

Fine-Tuning the Fight Against Food Waste

Jessica Aschemann-Witzel, Ilona E. de Hooge, Valérie L. Almli, and Marije Oostindjer

Jessica Aschemann-Witzel is Associate professor at MAPP - Centre for Research on Customer Relations in the Food Sector, Aarhus University, Bartholinsalle 10, 8000 Aarhus, Denmark (Tel: +45 87165217, E-mail: jeaw@mgmt.au.dk). *Ilona E. de Hooge* is Assistant Professor at Department of Marketing and Consumer Behaviour, Wageningen University, P.O. Box 8130, 6700 EW Wageningen, The Netherlands (Tel: + 31 317486124, E-Mail: Ilona.deHooge@WUR.nl). *Valérie L. Almli* is Research Scientist at Nofima AS, Postboks 210, NO-1431 Ås Norway (Tel: +47 64970305, E-mail: valerie.almli@nofima.no). Before joining the industry, *Marije Oostindjer* had been Senior Researcher at Department of Chemistry, Biotechnology and Food Science, Norwegian University of Life Sciences, P.O. Box 5003, 1432 Ås, Norway (Tel: +47 67232537, current E-Mail: marije.oostindjer@nortura.no).

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Abstract

The complex causes of consumer food waste make it difficult for commercial actors and public policy makers to develop successful food-waste reduction campaigns. One of the essential problems is that consumer food waste seems to be the un-planned result of divergent food-related behaviors. The current research investigates the relationship between distinctive consumer food-related lifestyle patterns and food waste. A survey with 848 consumers in a Northern European country (Denmark) reveals that segmenting consumers on the basis of food-related behaviors, especially on the basis of various food involvement dimensions (in particular cooking and enjoyment, food planning, and price orientation, the social relations related to meals and food-related concerns such as safety), allows to identify differences in self-reported food waste and food waste-related behaviors. This suggests that there exists a relevant relationship between food-related lifestyle patterns and food waste. Directions for the further development of macromarketing actions and policies targeting different consumer segments are derived.

Keywords

Food Waste; Consumer Lifestyle; Consumer Behavior; Segmentation; Public Policy

Introduction

To successfully and sustainably secure food for 9 billion people, both scholars and societal stakeholders recommend actions that are aimed at avoiding food loss and food waste (FAO 2013; Foley et al. 2011; Godfray et al. 2010). Food waste can be defined as “any food, and inedible parts of food, removed from the food supply chain to be recovered or disposed (including composted, crops ploughed in/not harvested, anaerobic digestion, bio-energy production, co-generation, incineration, disposal to sewer, landfill or discarded to sea)” (FUSIONS, 2014, p. 6). It thus includes all food that is discarded, even though it is appropriate for human consumption (FAO 2013). Exact numbers on food waste vary, but multiple sources suggest that about one-fourth to one-third of human food production is being lost or wasted along the food supply chain and in consumer households (FAO 2013; Kummu et al. 2012; Brautigam, Jorissen and Priefer 2014). Food losses in the supply chain occur predominantly in developing countries, whereas food waste in consumer households occurs primarily in developed countries (Parfitt, Barthel and Macnaughton, 2010). For example, between 25% and 40% of food in the US – and even more in some single food categories (Love et al. 2015) - is lost or wasted (Cuéllar and Webber 2010; Venkat 2011). This amount is equivalent to 10% (in value) of US household food purchases (Buzby and Hyman 2012).

Food waste is not only problematic from a food security (Garnett, 2011) or societal equity (Gjerres and Gaiani, 2013) perspective, it also contributes to the worrisome overexploitation of our natural resource base. Agriculture, livestock and human food production have been identified as some of the most important domains in this regard (Rockström et al. 2009; EC 2006). The food and agriculture sectors as a whole contribute to greenhouse gas emissions through land use change, methane emissions, water usage, and fertilizer application

(Aleksandrowicz et al., 2016; Carlson, et al., 2017; Lamb et al. 2016). Of the systems identified as beyond safe boundaries, all three – biodiversity, climate change, and the phosphorous and nitrogen cycle (Rockström et al. 2009) – are directly impacted by the agriculture and food sector. Actions suggested to reduce the large environmental impact of agriculture and to secure that the sector is better equipped to withstand risks and to ensure food security range from technological mitigation, diversification and sustainable intensification of agriculture, to dietary shifts towards plant-based diets and avoidance of food losses and food waste (Aleksandrowicz et al. 2016; Foley et al. 2011; Garnett 2011; Reisch, Eberle and Lorek 2013). It is difficult to identify the exact role of food waste in this process, but a study suggests that about 16% of the EU food sector's contribution to global warming (in 2011, CO₂ equivalents) is caused by food waste (Fusions 2015). Food waste is thus a problem that hinders the agricultural and food sector to sustainably feed the growing population without depleting the resources that future generations depend on, and impairs sustainable development in all three dimensions of sustainability – social, economic, and environmental.

Food waste occurs along the food supply chain and is the result of multiple actors, such as institutions, supply chain actors, and consumers (Stuart 2009). Yet, in developed countries, the essential contributor to the food waste production appears to be the consumer (e.g., Buzby and Hyman 2012, Beretta et al 2013). In the EU, consumer households account for approximately 40-45% of the food waste (EC 2010; Fusions 2015), or on average 76 kg per capita per year (EC 2010). This means that consumers waste approximately 10-25% of the food that they purchase, for example, 10-14% in Germany by value (Universität Stuttgart 2012) or 22% in the UK by weight (WRAP 2012). Therefore, altering consumer behavior is a crucial step in sufficiently 'scaling up' efforts towards sustainable development (Dietz et al. 2009; Prothero et al. 2011), in

particular in the food area (Macdiarmid et al. 2012; Reisch, Eberle, and Lorek 2013). According to Beverland (2014), sustainability of eating and diets has not yet received the macromarketers' attention that it deserves.

There are, however, at least two main issues with addressing consumer-level food waste (FUSIONS 2014, 2015). Firstly, consumer-level food waste is influenced by multiple interacting factors (Quested et al. 2013; Stuart 2009). These factors range from macro-level environmental, political, economic, technological, and legal contexts, to societal-level consumer culture and social norms, to individual-level socio-demographic characteristics and psychographic mind-sets (Aschemann-Witzel et al. 2015; EC 2010; Evans 2014; FAO 2011). Consumer-level food waste, just as waste overall (e.g., Guillard and Roux 2014), appears to be an issue that emerges from the interaction between supply chains, marketing and society (Stuart 2009). Therefore, potential solutions to address food waste should be approached with a broader macromarketing perspective (Dolan 2002). Yet, thus far most interventions aimed at reducing consumer-level food waste have taken a more narrow micromarketing perspective, and focused on for example providing nudges (e.g., plate sizes) in restaurants (Kallbekken and Saelen 2013), using forced choices in schools (Lombardini and Lankoski 2013), or providing information on sustainable options (Panzone et al., 2011). Instead, we suggest that a macromarketing approach towards consumer-level food waste behaviors might provide new, valuable insights that can be used to derive potential interventions aimed at reducing consumer-level food waste.

A second main problem of addressing consumer-level food waste is that food waste is not necessarily a consciously chosen behavior that consumers engage in. Instead, food waste seems to be an unwanted consequence of consumption prediction errors or of inadequate practices in consumer food-related behaviors such as planning, shopping, storing, preparing, and cooking

(Evans, 2012; Stefan 2013; Terpstra et al. 2005). Especially qualitative research studies have highlighted that consumers report feelings of guilt when throwing away foods (Comber and Thieme, 2014; Graham- Rowe, Jessop and Sparks, 2014; Parizeau, Massow and Martin, 2015; Redman and Redman, 2014; Watson and Meah, 2013), and that consumers are embarrassed and emotionally affected by wasting food, maybe even more than by other types of waste behaviors (Gjerres and Gaiani, 2013). To develop potential macromarketing interventions that would be able to successfully reduce consumer-level food waste, it is therefore useful to move beyond consumer food-waste behaviors and to study consumers' lifestyles and consumption habits concerning foods and food waste as the antecedent of wastage. Such an approach acknowledges that the sum of the complex and interacting factors impacting food waste are reflected in a consumer's lifestyle (Evans and Abrahamse 2009; Plummer 1974), and it combines both attitudinal and behavioral indicators of consumer behavior (Lavelle, Rau, and Fahy 2015).

From a macromarketing perspective, all types of waste can be understood as a consequence and symbol of consumerism and overconsumption (Gjerres and Gaiani, 2013). Reduction of consumption has been highlighted as a crucial element of 'real' sustainable consumption (De Coverly et al. 2008), and consequently, it is necessary to reduce consumption and (re-)insert the notion of sufficiency and frugality into consumption behavior. We suggest that food waste is a particularly well-suited issue to trigger consumer reflection on consumerism overall, given the guilt and emotion that the topic creates.

In sum, the current research addresses the issue of food waste from a macromarketing perspective by elucidating how segments of consumers differ in terms of lifestyle and food waste-related indicators. The goal is to provide a basis for efficiently-refined and targeted food sector actions and public policies aimed at decreasing food waste. We do so, firstly, by

identifying consumer segments based on their food (waste)-related lifestyle; secondly, by characterizing these consumer segments on the basis of indicators of consumer food waste (knowledge, attitudes, behavior); and thirdly, by deriving recommendations for targeted actions for both food marketing and food market policies that are in line with the developed consumer segments. In our view, the present study contributes to the emerging literature on food markets, marketing and food waste (Devin and Richards 2016; Gruber, Holweg, and Teller 2016) and on targeted prevention strategies (Delley and Brunner 2017; Love et al. 2015) by applying the framework of food-related lifestyle to food waste.

Background

Consumer Lifestyles

Consumer lifestyles are understood as distinct ways of living of different groups within a given society (Ganglmair-Wooliscroft and Lawson, 2010; Plummer 1974). These distinctions are assumed to be anchored in the individual's value priorities – more than class or economic resources. These priorities are reflected in both psychographic indicators and observable consumption practices and behavior (Evans and Abrahamse 2009; Bin and Dowlatabadi, 2005; Lavelle, Rau, and Fahy 2015), with consumers appearing as consumption communities in the market (Gordon et al. 2014). In addition to the individual values, attitudes, and beliefs, consumer lifestyle is also suggested to be impacted by cultural influences, societal trends, and technology development. These factors can impact for example household characteristics and social norms, and determine such external influences as marketing and media (Ganglmair-Wooliscroft and Lawson, 2010; Lawson and Todd, 2002). As such, lifestyles are multi-dimensional, depend on

multiple interacting factors, and can potentially evolve over time and with the individual's circumstances.

Lifestyles are related to consumer identity, given that consumers with similarities in lifestyle will also have similar mental representations of how a consumer of a certain product 'thinks, feels and does' (Reed et al., 2012). Thus, consumers project similar identity-related associations on other individuals with whom they share a similar lifestyle with (Reed et al., 2012). When studying cultural practices in consumption, researchers explore the expression of underlying concepts such as identity and observe the resulting consumer lifestyles (Arsel and Thompson, 2011). However, a difference lies in that identity with its self-conceptualization (Rosenfeld and Burrow, 2017) can be a more deliberate process than lifestyle.

Factors Causing Consumer-Related Food Waste

Consumer perceived 'sub-optimality' of a food item is a crucial factor for distinguishing which items are eaten or discarded (for a definition, see Aschemann-Witzel et al. 2015; De Hooge et al. 2017). It is related to date labelling (Wansink and Wright 2006), to visual imperfections such as shape, color, or size (Loebnitz, Schuitema, and Grunert 2015), and to minor packaging damages (White et al. 2016). In the current situation of over-supply in the food market, where retailers strive to avoid out-of-stock situations, use volume and sales promotions (Theotokis, Pramataris, and Tsiros 2012), and have a wide assortment range (Gruber et al. 2016), many food products end up as 'unsellable' but not yet 'un-consumable'. Consumer perceptions of what is 'optimal' or not appear to have become overly narrow since developed countries left the times of food scarcity behind (Evans, Campbell, and Murcott 2013), not least due to anxiety regarding food safety (Watson and Meah 2013).

Even though consumers are increasingly aware of social and environmental consequences of their food purchases (e.g., growing interest in organic foods, local food, and ethical attributes, Willer and Lernoud 2016), consumers are relatively unaware of the high environmental impact of food production – especially of meat (Dietz et al. 2009) – and of how the impact is aggravated when food is wasted (Williams et al. 2012). Consumers are not necessarily conscious about the extent to which food waste, in addition to the resources embedded in the food wasted, leads to resources spent on disposal and emissions in landfills or from incineration (Bernstad Saraiva Schott and Andersson 2015). Often, the aspects of caring for the safety and preferences of the near family, which are important functions of food and meals, are given greater priority than consequences of food waste in day-to-day decision-making (Cappellini and Parsons, 2012; Graham-Rowe et al., 2014). In this trade-off, consumers might waste food despite feeling uneasy and guilty about it (Evans, 2014; Comber and Thieme 2012; Gjerres and Gaiani, 2013).

Approaches to Promoting Sustainable Behavior in a Market Context

One solution to address the issue of food waste could be trying to encourage consumers to avoid food wastage via their in-store behavior and at home by promoting a favorable ‘social idea’. In the case of food waste, the social idea consists of accepting that a consumer’s food decisions have wider societal implications. This implies perceiving oneself not only as a consumer, but as a consumer-citizen (Prothero et al. 2011). Promoting such a social idea is at the core of the definition of ‘social marketing’ as the application of commercial marketing practices to non-commercial aims (Andreasen 2002; Kotler and Zaltman 1971; McDermott, Stead, and Hastings 2005).

Next to influencing the consumer or citizen’s individual behavior in a targeted manner, social marketing also considers the context in which the consumer conducts the behavior, and the

extent to which decision makers ‘upstream’ (versus ‘downstream’) the supply chain ought to be encouraged to alter the consumer’s choice environment (Gordon et al. 2006; Grier and Bryant 2005; Hastings and Saren 2003; Stead, Hastings, and McDermott 2007). This is well in line with theoretical models of consumer behavior and behavior change that not only emphasize the role of factors internal to the individual, but also social influences and the crucial impact of the surrounding context and environment (e.g. theory of planned behavior, Ajzen 2011, and social cognitive theory, Bandura 2001). It is also in line with literature suggesting that both the individual (Lavelle, Rau and Fahy 2015) and the macro-environmental context is key for transformation towards sustainable consumption (Prothero et al. 2011; Sunstein and Reisch 2014; Thøgersen 2014). When commercial stakeholders support actions towards a favorable social idea such as food waste avoidance, this activity might be done in the scope of the concept of corporate social responsibility (CSR, Carroll and Shabana 2010). A refined targeting of social marketing or CSR-activities in food waste avoidance can improve the efficiency of these efforts. The present research aims at contributing to this.

Current Actions in Encouraging Consumers to Avoid Food Waste

A number of active campaigners and non-governmental organizations have drawn attention to the issue of food waste in the past five years in various countries with their information and social marketing campaigns (Bloom 2010; Juul 2016; Stuart 2009; WRAP 2016). International organizations and governmental authorities (such as the European Commission, United States Department of Agriculture and US Environmental Protection Agency, and the FAO) have commissioned research on the extent of the issue, on the factors causing food waste, and on ways to tackle the problem. The United Nations (UN 2015) have the goal to decrease global food waste at retail and consumer level by 2030 with at least 50%.

The increasing societal attention has sparked market actors to become involved in food waste reduction activities that focus on capacity building and creating awareness, redistribution of food otherwise wasted, or innovations in re-use (Aschemann-Witzel et al., 2017a). For example, food production and retail companies and organizations are allying up for collaborative analysis, agreement on goals and coordinated action (FWRA 2016). Societal attention has also led retailers to spearhead alteration of retail practices (Aschemann-Witzel 2018), and to create global media attention for the problem of food waste in their campaigns. For example, the abolishment of multi-item offers (such as ‘2 for the price of 1’) by one retailer in Denmark has triggered others to follow suit, and a campaign promoting sub-optimal fruits and vegetables in France has sparked worldwide media coverage (Aschemann-Witzel, et al. 2017a). The success of these retailer actions crucially depend on consumer support in reacting favorably towards the retailer and the campaign, and in adopting the related purchase behaviors. The current research thus aims at better understanding the behavior of distinct consumer groups.

Food Waste and Consumer Lifestyle Research

Despite the many public policies, NGOs and food market stakeholder actions that are currently undertaken to reduce food waste, it is unclear whether such actions actually reduce the food being wasted - instead of for example just moving the disposal from the retailer to the consumer household (Aschemann-Witzel 2016; Devin and Richards, 2016). It is imperative to understand food waste behavior as the symptom of the lifestyle that consumers in affluent societies lead, greatly marked by the cultural paradigm of consumerism (Assadourian 2010). Food consumer behavior is to be understood in relation to the consumer’s motives and value orientation and in its environmental and social context (Evans, 2014; Beverland 2014; Dolan 2002).

Macromarketers and policy makers have to take these interdependencies into account (Nyborg et

al. 2016; Prothero et al. 2011; Thøgersen 2014). Exploring food waste behavior and its underlying factors with a more complex perspective of consumer lifestyles can contribute to shedding light on how food waste avoidance actions will interact with consumers in their individual contexts. According to Bin and Dowlatabadi (2005, p. 198), “the basic premise underlying consumer lifestyle research is that by understanding consumers we can design better public policies”. Lorenzen (2012) even suggests that lifestyle change can be a deliberate process undertaken in response to a problem left under-addressed by current policies and practices. Thus, a consumer-lifestyle perspective can help to identify targeted actions and to align existing actions with consumer behaviors, so that social marketing or CSR activities of food sector stakeholders can be most effective.

Previous research with broad approaches such as lifestyle or items that represent consumer’s activities, interests and opinions in a specific domain, has been looking at sustainability (Poortinga and Darnton, 2016) or sustainability-related issues such as energy or housing (Bin and Dowlatabadi, 2005; Thøgersen, 2017a; Wei et al. 2007), and food behavior (Brunsø and Grunert, 1995; Buckley et al. 2005; Thøgersen, 2017b). In the food area, the ‘food-related lifestyle’ concept has been broadly applied and cross-culturally tested (see e.g. Scholderer et al. 2004). These studies have demonstrated that consumer and citizen groups often differ in the extent to which they are interested in and find food important. Thus, consumer involvement with the topic seems to be a relevant consumer distinction in food-related lifestyle. So far, looking at food waste from a food-related lifestyle angle is a yet under-researched area. A study in the UK (Mallinson et al., 2016) and another in Switzerland (Delley and Brunner, 2017) have explored food waste behaviors via segmentation, but to the best of our knowledge, this is the first study combining lifestyle and food waste research.

Material and Methods

The research presented here was part of a larger cross-country project. The current study builds upon previously conducted research in form of a literature review, expert interviews (Aschemann-Witzel et al. 2015), focus groups, and case studies (Aschemann-Witzel et al. 2017a). Measuring actual consumer-level food waste is difficult and time-consuming, hence, such studies are available only for small population samples. However, to explore consumer lifestyles with the intention to identify consumer segments, a large dataset is needed. Therefore, we used self-reported indicators of consumers' food waste behaviors as well as an experimental choice task. Interpretation was undertaken with the necessary caution required for such data (Pham 2013), and we interpreted only differences between consumer segments, not absolute numbers (more details on the method, data, measures and additional analysis can be accessed in the supplementary file or be provided on request).

Survey and Sample

Consumers from Denmark were surveyed.

A 10 to 15-minute questionnaire in national language was sent to nationally representative online consumer panels in May 2015 by the company Userneeds (<http://www.userneeds.co.uk/market-research>). Quotas applied to the completed survey responses ensured that the sample represented in terms of gender, age, region of residence, income, and education (see Table 1).

Insert Table 1

Lifestyle Survey Measure

To study lifestyles, we chose a well-established and cross-culturally valid measure of consumers' food-related lifestyle (FRL) (Brunsø, Scholderer, and Grunert 2004; Scholderer et al. 2004). The original FRL (Brunsø and Grunert 1995) was developed in Western Europe and consists of 69 statements on 7-point disagree-agree Likert scales, covering five aspects of a consumer's relation to food in everyday life: 1) purchasing motives, 2) quality aspects, 3) consumption situations, 4) ways of shopping, and 5) cooking methods. The measure has been applied and adapted to different cultural backgrounds such as China (Grunert et al. 2011; Huang et al. 2015) as well as to specific food issues such as convenience food (Ryan et al. 2004) and obesity (Pérez-Cueto et al. 2010).

We shortened and adapted the FRL to include attitudes, interests and behaviors identified as particularly relevant for the issue of food waste. To that aim, the study built on qualitative research on consumer food waste behavior (Aschemann-Witzel et al. 2015, 2017a). Moreover, the new statements included in the survey were based on empirical research on factors affecting consumer-related food waste or behaviors known to cause or avoid food waste (Lyndhurst 2010; van Boxstael et al. 2014; Watson and Meah 2013; Williams et al. 2012; WRAP 2013), and on food and sustainability-related research containing similar survey statements (de Boer et al. 2004; Chrysochou et al. 2010; Hartmann, Dohle, and Siegrist 2013; Lea and Worsley 2008). The final 'food (waste)-related lifestyle' measure consisted of 54 statements belonging to five aspects, labeled 1) purchasing and consumption motives, 2) quality aspects, 3) consumption situations, 4) ways of shopping, and 5) ways of cooking and handling food. The items were pre-tested internally and translated and back-translated into the languages of the countries of the study.

Food Waste Measure and Food Waste-Related Indicators

Apart from the measure of food (waste)-related lifestyle, the survey contained measures of the respondents' relation to food waste. These included 1) knowledge of the extent of food waste ('According to what you have heard or would guess: how much of ... the world's food do you think is wasted (in % across the global food supply chain)? / ... the foods in households are wasted (in % of the food bought)?'); 2) relative importance of the food waste issue ('How important is it to reduce food waste in comparison to ... reducing obesity in our society? / ... reducing environmental pollution in our society? / ... stabilizing the economy in our society?'), measured on a scale from 1 (Much less important) to 7 (Much more important); 3) self-reported estimation of own food waste in five food categories ('If you would try to estimate your own household, how much of the following food [Fresh fruit and vegetables, Milk and dairy, Bread and other bakery products, Meat and fish, Prepared dishes/meals] that you buy or cook ends up being thrown away at home?', expressed in %); and 4) frequency of choosing the 'optimal' product across six categories in an experimental hypothetical binary choice task.

Frequency of choosing the 'optimal' product was measured by offering respondents the choice between pictures of an optimal versus a suboptimal product from the following categories (sub-optimality in store/home in parenthesis): (brown spot) apple, (bent) cucumber, (close to expiration date/past expiration date) milk, (close to expiration date/past expiration date) yoghurt, (dented package) juice, and (some broken) biscuits. Respondents were asked, 'Imagine that you're in a supermarket, ready to select [category]. Given an identical price, which one would you choose? / Imagine that you're in your home, ready to select [category]. Which one would you choose?' and then counting how often the optimal product was chosen in the six choices. In this case, we defined suboptimal as "not perfect" in terms of date or appearance, but we did not label the options as optimal or suboptimal, as the definition of 'optimal' is a subjective

interpretation by the respondent (see Table 2). As economic theory also would suggest, in the data presented, few consumers chose suboptimal food in the store given it was not reduced in price (see de Hooge et al. 2017 as compared to Aschemann-Witzel, 2018). It has to be noted that purchase of a suboptimal food does not mean food waste is avoided, given it might be wasted at home, instead (for a discussion, see Aschemann-Witzel, Haagen Jensen, Hyldetoft Jensen, and Kulikovskaja, 2017b).

Insert Table 2 here

It was not possible to gather data from two different sources in this survey. Therefore, common method variance (CMV) was addressed ex ante by procedural measures through using different scale types, randomizing the sequence of the questions (Chang, van Witteloostuijn, and Eden 2010), and using multiple items for all attitudinal constructs (Fuller et al. 2016). A post hoc Harman single factor test (Chang, van Witteloostuijn, and Eden 2010; Podsakoff et al. 2003) indicated that CMV was not a problem in the dataset.

Factor Analysis and Item Reduction

We applied exploratory factor analysis common factor analysis with oblimin rotation) for each of the five lifestyle aspects separately (see Huang et al. 2015). We conducted these analyses because we wanted to identify the correlational structure within each aspect, but retain the five aspects. The reasons is that these represent five theoretically derived and empirically well-founded spheres of interaction of the consumer with his or her food, convergent with the multidimensionality found in other lifestyle research (Ganglmair-Wooliscroft and Lawson, 2010). A split-sample exploratory factor analysis applied to a random half of the data led to the same results.

Through the analysis, we determined which survey statements, according to the results of the factor loadings and the lifestyle dimensions to which the statements belonged, unequivocally appeared to carry the same meaning for respondents across at least four of the five countries. More specifically, we retained items if they a) loaded with at least 0.32 on the respective factor (Tabachnik and Fidell 2007), and b) loaded unequivocally on a factor (by a factor loading of at least 0.2 more than any other factor loading). Furthermore, dimensions were kept if they contained at least two items, showed a sufficient reliability with Cronbach's alpha (at least 0.5 or higher, Huang et al. 2015; Kaiser 1974) or - in case of only two items in the dimension - if the correlations were significant and exceeding 0.25 (Tabachnik and Fidell 2007). This process resulted in 32 items pertaining to 13 food (waste)-related lifestyle dimensions (see Table 3). These items were used in a factor analysis (fixing the factors to 13), which confirmed the dimensions of the lifestyle measure (KMO .869, Bartlett's test of sphericity $p > .001$).

Insert Table 3 here

Cluster Analysis and Segment Identification

We computed factor scores by calculating an averaged variable for each dimension (Tabachnik and Fidell 2007). We applied a two-step cluster analysis process (Punj and Stewart 1983) to determine how many and which consumer segments emerged from the variables that described respondents across countries on the food (waste)-related lifestyle dimensions. Hierarchical cluster analysis was conducted with four random samples of 100 respondents to assess the appropriate number of clusters across various random subsamples. We assessed the appropriate number of clusters through inspection of the agglomeration schedule and dendrogram. It appeared that a four or five-cluster solution was most appropriate, and we thus conducted K-Means cluster analysis with both four five clusters, finally deciding on the five cluster solution

on the grounds that it provided more meaningful and interpretable results (Tabachnik and Fidell 2007).

Segment Characterization

To describe the cluster characteristics we used ANOVAs for multiple group comparisons and tested for differences between groups with post-hoc Games-Howell tests (as a robust test when variances are not homogenous) and with Scheffé-tests (when variances are homogenous, tested by Levene-tests). Pearson chi-square tests (two-sided) were used for variables at nominal or ordinal measurement levels. Likert scales were treated as intervals. We undertook interpretation with the necessary caution required for such data (Churchill 1979; Fusions 2014, 2015): Given we expected consumers to have difficulties assessing food waste and self-reporting their own food-waste behavior, significant differences between consumer segments were interpreted rather than absolute numbers.

Results

Based on the thirteen dimensions of food (waste)-related lifestyles, we identified five consumer segments (see Table 4). In describing the segments, we used the concept ‘involvement/involved’ to summarize an underlying interest in or importance that is expressed when a segment scores high in the respective dimensions. The consumer segments were characterized on the food waste indicators as well as sociodemographic (see Table 5).

Insert Table 4

Insert Table 5

Segment 1 - the ‘Cooking-involved and spontaneous’

Segment 1 (called the ‘spontaneous’ for short) was characterized by an involvement with food in terms of interest in cooking and culinary experience, but also a highly favorable response to the dimension of taste and of price as a criterion in shopping, and in particular disagreed with the ‘security’ dimension – indicating an interest in culinary experiences and tasting new foods. This segment was specifically characterized by not planning neither purchases nor their meals in advance. With regard to sociodemographic profiles, the spontaneous were relatively younger, more often female, and there was a low share of high income respondents. . Concerning food waste measures (see Table 5), the spontaneous estimated their own food waste at a medium (compared to the other segments), in particularly high for fresh fruit and vegetables, dairy and prepared dishes, and they assessed the topic to be important. Of all segments, the spontaneous least likely mentioned that they use the optimal item first when at home, thus, appeared to use the suboptimal first. .

Segment 5 - the ‘Least concerned, normative and social’

Segment 5 (the ‘unconcerned’ for short), comprised of not very food-involved consumers, with low levels of interest in, and self-fulfillment derived from, cooking. They appeared to be the least focused on social relations around meals, and relatively least concerned about food safety and the price-quality relation. The un-concerned were the youngest segment, composed largely of males, and the segment in particular is characterized by the highest share of single households. Of all segments, the un-concerned found the topic of food waste least important, reported the highest estimates of own food waste , and were most likely to indicate to choose the optimal in the store and at home.

Segment 2 – the ‘Price versus quality-oriented and disliking cooking’

Segment 3 consumers (the 'price-oriented' for short) were also not very food involved when it comes to cooking and deriving self-fulfillment from the task. Compared to the other segments, they were especially characterized in that they paid most attention to price as a criterion when selecting food. They were balanced in terms of gender, of medium age, and of relatively lower education (although insignificantly). They reported low levels of food waste in their own household, in particular for prepared dishes.

Segment 3 – the 'Very involved and cooking-engaged'

Consumers in segment 3 (the 'involved' for short) was characterized by high engagement and involvement with food overall, as can for example be seen in the interest in cooking and culinary experience, and a highly favorable response across the majority of dimensions, including planning purchase and meals in advance and considering the price criterion in purchase. They in particular disagreed with the 'security' dimension – indicating an interest in culinary experiences and tasting new foods. Segment 3 had a high share of females, a higher medium age, and in particular the lowest share of single-households, thus indicating that persons with families are overrepresented.. The involved were most likely to choose the 'suboptimal' food in the supermarket situation compared to the other segments. Involved consumers made relatively low estimates across all food categories for food waste in their households, similar to segment 2, segment 3, however, made the lowest estimation of all segments for the category of bread.

Segment 4 – the 'Good food-involved and price-dismissive'

Segment 4 (the 'price-dismissive' for short) consumers were particularly characterized by being uninterested in using the price criterion during shopping. They consisted of moderately food-involved consumers that indicated importance of taste, food safety, and optimal choice in purchase. The segment also had a relatively higher interest in credence attributes of food.

Segment 4 was especially characterized by a greater share of respondents with above average income, and had a high share of females and respondents of higher age. Concerning food waste measures (see Table 5), the price-dismissive estimated their own food waste at a medium (compared to the other segments, and similar to segment 1).

Discussion

Our findings reveal that consumer segments can be developed along the continuum of ‘involvement’ with the food issue at hand. Previous studies have indicated the existence of so-called very involved versus very un-involved groups, or ‘indifferent’ versus ‘responsible’ groups, in the area of food (e.g. Burke, Eckert, and Davis 2014; Delley and Brunner, 2017; Mallinson, Russell, and Barker 2016; Verain et al. 2012, 2016). Various dimensions in our survey, such as food selection, cooking, and eating, can be regarded as an involvement with food or ‘food involvement’ (Marshall and Bell 2004).

We also found dimensions of food-related lifestyles, such as enjoying cooking, price-orientation, social relations via meals, or food quality, to be related to the core of characterization in other food-related lifestyle studies (e.g. Grunert et al. 2011; Mallinson et al. 2016; Ryan et al. 2004). The explorative segment characterizations presented in the findings provides a good basis for developing ideas on effective policy and marketing actions (see Table 6 for an overview). Such segment-specific actions may increase the effectiveness of policies in their fight against food waste (WRAP 2016).

Macromarketing and Policy Actions Targeting ‘Cooking-involved and spontaneous’

The food-related aspects of the ‘spontaneous’ (segment 1) demonstrate that these consumers can further the avoid food waste which might be related to a lack of planning, and that they are likely

to be motivated or proactive when the action relates to food experiences and food enjoyment. If they already act against food waste, the spontaneous are motivated to further reduce waste given they think the topic is important, and may accept new tools to help them achieve this (e.g., phone apps on food planning and handling, suggestions of recipes, credence logos highlighting food waste avoidance contributions). Moreover, as a younger and experiences-seeking group, they might most likely be pioneers or trendsetters who spread their knowledge and concern by talking to friends, relatives and through their social networks, or to be active as volunteers in NGOs, and they might be front-runners in shaping new social norms that favor sufficiency, enjoyment and experience instead of oversupply. In sum, the cluster characterization suggests that the “spontaneous” are already in a stage where they possess information (Beverland 2014) and think food waste is important to tackle, and could be leading sustainable behavior via enacting new social norms (Nyborg et al. 2016).

Macromarketing and Policy Actions Targeting ‘Least concerned, normative and social’

On the contrary, the un-concerned (segment 5) are unlikely to be motivated by ethical or economic motives, by normative appeals to avoid food waste, or by constraints on their food assortment as they are not particularly interested in food. This segment may therefore respond best to strategies that alter the standard situation, such as nudging (Thaler and Sunstein, 2009). For example, segment 5 will not be disappointed by food variety restrictions if stores sell fewer varieties of fruits to avoid food waste of unsold products. Any upstream alteration in the supply chain that does not involve consumers (e.g., packaging improvements to keep products fresh longer) will also work well for this group. Thus, for this consumer segment, social marketing campaigns should be focused on supply chain stakeholders, technological innovations, and alterations of food choice situations, rather than on targeting the consumers. Also, un-concerned

consumers need institutional change first (Prothero et al. 2011), which might call for policy makers (Thøgersen 2014) to make macro-environmental changes (e.g. laws on aesthetic standards, or funding research on technological innovation). Moreover, this segment consists of relatively younger and more likely male consumers, which provides the opportunity that they might alter their lifestyle when growing older and moving into another life stage (Devine 2005).

Macromarketing and Policy Actions Targeting 'Price versus quality-oriented and disliking cooking'

The price-oriented (segment 2) are aware of food prices, and will probably respond favorably to price incentives to reduce food waste. This can entail price changes in retail or canteen settings (e.g., price reductions of suboptimal foods close to the best-before date, see e.g. Aschemann-Witzel, 2018, or when selecting fewer side dishes in restaurants), monetary bonuses for environmentally friendly behavior (e.g., bonuses for households that have no food waste), or social marketing campaigns focused on economic 'thriftiness' arguments (e.g. for food waste avoidance in households). Given that the price-oriented show less concern about food credence attributes, do not have an overly heightened food safety concern and no particular ambition for cooking out of the ordinary, they especially might be the target group for suboptimal foods offered in alternative retail stores, including food banks, and may adapt to foods that do not conform to current market standards if such foods are significantly cheaper. Care needs to be taken to ensure that such actions do not move food waste from the supermarket to households (Setti et al., 2016), however, the low self-reported food waste level of this group does not suggest that greater problems should be expected here. Price-oriented consumers can improve their planning, and may therefore be sensitive to practical advice on this aspect. However, it needs to

be easy to implement, as they do not seem to enjoy cooking and food provision, and it should be justified by economic savings.

Macromarketing and Policy Actions Targeting ‘Very involved and cooking-engaged’ That there is a certain price-orientation during shopping of the very involved (segment 3) indicates that similar considerations can be made for segment 3 as for segment 2. However, focus needs to be given to the fact that the food is nevertheless safe and of good quality, and on communicating that the food waste avoidance is a sign of ethical actions of the supply chain actors. The low self-reported food waste and high likelihood of choosing ‘suboptimal’ items suggests that involved consumers might already be ‘best’ in avoiding food waste and already possess high perceived behavioral control over food waste (which is necessary to reduce food waste, Visschers, Wickli and Siegrist, 2016). Thus, they may be less of a priority for targeted policies, as their behavior may hardly improve. As involved consumers gain self-fulfillment from cooking and are ‘thrifty’ given they plan well, choose suboptimal at times, and waste less, they may be receptive to further challenging, but particularly effective, household management advice. This entails for example storage adapted to each type of fruit and vegetable, recipes for leftovers, and composting inedible parts. It may be particularly effective to include this segment in public social marketing neighborhood campaigns as ambassadors or role-models, where this group may share their advice and experience with others.

The cluster characterization suggests that involved consumers are closest to avoiding unnecessary food purchases, making use of the suboptimal, and enacting sufficiency in their behavior (De Coverly et al. 2008), as they seem to manage their food stock well. It is a segment (still) enacting a social norm that seems to have disappeared through the impact of consumerism culture (Assadourian 2010) in the other segments. Interestingly, their behavior might be seeing a

new recognition, given that new social norms (Nyborg et al. 2016) of simplicity and thriftiness are currently formed in societal groups, as for example by groups that are regarded as ‘voluntary simplifiers’ (Huneke, 2005). Given that segment 3 consists of primarily women and the actions might appear ‘housewifely’, care should be taken to ensure that their actions can appeal to both genders, and not re-produce gender stereotypes. The proliferation of food handling that avoids food waste as enacted by segment 4 could be further supported by macromarketing and policy. For example, local governments could support social initiatives that share food surplus (e.g. installing cupboards or fridges to place the food) in communities, or that ‘glean’ overproduction left on the field or on fruit trees in public spaces (allowing or organizing access).

Macromarketing and Policy Actions Targeting ‘Good food-involved and price-dismissive’

Finally, the relatively price-dismissive consumer segment 4, characterized by higher income, will probably not respond to price reductions on suboptimal food or to economic incentives. Instead, the price-dismissive consumers might become interested in food waste avoidance through communication that reminds them of their feelings of guilt and anxiety when wasting food and that suggests that food waste avoidance will increase their well-being, as well as underlying that food waste avoidance is an ethical action conducted by the supply chain. Other possibilities are communications that highlight the self-fulfillment aspect of thriftiness and that frame food waste avoidance as an element of good cooking, or even as a sign of higher status in society. Moreover, price-dismissive consumers have the economic resources to purchase services that support them in planning meals, as for example food box delivery schemes with recipes and the respective measured ingredients. Price-dismissive consumers may also respond well to interesting food product innovations that result in less food waste earlier in the supply chain, as for example premium foods or restaurant meals made from surplus in the supply chain. These consumers

might primarily act sustainably through ‘positive buying’ (Harrison, Newholm, and Shaw 2005), and might be receptive to changing social norms in joint meal contexts (Beverland 2014), such as accepting that ‘less is better’ when inviting guests.

Insert Table 6 here

Conclusions and Implications

Based on the results and the characterization of the consumer segments, we conclude that consumer groups specifically differ along the following dimensions: Firstly, their involvement with food expressed via several dimensions, but most importantly via self-fulfillment and cooking interest, secondly, their orientation towards price as a criterion in shopping, thirdly, the degree to which they are planning their meals and respective purchases, and fourthly, whether they are concerned with issues such as social relations via meals, food safety and quality. .

Furthermore, we conclude that comparing the consumer segments on food waste indicators shows that both involved and un-involved consumers report relatively higher levels of food waste, but they differ in the perceived importance of the food waste issue and the tendency to choose the ‘suboptimal’ products in the store or in their homes first. Thus, food involvement, planning, price orientation and food-related concerns are consumer lifestyle characterizations of specific relevance for differences in self-reported food waste and food waste-related behaviors.

As a practical implication, the study suggests that food market actors and policy makers should take the identified similarities and differences between consumer groups into account when devising actions to encourage consumer food waste avoidance. Both social marketing and commercial marketing that contribute to corporate social responsibility of the company can make use of the recommendations, in targeted ways depending on the consumer segment and activity

in question. In addition, the study indicates where micro-level approaches in the contact between retailers and consumers, or policy makers and consumers, reach their limit. In order to reduce food waste, policy actions (Vittuari et al. 2015) are needed which aim at changing the macro-level context and create more systemic change.

Our findings advance the literature on food waste. By applying the lifestyle concept, we have been able to identify segments with distinctive patterns that help to understand differences in food waste related behaviors. Our consumer segments reveal why some consumers waste suboptimal foods at their homes, while others do not. The findings can provide some indications for why consumers differ in their self-reported household food waste.

The present study extends previous conceptual research on lifestyle in this domain of application. It does so by adapting and applying the food-related lifestyle to the issue of food waste, and showing that the core dimensions of the measure are applicable. In addition, the findings demonstrate that the newly emerged dimensions of ‘food safety’, ‘purchase planning’, ‘norms and control’ and ‘optimal choice during shopping’ play a role in consumer food-related behaviors related to the issue at hand. These new dimensions theoretically expand the concept of food-related lifestyle and should be considered in future research.

When looking further into the relation between consumer lifestyles, food and sustainability, the present research underpins the importance of understanding a sustainable consumption issue in its context, and the value of approaching it from a macromarketing perspective. The findings show that consumer might appear similar, but nevertheless could behave unsustainable in certain aspects but for different reasons. Thus, it is useful to apply multiple approaches both on a micro- and on a marketing-level in order to tackle unsustainable behavior.

In sum, the present research presents the successful identification of five food (waste)-related lifestyle consumer segments across several Northern European countries. It also reveals how these can be used to derive further research and suggests recommendations for food waste mitigation targeted to specific consumer groups. Ultimately, the findings may contribute to a better fine-tuning of social marketing actions and supply chain policies addressing the sustainability issue of food waste from a macromarketing perspective.

Limitations and Future Research

As a limitation, we caution that cultural and socio-economic differences among countries can be expected to partly influence the results and its transferability to other country contexts. At the time of the survey, the topic had already received particular media coverage in Denmark for multiple years. Furthermore, results of survey may have limitations due to the potential method bias inherent in the self-report element. This means that our findings need to be interpreted with awareness of the type of data, especially because food waste is difficult to assess for consumers (Fusions, 2014). A survey about the topic of food waste practices can only partly capture the complexity of the causes of food waste and of the practices and behaviors related to food waste in consumer households, and is prone to potential deviations between what consumers do and what they express. However, the research goal was to quantify lifestyle segments in relation to indicators of consumers' knowledge, perceived importance, and their own behavior with regard to food waste.

A second potential weakness of our study is the omission of statements based on differences in meanings. This method has led to multiple dimensions that are based on two statements, which might be considered sub-optimal. Relatedly, because we retained the five

dimensions of the food-related lifestyle and tried to cover a rather diverse set of consumer interaction with food, we conducted separate factor analysis and accepted poorer measures of internal consistency (a threshold of 0.5 for Cronbach alpha values). Some researchers might consider such an internal consistency threshold too low. Future research is therefore poised to examine the consistence of our developed food-related lifestyle measure across countries and setting.

Further research might establish whether the consumer groups identified in the present study are indeed more or less receptive towards the discussed segment-unique marketing actions and policies. Of particular interest thereby is studying the promising characteristics of segments with low food waste and choice of suboptimal food, for example by more in-depth qualitative methods. Conducting surveys of policy acceptance or experiments on the latter issue would make it possible to identify whether the segments are responding favorably to the policy measures that appear best fitting to their profile. The findings contribute to the exploration of the concept of lifestyle within the domain of food. Further research might provide greater insight into how food behavior and waste behavior is conceptually linked, and how certain food waste avoidance behaviors can be explained by tendencies such as ‘thriftiness’. Research into food consumer behavior needs to move further into experimenting and testing with suggested recommendations, to test the effectiveness of our findings in real-life context. All in all, it seems that with our results in hand, there are many interesting lines of research and potentials to move the fight against food waste at the consumer level forward.

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Table 1. Sample characterization

Sample size (n)		848
Share of gender, female (%)		51.8
Share of education level (%):		
	Primary school	8.5
	Secondary school / at university or in higher education	11.0
	Vocational education	
	Undergraduate degree (BSc)	24.3
	Graduate degree (MSc)	27.7
	PhD	27.0
		1.5
Share of age range (%):		
	18-34 years old	29.5
	35-49 years old	31.4
	50-70 years old	39..2
Age (mean /SD), years)		45.4 (15.4)
Sample size with income information (n)		728
Of these, share of income level range (%):		
	Less than half of average	22.7
	Between half of average and average	19.6
	Average	18.8
	Between average and 1.5 times average	22.0
More than 1.5 times average		16.9

Note. Average income levels refers to national statistics.

Table 2. Food waste-related measures

	Mean (SD)
Knowledge of the extent –	
% estimated world’s food waste	39.7 (18.6)
% estimated consumer food waste	30.9 (17.4)
Relative importance of food waste compared to...(Scale 1-7) –	
reducing obesity	4.1 (1.9)
reducing pollution	4.9 (1.7)
stabilizing the economy	4.5 (1.8)
Tendency to choose ‘optimal’ products –	
in the store	5.1 (1.1)
at home	3.4 (2.0)
Self-reported % food waste at home –	
% Fresh fruit and vegetables	14.5 (16.8)
% Milk and dairy	10.2 (15.0)
% Bread and other bakery products	13.9 (16.9)
% Meat and fish	7.9 (13.9)
% Prepared dishes/meals	11.5 (16.7)
% Mean self-reported food waste across all five categories	11.6 (13.3)

Table 3. Statements for food (waste)-related lifestyle in the cross-country segmentation (I)

Statement and origin, and aspect / dimension in the F(W)RL measure	Mean/SD	Cronbach alpha or Inter-item correlation
Purchase and consumption motives / Self-fulfillment	4.78/1.52	.566 **
I am an excellent cook. ^{FRL}	4.34/1.71	-
I enjoy being able to create meals from scratch. ^{Developed}	5.22/1.74	-
Purchase and consumption motives / Security	3.26/1.26	.258 **
I only buy and eat foods which are familiar to me. ^{FRL}	3.60/1.59	-
I dislike anything that might change my eating habits. ^{FRL}	2.91/1.58	-
Purchase and consumption motives / Social relationships	5.24/1.28	.436 **
Over a meal one may have a lovely chat. ^{FRL}	5.53/1.41	-
When eating dinner, the most important thing is that we are together. ^{FRL}	4.94/1.60	-
Quality aspects / Credence attributes	4.41/1.32	.838; If item deleted:
It is important to me that the foods I choose are environmentally friendly. ^{Developed}	4.31/1.63	.778
I often think about food safety when choosing foods to buy. ^{Developed}	4.22/1.75	.825
I control what I eat to make sure it is healthy. ^{Chrysochou et al. 2010}	4.81/1.51	.832
I prefer to buy natural products, i.e. products without preservatives. ^{FRL}	4.70/1.66	.792
I make a point of using organic food products. ^{FRL}	3.94/1.91	.796
Quality aspects / Price-quality	5.38/1.17	.383 **
I compare prices between product variants in order to get the best value for money. ^{FRL}	5.09/1.56	-
I always try to get the best quality for the best price. ^{FRL}	5.67/1.24	-
Quality aspects / Taste	5.82/1.02	.520 **
I find taste in food products important. ^{FRL}	6.17/1.09	-
When cooking, I first and foremost consider taste. ^{FRL}	5.47/1.25	-

Note. ** $p \leq .001$. Inter-item correlations stated for dimensions with only two items, else, the Cronbach alpha is given. ‘Developed’ indicates that the item is based on knowledge gained through the literature review, expert interviews, focus group research, or several of these sources. ‘Inspired by’ indicates that the phrasing of the statement is based on a specific research study result with the reference given afterwards, items directly taken from another published study are indicated with the reference, and ‘FRL’ indicates that the item originates from the original food-related lifestyle measure.

Table 3. Statements for food (waste)-related lifestyle in the cross-country segmentation (II)

Statement and origin, and aspect / dimension in the F(W)RL measure	Mean/SD	Cronbach alpha or Inter-item correlation
Ways of cooking and handling / Cooking interest	4.74/1.44	.484 **
I like to have ample time in the kitchen. ^{FRL}	5.19/1.52	-
Recipes and articles on food from other culinary traditions make me experiment in the kitchen. ^{FRL}	4.30/1.81	-
Ways of cooking and handling / Norms and control	4.56/0.88	.718; If item deleted:
I hate it when I need to throw food in the bin. ^{inspired by Evans 2012}	5.76/1.47	.635
As long as there are still hungry people in this world, food should not be thrown away. ^{Developed}	5.08/1.75	.667
I rather take second helpings than having more on my plate than I want to eat. ^{Developed}	5.47/1.51	.704
I re-use food leftovers for new meals. ^{Developed}	5.25/1.61	.663
I assess whether food is still edible by smelling, tasting and looking at it. ^{Developed}	5.82/1.32	.680
Ways of cooking and handling / Planning	3.75/1.59	.568 **
I always plan what we are going to eat a couple of days in advance. ^{FRL}	3.48/1.83	-
What we are going to have for supper is very often a last-minute decision. ^{FRL} (reverse)	4.02/1.77	-
Ways of cooking and handling / Food safety	5.69/1.39	.291 **
I am concerned about whether foods I have in my fridge could become unsafe to eat. ^{Developed}	5.69/1.39	-
I rather discard a food than use it when I am unsure whether it is still good. ^{Developed}	5.01/1.73	-
Ways of shopping / Purchase planning	4.08/1.49	.300 **
We usually do a big weekly shopping trip. ^{Developed}	3.05/1.94	-
Before I go shopping for food, I make a list of everything I need. ^{FRL}	5.11/1.75	-
Ways of shopping / Optimal choice	5.58/1.20	.286 **
I compare product appearance to decide which fruit and vegetable to buy. ^{Van Boxstael et al. 2014}	5.55/1.44	-
I compare date labels to select food with the longest shelf life. ^{Van Boxstael et al. 2014}	5.61/1.56	-
Ways of shopping / Price criterion	4.60/1.59	.296 **
I frequently buy food close to the best-before date, if it is offered at a lower price. ^{Developed}	4.67/1.92	-
I look for ads in the newspaper for store specials or purchase food that is on discount. ^{FRL & inspired by Williams et al. 2012}	4.53/2.03	-

Table 4. Characterization of food(waste)-related consumer lifestyle segments, segment differences for the dimensions

		1	2	3	4	5
Dimension:	Mean	4.85	4.58	5.56	4.78	3.74
Self-fulfillment from cooking	4.78	5.57 ^a	3.15 ^c	5.87 ^a	5.17 ^b	3.39 ^c
Security and familiarity	3.26	2.81 ^b	3.43 ^a	3.21 ^{a, b}	3.55 ^a	3.35 ^a
Social relations via meals	5.24	5.29 ^{b, c}	5.08 ^c	5.83 ^a	5.65 ^{a, b}	4.00 ^d
Importance of credence attributes for quality	4.41	4.51 ^b	3.52 ^c	5.16 ^a	4.88 ^{a, b}	3.59 ^c
Price-quality relation	5.38	5.68 ^b	5.82 ^{a, b}	6.12 ^a	4.79 ^c	4.33 ^d
Taste importance	5.82	6.11 ^a	5.64 ^b	6.36 ^a	6.13 ^a	4.49 ^c
Cooking and culinary interest	4.74	5.67 ^a	3.37 ^c	5.80 ^a	4.88 ^b	3.41 ^c
Norms and control	4.56	4.77 ^b	4.58 ^b	5.11 ^a	4.54 ^b	3.57 ^c
Planning meals	3.75	2.73 ^c	3.83 ^b	5.48 ^a	3.57 ^b	3.01 ^c
Food safety	5.67	5.64 ^c	5.78 ^{b, c}	6.44 ^a	6.12 ^{a, b}	4.09 ^d
Purchase planning	4.08	3.25 ^c	4.42 ^b	5.43 ^a	4.02 ^b	3.17 ^c
Optimal choice during shopping	5.58	5.75 ^{a, b}	5.45 ^b	6.02 ^a	5.86 ^a	4.52 ^c
Price as criterion for shopping behavior	4.60	5.40 ^a	5.42 ^a	5.41 ^a	3.00 ^c	3.71 ^b

Note. Respondents' assessment measured on a 7-point Likert disagree/agree scale. Statistical test: One-way ANOVA with post-hoc Games-Howell test. Significant mean differences in group comparison in the post-hoc test (with $p \leq .001$) are indicated by different superscript letters, starting with a = highest mean. For all ANOVA's: $p < .001$.

Table 5. Differences in food waste and food waste-related indicators between segments and in sociodemographic profile

Segment:	1	2	3	4	5	
	Mean	Mean	Mean	Mean	Mean	p-value
Knowledge of the extent:						
% estimated world's food waste	38.9	38.8	42.2	38.9	39.2	ns.
% estimated consumer food waste	30.2	30.2	32.3	30.4	31.2	ns.
Relative importance:						
reducing obesity	4.2 ^a	4.1 ^{a, b}	4.6 ^a	4.1 ^a	3.5 ^b	$p < .001$
reducing pollution	5.2 ^a	4.9 ^a	5.4 ^a	5.0 ^a	4.0 ^b	$p < .001$
stabilizing the economy	4.6 ^{a, b}	4.3 ^b	5.1 ^a	4.5 ^{a, b}	3.6 ^c	$p < .001$
Tendency to choose 'optimal':						
in the store	5.2 ^{a, b}	5.1 ^{a, b}	4.9 ^b	5.1 ^{a, b}	5.4 ^a	.029
at home	2.9 ^b	3.3 ^{a, b}	3.3 ^{a, b}	3.8 ^a	3.9 ^a	.015
Self-reported food waste at home:						
% Fresh fruit and vegetables	16.1 ^{a, b}	11.2 ^b	11.5 ^b	14.4 ^b	20.1 ^a	$p < .001$
% Milk and dairy	11.9 ^{a, b}	7.4 ^b	7.5 ^b	9.8 ^b	14.9 ^a	$p < .001$
% Bread and other bakery	15.0 ^b	11.1 ^{b, c}	9.3 ^c	13.9 ^{b, c}	21.4 ^a	$p < .001$
% Meat and fish	7.2 ^b	6.1 ^b	5.7 ^b	6.6 ^b	14.8 ^a	$p < .001$
% Prepared dishes/meals	13.0 ^{a, b}	7.2 ^c	9.6 ^{b, c}	11.6 ^{a, b, c}	16.4 ^a	$p < .001$
% Mean across categories	12.7 ^b	8.6 ^b	8.6 ^b	11.3 ^b	17.5 ^a	$p < .001$
Age (years)	42.2 ^{b, c}	46.2 ^{a, b}	48.0 ^a	49.8 ^a	39.9 ^c	$p < .001$
Gender (% female)	59.4 ^a	46.9 ^{a, b}	57.2 ^a	57.8 ^a	31.2 ^b	$p < .001$
Single household (%)	29.3 ^{a, b}	26.6 ^{a, b}	17.7 ^a	24.6 ^{a, b}	38.1 ^a	$p < .001$
High education (%)	62.0	50.4	51.9	62.7	51.8	.035
High income (%)	33.1 ^b	37.2 ^{a, b}	36.9 ^{a, b}	49.7 ^a	37.6 ^{a, b}	.034
Low income (%)	49.4	47.9	38.9	34.6	47.9	.046

Note. Statistical test: One-way ANOVAs with post-hoc test Games-Howell test. Significant mean differences in group comparison in the post-hoc test (with $p < .001$) are indicated by different superscript letters, starting with a = highest mean.

Table 6. Major characteristics and suggested policy actions for each segment

Segment number and key characteristics	Policy suggestions for market actors	Policy suggestions for policy makers
1 - 'Cooking-involved and spontaneous'	<p>Apps to support consumer food waste avoidance behavior via better planning and knowing what one has in stock</p> <p>Logo/certificate highlighting the operators' contribution to food waste avoidance</p> <p>Provide attractive and diverse meal solutions in-store (e.g. measured ingredients and the recipe)</p>	<p>Educate or disseminate knowledge on simple advice for purchase and meal planning</p> <p>Communicate new social norms of sufficiency / 'less is better' instead of abundance</p>
2 - 'Price versus quality-oriented and disliking cooking'	<p>Reduce prices of food close to the expiration date or which have become suboptimal, or for restaurant/canteen leftovers</p> <p>Offer foods not conforming to current market standards at lower prices</p> <p>Provide easy tips for storage and food handling</p> <p>Donate food to alternative retail / food banks</p>	<p>Financially incentivize households to avoid wasting food via their waste bin</p> <p>Communicate the personal economic benefit of avoiding waste, or of 'thriftiness' behavior</p> <p>Educate or disseminate knowledge on simple advice for storage and food handling</p>
3 - 'Very involved and cooking-engaged'	<p>Provide effective household management advice (category-specific storage, cooking, composting, etc.)</p>	<p>Educate or disseminate knowledge on effective household management advice (category-specific storage, cooking, composting, etc.)</p> <p>Work towards engaging the segment to share advice in peer-to-peer knowledge and experience exchange and citizen interaction</p> <p>Communicate renewed social norms on thriftiness and simplicity</p> <p>Support NGOs or citizen activities such as food sharing and gleaning</p>
4 - 'Good food-involved and price-dismissive'	<p>Logo/certificate highlighting the operators' contribution to food waste avoidance</p> <p>Communicate food otherwise wasted in-store as an action reducing guilt, heightening status, and boosting cooking enjoyment</p> <p>Increase prices in return for actions to avoid food waste in stores (e.g. innovations) or restaurants/canteens (e.g. premium zero food waste restaurants)</p> <p>Offer services (e.g. box schemes with food ingredients for cooking a certain recipe)</p>	<p>Support development of logos or certificates highlighting the operators' contribution to food waste avoidance to consumers</p> <p>Fund research on technology and processes for innovation in the supply chain or in restaurants/canteens</p> <p>Communicate new social norms of sufficiency / 'less is better' instead of abundance</p>
5 - 'Least concerned, normative and social'	<p>Apply nudging strategies to sell food otherwise wasted in-store</p> <p>Change products and offers to reduce food wastage in store (e.g. reduce assortment) and in households (smart packaging, longer expiration date)</p>	<p>Support supply chain stakeholders collaboration in reducing food wastage in the operations and in store</p> <p>Fund research on technology and processes for innovation in the supply chain or on nudging strategies in store</p> <p>Revise food-related laws which affect food waste</p>

