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Consumers' Food Waste Knowledge in Austria

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ABSTRACT

In times of increasing environmental awareness, the topic of food waste receives a lot of attention from practitioners and scholars alike. In this study, we analyze how well-informed Austrian consumers regard food waste and what factors might influence this knowledge. In a consumer survey (n = 470), we examined consumer food and food handling knowledge, cooking skills, place of residence, personal ties to agriculture, engagement in initiatives against food waste, and their effect on food waste knowledge. To understand what effect social desirability might have on participants' answers, we administered the survey in both online and face-to-face settings. Amongst others, our findings suggest a positive relationship between knowledge about food and food handling and knowledge about food waste prevention as well as a social desirability bias in reporting one's own knowledge about food waste prevention. We could not find a statistically significant relationship between food and food handling knowledge, and food waste knowledge. Furthermore, we did not find evidence that a personal connection to agriculture or a rural place of residence leads to better food waste knowledge. Finally, the unexpected influence of cooking skills is at least surprising to a certain extent. We conclude this study by outlining potential areas for future research as well as managerial implications.

Keywords: *food waste; food waste knowledge; consumer behavior; social desirability bias; consumer survey.*

1 Introduction

Over the last few decades, the topic of food waste has gained substantial traction in both political debate and academic literature. Around one third of food for human consumption is wasted unconsumed (Gustavsson et al., 2011). This food waste, defined by Thyberg and Tonjes (2016) as food "which was originally produced for human consumption but then was discarded or was not consumed by humans" (p. 112), arises for a number of reasons. From a consumer perspective, food waste may be a result of shopping behavior, such as over-provisioning, bulk purchases (Priefer and Jörissen, 2012; Pearson et al., 2013), or oversized packages (Williams et al., 2012), and consumption behavior, such as inadequate cooking skills (Koivupuro et al., 2012), or erroneous food safety concerns over food that is perceived to be expired given its expiration date (Thyberg and Tonjes, 2016). Additionally, decreasing household size – smaller households generate more food waste per person (Parizeau et al., 2015) – and cultural and economic factors (Thyberg and Tonjes, 2016), as well as increased urbanization (Parfitt et al., 2010) may have an impact on food waste.

The implications of food waste affect both humans and the environment negatively. As food production can be highly resource-intense, in some cases to the extent of environmental harm (e.g. beef, coffee), wasted food, i.e. an overproduction of food in some markets, may be viewed as an amplification of the environmental strain or poorly allocated resources in the fight against world hunger (Thyberg and Tonjes, 2016). We thus raise the question: *Are consumers aware of the impact their food consumption choices can have?* In other words, what their food waste knowledge is, and what factors may influence this awareness and knowledge.

While there are a large number of studies in the food waste field, only a few have so far examined consumer food waste knowledge as a specific topic (Neff et al., 2015; Visschers et al., 2016). Neff et al. (2015), for instance, found that US consumer awareness of food waste is growing. Building on this, we aim to understand what factors can drive consumer food waste knowledge and how this might help practitioners, researchers, and consumers going forward. This study is structured into four distinct sections: It commences by outlining the hypotheses developed for this study. Next, the methodology employed is detailed and the experimental design discussed. Thereafter, the results are presented before the study is concluded with a discussion of said results, potential future research avenues, managerial implications, and limitations.

2 Hypothesis development

In order to examine the drivers for waste knowledge, a common understanding of this term (i.e. a working definition) is required for this study. We thus propose the following definition: Food waste knowledge is the information consumers consciously possess of the adverse effects of food waste on the environment and society, which leads them to engage in sustainable (i.e. less wasteful) shopping and consumption behavior. Based on a comprehensive literature research (see below), this study examines four potential drivers of food waste knowledge: (1) food and food handling knowledge, (2) cooking skills, (3) place of residence and personal ties to agriculture, and (4) engagement in initiatives against food waste.

(1) Food and food handling knowledge: Several studies have found that poor food handling knowledge may result in an increase of food waste, from inadequate food storage (Terpstra et al., 2005; Wayne, 2014) to misconceptions about food safety, predominantly stemming from expiration dates. Limited knowledge thereof may lead consumers to throw out food past its expiration date despite it still being edible (Thyberg and Tonjes, 2016). As a result, we hypothesize the following relationships:

H_{1a}: There is a positive relationship between knowledge about food and food handling and knowledge about food waste.

H_{1b}: There is a positive relationship between knowledge about food and food handling and knowledge about food waste prevention.

(2) Cooking skills: Cooking skills or rather the lack thereof can be an influential factor in generating food waste through preparing too much food (Graham-Rowe et al., 2014; Porpino, 2016) or not engaging in preparing meals with leftover ingredients rather than sticking to predefined recipes (Ganglbauer et al., 2013; Graham-Rowe et al., 2014). Additionally, people who tend to consume convenience food tend to also exhibit higher levels of food waste (Mallinson et al., 2016). We further assume that cooking skills will also have an influence on food waste prevention behavior. However, at this point we are not determining whether these skills influence food waste prevention positively or negatively, because both directions are conceivable. Better cooking skills might result in better and more comprehensive usage of food (and thus

less food waste) or in more careful, cautious behavior (resulting in more food waste). We thus theorize that:

H_{2a}: There is a positive relationship between cooking skills and knowledge about food waste.

H_{2b}: Cooking skills influence the knowledge about food waste prevention behavior.

(3) Place of residence and personal ties to agriculture: Increased urbanization has led to broader food systems and diversified diets (Thyberg and Tonjes, 2016), which may lead to a detachment from food production methods. Some studies report that people living in urban areas generate a larger amount of food waste compared to people living in rural areas (Cecere et al., 2014; Secondi et al., 2015). In a similar vein, it can be argued that people with personal ties to agriculture (e.g. having grown up on a farm) may have a better understanding of the origins of the food they consume; the lack of such ties may render people unfamiliar with food production and thus increase the generation food of waste (Parfitt et al., 2010; Thyberg and Tonjes, 2016). Thus, we propose that:

H_{3a}: People living in rural areas exhibit a higher degree of food waste knowledge compared to those living in urban areas.

H_{3b}: People with personal ties to agriculture exhibit a higher degree of food waste knowledge compared to those without such ties.

(4) Engagement in initiatives against food waste: As the topic of food waste grows increasingly popular, several initiatives have been launched by non-profit organizations, consumers, and retailers alike. Aschemann-Witzel et al. (2017) categorize these initiatives into three groups given their goals and features: information and capacity building, redistribution, and retail and supply chain alteration. These initiatives can range from raising awareness to donating food to dumpster diving. On a consumer level, we hypothesize that:

H_4: People who actively engage in initiatives against food waste exhibit a higher degree of food waste knowledge compared to those without such engagement.

(5) Food waste prevention knowledge and behavior: As human food waste is largely generated at the consumer level (Monier et al., 2010), it can be sensible to examine consumers' knowledge of and behavior regarding the actions that can be undertaken on a personal level to decrease or prevent the generation of food waste such as cooking leftovers or pickling fruit and vegetables. Thus, we argue that:

H_5: There is a positive relationship between food waste prevention knowledge and food waste prevention behavior.

(6) Social desirability bias: On an individual level, consumers' food waste generation is visible only to the members of the same household and difficult to measure in great detail. To address this, researchers often have to rely on self-reported consumer behavior. This can lead to distorted results depending on the mode in which a consumer survey is administered. For self-reported behavior, consumers can be prone to respond in a socially desirable manner – especially if no anonymity is given (Grimm, 2010). To understand the extent of this social desirability bias, we opted for a two-fold study administration – online and face to face (F2F). To contrast this, consumers' knowledge of general food waste facts (e.g. quantities, initiatives, origins) was tested as this does not provide an opportunity for respondents to display themselves in a favorable light. Therefore, we hypothesize that:

H_{6a}: Respondents who participated in the survey F2F exhibit a higher degree of self-reported food waste prevention knowledge compared to respondents who participated in the survey online.

H_{6b}: Respondents who participated in the survey F2F exhibit a higher degree of self-reported food waste prevention behavior compared to respondents who participated in the survey online.

H_{6c}: Respondents who participated in the survey F2F reported a greater food waste knowledge compared to respondents who participated in the survey online.

Altogether, the assumptions of this study can be summarized according to Figure 1. Consequently, the research model will be tested by means of adequate analytical methods.

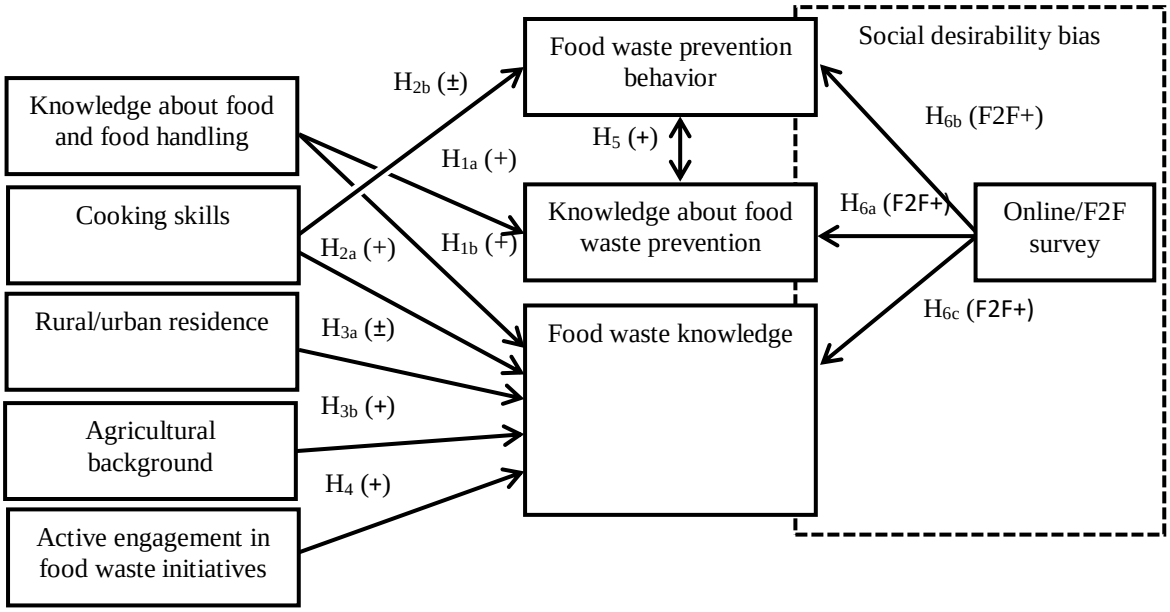

Figure 1. Research framework

3 Methodology

3.1 Data collection

Data were collected by way of a survey in late 2017, administered online and in person in Upper Austria, yielding a total of 470 valid responses (online n = 368, F2F n = 102). The survey format was pre-tested with ten people before being distributed to our sample. While we attempted to capture a sample representative of the Austrian population, there are some deviations (regarding gender, age, income, and education). Table 1 gives an overview of the sample of this study compared to the overall Austrian population. Keeping this deviation in mind, it is not possible to generalize the following results.

Table 1.
Sociodemographic variables of the sample (n = 470)

		n	Valid %	Austria (2017) %[a]
Gender	Female	349	74.3	50.8
	Male	121	25.7	49.2
Age (years)	≤ 20	14	3.0	20.8
	21–30	217	46.2	13.2
	31–45	105	22.3	20.2
	46–60	85	18.1	22.6
	61+	49	10.4	23.1
Education	Compulsory schooling	17	3.6	18.0
	Vocation/apprenticeship	98	20.9	48.8
	High school diploma	138	29.4	15.6
	University degree	217	46.2	17.5
Place of residence	Urban	301	64.0	47.2
	Rural	137	29.1	52.8
	Other	32	6.8	
Household size	1 person	128	27.2	16.8
	2 persons	180	38.3	27.3
	3 persons	64	13.6	20.2
	4 persons	61	13.0	20.7
	5 persons or more	37	7.9	15.0
Average monthly income per person		420	ca. €1,616	€1,887

[a] Source: http://www.statistik.at

3.2 Measures

The survey contained a variety of questions to quantify the constructs in this study. Participants were presented with several statements regarding knowledge about food and food handling, cooking skills, food waste prevention knowledge, and food waste prevention behavior. They were asked to rate every statement on a four-point scale ranging from *fully agree* to *fully disagree*. For each of the four constructs, the mean score was calculated and used for subsequent analyses. Food waste knowledge was gauged in several true/false questions where the study participants were asked to choose the correct statement regarding a variety of food waste facts (e.g. quantities, initiatives, origins). Based on the participants' scores, a four-point scale rating of their food waste knowledge was computed. Lastly, in addition to commonly extracted sociodemographic data, we asked the participants to report their place of residence (rural, urban, or other), their participation in anti-food waste initiatives, and if they had a connection to agriculture.

3.3 Hypothesis testing

Statistical analysis was conducted using the software solution SPSS (Statistical Package for Social Sciences, version 26). For hypotheses H_{1a}, H_{1b}, H_{2a}, H_{2b}, and H_5, each theorizing relationships, we used Pearson's correlation analysis between the different constructs. To test the validity of these hypotheses, we also used the bootstrap method, in order to further improve the reliability of the test results (Preacher and Hayes, 2008). Bootstrapping can help to better understand the outcome of standardized tests where standard normal distribution cannot be guaranteed. In general, bootstrapping is "a computationally intensive method that involves repeatedly sampling from the data set and estimating the indirect effect in each resampled data set" (Preacher and Hayes, 2008, p. 80). It has been applied in statistics since the 1970s and helps to further increase the reliability of approximations based on quantitative statistics (Efron, 1979; DiCiccio and Efron, 1996). In food sciences, a number of applications of bootstrapping are available (e.g. Filimonau et al., 2020; Liu et al., 2020). As a result, out of 5,000 randomly selected sub-samples (Hair et al., 2011), bandwidths of Pearson's correlation coefficients *r* were estimated.

For hypotheses H_{3a}, H_{3b}, H_4, H_{6a}, H_{6b}, and H_{6c}, we employed Mann–Whitney U tests to assess differences between the groups in question, a convenient method in cases where one intends to analyze the significance of differences and normal distribution of data cannot be guaranteed.

4 Results

The first part of our analysis consisted of examining the hypothesized correlations. The general distribution of the five relevant indicators can be taken from Figure 2 for food waste knowledge and behavior, as well as from Figure 3 for food knowledge and cooking skills. As we can see from these figures, the variables measuring the constructs were aggregated to an index with a maximum value of 1 (highest knowledge, skills, etc.) and a minimum of 0 (no knowledge, skills, etc.). In general, the index numbers tend towards 1; in particular, the variable "Food waste prevention knowledge" shows that almost all participants knew about prevention of food waste. Many of them obviously are, however, not behaving accordingly as the comparison of the distribution of the index "Food waste prevention knowledge" with "Food waste prevention behavior" in Figure 2 shows.

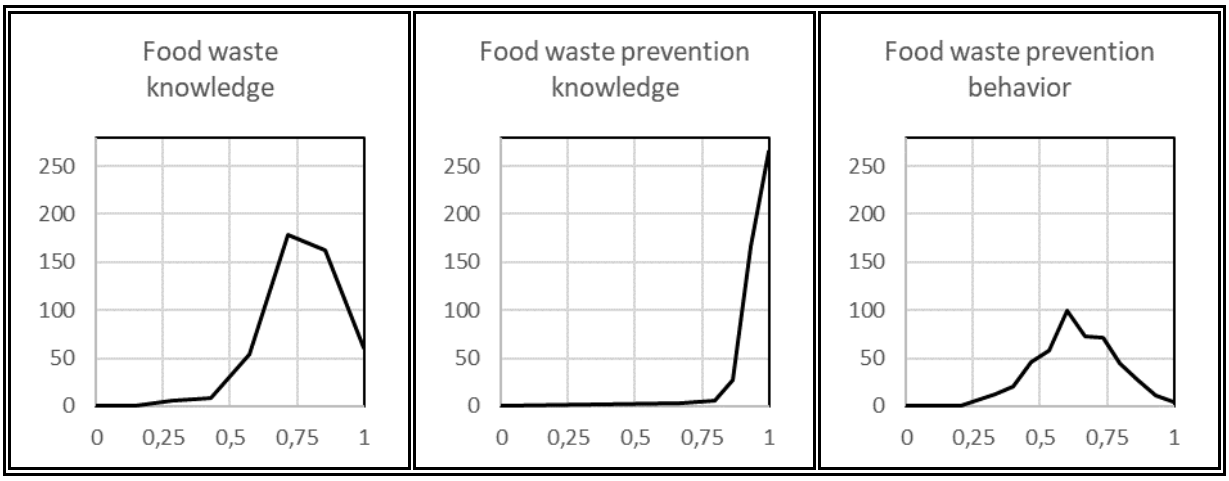

Figure 2. Food waste knowledge and behavior (n = 470)

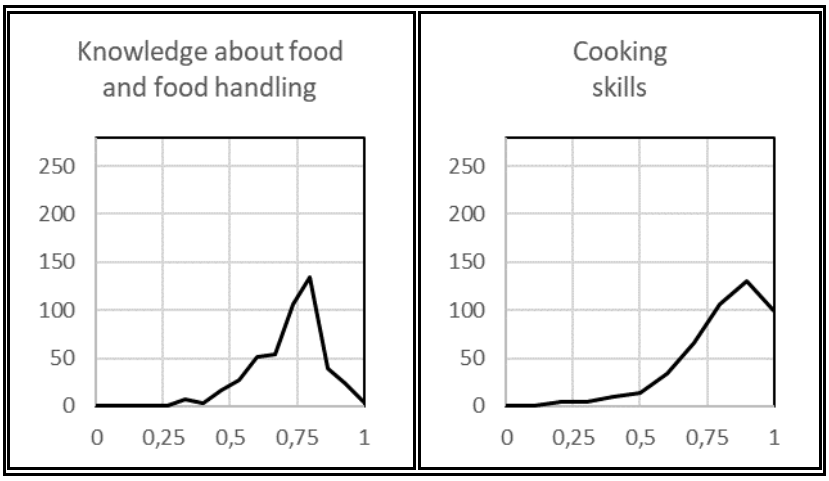

Figure 3. Food knowledge and cooking skills (n = 470)

We did not find a significant positive relationship between "Knowledge about food and food handling" and "Knowledge about food waste" (Table 2). H_{1a} is not supported. We did, however, find a positive relationship between "Knowledge about food and food handling" and "Food waste prevention knowledge" ($r_{1,3}$ = 0.163, $p \leq 0.001$), so H_{1b} is supported. However, the effects are rather low and should not be overrated. We also hypothesized a positive relationship between "Cooking skills" and "Food waste knowledge" but could not find a significant correlation for that either. As a result, H_{2a} is not supported. In contrast to that, there seems to be a *negative, rather strong* relationship between the variables "Cooking skills" and "Food waste prevention behavior" ($r_{2,4}$ = −0.549, $p \leq 0.001$). H_{2b} is therefore clearly supported: Cooking skills influence food prevention behavior negatively. Thus, in our sample, better cooking skills result in poorer food waste prevention behavior. Further, we found a significant relationship between "Food waste prevention knowledge" and "Food waste prevention behavior"; the relationship was negative in nature ($r_{3,4}$ = −0.384, $p \leq 0.001$). H_5 is not supported; the alternative hypothesis $H_{5'}$ would, however, be supported: There is a *negative* relationship between "Food waste prevention knowledge" and "Food waste prevention behavior", which is, of course, surprising and has to be discussed. In addition to the assumed relationships, we found other, minor and positive, correlations between "Cooking skills" and "Knowledge about food and food handling" ($r_{1,2}$ = 0.175, $p \leq 0.001$), and between "Food waste knowledge" and "Food waste prevention knowledge". The latter is, although significant, very low with $r_{3,5}$ = 0.098 (p = 0.035). Finally, we discovered a significant, slightly negative correlation between "Knowledge about food and food handling" and "Food waste prevention behavior" ($r_{1,4}$ = −0.149, $p \leq 0.01$).

Table 2.
Pearson's correlations *r* between constructs (n = 469)

	1.	2.	3.	4.	5.
1. Knowledge about food and food handling	1				
2. Cooking skills	0.175***	1			
3. Food waste prevention knowledge	0.163***	0.277***	1		
4. Food waste prevention behavior	−0.149**	−0.549***	−0.374***	1	
5. Food waste knowledge	0.023	0.074	0.097*	−0.042	1

*** Significance $p \leq 0.001$; ** $p \leq 0.01$; * $p \leq 0.05$.

Bootstrap sampling (with 5,000 randomly selected sub-samples) delivered reliable bandwidths within which the "true" correlation coefficients might lie (based on a 95% confidence interval). As we can see from this analysis (Table A1 in Appendix), the lower (*l*) and upper (*u*) limit of the correlation coefficient for "Knowledge about food and food handling" and "Cooking skills" amounts to $r_{1,2}$ = 0.069 to 0.278. For the other significant correlation coefficients, comparable *l* and *u* were calculated based on bootstrap sampling, supporting the approximation of relations and interpretations between the variables: $r_{1,3}$ = 0.191 to 0.260; $r_{1,4}$ = −0.232 to −0.063; $r_{2,3}$ = 0.179 to 0.370; $r_{2,4}$ = −0.630 to −0.485; $r_{3,4}$ = −0.446 to −0.296. One exception here affects the correlation between "Food waste prevention behavior" and "Food waste knowledge" ($r_{3,5}$ = 0.097). Based on bootstrapping, the correlation coefficient amounts to $r_{3,5}$ = −0.022 to 0.216. Therefore, the actual size of $r_{3,5}$ is not quite clear for these variables and could amount to 0 as well (no interdependency).

Regarding the hypothesized group differences concerning "Food waste knowledge" (H_{2a}, H_{3a}, H_{3b}, H_4), no significant relationships could be identified. There are no significant differences between respondents with and without an active involvement in anti-food waste initiatives (H_4 not supported at the 5% significance level). The individual connection to agriculture and the place of residence (rural vs urban) are not significant either (H_{3a} and H_{3b} not supported).

Concerning the social desirability bias-related hypotheses, H_{6a} is supported at the 1% significance level, i.e. F2F respondents had a significantly different self-reported level of food waste prevention knowledge (F2F respondents reported a slightly better knowledge about food waste prevention; however, differences are still very low). H_{6b}, the hypothesized difference between self-reported "Food waste prevention behavior" between the two groups, is not supported. H_{6c} is not supported, either: We assumed differences between the two groups and did not find significant differences between online and F2F respondents regarding their general "Food waste knowledge". Altogether, social desirability does not seem to be a big issue in our study. There are almost no differences between F2F and online interviews. Table 3 provides an overview of the Mann–Whitney U tests conducted.

Table 3.
Mann–Whitney U tests for selected variables

	Group	**n**	**Mean rank**	***p***
Food waste prevention knowledge	Online	368	247.94	≤ 0.001
	F2F	102	190.60	
Food waste prevention behavior	Online	368	231.51	0.222
	F2F	102	249.88	
Food waste knowledge	Online	368	230.87	0.139
	F2F	102	252.20	
Food waste knowledge	Rural	137	211.97	0.375
	Urban	301	222.93	
Food waste knowledge	Connection to agriculture	280	240.07	0.351
	No connection to agriculture	190	228.77	
Food waste knowledge	Active in anti-FW initiatives	183	245.87	0.164
	Not active in anti-FW initiatives	287	228.89	

p = significance.

5 Discussion and conclusion

This study set out to offer some explanations for consumers' food waste knowledge and led to intriguing findings. While we found little evidence for social desirability bias in reporting one's own food waste prevention knowledge, we were surprised not to find important explanatory variables for food waste knowledge. This might be a signal that food waste knowledge depends on other variables not investigated herein. However, it is probably more realistic to question measurement of food waste knowledge as it was done within this study (see limitations).

We also did not identify a significant difference between online and F2F respondents regarding their food waste prevention behavior. One explanation might be that there may be limited social backlash regarding the generation of average amounts of food waste, thus resulting in a limited need to present oneself in a more favorable light. Similarly, it was interesting to find that neither a personal connection to agriculture nor living in a rural region led to a significantly greater knowledge about food waste.

Even more surprising is the fact that cooking skills exert a strong negative influence on food waste behavior (and that they do not have an influence on food waste knowledge). This is a clear contradiction to findings from other studies (Graham-Rowe et al., 2014; Porpino, 2016). At least in our sample, the link between food trends such as convenience food, weaker cooking skills, and higher levels of food waste (Mallinson et al., 2016) may not be valid. Potentially, better cooking skills lead to a behavior where food is thrown away even earlier to guarantee high-quality cooking. Or, respondents with a greater interest in cooking (or in food and food waste) may report food waste more truthfully. This would be in accordance with Neff et al. (2015), assuming a greater awareness of food waste. However, these are only assumptions and would have to be investigated further.

5.1 Future research areas and managerial implications

Our research offers some insights into the topic of food waste knowledge. As a first step beyond this study, we can envision researchers employing more complex methodologies (e.g. structural equation models) to shed more light on food waste knowledge to further our understanding of whether and how consumers educate themselves regarding food waste. More generally, regarding consumer food waste as a larger research topic, we can envision several topics of interest such as linking food waste behavior to other consumer characteristics such as organic food purchases and price consciousness. In a similar vein, Porpino (2016) offers an extensive suggestion for future research avenues in the field of consumer food waste.

Additionally, our findings hold implications for legislators, producers, and retailers alike. We would argue that food waste knowledge or the lack thereof is primarily an awareness issue. In order to heighten consumer knowledge, we propose several options:

- Raise awareness on the societal and environmental impact of food waste and educate consumers regarding the difference between expiry dates and food spoilage. More knowledge about food handling (slightly) affects knowledge about food waste prevention.
- Empower people to engage in preventive behavior – from the planning stage (e.g. writing shopping lists) to the cooking stage (e.g. cooking leftovers, pickling food). However, better cooking skills possibly cause even more food waste.

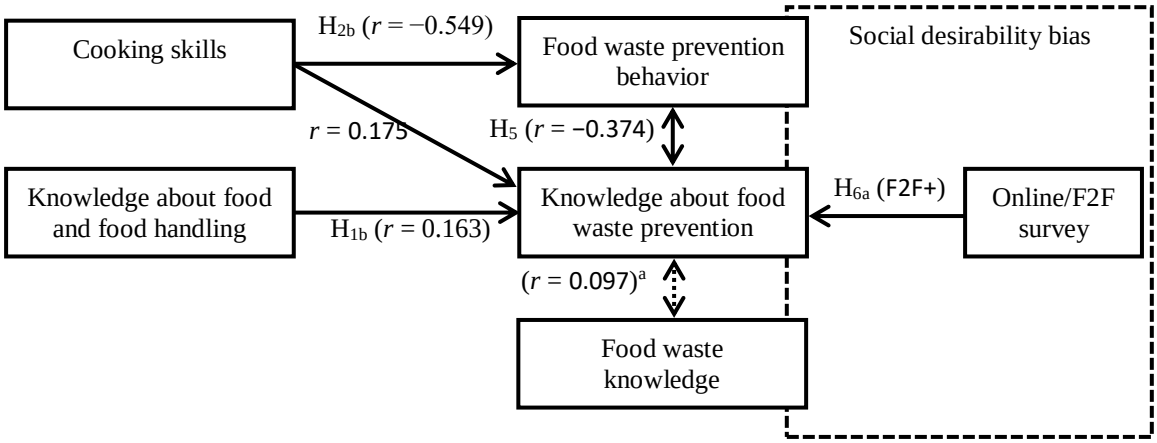

Figure 4. Evaluated research model

[a] Based on bootstrap sampling, there is no clear evidence if $r <> 0$.

Regarding food waste reduction in general, Priefer et al. (2016) suggest numerous measures for all societal stakeholders that could result in a decrease in food waste. However, as we saw from our model, food waste knowledge is not an easily explained variable. From our initial research model, only a few relationships are left and some new ones were discovered (Figure 4), and even those are surprising to some extent. In particular, the negative correlation between cooking skills and food waste prevention behavior cannot easily be explained and needs further attention. This leads to some important limitations of our approach.

5.2 Limitations

There are some important limitations of our study. Several questionnaire items in our survey measured self-reported knowledge and behavior. While extracting self-reported behavior is a useful tool in attempting to assess the role social desirability bias plays, different modes to gauge consumer knowledge or behavior can be more appropriate to gain a more accurate representation of consumers' actual knowledge and behavior. Similarly, food waste knowledge was tested largely by administering binary (correct/incorrect) questions as it is not the intention of this study to offer a fully-fledged representative state of consumer food waste knowledge in Austria but rather to allow for a rudimentary categorization of individuals' knowledge to test it against other constructs. To accurately measure the state of consumer food waste knowledge in a way that is precise, detailed, and representative of the Austrian population, a more rigorous and thorough questionnaire design is advisable. To overcome the self-reporting bias in research topics which are highly relevant to consumers (for instance, there might be a high degree of awareness because of public climate change discussion), other methods like scientific observation, diary methods, or experimental designs, might deliver even more robust findings. Concerning the hypothesized social desirability bias between F2F interviews and online surveys, our study clearly shows that this consideration seems to be of lower importance. Finally, the implementation of bootstrap sampling showed at one point that the approximation of significant but low correlations might not hold in reality.

References

Aschemann-Witzel, J., de Hooge, I. E., Rohm, H., Normann, A., Bossle, M. B., Grønhøj, A., and Oostindjer, M. (2017). Key characteristics and success factors of supply chain initiatives tackling consumer-related food waste – A multiple case study. *Journal of Cleaner Production*, **155:** 33–45. https://doi.org/https://doi.org/10.1016/j.jclepro.2016.11.173.

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

DiCiccio, T. J., Efron, B. (1996). Bootstrap confidence intervals. *Statistical Science*, **11(**3): 189–228. https://doi.org/10.1214/ss/1032280214.

Efron, B. (1979). the 1977 Rietz Lecture - bootstrap methods: another look at the jackknife. *The Annals of Statistics*, **7**(1): 1–26.

Filimonau, V., Matute, J., Kubal-Czerwińska, M., Krzesiwo, K., and Mika, M. (2020). The determinants of consumer engagement in restaurant food waste mitigation in Poland: An exploratory study. *Journal of Cleaner Production*: 247. https://doi.org/10.1016/j.jclepro.2019.119105.

Ganglbauer, E., Fitzpatrick, G., and Comber, R. (2013). Negotiating food waste: Using a practice lens to inform design. *ACM Transactions on Computer-Human Interaction (TOCHI)*, **20**(2): 11. https://doi.org/10.1145/2463579.2463582.

Graham-Rowe, E., Jessop, D. C., and Sparks, P. (2014). Identifying motivations and barriers to minimising household food waste. *Resources, Conservation and Recycling*, **84**: 15–23. https://doi.org/10.1016/j.resconrec.2013.12.005.

Grimm, P. (2010). Social Desirability Bias. In *Wiley International Encyclopedia of Marketing*. Wiley Online Library.

Gustavsson, J., Cederberg, C., Sonesson, U., Van Otterdijk, R., and Meybeck, A. (2011). *Global food losses and food waste*. Rome: FAO Rome.

Hair, J. F., Ringle, C. M., and Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice*, *19*(2), 139–152. https://doi.org/10.2753/MTP1069-6679190202.

Koivupuro, H., Hartikainen, H., Silvennoinen, K., Katajajuuri, J., Heikintalo, N., Reinikainen, A., and Jalkanen, L. (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.

Liu, R., Gao, Z., Snell, H. A., and Ma, H. (2020). Food safety concerns and consumer preferences for food safety attributes: Evidence from China. *Food Control*, **112**(February): 1–13. https://doi.org/10.1016/j.foodcont.2020.107157.

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

Monier, V., Mudgal, S., Escalon, V., O'Connor, C., Gibon, T., Anderson, G., …and Ogilvie, S. (2010). *Preparatory study on food waste across EU 27. European Commission, Directorate-General for the Environment*.

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

Parfitt, J., Barthel, M., and Macnaughton, S. (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., von Massow, M., and Martin, R. (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., Minehan, M., and Wakefield-Rann, R. (2013). Food waste in Australian households: Why does it occur. *Aust. Pac. J. Reg. Food Stud*, **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.

Preacher, K. J., Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, **40(**3): 879–891. https://doi.org/10.3758/BRM.40.3.879.

Priefer, C., Jörissen, J. (2012). Frisch auf den Müll. *Verringerung Der Lebensmittelverluste Als Ansatz Zur Verbesserung Der Welternährungssituation. Karlsruhe: ITAS Pre-Print*: *22*.

Priefer, C., Jörissen, J., and Bräutigam, K.-R. (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/https://doi.org/10.1016/j.resconrec.2016.03.004.

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

Terpstra, M. J., Steenbekkers, L. P. A., De Maertelaere, N. C. M., and Nijhuis, S. (2005). Food storage and disposal: consumer practices and knowledge. *British Food Journal*, **107(**7): 526–533. https://doi.org/10.1108/00070700510606918.

Thyberg, K. L., Tonjes, D. J. (2016). Drivers of food waste and their implications for sustainable policy development. *Resources, Conservation and Recycling*, **106**: 110–123. https://doi.org/https://doi.org/10.1016/j.resconrec.2015.11.016.

Visschers, V. H. M., Wickli, N., and Siegrist, M. (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/https://doi.org/10.1016/j.jenvp.2015.11.007.

Wayne, M. (2014). Using consumer surveys to determine food sustainability. *British Food Journal*, **116**(7): 1194–1204. https://doi.org/10.1108/BFJ-09-2013-0242.

Williams, H., Wikström, F., Otterbring, T., Löfgren, M., and Gustafsson, A. (2012). Reasons for household food waste with special attention to packaging. *Journal of Cleaner Production*, **24**: 141–148. https://doi.org/https://doi.org/10.1016/j.jclepro.2011.11.044.

Appendix

Table A1.
Pearson's correlation coefficients *r* including bootstrap sampling

					1.	2.	3.	4.	5.
1.	Knowledge about food and food handling	*r*			1				
2.	Cooking skills	*r*			0.175**	1			
		Sig.			≤ 0.001				
		Bootstrap	Bias		−0.001				
			SE		0.053				
			95% *CI*	*l*	0.069				
				u	0.278				
3.	Food waste prevention knowledge	*r*			0.163**	0.277**	1		
		Sig. (2-tailed)			≤ 0.001	≤ 0.001			
		Bootstrap	Bias		0.001	0,000			
			SE		0.048	0.049			
			95% *CI*	*l*	0.069	0.179			
				u	0.260	0.370			
4.	Food waste prevention behavior	*r*			−0.149**	−0.549**	-0.374**	1	
		Sig. (2-tailed)			0,001	≤ 0.001	≤ 0.001		
		Bootstrap	Bias		0.001	−0.001	0.001		
			SE		0.043	0.032	0.038		
			95% *CI*	*l*	−0.232	−0.610	−0.446		
				u	−0.063	−0.485	−0.296		
5.	Food waste knowledge	*r*			0.023	0.076	0.097*	−0.044	1
		Sig. (2-tailed)			0,616	0.102	0.035	0.340	
		Bootstrap	Bias		0.001	−0.001	−0.001	0.000	
			SE		0.055	0.052	0.061	0.046	
			95% *CI*	*l*	−0.079	−0.027	−0.022	−0.136	
				u	0.138	0.178	0.216	0.047	

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
Bootstrap results are based on 5,000 bootstrap samples.
Sig. = significance; *r* = Pearson's correlation coefficient; *CI* = confidence interval; *SE* = standard error; *l* = lower limit of 95% *CI*; *u* = upper limit of 95% *CI*.