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Got waste: knowledge, behavior and self-assessment on food waste of university students in Germany

RESEARCH ARTICLE

Andreas Gabriel[ⓘa,b], Meike Rombach[c], Hannah Wieser[d] and Vera Bitsch[e]

[a]Research associate, [d]MSc, [e]Professor, Technical University of Munich, School of Management and School of Life Sciences Weihenstephan, Chair of Economics of Horticulture and Landscaping, Alte Akademie 16, 85354 Freising, Germany

[b]Research assistant, Institute for Agricultural Engineering and Animal Husbandry, Bavarian State Research Center for Agriculture, Voettinger Strasse 36, 85354 Freising, Germany

[c]Lecturer, Department of Land Management and Systems, Orchard O05, P.O. Box 85084, Lincoln University, Lincoln 7647, Christchurch, New Zealand

Abstract

The paper analyzes German students' interest, perceived importance, knowledge, and behavior regarding food waste. This target group was expected to differ from the general population in terms of food consumption (shopping, cooking, and storage of food) and increased food waste due to their lifestyle. An online survey resulted in 253 participants enrolled in different study programs. Of the sample, 64% studied in life science programs, which were anticipated to have an impact on students' behavior regarding food. Linear regression models were used to determine the importance of food waste avoidance to students, and their frequency of food disposal. In addition, students were asked about reasons for food waste and assessed statements for each consumption phase. High positive impacts were found for students' general interest in food waste topics. They attested themselves sensible handling of food products, and rated themselves better than the average German consumer in all surveyed statements. For the target group of university students, detailed knowledge of food waste issues showed little influence on reported behaviors. In conclusion, awareness campaigns, while useful, should not be the only way to target a reduction in food waste, but have to be supplemented by other means.

Keywords: food disposal behavior, food waste, knowledge of food waste, student survey
JEL code: Q10, Q13, Q19

ⓘCorresponding author: andreas.gabriel@tum.de

1. Problem definition and aim of the paper

The issue of food losses and food waste has garnered importance worldwide in recent years. Thus, interest in food waste among local and national politicians, international organizations, non-governmental organizations (NGOs), and scientists has increased, as have presence and discussion of the issue in the public and the media. The background of this increasing interest are emerging concerns about negative impacts on the environment, society and the economy. The reduction of food waste has become a primary goal of the global and many national political agendas (Xue *et al.*, 2017). Food losses occur at all stages of food supply chains, starting with agricultural production. Food losses also occur at the post-harvest and processing stages and during distribution. Finally, in industrialized countries most food losses occur in private households (Gustavsson *et al.*, 2011; Hausschild and Schulze-Ehlers, 2014; Kouwenhoven *et al.*, 2012; Szabó-Bódi *et al.*, 2018). For example, in the European Union (EU), almost half of all consumable food is disposed at the household level. In absolute numbers, around 88 million tons of food are disposed each year across the EU (European Parliament, 2017). The resulting costs amount to 143 billion euros, of which around 98 billion euros can be attributed to the household level (Stenmarck *et al.*, 2016). During the production, processing and disposal of the lost and disposed food, 26 million tons of resources are used and 170 million tons of CO_2 are emitted. The European Parliament has therefore set the target of reducing food waste from the reference value of 2014 by 30% until 2025 and by 50% until 2030 (European Parliament, 2017).

Because common and widely acknowledged definitions of food loss and food waste do not yet exist (Timmermans *et al.,* 2014), and the terms are used differently in different studies, terminological ambiguity arises and results of different studies are difficult to compare. Accordingly, it is important to pay attention to the respective definitions in the literature to draw the correct conclusions from studies' results. In a significant number of studies, 'food loss' relates to food items that were initially intended for human consumption and occurs at all stages of the food chain prior to the consumer (Timmermans *et al.*, 2014). This includes, in particular, the early stages of the chain such as production, post-harvest, and processing of food products. At any of these stages, a reduction in food quality and quantity can occur, e.g. due to inadequate harvesting techniques, unsuitable storage, processing, packaging, and transport resulting in product damages, over ripeness, and pest infestation. According to existing food standards, these quality limitations prevent human consumption (Gustavsson *et al.*, 2011; Parfitt *et al.*, 2010; Timmermans *et al.*, 2014).

In contrast to food loss, the term 'food waste' is frequently used for the losses incurred by the end consumer. Alternatively, the term food waste may also address losses at the final stages of the food supply chain, during the handling of food products either in retail or by the end consumer. Regarding the end consumer, the loss of food products suitable for human consumption is mostly caused by shopping, storage, and eating behavior (Do Carmo Stangherlin and de Barcellos, 2018; Timmermans *et al.*, 2014).

At the point of sale, food quality standards, the best-before-date, and frequent unplanned food shopping are important factors causing food disposal in industrialized countries. Another contributing factor is that consumers expect products to be available at all times and in flawless condition and appearance (Stenmarck *et al.*, 2016). Even small optical shortcomings, e.g. damaged packaging, can lead to rejection of the product from retail shelves or at home (Raak *et al.*, 2017). To summarize, several cross-national statistics have shown that in industrialized countries the consumer is the central actor regarding food waste. However, the disposal behavior of consumers cannot be explained by a single factor; rather, the causes of food waste are varied and complex (Mondéjar-Jiménez *et al.*, 2016; Quested *et al.*, 2013).

Main sources of food waste in private households are household and nutrition management (Aschemann-Witzel *et al.*, 2015). There are often deficits in knowledge regarding shelf life and handling of food products (Gustavsson *et al.*, 2011; Parfitt *et al.*, 2010; Timmermans *et al.*, 2014), but also lack of competence in utilization of leftovers and lack of skills in food preparation (Abeliotis *et al.*, 2014; Blichfeldt *et al.*, 2015). Socio-demographics, social and psychological factors also influence consumers' disposal behavior. Several studies of food waste at the consumer level have shown that younger generations dispose a lot of food still

consumable (e. g., Hamilton *et al.*, 2005; Quested *et al.*, 2013; Secondi *et al.*, 2015). Another aspect is that the lifestyle of many segments of society leads to a low appreciation of food, which results in little concern about food waste (Aschemann-Witzel *et al.*, 2015). Parizeau *et al.* (2015) focused on food waste behavior in Canadian households and concluded that members of households who practiced alternative diets, such as vegans and vegetarians, consider food waste reduction as an appropriate strategy of household management.

Among students it can be assumed that due to their lifestyle with frequent changes of residence and temporary secondary residences, a relatively high amount of food waste occurs (Cecere *et al.*, 2014). A recent study analyzed awareness and behavior of students in the United Kingdom (UK) regarding food waste (Clark and Manning, 2018). The results showed that students had shortcomings in food planning, procurement, and housekeeping. UK students cited the preparation of too much food, late consumption of food and 'overbuying' of food in the shop as the main causes of food waste.

This study builds on findings of Quested *et al.* (2013), Schanes *et al.* (2018) as well as Clark and Manning (2018) who emphasized that food shopping and poor household management are major causes of food waste. The present study aims to analyze to what extent perceived importance of, interest in and knowledge of food waste influence students' behavior with respect to food purchases, preparation and storage causing food waste. Even though consumer knowledge and subsequent consumption and waste patterns have been widely discussed in the existing body of literature, fewer studies focused on students (Alattar *et al.*, 2020). Students are a unique consumer group because their academic environment shapes their knowledge, skills, and behavior. Behavioral changes, knowledge and policies to decrease food waste can be easier implemented on campus and in academic environments (Alattar *et al.*, 2020), and therefore it is important to understand students as a distinct consumer group. Knowledge and concern regarding food waste can be expected among students aiming to be professionals in the area of life sciences and primary production (Di Talia *et al.*, 2019).

The main objectives of this study are to (1) analyze to what extent sociodemographic characteristics, a stronger connection to agriculture, and the type of study program (life science students versus all other types of study programs) have an impact on students' behavior regarding food waste; and (2) explore whether or not students display a social desirability bias, when self-assessing reasons for food waste occurring in the different consumption phases (purchasing, storage, food preparation).

The subsequent section presents a knowledge framework based on the literature review. The literature review focuses on the relationships between socio-demographic background and food waste generation, as well as knowledge regarding the causes of food waste generation. In Section 3, the quantitative research approach, data collection via online survey and analysis through descriptive and multivariate statistics are explained. The results of the survey are analyzed and discussed in Section 4; followed by best practice recommendations for initiatives to reduce food waste in Section 5. Section 6 concludes by providing suggestions for future research based on the specific findings of this exploratory study.

2. Literature review

The body of literature on food waste can be structured into three main branches (Schanes *et al.*, 2018). The first one builds on a psychological approach, exploring people's attitudes and behavior towards pro-environmental behavior, including food waste reduction. The second branch is of sociological nature and explores social movements and change in the context of food waste. The third branch is of normative and regulative character, and these studies aim to develop best practice recommendations and regulations to reduce food waste (Schanes *et al.*, 2018). The present study draws primarily from the first branch of literature. A framework presenting relationships between socio-demographic background, food waste generation, knowledge on the causes of food waste, self-critical assessment on food waste generation, and social desirability bias has been developed (Figure 1).

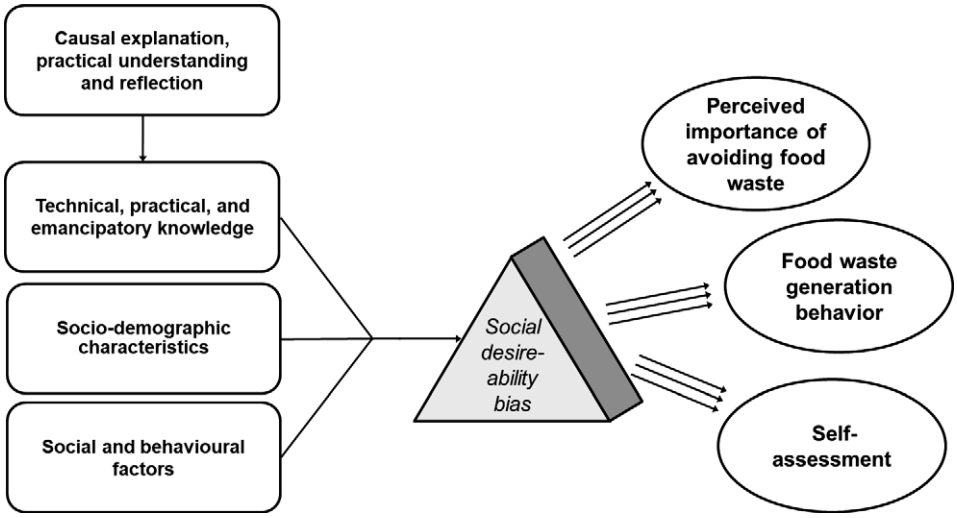

Figure 1. Framework explaining student's relationship with food waste distorted by social desirability bias.

A plethora of studies intended to understand why consumers generate food waste applied the theory of planned behavior (TPB) and several conceptual TPB extensions. A meta-analysis (Stöckli *et al.*, 2018) summarized many of the empirical studies in the field of food waste and evaluated the TPB approach in this context. The present paper distances itself from this theory, since the explanatory variance among core model constructs is often very limited (Armitage and Connor, 2001). In addition, many of the applied theoretical constructs such as subjective norm or perceived behavioral control suffer from incorrect measurements and add little explanatory value beyond the theory of reasoned action, especially in the context of self-reported behavior (Armitage and Connor, 2001). Furthermore, Sniehotta *et al.* (2014) reviewed the extensive criticisms of TPB in the context of health behavior and added validity and utility concerns. In particular, they claimed that extended TPB models do a disservice to novel ideas and provide unwarranted support to the model. They suggested to focus on the discovery of better explanations of behavior.

The framework (Figure 1) builds on Habermas' theory of knowledge and interest and on the assumption that knowledge refers to awareness and understanding of people, such as information, facts, or skills obtained. Knowledge can be of practical or theoretical nature and is commonly acquired through experience or education (Habermas, 2015). A requirement that allows people to generate knowledge is the interest of exploring and understanding the physical and social world, as well as implementing this knowledge into action. Acquiring technical knowledge requires an interest in instrumental and causal explanations. Technical knowledge enables people to control their physical or social world. Practical knowledge requires an interest in practical understanding and allows for improved communication in a person's lifeworld. Gaining emancipatory knowledge requires an interest in reflection. This type of knowledge leads to freedom, rationality and autonomy (Habermas, 2015). Each form of interest is essentially an orientation, geared towards learning and practice. (Delany *et al.*, 2020).

Exploring people's disposal of food requires understanding people and their lifeworld's, which is accomplished through the inclusion of socio-demographic characteristics into the framework. Investigating knowledge of food waste and waste generation requires understanding causes and effects, control mechanisms, and communication. Self-critical assessment of food waste generation requires people to have emancipatory knowledge. Emancipatory knowledge requires people to have a strong sense of ethics and an interest in reflecting on ethic aspects of a given context (Delany *et al.*, 2020). Yet, reflections on ethics and one's own behavior are often biased. In surveys, undesirable behaviors are rarely reported truthfully due to social desirability bias (Fisher, 1993; Nederhoff, 1985). Reporting on food waste generation is a typical example of potential social desirability bias (Annunziata *et al.*, 2020; Coderoni and Perito, 2020).

As stated by Neff *et al.* (2015) and Schanes *et al.* (2018) food waste generation is considered an undesirable behavior. Acknowledging undesirable behavior contradicts people's tendencies to protect themselves and present themselves in a positive light (Fisher, 1993; Nederhoff, 1985). Reporting about food waste generation can be regarded as a social situation where people may be concerned how they are perceived by others. According to Graham-Rowe *et al.* (2015), Neff *et al.* (2015), and Qi and Roe (2016) food waste generation is a topic were people are prone to providing socially desirable answers. These studies indicated that people either report to generate very little waste or at least not more than others. Reporting bias extends to products disposed, quantities disposed, as well as shopping and household practices (Annunziata *et al.*, 2020; Coderoni and Perito, 2020). People answering truthfully admit being concerned about their behavior (Principato *et al.*, 2015; Schanes *et al.*, 2018).

2.1 Relationships between socio-demographic background and food waste generation

Various studies tried to determine knowledge and behavior concerning food waste generation through socio-demographic characteristics. The outcomes of these studies are diverse and appear to be a combination of different socio-demographic factors determining interest in food waste (Quested *et al.*, 2013). Up to present there is no agreement among researchers how food waste generation is determined by age (Qui and Roe *et al.*, 2016; Secondi *et al.*, 2015; Visschers *et al.*, 2016). Similarly, studies exploring the connection between education level and food waste found only weak correlations (Neff *et al.*, 2015). In contrast, a relationship between gender and food waste behavior has been found. Several studies found women to generate less food waste than men (Cecere *et al.*, 2014; Secondi *et al.*, 2015). However, the contrary has also been found (e.g. Visschers *et al.*, 2016). Stancu *et al.* (2016) found a relationship between employment status and food waste, as well as between income and food waste. People with higher income tend to be less concerned about food waste generation. Melbye *et al.* (2017) presented different findings. While they could not identify a direct correlation between income and food waste generation, they found a higher aversion to food waste with increasing age.

Students, as a (mostly) young and low-income consumer group is also expected to differ in terms of food shopping and the use of food products and are assumed to produce a higher amount of food waste than the general population due to their specific lifestyle during this period in their lives (Cecere *et al.*, 2014). Young people, in general, are expected to show unique behaviors in relation to food consumption and food waste triggered, for example, by marketing and sales strategies that increase their food disposal amounts (Mondéjar-Jiménez *et al.*, 2016). However, it should not be ignored that there are also differences to take into account based on the origin and preferences of students (Cecere *et al.*, 2014). Social preferences can also play a role in the choice of study program. Based on Cecere *et al.* (2014), one could argue that students enrolled in life science programs (e.g. agriculture or nutritional sciences) may behave differently regarding to food disposal than students enrolled in other study programs. Studies investigating the relationship between employment status and food waste are also relevant to this study (Cecere *et al.*, 2014; Joerissen *et al.*, 2015; Secondi *et al.*, 2015) and the period of life of students. These studies indicate higher food waste generation in periods were people have high workloads. Periods of high workloads are applicable to students, studying for exams, or combining part time work and studies. The relationship between pro-environmental behavior and socio-demographic factors, such as a relationship with agriculture and other study programs that are closely related to food production, processing and the environment, have not been explored much in the recent body of literature. Based on Schanes *et al.* (2018), an overview of studies investigating the relationships between socio-demographic characteristics and interest in as well as knowledge regarding food waste is presented below (Table 1).

Table 1. Overview of studies on socio-demographic characteristics' relationships with interest in and knowledge regarding food waste.

Socio-demographic characteristics	Relationship to food waste	Studies
Gender	Women generate less food waste than men	Barr (2007), Cecere *et al.* (2014), McCarthy and Liu (2017), Schanes *et al.* (2018), Secondi *et al.* (2015)
	Women generate more food waste than men	Kuo and Shih (2016), Mallinson *et al.* (2016), Painter *et al.* (2016), Schanes *et al.* (2018), Silvennoinen *et al.* (2014), Visschers *et al.* (2016)
	No difference in food waste generation behavior between men and women	Principato *et al.* (2015), Schanes *et al.* (2018)
Age	Negative correlation between food waste generation and age	Schanes *et al.* (2018), Secondi *et al.* (2015), Stancu *et al.* (2016), Visschers *et al.* (2016)
	Older people generate higher quantities of food waste	Cecere *et al.* (2014), Schanes *et al.* (2018)
	People in their sixties are most conscious of food waste	Qi and Roe (2016), Quested *et al.* (2013), Schanes *et al.* (2018)
	Young people are more susceptible to food-waste-increasing marketing and sales strategies of food retailers	Mondéjar-Jiménez *et al.* (2016)
Employment situation	Employed people generate more food waste than unemployed people	Cecere *et al.* (2014), Mattar *et al.* (2018), Schanes *et al.* (2018), Secondi *et al.* (2015)
	Employed people generate more food waste during periods of high workloads	Qi and Roe (2016), Schanes *et al.* (2018)
Income	People with low incomes generate less food waste than people with higher incomes	Koivupuro *et al.* (2012), Miliute-Plepiene and Plepys (2015), Pearson *et al.* (2013), Porpino *et al.* (2016), Schanes *et al.* (2018), Setti *et al.* (2016)
Household size	Households with children tend to produce higher quantities of food waste	Hill and Lynchehaun (2002), McCarthy and Liu (2017), Neff *et al.* (2015), Parizeau (2015), Schanes *et al.* (2018), Visschers *et al.* (2016)
	Single households generate the most food waste per person	Cecere *et al.* (2014), Joerissen *et al.* (2015), Schanes *et al.* (2018), Secondi *et al.* (2015), Silvennoinen *et al.* (2014)
Residency	People living in urban areas generate higher quantities of food waste	Cecere *et al.* (2014), Farr-Wharton *et al.* (2014), Schanes *et al.* (2018), Secondi *et al.* (2015)
	No difference in food waste generation between people residing in rural or urban areas	Neff *et al.* (2015), Schanes *et al.* (2018)
Education level	No correlation between food waste generation and education level	Cecere *et al.* (2014), Neff *et al.* (2015), Schanes *et al.* (2018)

2.2 Knowledge regarding the causes of food waste generation

While the literature on socio-demographic characteristics is quite diverse, studies on household and shopping practices show a more unified picture. Household routines that contribute or preventing food waste are planning, shopping, storing, cooking, eating, and managing leftovers (Evans, 2012; Romani *et al.*, 2018; Stancu *et al.*, 2016; Stefan *et al.*, 2013; Visschers *et al.*, 2016). Following Stefan *et al.* (2013) and Schanes *et al.* (2018), these routines require consumers to assess whether the food is suitable for human consumption,

and decide if these items should be disposed and food waste generated (Blichfeld *et al.*, 2015). The decision whether to dispose a food item can be associated with guilt or shame (Graham-Rowe *et al.*, 2015). People are usually aware of their failures with respect to household routines and food waste generation. These include failure to check stocks, improper planning and storage habits, bulk buying, the best before date, and expectations regarding food quality and availability (Goebel *et al.*, 2015; Hermsdorf *et al.*, 2017; Joerissen *et al.*, 2015; Richter, 2017; Secondi *et al.*, 2015). These failures and the ensuing food waste are commonly viewed as a social problem (Table 2). Food waste generation is considered an undesirable behavior and in this context, ethical concerns are high because of the socially attributed value of food (Mirosa *et al.*, 2016; Neff *et al.*, 2015). Interestingly, subjective norms have very little influence on food waste behavior, while personal and descriptive norms have a high influence (Do Carmo Stangherlin *et al.*, 2020; Graham-Rowe *et al.*, 2015; Porpino *et al.*, 2016; Schanes *et al.*, 2018; Visschers *et al.*, 2016). People's knowledge regarding information and education campaigns has not yet been widely explored. A few intervention studies show personalized information on waste-generation for different consumer groups are more effective than general information lists (Schmidt, 2016).

Based on the literature review and the established framework, the present study builds on both, objective and subjective knowledge. Following Han (2019) and Macaulay *et al.* (2020), objective knowledge refers to how much individuals actually know about a given topic (factual knowledge), and subjective knowledge refers to how much individuals think they know about a topic. Subjective knowledge is also called perceived or self-assessed knowledge. Both types of knowledge are relevant to the study as technical, practical and emancipatory knowledge allow driving interventions and behavioral change with respect to food waste. Subjective knowledge allows understanding norms, values, emotions and external societal influences on individuals that guide behavior. The study emphasizes objective knowledge due to the lack of existing studies in the context of food waste (Schanes, 2018).

Table 2. Overview of studies on the social and behavioral factors regarding food waste.

Social and behavioral factors	Relation to food waste	Studies
Unacceptable behavior	Generating food waste is socially unacceptable	Graham-Rowe *et al.* (2015), Melbye *et al.* (2017), Porpino *et al.* (2016), Schanes *et al.* (2018), Stefan *et al.* (2013), Visschers *et al.* (2016)
Concern	Concern about food waste is an indicator of improved behavior (food waste minimization)	Graham-Rowe *et al.* (2015), Neff *et al.* (2015), Schanes *et al.* (2019), Stancu *et al.* (2016)
	Financial concerns are strongly associated with food waste	Blichfeldt *et al.* (2015), Graham-Rowe *et al.* (2015), Principato *et al.* (2015), Qi and Roe (2016), Schanes *et al.* (2018), Stancu *et al.* (2016)
	Environmental concerns are only a minor incentive to reduce food waste generation	Graham-Rowe *et al.* (2015), Pearson *et al.* (2013), Principato *et al.* (2015),`Quested *et al.* (2013), Schanes *et al.* (2018), Stefan *et al.* (2013)
	Food waste generation is considered a social problem	Schanes *et al.* (2018), Setti *et al.* (2016)
Emotion	Food waste generation is associated with negative emotions such as guilt, hate, or disgust	Evans *et al.* (2012), Graham-Rowe *et al.* (2015), Mirosa *et al.* (2016), Schanes *et al.* (2018)
Behavior change	Guilt can be used as an intervention mechanism to suggest behavior changes	Neff *et al.* (2015), Qi and Roe (2016), Schanes *et al.* (2018)
	Subjective norms have little influence on food waste generation; personal and descriptive norms have high influence and may lead to behavior change	Do Carmo Stengherlin *et al.* (2020) Graham-Rowe *et al.* (2015), Porpino *et al.* (2016), Schanes *et al.* (2018), Visschers *et al.* (2016)

3. Methods

As the study aims to analyze study students' knowledge and behavior, an explorative, quantitative research approach was chosen. The exploratory approach is particularly useful as student's have not been widely studied in the context of food waste, and new perspective to an existing body of literature will be added (Stebbins, 2001). For this purpose, an online survey was carried out with German students in the fall of 2018. Online surveys are of advantage when dealing with students, as this target group regularly learns, communicates and interacts online. Further, online surveys are low in costs, quickly completed and show no significant difference in results compared to paper-pen surveys (Fleming and Bowden, 2009; Olynk and Ortega, 2013). The survey design included four main groups of questions. The first group of questions asked for respondents' demographic information as well as their interest in the general topic of food waste, their interest in the daily handling of food (nutrition, cooking), and perceived importance of reducing food waste. The second group of questions addressed students' general knowledge regarding food waste, and their active involvement in campaigns and initiatives focusing on the reduction of food waste. A third group of questions asked students about their behavior in purchasing, storage, and processing of food at home (weekly frequency of food disposal, type of food products disposed).

A final set of scaled statements reflected students' assessment of their specific reasons for disposing food in daily life and, in addition, in relation to the 'average consumer' in Germany. The reasons for food waste along different phases of food consumption to be included in the questionnaire were compiled with the help of literature. For example, Stöckli *et al.* (2018) provided an overview of most commonly cited consumer food waste behaviors along the consumption phases from shopping to serving. Five-point Likert scales were used to analyze the set of predefined reasons assigned to three phases of food consumption, namely shopping, cooking, and food storage. In the context of food waste and the various consumption phases addressed in this survey, five-point Likert scales are common in German consumer research and implemented for comparability with existing studies (e.g. Lorenz *et al.*, 2017; Stefan *et al.*, 2013; Von Kameke and Fischer, 2018). The consumption phases were supplemented by three preset categories of situation-dependent circumstances (shortage of time, poor planning in food processing, preparing more food than necessary when expecting guests). In addition, survey respondents were asked to compare their self-assessment with the German population, and estimate whether they act better, the same or worse than the average consumer. Various studies dedicated to self-reported behaviors, show a social desirability bias, resulting in underreporting negative behaviors and over-reporting positive ones (Giordano *et al*., 2018; Meixner *et al.*, 2020). The current study will assess whether this response behavior is also exhibited by students in the context of food waste.

Social media as well as direct contacts via email and messenger services were used to promote the survey and obtain a sufficient sample size to perform multivariate analysis. This approach also made it possible to reach students enrolled in study programs that extended beyond the main site of the study. After pre-testing the questionnaire, the link to the survey was distributed via personalized emails and social media and participation was encouraged by the prospect on a small incentive. After quality control of the incoming dataset, a sample of 253 students was used for analysis. Preparation of the raw data as well as descriptive and multivariate analysis of the data was carried out with SPSS Statistics 25 (IBM, Armonk, NY, USA). The preparation of the raw data also included calculating indexes of three thematic fields, students' knowledge about food waste topics, cooking skills and cooking behavior, as well as students' active involvement in initiatives against food waste. For each of the three thematic fields an index variable was calculated by adding up the individual results for each sub-question, which were weighted with the rate of the same answer in the total sample.

For example, the index 'knowledge on food waste' was calculated based on three sub-questions regarding quantity and type of food waste in Germany and worldwide (c1, c2, c3). Correct answers of each individual respondent to each of the three sub-questions were multiplied by the rate of correct answers of the total sample and added up. A respondent who was not able to answer any of the three questions correctly would have an index value of zero. The higher the number of correct answers and the lower the overall rate of correct answers in the overall sample, the higher the index value of the respective respondent. The two indices active

involvement (AI) and cooking behavior (CB) were calculated analogously. AI was calculated on the basis of respondents' agreement to three sub-questions regarding their knowledge of and voluntary participation in anti-food waste campaigns or environmental organizations. The CB index consisted of three sub-questions on cooking skills, cooking of own meals and frequency of cooking.

Calculation of the knowledge index (KI):

$$KI_i = c_1 \times (\sum_{i=1}^{n} c_1 /n) + c_2 \times (\sum_{i=1}^{n} c_2 /n)\ c_3 \times (\sum_{i=1}^{n} c_3 /n) \quad (1)$$

Sub-questions c_1, c_2, c_3; correct answer = 1, incorrect answer = 0
n = number of respondents

When evaluating the impact of students' characteristics on the reported importance of food waste reduction and on disposal behavior (weekly frequency of food thrown away), the limited sample size and explorative character of the study must be considered. In addition, the three indices (*AI, KI, CB*), metric values for the scale variables, interest in food waste topics (*IFWT*), and interest in nutrition, food and cooking (*INFC*) were included in the regression models. Further predictor co-variables (*Gender*, *Age*, *Diet*, Size of the community or town of residence (*Size)*, Connection to Agriculture (*AgCon*), *Income*, and study program (*StudProg*)) were dummy-coded and included in the regression models, using binary coding (0/1). For this purpose, ordinal variable categories, e.g. for age or income classes, were reduced to binary categories, with '1' representing the expected category, and '0' representing all others.

We estimated both models using ordinary least squares (OLS) regression, applying the 'enter method' to include the independent variables. Thus, the two models employed are:

$$\begin{aligned}\text{Reported importance}_i = {} & \beta_0 + \beta_1 IFWT_i + \beta_2 INFC_i + \beta_3 CB_i + \beta_4 AI_i + \beta_5 KI_i \\ & + \beta_6 Gender_i, + \beta_7 Age_i + \beta_8 Diet_i + \beta_9 Size_i + \beta_{10} AgCon_i \\ & + \beta_{11} Income_i + \beta_{12} StudProg_i + \varepsilon_i\end{aligned} \quad (2)$$

$$\begin{aligned}\text{Weekly food disposal}_i = {} & \beta_0 + \beta_1 IFWT_i + \beta_2 INFC_i + \beta_3 CB_i + \beta_4 AI_i + \beta_5 KI_i \\ & + \beta_6 Gender_i, + \beta_7 Age_i + \beta_8 Diet_i + \beta_9 Size_i + \beta_{10} AgCon_i \\ & + \beta_{11} Income_i + \beta_{12} StudProg_i + \varepsilon_i\end{aligned} \quad (3)$$

where β_0 is the intercept and β_i is the coefficient of each independent variable. The subscript i determines the individual, and ε_i the error term.

4. Results

Results are divided into three sections. The first section describes the sociodemographic characteristics of the sample. In addition, the results of the index calculation regarding students' knowledge on and involvement in initiatives on the subject of food waste are presented. In the second section, the factors impacting the avoidance of food waste as well as the students' weekly frequency of food disposal are presented. The third section provides an overview of the reported reasons for food waste and the students' perception of how they compare to the German population.

4.1 Sample description

The sample consists of a majority of female respondents (63%) (Supplementary Table S1). Due to students being the target group, only a small proportion of the sample is younger than 20 years (4%) or older than 30 years (6%). Most respondents fall in the age group of 20 to 25 years (65%). Many respondents live in multi-person households (60%) with more than two household members, amongst them people living in shared flats, dormitories, or families with children. A question on the size of the community or town of residence

was included in the questionnaire to evaluate respondents' opportunities for grocery shopping. About 20% of the respondents live in towns with more than 100,000 inhabitants and around half of the respondents live in towns between 5,000 and 100,000 inhabitants. With 86%, a majority of the respondents who answered that question have less than 1000 Euro per month at their disposal, 46% even less than 600 Euro. Almost every fifth student has to manage with less than 400 Euro per month.

Since the survey focused on behavior of students regarding food waste, further questions asked whether the students were close to the agricultural sector or food production through their origin (e.g. growing up in a farm family) or through their education. The sample included a significant share of respondents, reporting a direct connection to agricultural topics (54%), which also reflected the large share of students enrolled in life science programs; 64% studied agricultural and nutritional sciences or related fields. Other more frequently indicated study programs were engineering (19%), law and economics (5%), and mathematics (3%).

Another survey question aimed at the respondents' diets, since an impact of diet on food disposal behavior was expected. The student sample was composed of vegans (3%), vegetarians (6%), pescatarians (5%), flexitarians (consumption of only small amounts of high-quality meat; 32%), and omnivores (54%). Students reported high interest regarding food and food waste (Figure 2). A large share of the respondents reported to be very interested (63%) or interested (34%) in nutrition, food and cooking. The level of interest in food waste and food waste reduction is slightly lower (47% very interested, 46% interested). Almost 60% of respondents rated avoiding food waste as very important and 37% as important.

On the level of the sub-questions for the AI index, almost half of the respondents were familiar with relevant initiatives and campaigns, but only one in ten respondents is actually active in a campaign or organization addressing food waste (Table 3). Only a small share of respondents achieved medium or high index values for AI, which shows a weak involvement in the topic of food waste. Regarding the individual questions on cooking skills and behavior, almost two thirds of the respondents rated their cooking skills as 'very good' or 'good', while only 10% do not cook for themselves at all. Every second respondent cooks a meal more than four times per week. The distribution of the CB index also shows almost 40% of the respondents in in the highest index section, and about 25% in the lowest index range. The three sub-questions measuring the respondents' knowledge on food waste showed shares of less than 45% correct answers, ranging from 33% to 42%. Only one third of the sample was able to answer more than one question correctly. The three indices calculated were used to analyze the distribution of respondents on the basis of their index values (Figure 3). The distribution of the KI index shows the low number of respondents in the higher index sections.

Figure 2. Students' interest in nutrition and food waste topics and reported importance of food waste avoidance (n=253).

Table 3. Questions and indices of active involvement, cooking skills and behavior, and knowledge on food waste.

Index: Active involvement (AI)	
Original question (answer category used)	**Share in category**
Q1. There are various campaigns and initiatives to reduce food waste. Do you know any? (yes)	46.6%
Q2. Do you take part in initiatives or campaigns against food waste? (yes)	11.5%
Q3. Are you involved in organizations or projects that are committed to environmental protection or sustainability on a volunteer basis? (yes)	9.9%
Index: Cooking skills and behavior (CB)	
Original question (answer category used)	**Share in category**
Q4. How do you rate your cooking skills? ('very good' and 'good')	63.6%
Q5. Do you cook your meals yourself? (yes)	89.3%
Q6. How often do you cook in a normal week? (more than four times per week)	50.6%
Index: Knowledge on food waste (KI)	
Original question (correct answer)	**Share of correct answers**
Q7. At what level does most food waste occur in the industrialized countries? (consumer level)	39.9%
Q8. What percentage of food produced for humans is lost or wasted every year, worldwide? (33%)	32.8%[1]
Q9. Which foods do consumers throw away most often in Germany? (fruits and vegetables)	41.5%

[1] Accepted accuracy level of answer ±5%.

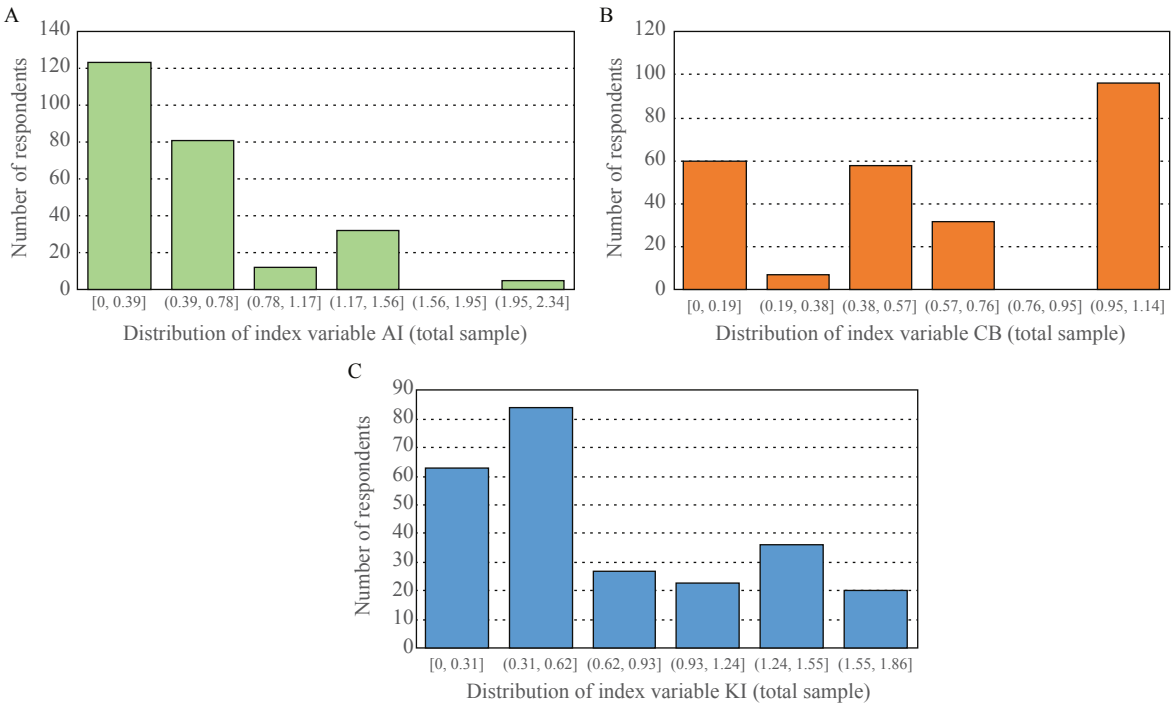

Figure 3. (A) distribution of index 'Active involvement' (AI); (B) distribution of index 'Cooking skills and behavior' (CB); (C) distribution of index 'Knowledge on food waste' (KI).

4.2 Regression analysis

Multivariate regression analysis was used to identify the impacts of respondents' characteristics and interests, as well as of the indices calculated regarding knowledge, active involvement in food waste initiatives, and cooking behavior. The two linear regression models measured the impacts of these independent variables on the reported importance of avoiding food waste (model 1) and on the stated frequency of weekly food disposal from zero to seven days per week (model 2) (Table 4). Both models showed only few statistically significant impact factors. High positive effects were determined when respondents had stated a higher interest in the topic of food waste reduction. The three indices (AI, KI, CB) had only minor (positive) effects on the reported importance of avoiding food waste, and minor reduction effects on the stated frequency of food disposal.

In contrast to previous studies (e.g. Cecere *et al.*, 2014; Melbye *et al.*, 2017; Secondi *et al.*, 2015), the sample showed few effects of sociodemographic characteristics on either dependent variable. Albeit not statistically significant, a higher reported importance of food waste avoidance can be observed for female students, as well as students who live in smaller towns, and who prefer alternative diets (vegetarian, vegans, limited meat eaters such as pescatarians and flexitarians) in model 1. The choice of study program (life science programs) had a significant impact on the importance of food waste avoidance for the surveyed students. The income level also has an impact on the importance of food waste avoidance (students with available incomes under 600 Euro per month stated higher importance).

Table 4. Regression of importance of avoiding food waste and weekly frequency of food disposal.

Independent variables[1]	**Model 1 Importance of avoiding food waste**[2] **Coefficients**[4]	**Model 2 Frequency of weekly food disposal**[3] **Coefficients**[4]
Constant	1.040	1.324
Indices (metrically scaled)		
Cooking skills and behavior (CB)	0.057	-0.105^{+}
Active involvement (AI)	0.041	-0.036
Knowledge on food waste (KI)	-0.001	-0.019
Scale variables (standardized)		
Interest food waste (IFWT)	0.523***	-0.280***
Interest in food, cooking, and nutrition (INFC)	-0.014	-0.034
Socio-demographics and study programs (dummy-coded)		
Gender (1: male; 0: female, divers)	-0.058	0.004
Age (1: <25 years; 0: 25 years and older)	0.011	0.075
Diet (1: unrestricted meat eater; 0: all others)	-0.024	0.059
Size (1: >19,999 inhabitants; 2: <20,000 inhabitants)	-0.096	0.026
AgCon (1: yes; 0: no)	0.016	-0.155^{+}
Income (1: <600 Euro/month; 0: >599 Euro/month)	0.095^{+}	-0.140*
StudProg (1: life science programs; 0: all others)	0.163*	0.099
R^2	0.364	0.128
R^2-adj.	0.329	0.079

[1] Correlation analysis of both dependent variables showed negative bivariate correlation (r_s = -0.414, P<0.01, two-sided).

[2] Standardized.

[3] Days per week.

[4] Coefficients: *P<0.05; ***P<0.001; ^{+}P<0.1.

The level of available income also has a significant impact in model 2. Students who have less money available per month reported to throw away food on fewer days per week. A study in Australia found similar results, with high-income households less conscientious when buying food, and an increase in food waste at higher income levels (Hamilton *et al.*, 2005). Model 2 showed a strong relationship between a direct connection to agriculture stated by the respondents and the reported frequency of food disposal. Respondents who are connected to the agriculture and food sectors indicated that less food was thrown away. This corresponds with results of an Austrian study, which showed that rural areas with a high proportion of agriculture had lower quantities of food waste on the consumer level (Obersteiner and Schneider, 2006).

4.3 Self-assessment of reasons for food waste behavior

Respondents were asked about their individual reasons for a surplus of food during food shopping, cooking, storage, and about situation-related circumstances leading to a higher potential for food waste. The surveyed students rated statements provided for each consumption phase on a five-point scale (Figure 4). Furthermore, respondents were asked to compare themselves to the average consumer in Germany, whether they act better or worse regarding food waste.

The bars represent the difference between positive response options ('I totally agree', 'I agree') and the negative options ('I disagree'; I totally disagree') in relation to the total number of responses (n=253) (Figure 4). Respondents' self-assessment showed that the proposed reasons for food waste behavior apply to a rather limited extent. Especially in the cooking and food storage phases, respondents predominantly disagreed with the statements provided. 'Cooked too much' is the only statement in these phases to which more students agreed than disagreed. With regard to the shopping phase, there was more agreement than disagreement with the statement 'Shopped hungry'. Situation-related reasons for food waste were accepted less for reasons of

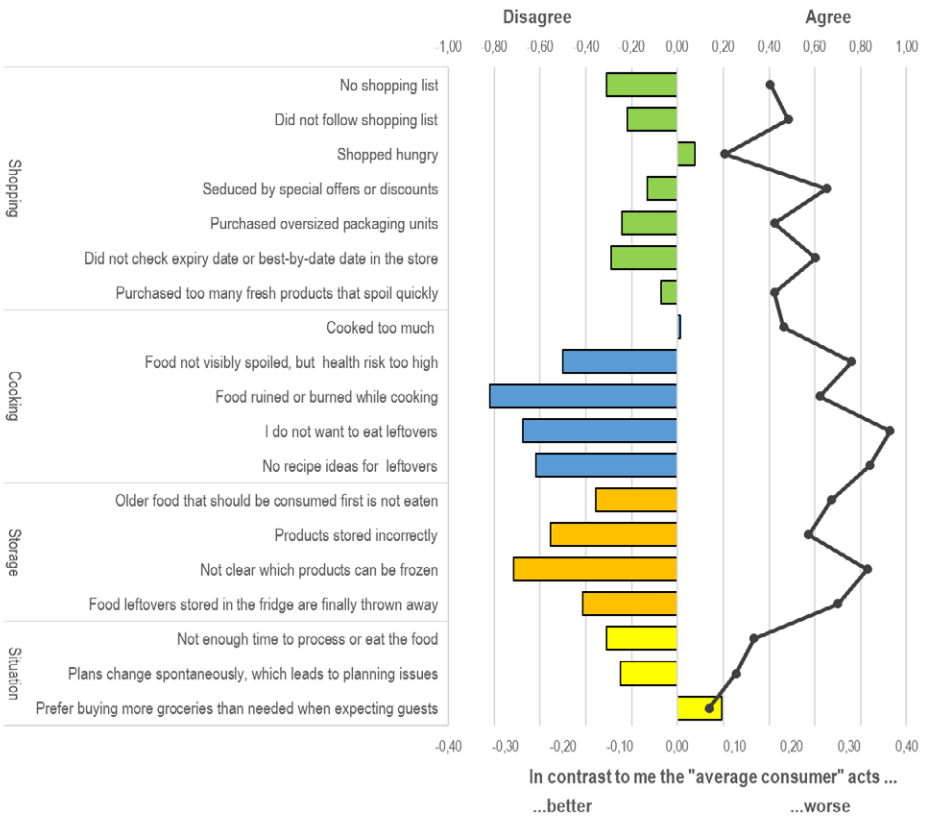

Figure 4. Self-assessment of reasons for food waste (upper axis, bars) and comparison with the average consumer in Germany (lower axis, line) (n=253).

time constraints and planning issues, but rather for hospitality reasons when too much food is prepared for a visit of friends and acquaintances.

It is also noticeable that the students surveyed evaluated themselves better or at least equal to the average consumer in Germany in all statements (line diagram in Figure 4). In all categories surveyed within the three consumption phases and the situation-related conditions, the students rated themselves better than the average consumer. For two of the three statements, in which students were more self-critical ('Shopped hungry' and 'Prefer buying more groceries than needed when expecting guests'), they also assumed more similarity with the average German consumer. The self-critical evaluation for shopping when hungry is in line with prior research (Widmar *et al.*, 2016). The acceptance of food waste generation when respondents 'prefer buying more groceries than needed when expecting guests' is not surprising. The preparation for a hosting situation, requires to show more desirable behavior for instance generosity, which may involve wasteful behavior (Farr-Wharton *et al.*, 2014). Yet, this behavior conforms with social norms. Therefore, reporting of the respective waste behavior may be more truthful and more accepted.

5. Practical implications

The results of the student survey showed a lack of knowledge on food waste issues even for the relatively highly educated population of students in Germany. To achieve a long-term change in behavior, it is important to raise awareness of individual consumers regarding food disposal, and provide effective information on negative effects of food waste on the environment, society and the economy (Langen *et al.*, 2015). Information events and panel discussions at higher education institutions could help raise awareness among students. Furthermore, information posters about food waste in cafeterias and lunchrooms, as well as displays on campus could educate students and raise awareness (Whitehair *et al.*, 2013). Privately initiated campaigns or governmental initiatives, such as the national food waste strategy of the German Federal Ministry of Food and Agriculture, are options to raise awareness of how to store and handle food in private households. The fact that only small differences in food waste behavior were found between students in life science programs and other programs, despite the stated importance of food waste topics, provides evidence that the actual behavior of students is likely to have been shaped before they entered their study program. If the curriculum of primary and secondary schools offered subjects, such as cooking, household management, or nutrition management, and explained the handling of food (shopping, storage, and preparation) at an early age, this would likely lead to less food waste in adulthood.

Both, food industry and retailers can also contribute to reducing food waste at the consumer level through technical and product-specific improvements such as longer shelf lives, smaller packaging sizes, and suggestions for food preparation (Lebersorger and Schneider, 2014). Food waste is on the agenda of the food retail sector in Germany, but up to now, voluntary actions were mainly used for image enhancement, since waste prevention along the food supply chain is expected to be accompanied by noticeable losses in sales. Influencing consumers to buy more goods than needed and offering quantity discounts continues to play an important role in sales strategies of the German retail sector. But to reduce this potential for food waste, more sustainable sale strategies are needed. One possible approach would be the example of the British supermarket chain Tesco, which introduced the campaign 'Buy one get one later' in 2010. Customers who bought a specific product on special offer received a voucher for the product at checkout, which they were able to redeem in the following week (BBC, 2010).

Legislators and regulatory bodies are also encouraged to provide information to all actors in the food sector. Consumer behavior can be influenced by information and education (Priefer *et al.*, 2016). In the past, various campaigns and initiatives against food waste were implemented to raise awareness among all stakeholders along the food supply chain and to increase the value of food. As an example, the initiative 'Too Good for the Bin' of the German Federal Ministry of Food and Agriculture provided practical tips and recipe ideas to consumers and organized action days. However, only few of the students in this survey knew of the ongoing

initiative. Furthermore, the possibilities of rapid and wide dissemination of information through social media could increase awareness of initiatives and provide a rapid knowledge transfer (Hanss and Böhm, 2013).

6. Conclusions

Results of the present survey showed a high interest of the student sample in food topics and indicated strong intentions to avoid food waste. This was also reflected in the very positive self-assessment of the students in dealing with food waste in comparison to the average German consumer. This study explored self-assessment as an indirect question in relation to the average consumer as a comparison group. The answers show that the respondents view themselves as superior to others in dealing with food waste across all phases of consumption. Social desirability bias usually varies across methods of data collection and topics of interest. Students' answers displayed the expected social desirability bias as they understated their own undesirable behavior. However, the indirect question asking students to compare themselves to the average consumer showed a bias similar to the direct questions on behaviors. In addition, the self-selection of interested students into the sample may have increased the bias.

In addition to self-selection bias, the use of an online questionnaire as a survey method had the disadvantages that the number of questions had to be restricted and, also, the quality of the answers could not be controlled during the process of administrating the questionnaire. For this reason, about one third of the survey participants had to be removed from the sample, among others reasons due to dropouts. Nevertheless, 253 complete data sets allowed the required statistical analyses to be carried out. The sampling approach and the data collection process characterize this research as an exploratory study and thus, prevent the findings from being extended to the entire population of students in Germany. However, despite these limitations, some conclusions can be drawn about students' interest, perceived importance, knowledge, and behavior regarding food waste. Respondents showed interest in and awareness of the subject of food waste, but this did not lead to a higher level of knowledge about the issue among the majority of respondents. In contrast to some prior studies concerning food waste on the consumer level (e.g. Barr *et al.*, 2007; Melbye *et al.*, 2017) the analysis of the survey results could not show a direct impact of students' knowledge on food disposal behavior. However, in prior studies, knowledge was often equated with political knowledge, which led to a reduction of food waste among consumers (Barr, 2007). Furthermore, knowledge about food waste is often reduced to a purely economic consciousness. The economic approach equates food waste with monetary losses (Clark and Manning, 2018), and puts less emphasis on protecting the environment or securing food resources. Since the questions used for the knowledge index in this study addressed general knowledge about quantity and type of food waste in Germany and worldwide, no distinctions were made concerning the nature of knowledge. For future studies of food waste related behavior, it is recommended that regardless of the target population, different forms of knowledge need to be taken into account and be part of the survey. The distinction between the theoretical, practical and emancipatory nature of knowledge is useful to structure and understand the underlying interest in the actual effects of one's food waste and the practical implementation of desired behaviors.

Based on the self-reported frequency of throwing away raw food or leftovers by the students surveyed, results have shown a highly statistically significant correlation between the awareness of the importance of the topic and the amount of food waste. Sociodemographic characteristics, such as age, gender, and diet (vegan or vegetarian versus omnivores) had no or minor effects on the food disposal behavior. Thus, the present survey of German students showed that behaviors in dealing with food does not depend much on exact knowledge regarding food waste issues or sociodemographic characteristics, but rather on general involvement in issues related to food waste and the students' general awareness of food waste as a problem. These two points should be analyzed more in-depth in future investigations to allow more targeted recommendations for policies. Better knowledge of attitudes and behavior of specific consumer groups will enable better alignment, as well as targeting of government campaigns and more effective consumer initiatives. These findings also offer the food industry opportunities to develop and improve resource-saving products (e.g. save food packaging, on-product ripeness indicators), and services (e.g. second-use approaches).

Supplementary material

Supplementary material can be found online at https://doi.org/10.22434/IFAMR2020.0145

Table S1. Sample characteristics (n=253).

Conflict of interest

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References

Abeliotis, K., K. Lasaridi and C. Chroni. 2014. Attitudes and behaviour of Greek households regarding food waste prevention. *Waste Management and Research* 32(3): 237-240. https://doi.org/10.1177/0734242X14521681

Alattar, M.A., J. DeLaney, J.L. Morse and M. Nielsen-Pincus. 2020. Food waste knowledge, attitudes, and behavioral intentions among university students. *Journal of Agriculture, Food Systems, and Community Development* 9(3): 1-16. https://doi.org/10.5304/jafscd.2020.093.004

Annunziata, A., M. Agovino, A. Ferraro and A. Mariani. 2020. Household food waste: a case study in Southern Italy. *Sustainability* 12: 1495. https://doi.org/10.3390/su12041495

Armitage, C.J. and M. Conner. 2001. Efficacy of the theory of planned behaviour: a meta-analytic review. *British Journal of Social Psychology* 40(4): 471-499. https://doi.org/10.1348/014466601164939

Aschemann-Witzel, J., I. De Hooge, P. Amani, T. Bech-Larsen and M. Oostindjer. 2015. Consumer-related food waste: causes and potential for action. *Sustainability* 7(6): 6457-6477. https://doi.org/10.3390/su7066457

Barr, S. 2007. Factors influencing environmental attitudes and behaviors: a U.K. case study of household waste management. *Environment and Behavior* 39(4): 435-473. https://doi.org/10.1177/0013916505283421

BBC. 2010. Tesco launches 'Buy one now, get one free… later'. *BBC News*, January 21. Available at: http://news.bbc.co.uk/2/hi/business/8473122.stm

Blichfeldt, B.S., M. Mikkelsen and M. Gram. 2015. When it stops being food: the edibility, ideology, procrastination, objectification and internalization of household food waste. *Food, Culture and Society* 18(1): 89-105. https://doi.org/10.2752/175174415X14101814953963

Cecere, G., S. Mancinelli and M. Mazzanti. 2014. Waste prevention and social preferences: the role of intrinsic and extrinsic motivations. *Ecological Economics* 107: 163-176. https://doi.org/10.1016/j.ecolecon.2014.07.007

Clark, J. and L. Manning. 2018. What are the factors that an opportunity sample of UK students insinuate as being associated with their wastage of food in the home setting? *Resources, Conservation and Recycling* 130: 20-30. https://doi.org/10.1016/j.resconrec.2017.11.005

Coderoni, S. and M.A. Perito. 2020. Sustainable consumption in the circular economy. An analysis of consumers' purchase intentions for waste-to-value food. *Journal of Cleaner Production* 252: 119870. https://doi.org/10.1016/j.jclepro.2019.119870

Delany, C., B. Kameniar, J. Lysk and B. Vaughan. 2020. Starting from a higher place: linking Habermas to teaching and learning clinical reasoning in the emergency medicine context. *Advances in Health Sciences Education* 25: 809-824. https://doi.org/10.1007/s10459-020-09958-x

Di Talia, E., M. Simeone and D. Scarpato. 2019. Consumer behaviour types in household food waste. *Journal of Cleaner Production* 214: 166-172. https://doi.org/10.1016/j.jclepro.2018.12.216

Do Carmo Stangherlin, I. and M.D. De Barcellos. 2018. Drivers and barriers to food waste reduction. *British Food Journal* 120(10): 2364-2387. https://doi.org/10.1108/BFJ-12-2017-0726

Do Carmo Stangherlin, I., M.D. De Barcellos and K. Basso. 2020. The impact of social norms on suboptimal food consumption: a solution for food waste. *Journal of International Food and Agribusiness Marketing* 32(1): 30-53. https://doi.org/10.1080/08974438.2018.1533511

European Parliament. 2017. *Cutting food waste*. European Parliament, Brussels, Belgium. Available at: https://www.europarl.europa.eu/news/en/press-room/20170509IPR73930/cutting-food-waste

Evans, D. 2012. Binning, gifting and recovery: the conduits of disposal in household food consumption. *Environment and Planning: Society and Space* 30(6): 1123-1137. https://doi.org/10.1068/d22210

Farr-Wharton, G., M. Fothand and J.H.J Choi. 2014. Identifying factors that promote consumer behaviours causing expired domestic food waste. *Journal of Consumer Behaviour* 13(6): 393-402. https://doi.org/10.1002/cb.1488

Fisher, R.J. 1993. Social desirability bias and the validity of indirect questioning. *Journal of Consumer Research* 20(2): 303-315. https://doi.org/10.1086/209351

Fleming, C.M. and M. Bowden. 2009. Web-based surveys as an alternative to traditional mail methods. *Journal of Environmental Management* 90(1): 284-292. https://doi.org/10.1016/j.jenvman.2007.09.011

Giordano, C., S. Piras, M. Boschini and L. Falasconi. 2018. Are questionnaires a reliable method to measure food waste? A pilot study on Italian households. *British Food Journal* 120(12): 2885-2897. https://doi.org/10.1108/BFJ-02-2018-0081

Goebel, C., N. Langen, A. Blumenthal, P. Teitscheid and G. Ritter. 2015. Cutting food waste through cooperation along the food supply chain. *Sustainability* 7(2): 1429-1445. https://doi.org/10.3390/su7021429

Graham-Rowe, E., D.C. Jessop and P. Sparks. 2015. Predicting household food waste reduction using an extended theory of planned behavior. *Resources, Conservation and Recycling* 101: 194-202. https://doi.org/10.1016/j.resconrec.2015.05.020

Gustavsson, J., C. Cederberg, U. Sonesson, R. Van Otterdijk and A. Meybeck. 2011. *Global food losses and food waste: extent, causes and prevention.* SAVE FOOD: an initiative on Food Loss and Waste Reduction, FAO, Rome, Italy.

Habermas, J. 2015. *Knowledge and human interests*. John Wiley and Sons, New York, NY, USA.

Hamilton, C., R. Denniss and D.G. Baker. 2005. *Wasteful consumption in Australia*. Australia Institute, Canberra, Australia.

Han, T.I. 2019. Objective knowledge, subjective knowledge, and prior experience of organic cotton apparel. *Fashion and Textiles* 6(1): 4. https://doi.org/10.1186/s40691-018-0168-7

Hanss, D. and G. Böhm. 2013. Promoting purchases of sustainable groceries: an intervention study. *Journal of Environmental Psychology* 33: 53-67. https://doi.org/10.1016/j.jenvp.2012.10.002

Hauschildt, V. and B. Schulze-Ehlers. 2014. An empirical investigation into the adoption of green procurement practices in the German Food Service Industry. *International Food and Agribusiness Management Review* 17(3): 1-32. https://doi.org/10.22004/ag.econ.183433

Hermsdorf, D., M. Rombach and V. Bitsch. 2017. Food waste reduction practices in German food retail. *British Food Journal* 119(12): 2532-2546. https://doi.org/10.1108/BFJ-06-2017-0338

Hill, H. and F. Lynchehaun. 2002. Organic milk: attitudes and consumption patterns. *British Food Journal* 104(7): 526-542. https://doi.org/10.1108/00070700210434570

Joerissen, J., C. Priefer and K.R. Bräutigam. 2015. Food waste generation at household level: results of a survey among employees of two European research centers in Italy and Germany. *Sustainability* 7(3): 2695-2715. https://doi.org/10.3390/su7032695

Koivupuro, H.K., H. Hartikainen, K. Silvennoinen, J.M. Katajajuuri, N. Heikintalo, A. Reinikainen and L. Jalkanen. 2012. Influence of socio-demographical, behavioural and attitudinal factors on the amount of avoidable food waste generated in Finnish households. *International Journal of Consumer Studies* 36(2): 183-191. https://doi.org/10.1111/j.1470-6431.2011.01080.x

Kouwenhoven, G., V. Reddy Nalla and T. Lossonczy von Losoncz. 2012. Creating sustainable businesses by reducing food waste: a value chain framework for eliminating inefficiencies. *International Food and Agribusiness Management Review* 15(3): 119-138. https://doi.org/10.22004/ag.econ.133489

Kuo, C. and Y. Shih. 2016. Gender differences in the effects of education and coercion on reducing buffet plate waste. *Journal of Foodservice Business Research* 19(3): 223-235. https://doi.org/10.1080/15378020.2016.1175896

Langen, N., C. Göbel and F. Waskow. 2015). The effectiveness of advice and actions in reducing food waste. *Proceedings of the Institution of Civil Engineers-Waste and Resource Management* 168 (2): 72-86. https://doi.org/10.1680/warm.13.00036

Lebersorger, S. and F. Schneider. 2014. Food loss rates at the food retail, influencing factors and reasons as a basis for waste prevention measures. *Waste Management* 34(11): 1911-1919. https://doi.org/10.1016/j.wasman.2014.06.013

Lorenz, B.A., M. Hartmann, S. Hirsch, O. Kanz, and N. Langen. 2017. Determinants of plate leftovers in one German catering company. *Sustainability* 9(5): 807. https://doi.org/10.3390/su9050807

Macaulay, P.J., M.J. Boulton, L.R. Betts, L. Boulton, E. Camerone, J. Down, J. Hughes, C. Kirkbride and R. Kirkham. 2020. Subjective versus objective knowledge of online safety/dangers as predictors of children's perceived online safety and attitudes towards e-safety education in the United Kingdom. *Journal of Children and Media* 14(3): 376-395. https://doi.org/10.1080/17482798.2019.1697716

Mallinson, L.J., J.M. Russell and M.E. Barker. 2016. Attitudes and behaviour towards convenience food and food waste in the United Kingdom. *Appetite* 103: 17-28. https://doi.org/10.1016/j.appet.2016.03.017

Mattar, L., M.G. Abiad, A. Chalak, M. Diab and H. Hassan. 2018. Attitudes and behaviors shaping household food waste generation: lessons from Lebanon. *Journal of Cleaner Production* 198: 1219-1223. https://doi.org/10.1016/j.jclepro.2018.07.085

McCarthy, B. and H.B. Liu. 2017. Food waste and the 'green' consumer. *Australasian Marketing Journal* 25(2): 126-132. https://doi.org/10.1016/j.ausmj.2017.04.007

Meixner, O., N.E. Kolmhofer and F. Katt. 2020. Consumers' food waste knowledge in Austria. *International Journal on Food System Dynamics* 11(4). https://doi.org/10.18461/ijfsd.v11i4.63

Melbye, E.L., Y. Onozaka and H. Hansen. 2017. Throwing it all away: exploring affluent consumers' attitudes toward wasting edible food. *Journal of Food Products Marketing* 23(4): 416-429. https://doi.org/10.1080/10454446.2015.1048017

Miliute-Plepiene, J. and A. Plepys. 2015. Does food sorting prevents and improves sorting of household waste? A case in Sweden. *Journal of Cleaner Production* 101: 182-192. https://doi.org/10.1016/j.jclepro.2015.04.013

Mirosa, M., H. Munro, E. Mangan-Walker and D. Pearson. 2016. Reducing waste of food left on plates. *British Food Journal* 118(9): 2326-2343. https://doi.org/10.1108/BFJ-12-2015-0460

Mondéjar-Jiménez, J.A., G. Ferrari, L. Secondi and L. Principato. 2016. From the table to waste: an exploratory study on behaviour towards food waste of Spanish and Italian youths. *Journal of Cleaner Production* 138(1): 8-18. https://doi.org/10.1016/j.jclepro.2016.06.018

Nederhof, A.J. 1985. Methods of coping with social desirability bias: a review. *European Journal of Social Psychology* 15(3): 263-280. https://doi.org/10.1002/ejsp.2420150303

Neff, R.A., M.L. Spiker and P.L. Truant. 2015. Wasted food: US consumers' reported awareness, attitudes, and behaviors. *PLoS ONE* 10(6): e0127881. https://doi: 10.1371/journal.pone.0127881

Obersteiner, G. and F. Schneider. 2006. NÖ Restmüllanalysen 2005/2006: Studie im Auftrag des NÖ Abfallwirtschaftsvereins unterstützt vom Amt der NÖ Landesregierung und der ARGEV. Available at: https://tinyurl.com/y3s8mm6v

Olynk, N.J. and D.L. Ortega. 2013. Consumer preferences for verified dairy cattle management practices in processed dairy products. *Food Control* 30(1): 298-305. https://doi.org/10.1016/j.foodcont.2012.07.030

Painter, K., G. Thondhlana and H.W. Kua. 2016. Food waste generation and potential interventions at Rhodes University, South Africa. *Waste Management* 56: 491-497. https://doi.org/10.1016/j.wasman.2016.07.013

Parfitt, J., M. Barthel and S. Macnaughton. 2010. Food waste within food supply chains: quantification and potential for change to 2050. *Philosophical Transactions of the Royal Society B: Biological Sciences* 365(1554): 3065-3081. https://doi.org/10.1098/rstb.2010.0126

Parizeau, K., M. Von Massow and R. Martin. 2015. Household-level dynamics of food waste production and related beliefs, attitudes, and behaviours in Guelph, Ontario. *Waste Management* 35: 207-217. https://doi.org/10.1016/j.wasman.2014.09.019

Pearson, D., M. Minehan and R. Wakefield-Rann. 2013. Food waste in Australian households: why does it occur. *The Australasian-Pacific Journal of Regional Food Studies* 3: 118-132.

Porpino, G. 2016. Household food waste behavior: avenues for future research. *Journal of the Association for Consumer Research* 1(1): 41-51. https://doi.org/10.1086/684528

Priefer, C., J. Jörissen and K.R. Bräutigam. 2016. Food waste prevention in Europe – a cause-driven approach to identify the most relevant leverage points for action. *Resources, Conservation and Recycling* 109: 155-165. https://doi.org/10.1016/j.resconrec.2016.03.004

Principato, L., L. Secondi and C.A. Pratesi. 2015. Reducing food waste: an investigation on the behaviour of Italian youths. *British Food Journal* 117(2): 731-748. https://doi.org/10.1108/BFJ-10-2013-0314

Qi, D. and B.E. Roe. 2016. Household food waste: multivariate regression and principal components analyses of awareness and attitudes among US consumers. *PLoS ONE* 11(7): e0159250. Available at: https://doi.org/10.1371/journal.pone.0159250

Quested, T.E., E. Marsh, D. Stunell and A.D. Parry. 2013. Spaghetti soup: the complex world of food waste behaviours. *Resources, Conservation and Recycling* 79: 43-51. https://doi.org/10.1016/j.resconrec.2013.04.011

Raak, N., C. Symmank, S. Zahn, J. Aschemann-Witzel and H. Rohm. 2017. Processing- and product-related causes for food waste and implications for the food supply chain. *Waste Management* 61: 461-472. https://doi.org/10.1016/j.wasman.2016.12.027

Richter, B. 2017. Knowledge and perception of food waste among German consumers. *Journal of Cleaner Production* 166: 641-648. https://doi.org/10.1016/j.jclepro.2017.08.009

Romani, S., S. Grappi, R.P. Bagozzi and A.M. Barone. 2018. Domestic food practices: a study of food management behaviors and the role of food preparation planning in reducing waste. *Appetite* 121: 215-227. https://doi.org/10.1016/j.appet.2017.11.093

Schanes, K., K. Dobernig and B. Gözet. 2018. Food waste matters – a systematic review of household food waste practices and their policy implications. *Journal of Cleaner Production* 182: 978-991. https://doi.org/10.1016/j.jclepro.2018.02.030

Schmidt, K. 2016. What a waste! Developing the food waste-preventing behaviors scale. A useful tool to promote household food waste-prevention. *International Journal of Food and Nutritional Science* 3(3): 1-14.

Secondi, L., L. Principato and T. Laureti. 2015. Household food waste behaviour in EU-27 countries: a multilevel analysis. *Food Policy* 56: 25-40. https://doi.org/10.1016/j.foodpol.2015.07.007

Setti, M., L. Falasconi, A. Segrè, I. Cusano and M. Vittuari. 2016. Italian consumers' income and food waste behavior. *British Food Journal* 118(7): 1731-1746. https://doi.org/10.1108/BFJ-11-2015-0427

Silvennoinen, K., J.M. Katajajuuri, H. Hartikainen, L. Heikkilä and A. Reinikainen. 2014. Food waste volume and composition in Finnish households. *British Food Journal* 115(11): 1628-1637. https://doi.org/10.1108/BFJ-12-2012-0311

Sniehotta, F.F., J. Presseauand V. Araújo-Soares. 2014. Time to retire the theory of planned behavior. *Health Psychology Review* 8(1): 1-7. https://doi.org/10.1080/17437199.2013.869710

Stancu, V., P. Haugaard and L. Lähteenmäki. 2016. Determinants of consumer food waste behaviour: two routes to food waste. *Appetite* 96: 7-17. https://doi.org/10.1016/j.appet.2015.08.025

Stebbins, R.A. 2001. *Exploratory research in the social sciences.* Sage, Thousand Oaks, CA, USA.

Stefan, V., E. Van Herpen, A.A. Tudoran and L. Lähteenmäki. 2013. Avoiding food waste by Romanian consumers: the importance of planning and shopping routines. *Food Quality and Preference* 28(1): 375-381. https://doi.org/10.1016/j.foodqual.2012.11.001

Stenmarck, Å., C. Jensen, T. Quested and G. Moates, G. 2016. *Estimates of European food waste levels*. IVL Swedish Environmental Research Institute, Stockholm, Sweden.

Stöckli, S., E. Niklaus and M. Dorn. 2018. Call for testing interventions to prevent consumer food waste. *Resources, Conservation and Recycling* 136: 445-462. https://doi.org/10.1016/j.resconrec.2018.03.029

Szabó-Bódi, B., G. Kasza, G. and D. Szakos. 2018. Assessment of household food waste in Hungary. *British Food Journal* 120(3): 625-638. https://doi.org/10.1108/BFJ-04-2017-0255

Timmermans, A.J.M., J. Ambuko, W. Belik and J. Huang. 2014. *Food losses and waste in the context of sustainable food systems*. No. 8. Committee on World Food Security, FAO, Rome, Italy.

Visschers, V.H., N. Wickli and M. Siegrist. 2016. Sorting out food waste behaviour: a survey on the motivators and barriers of self-reported amounts of food waste in households. *Journal of Environmental Psychology* 45: 66-78. https://doi.org/10.1016/j.jenvp.2015.11.007

Von Kameke, C. and D. Fischer. 2018. Preventing household food waste via nudging: an exploration of consumer perceptions. *Journal of Cleaner Production* 184: 32-40. https://doi.org/10.1016/j.jclepro.2018.02.131

Whitehair, K.J., C.W. Shanklin and L.A. Brannon. 2013. Written messages improve edible food waste behaviors in a university dining facility. *Journal of the Academy of Nutrition and Dietetics* 113(1): 63-69. https://doi.org/10.1016/j.jand.2012.09.015

Widmar, N.J.O., E.S. Byrd, S.R. Dominick, C.A. Wolf and L. Acharya. 2016. Social desirability bias in reporting of holiday season healthfulness. *Preventive Medicine Reports* 4: 270-276. https://doi.org/10.1016/j.pmedr.2016.06.017

Xue, L., G. Liu, J. Parfitt, X. Liu, E. Van Herpen, Å. Stenmarck, C. O'Connor, K. Östergen and S. Cheng. 2017. Missing food, missing data? A critical review of global food losses and food waste data. *Environmental Science and Technology* 51(12): 6618-6633. https://doi.org/10.1021/acs.est.7b00401