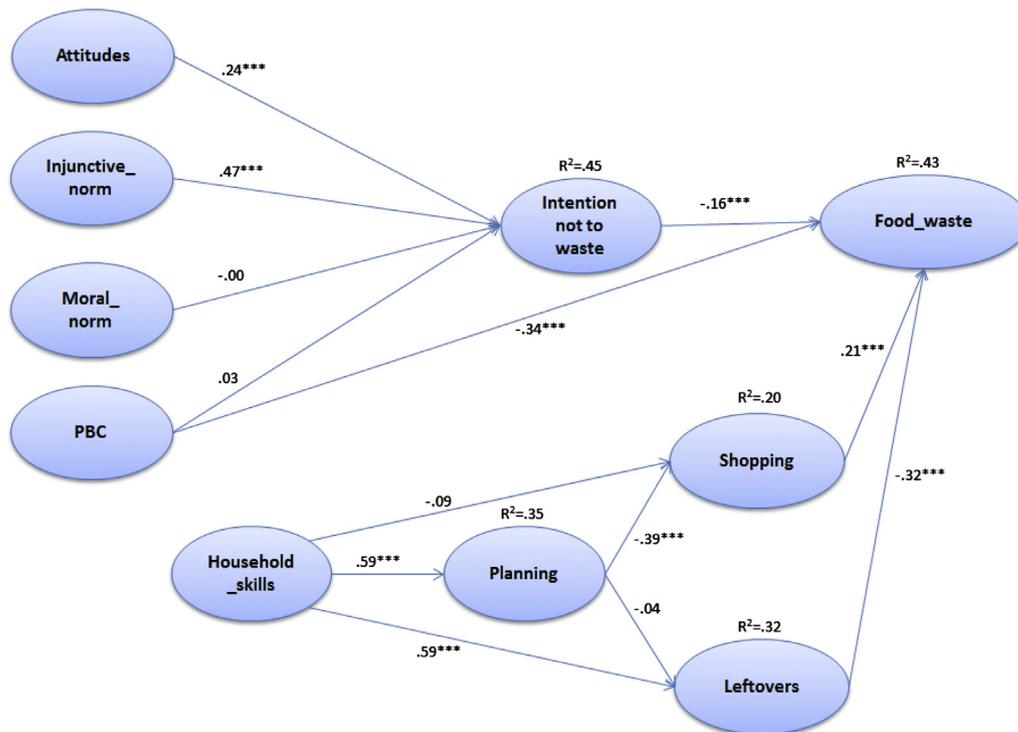


Fig. 2. The combined structural model of food waste behaviour: effects of psychological and household-related constructs. Note! The model allows covariation between Attitudes, Injunctive norm, Moral norm, Perceived behavioural control and Household skills (covariances between all of these are allowed). **Goodness of fit indices:** Chi-square = 1478.92, df = 411; p < .001; IFI = .93, CFI = .93, RMSEA = .05. ***p < .001; **p < .01; *p < .05. N = 1037 (due to exclusion of multivariate outliers). R² = Squared multiple correlations.

Table 1
Socio-demographic and background characteristics of respondents (N = 1062).

	Sample (%)
Gender	
Male	46.9
Female	53.1
Education	
Basic school	9.5
A level	31.7
Professional training	35.0
University level	23.8
Occupation	
Full time work (>30 h per week)	56.6
Part time work (<=29 h per week)	5.9
Retired	22.4
Pupil or Full time student	7.2
Unemployed	6.5
Homemaker	1.4
Location	
Urban area	89.0
Rural area	11.0
Income	
Up to DKK 599.999	49.2
DKK 600.000–699.999	9.2
DKK 700.000 and over	27.4
Do not know	3.2
Prefer not to say	11.0
	Mean/SD
Age	48.0/14.7
Household size	2.3/1.1
Number of children (under 16 years old)	1.4/0.9
Awareness of environmental and social impacts (maximum value 7)	4.7/1.6
Awareness of economic impacts (maximum value 7)	4.4/1.7

3.2. Measures

The questionnaire contained measures of self-reported food waste behaviour, intentions not to waste food, food-related routines, household skills, attitudes towards food waste, moral and injunctive norms, perceived behavioural control, awareness of food waste consequences and socio-demographics (see Table 2 for the measures included in the structural models). These measures were part of a larger questionnaire on food and meals. Results of the remaining data will be presented elsewhere. For most items the instructions included "thinking about your household" (e.g. "Please rate your disagreement/agreement with the following statements, *thinking about your household*").

3.2.1. Food waste behaviour (self-reported)

In the questionnaire, food waste was defined as, "all food and drink which at some point prior to being thrown away was edible (e.g. slices of bread, apples, cooked food)". Self-reported food waste behaviour was measured using a 5-item scale (Stefan et al., 2013). The items referred to the food waste in general and four specific sub-categories of food, namely dairy, fresh fruit and vegetables, meat and fish and finally bakery products.

3.2.2. Intention not to waste food

Intention **not** to waste food was measured as a more ordinary way of expressing intentions towards food waste, as wasting food was considered an odd purposeful behaviour. The intention was measured using three items, developed following the Theory of Planned Behaviour (Ajzen, 1991, 2005) guidelines.

3.2.3. Shopping routines

Shopping routines were measured with a 3-item scale regarding purchase of larger amounts of food than needed. The scale was

developed based on measures of shopping routines used in previous literature (Brook Lyndhurst, 2007; Exodus, 2007; Stefan et al., 2013). One scale item, referring to purchase of larger amounts of food when they offer good value for money, was omitted in the Confirmatory Factor Analysis step due to low loading on the construct.

3.2.4. Leftovers reuse routines

Routines in terms of reuse of leftovers were measured with a 3-item scale referring to method of reuse and storage of leftovers. The items were developed by the authors based on previous studies (Brook Lyndhurst, 2007; Exodus, 2007).

3.2.5. Planning routines

Planning routines were measured with two items referring to planning of shopping trips and of meals ahead. Items were adapted from previous studies of consumer food waste (Exodus, 2007; Stefan et al., 2013).

3.2.6. Attitudes towards food waste

A measure of general attitude towards food waste was used, consisting of four items rated on 7-point scales. In the Confirmatory Factor Analysis one of the items was omitted due to cross-loading with another factor. Two of the items referred to throwing away food and the remaining to loading the environment with one's household food waste. The items were developed in accordance with the Theory of Planned Behaviour (Ajzen, 1991, 2005) guidelines.

3.2.7. Moral norms

Moral norms were measured with a 3-item scale adapted from prior literature on food-related behaviours (Olsen, Sijtsema, & Hall, 2010) and environmental behaviours (Thøgersen & Ölander, 2006).

3.2.8. Perceived behavioural control

Perceived behavioural control was measured with a 3-item scale. Two items asked about the degree to which food waste in general and in relation to the environment is avoidable/unavoidable, and one item asked about ease or difficulty of not wasting food. The items were developed in line with the Theory of Planned Behaviour (Ajzen, 1991, 2005) and prior studies on household food waste by Brook Lyndhurst (2007).

3.2.9. Injunctive norms

The norms were measured with a 4-item scale. The items referred to what *one ought to do* regarding food waste in general and food waste in relation to the environment, representing as such social injunctive norms (Thøgersen, 2006). One item related to the norm of composting food waste was dropped during the Confirmatory Factor Analysis due to cross-loading with another factor.

3.2.10. Household skills

The perceived capabilities to deal with household food-related activities were assessed with five items referring to how poor or good do people perceive their skills related to several specific household related activities. The items were developed based on previous studies (Brook Lyndhurst, 2007; Exodus, 2007). One item was dropped during the Confirmatory Factor Analysis due to cross-loading with another factor.

Finally, consumers' awareness of food waste consequences and their socio-demographic characteristics were measured.

Awareness of food waste consequences was measured as a background variable to assess whether the respondents were at least to some extent aware of the issues related to food waste. Awareness of environmental and social impact was measured with

Table 2
Results of confirmatory factor analysis (N = 1037^a).

Factors and items	Factor loadings	CR	AVE
Food waste behaviour		.85	.52
Items worded as 'How much ... is thrown away in your household of what you buy and/or grow, in a regular week':			
Food	.79		
Milk and dairy products	.62		
Fresh fruits and vegetables	.73		
Meat and fish	.74		
Bread and other bakery products	.73		
Scale: <i>hardly any (1), less than a tenth (less than 10%) (2), more than a tenth but less than a quarter (between 10% and 25%) (3), more than a quarter but less than a half (between 25% and 50%) (4), more than a half (more than 50%) (5)</i>			
Intention not to waste food		.94	.83
Introduction: 'Please answer the following questions thinking about the near future (e.g. next one/two weeks) and your household'			
I intend not to throw food away	.94		
My goal is not to throw food away	.87		
I will try not to throw food away	.92		
Scale: <i>strongly disagree(1) to strongly agree(7)</i>			
Shopping routines		.56	.41
We often buy unintended food products when shopping	.80		
We often buy food in packages that are too big for our household's needs	.43		
We usually buy higher amounts of food when they offer good value for money (D)	–		
Scale: <i>strongly disagree(1) to strongly agree(7)</i>			
Leftovers reuse routines		.59	.33
The leftovers are usually eaten as such or just reheated when used again	.47		
The leftovers are usually transformed into a different dish by adding some ingredients before eating them	.51		
The leftovers are stored in appropriate conditions so they will last	.71		
Scale: <i>strongly disagree(1) to strongly agree(7)</i>			
Planning routines		.75	.61
The shopping trips are usually planned in advance (shopping list are made, inventories are checked, etc.)	.85		
The home meals are usually planned for a couple of days ahead	.70		
Scale: <i>strongly disagree(1) to strongly agree(7)</i>			
Household skills		.86	.61
Items worded: Thinking about the activities related to food within your home, how would you rate your household's skills, in terms of			
Planning the meals	.85		
Planning the shopping (making shopping lists, checking inventories, etc.)	.82		
Buying the right food in right amounts to prepare the meals and for household consumption in general	.78		
Cooking/preparing the food	.66		
Storing and reusing leftover food (D)	–		
Scale: <i>very poor(1) to very good(7)</i>			
Attitudes towards food waste		.82	.60
In my opinion wasting food is	.89		
Scale: <i>not at all negative(1) to extremely negative(7)</i>			
In my opinion wasting food is	.84		
Scale: <i>not at all foolish(1) to extremely foolish(7)</i>			
In my opinion loading the environment with my household's food waste is (D)	–		
Scale: <i>not at all harmful(1) to extremely harmful(7)</i>			
In my opinion loading the environment with my household's food waste is	.56		
Scale: <i>not at all negative(1) to extremely negative(7)</i>			
Moral norms		.87	.69
Items were worded: 'Wasting food would'			
Make me feel guilty about people who do not have enough food	.80		
Make me feel guilty about the environment	.85		
Give me a bad conscience	.84		
Scale: <i>strongly disagree(1) to strongly agree(7)</i>			
Perceived behavioural control		.80	.57
In my opinion wasting food is (R)	.83		
Scale: <i>avoidable(1) to unavoidable(7)</i>			
In my opinion loading the environment with my household's food waste is (R)	.75		
Scale: <i>avoidable(1) to unavoidable(7)</i>			
Not to throw food away would be (was asked with the same introduction as the intention items) (R)	.67		
Scale: <i>easy(1) to difficult(7)</i>			
Injunctive norms		.70	.43
Items were worded as 'One should ...'			
Never waste any food	.62		
Reuse leftovers	.65		
Recycle the food waste generated (e.g. composting) (D)	–		
Not load the environment with food waste	.70		
Scale: <i>strongly disagree(1) to strongly agree(7)</i>			

Goodness of fit indices: Chi-square = 1198.48, df = 389; p < .001; IFI = .95, CFI = .95, RMSEA = .045.

R-item was reversed for analyses.

D-item was deleted from further analyses.

^a After multivariate outliers were excluded from the analyses.

four items: “Food waste generated in Denmark does not impact the resources of the developing countries” (reversed); “Food waste generated in Denmark does not have an impact on the undernourished people in the world” (reversed); “Food waste is not a problem for the environment as it is natural and biodegradable” (reversed); “Discarded food packaging is a greater environmental issue than food waste” (omitted from analyses due to low loading) using a 7-points agreement rating scale. Awareness of economic consequences was measured with two items, “In my household, we never think about how much money we use weekly for food that gets thrown away” (reversed) and “In my household, we are aware of how much money we use weekly for food that gets thrown away” using a 7-points agreement rating scale. Items were developed based on prior food waste literature (Brook Lyndhurst, 2007; Stefan et al., 2013).

Respondents' socio-demographic characteristics were inquired into at the end of the survey (Table 1).

3.3. Data analyses

The data analyses were conducted in two stages. First, a Confirmatory Factor Analysis was run in SAS 9.4 (SAS Institute Inc., Cary, North Carolina, USA) in order to test the reliability and validity of the measurements. Secondly, the conceptual models were tested using Structural Equation Modelling in SAS 9.4 (SAS Institute Inc., Cary, North Carolina, USA).

3.3.1. Confirmatory factor analysis (CFA)

The Confirmatory Factor Analysis showed very good fit of the measurement model, as indicated by the overall goodness-of-fit indices, with incremental fit index (IFI) and comparative fit index (CFI) values at the threshold point of .95 and RMSEA lower than .05 (Hu & Bentler, 1999; MacCallum, Browne, & Sugawara, 1996) presented under Table 2. In addition, the convergent validity and discriminant validity (Anderson & Gerbing, 1988) of the scales were investigated.

All items had significant loadings ($p < .001$) higher than or very close to .50 on their corresponding factors, providing evidence for convergent validity. The average variance extracted (AVE) and construct reliability (CR) were also used to assess item convergence. Constructs with AVE values equal or higher than .50 and with CR values equal or higher than .70 are considered to show convergent validity (Fornell & Larcker, 1981). In our study the injunctive norms had an AVE value slightly under the threshold of .50 while the shopping and leftovers reuse routines slightly missed the threshold values for both AVE and CR. All other constructs had AVE and CR values higher than these thresholds.

The discriminant validity of the constructs was investigated as suggested by Fornell and Larcker (1981). As the average variance extracted for each one of the factors was larger than the square of the correlation estimate of the factor with all measures of the other constructs in the model (Table 3), we can conclude that the measures show sufficient discriminant validity. Taking all these indicators into account, we can conclude that the measurement model is satisfactory.

3.3.2. Test of the structural models (SEM)

In the present study several competing models of food waste were tested. The starting point was a constrained model considering just some of the effects of psychological factors, and subsequent models were constructed by relaxing few constraints at the time until the combined model of psychological and household-related routines was reached. Of these models only the most relevant ones are presented in this study (see Figs. 1 and 2). These two models were compared in order to identify whether a combined

model of psychological factors and household-related routines performs better than the psychological effects model.

4. Results

4.1. Test of the conceptual models

The results of testing the two competing conceptual models are presented in Figs. 1 and 2. The models converged well and had satisfactory goodness-of-fit. As can be seen in the goodness-of-fit indices presented under Fig. 2, the combined model had the best goodness-of-fit indicators which are closer to the strictest threshold value of .95 for CFI and IFI and at the strictest cut-off point of .05 for RMSEA, which were suggested by Hu and Bentler (1999) or MacCallum et al. (1996). The other model had slightly lower fit indices (Fig. 1), however still acceptable (MacCallum et al., 1996).

The improvement in fit between the psychological effects model to the combined model was significant (Table 4), meaning that the combined model fits the data better compared to the psychological effects model. In terms of variance explained, the combined model explained more of the variance in reported food waste behaviour compared to the psychological effects model (Figs. 1 and 2).

4.2. Explaining food waste

As the combined model provides the best fit indices and explains more of the variance in reported food waste behaviour (Fig. 2), this one will be interpreted further on. In the combined model, the impacts of intentions not to waste food and perceived behavioural control were lower compared to the psychological effects model (Fig. 1). The combined food waste model explained 43 per cent of the variance in food waste, 45 per cent in intention not to waste food, 20 per cent in shopping routines, 32 per cent in leftovers reuse routines and finally 35 per cent in planning routines (Fig. 2). Perceived behavioural control, leftovers reuse routines, and the intention not to waste food had the expected negative impact on the self-reported food waste behaviour, while shopping routines had the expected positive impact. Intention not to waste food had a rather small contribution in explaining food waste behaviour compared to food-related routines and perceived behavioural control.

Intention not to waste food was determined by injunctive norms and attitudes towards food waste, while moral norms and perceived behavioural control made no significant contribution. Of these, injunctive norms were the strongest predictors and had the expected positive effect, thus the more consumers believe that they should not waste food, the stronger their intention not to waste food. Further, attitudes towards food waste made a positive contribution in explaining intention not to waste food, as expected.

Higher perceived capabilities in dealing with household-related activities were positively related to *leftovers reuse routines*, but planning routines were not significantly related to leftovers reuse routines. On the other hand, *shopping routines* were explained to some extent by the variation in planning routines; stronger planning routines were related to lower reporting of buying unplanned items and big packs, while household skills had no significant association with shopping routines, however they did make an indirect contribution through planning routines. *Planning routines* were associated strongly and positively to household skills, thus perceived higher capabilities to deal with household food-related activities were related to stronger planning routines.

Table 3
Descriptives and correlations between food waste and psychological and household food-related constructs (N = 1037^a).

	Food waste behaviour ^b	Intention not to waste food ^c	Shopping routines ^c	Leftovers reuse routines ^c	Planning routines ^c	Household skills ^c	Attitudes towards food waste ^c	Moral norms ^c	Perceived behavioural control ^c	Injunctive norms ^c
Food waste behaviour	1									
Intention not to waste food	-.40**	1								
Shopping routines	.27**	-.08**	1							
Leftovers reuse routines	-.40**	.44**	-.12**	1						
Planning routines	-.18**	.17**	-.27**	.21**	1					
Household skills	-.41**	.37**	-.23**	.40**	.46**	1				
Attitudes towards food waste	-.27**	.51**	-.02	.31**	.10**	.18**	1			
Moral norms	-.10**	.37**	.03	.21**	.11**	.13**	.56**	1		
Perceived behavioural control	-.44**	.35**	-.15**	.34**	.10**	.28**	.41**	.25**	1	
Injunctive norms	-.33**	.49**	-.02	.40**	.11**	.24**	.49**	.39**	.37**	1
Mean	1.7	5.9	3.7	5.3	4.0	5.3	5.4	4.0	4.8	5.5
Standard deviation	.6	1.4	1.5	1.1	1.7	1.2	1.3	1.8	1.5	1.3

**p < .01.

^a Due to exclusion of multivariate outliers.

^b Rated on a 5-point rating scale.

^c Rated on a 7-point rating scale.

Table 4
Comparison between the psychological effects model and the combined model.

Total N = 1037										
Model	Constraints relaxed	χ^2	df	RMSEA	$\Delta\chi^2$	Δ df	p	NFI	CFI	TLI
0	Psychological effects model (Fig. 1)	1586.25	413	.052						
1	Combined model (Fig. 2)	1478.92	411	.050	107.33	2	.000	.068	.090	.085

4.3. Socio-demographic and background characteristics

Consumers' reported food waste behaviour was significantly correlated with household size, income and age (Table 5). Lower amounts of food waste were associated with older consumers, fewer members in the household and lower income. When socio-demographics were added to the models tested in the present study, they did not interact with the other factors in the model and did not contribute much to the improvement of the model. Therefore, the more parsimonious models without socio-demographics are reported in the present study.

Awareness of food waste consequences was also significantly related to food waste, with awareness of economic impact having a stronger negative association compared to awareness of environmental and social consequences (Table 5). Both types of awareness were associated with psycho-social factors; however, awareness of environmental and social consequences had stronger associations with attitudes and moral norms. Awareness of economic consequences was strongly associated to food-related routines such as planning, shopping or reuse of leftovers as well as household skills, while awareness of environmental and social impact was related to a low extent only to reuse of leftovers practices. Thus, awareness of environmental and social impact seems to be more strongly related to some of the psycho-social factors, while awareness of economic impact is more related to household skills and food-related routines. As to varying degrees awareness of food waste consequences was associated with all the factors in the conceptual model, in order to keep the model parsimonious it was omitted from the structural models tested for the purpose of this study.

5. Discussion

5.1. Factors associated with food waste

The present study examined how household food-related routines, skills and psycho-social factors are associated with household

food waste behaviour. When two competing models of food waste were compared (one containing structural relationships of the psychological factors with food waste while the second contained the additional impact of household food-related routines), the combined model fitted the data slightly better and explained more of the variance in reported food waste behaviour compared to the psychological effects model. Adding food-related routines to the selected psycho-social factors makes an important contribution towards explaining food waste behaviour and provides alternative ways to influence food waste behaviour. The findings of this study with Danish households parallel well prior evidence of drivers of food waste behaviour from Romania (Stefan et al., 2013). The few differences could to some extent be due to country-specific differences between the samples of the two studies, as culture is known to play an important role in food waste behaviour (Stuart, 2009). This suggests that drivers of food waste are likely to be similar in many cultures and thereby the suitability of adopting means to reduce food waste from one country to another can be explored as it is possible to learn from the experience of other countries.

The combined conceptual model showed that the shopping and leftovers reuse routines and the perceived behavioural control were more important determinants of reported food waste than stated intentions not to waste food, as could be expected based on prior literature (Stefan et al., 2013). However, in this study intentions reached a significant, although weak, effect on food waste unlike in the earlier study among Romanian consumers. Further, the planning routines made only an indirect contribution through these, unlike the findings from a prior study (Stefan et al., 2013). Planning routines are likely to be mediated through other food-related routines (Jensen et al., 2012); for example, insufficient planning may result, for some consumers, in the underestimation of stocks and thereby lead to overbuying (Chandon & Wansink, 2006). Finally, the perceived behavioural control had a significant and strong effect on food waste directly compared to its effect on intentions not to waste food. This finding seems to suggest that food waste behaviour is not under strong volitional control (Ajzen, 1991;

Table 5
Correlations between constructs in structural model and background variables (N = 1037^a).

	Awareness of environmental and social impacts	Awareness of economic impacts	Age	Household size	Income
Food waste behaviour	-.12**	-.32**	-.25**	.16**	.19**
Intention not to waste food	.21**	.37**	.21**	-.09**	-.07*
Shopping routines	-.03	-.19**	-.06	-.11**	-.04
Leftovers reuse routines	.11**	.35**	.22**	-.11**	-.09**
Planning routines	.04	.22**	.07*	.15**	.05
Household skills	.06	.29**	.30**	-.05	-.00
Attitudes towards food waste	.44**	.35**	.09**	-.10**	-.13**
Moral norms	.40**	.31**	.05	-.12**	-.17**
Perceived behavioural control	.19**	.34**	.12**	-.16**	-.13**
Injunctive norms	.25**	.30**	.14**	-.11**	-.13**
Awareness of environmental and social impacts	1				
Awareness of economic impacts	.20**	1			
Age	-.09**	.19**	1		
Household size	-.01	-.10**	-.20**	1	
Income	-.05	-.13**	.04	.50**	1

**p < .01; *p < .05.

^a Due to exclusion of multivariate outliers.

Armitage & Conner, 2001), which is also supported by prior evidence into drivers of food waste behaviour (Stefan et al., 2013).

The finding that household skills or perceived capabilities to deal with food-related routines were directly and significantly associated to leftovers reuse routines and planning routines supports prior literature on the role of perceived skills (Hartmann et al., 2013; Winkler & Turrell, 2009). Furthermore it is in line with theoretical expectations based on the impact of self-efficacy on behaviour (Bandura, 1977). Household skills also made an indirect contribution to shopping routines through planning routines.

Intentions were determined by attitudes towards food waste as expected based on the Theory of Planned Behaviour (Ajzen, 1991) and similar to most food-related studies using this theory (Conner & Armitage, 2002). However, the injunctive norm was significantly more closely associated to intentions. This finding is in line with prior research emphasizing the importance of injunctive norms in explaining consumer behaviour (Kallgren, Reno, & Cialdini, 2000). Similarly, prior research in food-related behaviours using the injunctive norm to operationalize the subjective norm component of the Theory of Planned Behaviour has found that the injunctive norm is the strongest predictor of intention (Dunn, Mohr, Wilson, & Wittert, 2011) or is stronger than attitudes for some food-related practices, such as use of food thermometers (Shapiro, Porticella, Jiang, & Gravani, 2011). On the other hand, the moral norm did not make a significant contribution, which would be expected based on the Norm Activation Model (Schwartz, 1977) and prior studies into food-related behaviours (Raats et al., 1995). One explanation for this non-significant effect could be that even though there is a strong injunctive norm not to waste food, food waste may not evoke strong moral guilt-related affect among consumers.

5.2. Changing food waste behaviour

There is an increasing interest among policy makers towards ways to decrease food waste due to its environmental and social consequences. At the European level there is a coalition of public authorities, industry representatives, universities and other organizations, which aims to work towards reducing food waste in Europe.¹ Furthermore, some governments in the European Union have acknowledged the need to combat the increasing amounts of

food waste. For example, the British and the Dutch governments have already taken action in this direction by supporting research and initiating campaigns against food waste (Cox et al., 2010; Sharp, Giorgi, & Wilson, 2010). In Denmark action is taken as well through the non-profit consumer movement against food waste, “Stop wasting food” (Gustavsson et al., 2011). The campaign supported by the UK government, the “Love food hate waste” campaign, seems to have been successful in reducing the avoidable food waste at the household level by providing practical tools to reduce food waste and by raising awareness of the food waste issue.² These practical findings provide support for the results of the present study regarding the importance of household food provisioning routines (e.g. shopping or reuse of leftovers routines) in food waste behaviour.

The results of the present study provide useful information for designing campaigns aimed at reducing food waste at the household level. The results strongly support the approach targeting household routines (e.g. planning, shopping or reuse of leftovers) that many campaigns have already adopted. Based on our findings, efforts to change leftovers reuse routines may contribute to the largest effects on food waste, even though shopping routines also have great potential. One way to impact these routines is to improve people's skills related to their food routines through, for example, providing advice on how to deal with food-related activities at home through booklets or other such communication means, participation in cooking courses or implementing household economics education campaigns. Improvements in perceived skills will indirectly result in lower food waste. Alternatively, efforts could be directed to affecting the food-related routines directly by providing consumers with practical tools to deal with their routines around food. Such initiatives could be provision of shopping list templates or checklists regarding pre-shopping activities to remind consumers to, for example, check their inventories before going shopping. The provision of measurement instruments to facilitate the estimation of portion sizes or recipes for reuse of leftovers could also be initiatives that might result in lower food waste. Improvements in planning routines can indirectly impact food waste levels through shopping routines, while improvements in shopping and leftover reuse routines can directly lead to lower food waste.

Secondly, taking the intentional route, initiatives aimed

¹ <http://www.zerowasteurope.eu/about/>.

² <http://www.wrap.org.uk/content/consumers-save-%C2%A3300-million-worth-food-going-waste>.

at focussing on the injunctive norms of not wasting food can have the largest impact on intention, which subsequently impacts behaviour. Furthermore, direct efforts to change consumers' attitudes towards food waste have the potential to lead to decreases in food waste through intentional processes. If the intentional route is used, the efforts to strengthen injunctive norms coupled with changes in consumer attitudes towards food waste may contribute to the largest decrease in food waste.

5.3. Future research

Household routines related to planning, shopping and reuse of leftovers are important predictors of food waste. Our exploration of potential drivers of routines suggests that households' perceived capabilities to deal with these routines are significantly related to leftovers reuse routines. In addition, among the background factors, awareness of economic consequences was to a larger extent related to food-related routines compared to awareness of environmental and social impact. However, evidence into potential drivers of these routines is very limited, e.g. how they are developed and maintained. Future research into the determinants of routines and their development would provide us with a better understanding of these behaviours and help us to find improved ways to reduce food waste. Moreover, studies into the household food provisioning system and the interrelations between the different elements of the system could provide valuable insights into which other routines may be relevant in the study of food waste behaviour.

In the present study, awareness of economic consequences was correlated to a larger extent to food waste compared to awareness of environmental or social consequences when associations with background factors were examined. This may suggest that people are motivated to a larger extent by self-interest in their food waste behaviour. The close link between food waste and household economics found in the present study suggests that consumers perceive food waste behaviour mainly as food-related behaviour and only to a lower extent as environmental behaviour. Future research could explore which motivations are more central in relation to food waste and to what extent people perceive this behaviour as environmental compared to food-related.

The present study found that moral norms had no significant impact on intention, which could be explained by the injunctive norm capturing to some extent the moral perspective of food waste. This could be due to the fact that in the present study the injunctive norm was operationalized slightly differently than other applications of the Theory of Planned Behaviour on food waste which used the traditional subjective norm formulation. Future research could study whether when considering some antecedents of the moral norms from the Norm Activation Model, as for instance responsibility denial (Schwartz, 1977), the role of the moral norms would increase.

5.4. Limitations

The present study presents some limitations. First, the theoretical background used was the Theory of Planned Behaviour, which has its boundaries in its explanatory power. Intention is not always a good predictor of behaviour and the model is not highly effective for the study of behaviours that are not entirely under volitional control. Secondly, there were some methodological limitations. The food waste behaviour was self-reported, meaning that it could be a biased estimate of true behaviour. Some measures were adapted to be more suitable for the study of food waste behaviour, for example, asking about intentions *not* to waste food instead of intentions to waste food. Such adaptations represent slight departures from original recommendations of comparability

of constructs in the Theory of Planned Behaviour; however it was considered that such wording would be more natural to answer. Moreover, some constructs slightly missed the cut-offs for the indicators proving reliability and validity. Thus, future research could focus on improving the reliability and validity of such measures. Even though the study has some limitations, its findings are largely in line with theoretical insights and prior literature and reveal that food-related routines are an important addition to the determinants of food waste.

6. Conclusion

The present study investigated the explanatory power of two routes to food waste behaviour, the intentional one and the routinized one. The findings suggest that food-related routines (i.e. planning, shopping and leftovers reuse) are main drivers of food waste in addition to perceived behavioural control. Among the routines, the leftovers reuse routines were the most important contributors to food waste but were closely followed by shopping routines. Planning routines contributed only indirectly through shopping routines. These routines were closely associated with households' perceived skills. Nevertheless, the psycho-social factors included play a role as well. From the intentional route to food waste the paths from injunctive norm and attitudes towards food waste to intention not to waste food contributed the most to the explanation of food waste.

These findings bring evidence which can be used when designing initiatives to reduce food waste at the household level. Moreover, the study shows that considering food waste as part of the food provisioning process and as such accounting for food-related decisions and skills improves our understanding of significant factors related to food waste. Efforts aimed at changing food waste behaviour at the household level could target households' perceived capabilities and routines related to food waste or/and the intentional route through information campaigns aimed at placing focus on injunctive norms and changing attitudes towards food waste.

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