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Food leftovers in workplace cafeterias: an investigation of beliefs and psychosocial factors

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Food leftovers in workplace cafeterias: an investigation of beliefs and psychosocial factors

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Abstract:
Reducing food waste is a major challenge in achieving a more sustainable food system. This research analyzes the psychosocial factors and cognitions that determine actual food waste behaviors in mass catering services. 216 customers of a French worksite cafeteria completed an online questionnaire based on the theory of planned behavior extended to moral norms. Over a period of four days, the quantity of food left by each respondent was weighed and linked to the answers. Findings indicate that food waste behaviors in mass catering setting are mainly drive by perceived behavioral control. Analysis of the underlying control beliefs suggests that interventions should focus on two specific aspects: improving food quality and making portion sizes more flexible.

Keywords: Food waste, Mass catering, Theory of planned behavior, Beliefs, Perceived behavioral control, Moral norms

Gaspillage alimentaire en restauration d'entreprise : analyse des croyances et des facteurs psychosociaux

Résumé :
Réduire le gaspillage alimentaire est un défi majeur pour parvenir à un système alimentaire plus durable. Cette recherche analyse les facteurs psychosociaux et les cognitions qui déterminent les comportements de gaspillage alimentaire en restauration collective. 216 clients d'un restaurant d'entreprise en France ont rempli un questionnaire en ligne basé sur la théorie du comportement planifié. Sur une période de quatre jours, la quantité de nourriture laissée par chaque répondant a été pesée et reliée aux réponses. Les résultats indiquent que les comportements de gaspillage dans ce contexte de consommation dépendent principalement du contrôle comportemental perçu. L'analyse des croyances de contrôle sous-jacentes suggère que les interventions devraient se concentrer sur deux aspects spécifiques : améliorer la qualité des repas et apporter plus de flexibilité dans la taille des portions servies.

Mots clés: Gaspillage alimentaire, Restauration collective, Théorie du comportement planifié, Croyances, Contrôle perçu, Normes morales

JEL : A13 ; D12

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1 Introduction

Each year, one third of the food produced for human consumption in the world would appear to be lost or wasted (Gustavsson, Cederberg, Sonesson, van Otterdijk, & Meybeck, 2011), leading to significant environmental, economic and social impacts (Parfitt, Barthel, & Macnaughton, 2010). Thus, reducing food waste has emerged as a core issue in raising the sustainability of our global food system (United Nations, 2016). In Europe, it has been estimated the food service sector generates 12% of the total amount of food waste (Stenmarck et al., 2016). Within this sector, mass catering is directly involved (Betz, Buchli, Göbel, & Müller, 2015; Engström & Carlsson-Kanyama, 2004; Eriksson, Persson Osowski, Malefors, Björkman, & Eriksson, 2017; Katajajuuri, Silvennoinen, Hartikainen, Heikkilä, & Reinikainen, 2014; Painter, Thondhlana, & Kua, 2016). Indeed, in mass catering units, up to 23% of the food produced ends up in a bin (Eriksson et al., 2017) and a significant proportion of this waste results from food left on plates by customers (Engström & Carlsson-Kanyama, 2004; Silvennoinen et al., 2012). Mass catering therefore plays a key role as canteens need to limit their own contribution to the problem and offer the opportunity to target a large audience through interventions programs promoting sustainable food behaviors (Bond, Meacham, Bhunnoo, & Benton, 2013).

While a growing body of literature relies on the theory of planned behavior (Ajzen, 1991) to investigate consumer food waste in households (Graham-Rowe, Jessop, & Sparks, 2015; Stancu, Haugaard, & Lähteenmäki, 2016; Stefan, van Herpen, Tudoran, & Lähteenmäki, 2013; Visschers, Wickli, & Siegrist, 2016), to date, only one study has applied the conceptual framework to a university canteen (Lorenz, Hartmann, Hirsch, Kanz, & Langen, 2017). Results generally support the efficiency of the TPB to predict food waste behavior with regard to intentions, attitudes, personal norms, subjective norms and perceived behavioral control.

However, some limitations still need to be addressed. First, these works estimate food waste either through individuals' self-reported behavior that might bias the results (article 1), or by visual estimation, which is less accurate than weighing leftovers (Allison & Baskin, 2009). Second, none of the studies explored the beliefs that explain why people hold certain attitudes, subjective norms and perceptions of control. However, such an investigation of the underlying drivers of the behavior is necessary to identify how to change individual motivations and consumer behavior.

The aim of this paper is twofold: first to identify and measure behavioral, normative and control-related beliefs related to food leftovers among consumers in a food service institution; and second, to predict and explain food leftovers by linking behavioral determinants based on an extended version of the TPB to observed behavior (i.e., the weight of food left at the end of the meal). In the following pages, we first present the theoretical framework and research hypotheses derived from previous findings. The methodology developed to collect actual behavior and psychosocial data is explained before presenting the results of two structural models. In the final section, the implications of the findings are discussed and strategies for targeting beliefs within an intervention aimed at encouraging behavioral change are proposed.

1.1 The theory of planned behavior (TPB)

The main assumption of the TPB is that behavioral intention is the immediate precursor of behavior and combines three types of consideration: attitude, subjective norms and perceived behavioral control. Attitude is a general positive or negative evaluation, which summarizes behavioral beliefs that people hold about the probable consequences of the behavior. Subjective norms capture people's beliefs about what other relevant people think they ought to do, i.e. injunctive norms. Descriptive norms, or people's beliefs about what other relevant people actually do (Cialdini, Reno, & Kallgren, 1990), have proved to be a useful

complement (Rivis & Sheeran, 2003) and have been formally added to the theory to supplement the normative component (Fishbein & Ajzen, 2010). Finally, perceived behavioral control reflects people's beliefs about the potential factors that help or impede them from adopting the behavior. This construct is supposed to have an indirect effect through intention, or a direct effect on behavior when a person does not have the opportunity and/or sufficient resources to adopt the behavior.

Meta-analytic reviews have supported the efficacy of the TPB in investigating a wide range of behaviors (Armitage & Conner, 2001; Godin & Kok, 1996) such as food related behavior (Conner & Armitage, 2002), pro-environmental behavior (de Leeuw, Valois, Ajzen, & Schmidt, 2015) or recycling behavior (Knussen, Yule, MacKenzie, & Wells, 2004; Mannetti, Pierro, & Livi, 2004). More recently, the model has successfully been applied in studies to predict the self-reported amount of household food waste (Graham-Rowe et al., 2015; Stancu et al., 2016; Stefan et al., 2013; Visschers et al., 2016) and in one study concerning food leftovers in a university canteen (Lorenz et al., 2017). In the following pages, we rely on these studies to formulate the research hypotheses of the present work.

1.2 Determinants of food waste behavior and research hypotheses

Direct predictors of intention and behavior

Whether food consumption takes place in the home or outside the home, people state an intent to avoid or reduce food waste. Furthermore, the greater the intention, the lower the amount of self-reported (Graham-Rowe et al., 2015; Stancu et al., 2016; Stefan et al., 2013; Visschers et al., 2016) and observed (Lorenz et al., 2017) food waste. It has also been shown that this intention is positively linked to a favorable attitude towards avoiding or reducing food waste (Graham-Rowe et al., 2015; Stancu et al., 2016; Visschers et al., 2016). In contrast, social pressure seems to play a more limited role on personal intentions (Stefan et al., 2013; Visschers et al., 2016). It has been argued that, in domestic context, waste management and

practices are little exposed to the views and opinions of others (Quested, Easteal, & Swannell, 2011). However, in public consumption places such as canteens, a significant positive relationship between the perception of social pressure and intention has been found, although the relative importance remains weaker than that of the others determinants (Lorenz et al., 2017). Finally, perceived behavioral control emerges as a powerful driver with direct (Stancu et al., 2016; Visschers et al., 2016) and indirect (Graham-Rowe et al., 2015; Visschers et al., 2016) effects on behavior. Perceived or actual barriers differ depending on whether the individuals have to cope with constraints related to domestic issues (such as planning and shopping routines) or related to the options provided by catering services (such as limited choices, taste, portion sizes). Thus, food waste behavior is clearly not solely under a single person's control.

Based on these results, the following assumptions are made regarding the direct predictors of intention and behavior:

The quantity of food leftovers in a worksite cafeteria is negatively linked to:

H1a. the intention not to leave edible foods at the end of a meal,

H1b. the perceived personal control over behavior.

An intention not to leave edible foods is positively determined by:

H2a. a positive attitude towards not leaving edible foods,

H2b. supportive subjective norms towards not leaving edible foods,

H2c. a high level of perceived behavioral control over not leaving edible foods.

Moral norms as an additional predictor

Previous qualitative studies about food waste reported that people have a strong feeling of moral obligation to reduce waste while anticipating negative feelings such as guilt when

throwing food away (Graham-Rowe, Jessop, & Sparks, 2014; Quested, Marsh, Stunell, & Parry, 2013). Studies which applied TPB to food waste extended the model to capture the moral dimension of the behavior. Three of these found a significant effect of moral considerations on the prediction of intention (Graham-Rowe et al., 2014; Stefan et al., 2013; Visschers et al., 2016), and a partial direct link with the behavior was found in one study (Visschers et al., 2016). However, all these studies measured the basic variables of the TPB in relation to the absence of food waste, while negative anticipated feelings were assessed with regard to the opposite behavior (e.g., if I waste food, I will feel guilty). This approach breaks with the principle of compatibility of measures and is likely to over-estimate the residual effect of the construct on intention (Ajzen & Sheikh, 2013). Thus, in the present study, a measure of positive moral norms was included as an additional predictor of intention. It refers to anticipated positive feelings that stem from adherence to one's own moral principles (Arvola et al., 2008). Accordingly, it was expected that:

H3. the intention not to leave edible foods is positively determined by positive moral norms associated with not leaving edible foods.

Indirect determinants of intention

According to the theory, attitude, subjective norms and perceived behavioral control are hold to be determined by behavioral, normative and control-related beliefs respectively (Ajzen, 1991; Fishbein & Ajzen, 1977). Since no previous studies have investigated food waste beliefs in the TPB, specific assumptions were formulated about the strength of a specific belief on its respective construct. Significant relations are expected between:

H4a. behavioral beliefs and attitude,

H4b. normative beliefs and subjective norms,

H4c. control beliefs and perceived behavioral control.

Personal characteristics

Gender has been identified as an important determinant of food waste in canteens (Betz et al., 2015) and women are linked to greater quantities of waste than men (article 1). Furthermore, as explained in the following section dealing with the method used, the present study involved workers and students. Thus, gender (H5a) and professional status (H5b) were included as additional predictors of behavior over and above psycho-social factors.

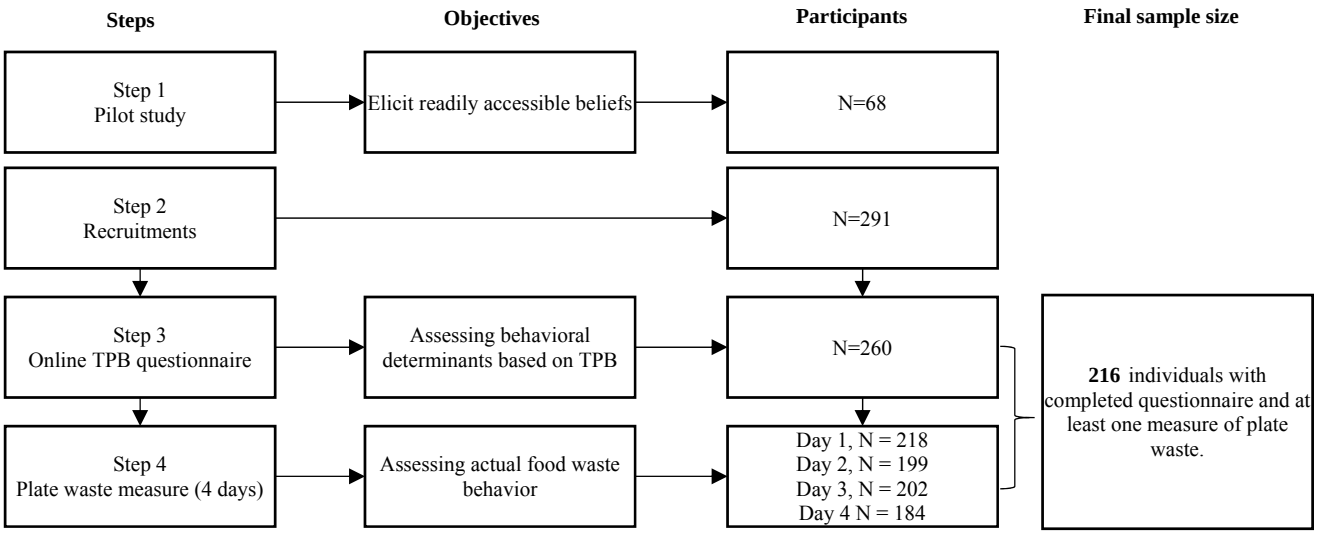
2 Method

2.1 Design

The study took place in 2016 in a French worksite cafeteria that caters to the staff of a research center as well as postgraduate students. This restaurant serves approximately 800 lunches per day. A four-step methodology was implemented to match a TPB questionnaire with the actual behavior of each respondent (see in figure 1). First, following the recommendations of Ajzen and Fishbein (1980, 2010), a pilot study was carried out to identify the beliefs to be retained in the final TPB questionnaire (step 1). For the main study, , a notice placed in the canteen two weeks before sending the TPB questionnaire asked for volunteers to take part in a study on "eating behaviors in the canteen" (step 2)[1]. Some 291 volunteers gave their e-mail address and an online TPB questionnaire was sent to them with instructions to complete it as soon as possible (step 3). Two weeks later, 260 completed questionnaires were returned. One week later, respondents' food leftovers were individually weighed over a period of 4 days (step 4).

[1] To prevent selection biases, there was no mention of food waste in the notice.

Figure 1: Study flow, objectives and sample size



2.2 Pilot study

Prior to the main survey, a pilot study was carried out to identify the behavioral, normative and control-related beliefs that are readily accessible in people's memories (de Leeuw et al., 2015; Fishbein & Ajzen, 1977). Among these salient beliefs, those that were the most widely shared among the population (i.e., modally salient beliefs) were selected for the main questionnaire (Ajzen, 1991). To this end, an online questionnaire was sent by e-mail to adults who are customers of various catering services (Sebbane, Costa, & Sirieix, 2016). People were asked to note what comes to mind when thinking about *"not leaving edible foods in the next few weeks in the canteen"*. Eight open-ended questions were included to elicit instrumental behavioral beliefs [what are the advantages / disadvantages], affective beliefs [what would you feel], injunctive beliefs [who would approve] descriptive beliefs [which individuals have a greater / lesser tendency] and control beliefs [what would make it easy / difficult].

Some 68 adults eating in 13 different institutional catering units completed the questionnaire (women = 67%, age: 18 to 34 = 16%, 35 to 49 = 59%, over 50 = 25%). An initial content

analysis was performed to develop generic themes for each belief categories. Two researchers then independently classified all semantic units into the thematic classes and inter-rater agreements were evaluated using Cohen's kappa coefficient (kappa test = 0.771; $p<0.001$). Finally, the most frequently cited outcome (behavioral beliefs), referents (injunctive and descriptive normative beliefs) and control factors (control-related beliefs) were retained for the final questionnaire.

2.3 Main study

Measurements of behavioral determinants

For the main study, an online questionnaire was sent by e-mail to the 291 customers who volunteered to take part in the survey. The questionnaire was structured as follows.

First, to identify each participant and match their answers with their food waste (see section below), respondents were asked to indicate the first three letters of their first name followed by the month and day of their birth.

In a second part, intentions, attitudes, subjective norms, perceived control and moral norms were rated on unipolar 7-point Likert scales (Francis, 2004). Given the individuals' negative attitude toward food waste and the moral dimension associated with the topic, it would have been irrelevant to question individuals about their "intention to waste food" (Stefan et al., 2013). On the other hand, "not wasting food" could be seen as a goal rather than a behavior. Hence; in the study, all the questions referred to *"not leaving edible food at the end of a meal during the coming weeks at the canteen"* and respected a high degree of compatibility in terms of action, context and time (Fishbein & Ajzen, 2010). The items, their means, standard deviations and construct properties are provided in appendix A.

Based on the results of the pilot study, a list of 9 behavioral beliefs, 5 injunctive normative beliefs, 2 descriptive normative beliefs and 7 control-related beliefs were presented in the final questionnaire. According to an expectancy-value model (Fishbein & Ajzen, 2010), behavioral beliefs were rated on unipolar 7-point Likert scales in terms of outcome likelihood (ranging from very unlikely to very likely) and importance (not important at all to very important). The score for the likelihood of an outcome was multiplied by the score of its importance to obtain a multiplicative component (de Leeuw et al., 2015).Each belief therefore falls within a range between 7 and 49 where the highest score indicates beliefs that support non-waste. The same calculation was made for all the other beliefs indicated hereafter. For injunctive normative beliefs, respondents were asked to what extent they though that specific referent groups expected them to adopt the behavior and then rated the importance they attach to the opinion of each reference group. Similarly, for descriptive normative beliefs, participants were asked to what extent referent groups used to adopt the behavior and the importance attached to what each referent group does. Finally, statements relating to control factors were rated in terms of probability of occurrence and perceived importance.

The last part of the questionnaire included questions about socio-demographic characteristics, such as gender and professional status.

Measurements of behavior

To measure actual food waste behavior, food leftovers were individually weighed for each respondent to the online questionnaire. To this end, over a period of 4 days, participants were given a short questionnaire at the entrance to the cafeteria and invited to complete it by the end of their meal. Questions related to the taste of the meal of the day, the quantities served and the participants' appetite[2]. As in the online questionnaire, respondents were asked to indicate the first three letters of their first name followed by the month and day of their birth.

[2] This questionnaire was mainly developed to match food waste measurements with the answers to the main questionnaire. Questions were worded as for a satisfaction survey in order not to raise awareness about food waste. Thus, even if the collected data could provide interesting information, the day-by-day questionnaires were not analyzed in the present study.

They were then asked to leave the tray with the questionnaire in the tray drop zone as usual. In the drop zone, trays with questionnaires were put aside by three investigators and taken to a separate room. Here, edible food was sorted and weighed by two investigators who recorded the weight of food waste in grams together with the identification code. It is important to note that, as the tray drop zone was separate from the dining room and measurements were carried out in an adjacent room, it is unlikely that participants were aware of these actions.

2.4 Data analysis

To analyze food waste behavior, a two-step approach was adopted. First, the underlying structure of beliefs was explored using multiple principal component analysis (PCA) before structural equation models were developed to explain the quantity of food left by each individual.

PCAs with varimax rotation were performed separately for each category of beliefs. Then, in the subsequent analyses, the extracted factors were modelled as latent variables to examine which specific behavioral, normative and control-related beliefs contribute to the prediction of their related construct (i.e., attitude, subjective norms and perceived behavioral control).

For the statistical analysis of behavior, partial least square structural equation models (Wold, 1985) were used with the mean amount of food waste for each participant as an observed dependent variable[3]. PLS-SEM is recommend for a relatively small sample and non-normality data (Hair, 2014, p. 15)[4]. Two structural models were developed: first, the main constructs of the TPB and their related beliefs were taken into account (model 1) before moral norms were included as an additional predictor of intention (model 2). To validate the measurement

[3] The decision to aggregae waste data into an average per individual is based on the following considerations. Not all participants were present on each weighing day. Retaining only the individuals for whom we had all 4 measures would have led to a drastic reduction in the sample size. Before calculating the mean amount, we conducted a one-factor ANOVA to ensure that the average waste in the sample did not vary significantly across the different days. These results are available on request.

[4] Owing to normality violation and zero inflated data for food waste, a complementary Tobit model (Tobin, 1958) with a log-transformed mean amount of food waste as a dependent variable was tested (Visschers, Wickli, & Siegrist, 2016). As the weights of behavior predictors and explained variance in the regressions were similar to those in the structural model, it was decided to retain the structural model.

models, the convergent and discriminant validity of all indicators was checked (Hair, 2014, p. 97). Structural models were evaluated by examining structural paths and explained variances (Hair, 2014, p. 186). Value significances were determined using a bootstrap resampling procedure with 1,000 sub-sample (Hair, 2014, p. 138). Analyses were conducted using XL STAT PLSPM software from Addin-soft SARL 2007–2008.

3 Results

3.1 Participants in the main study

According to daily attendance, the number of enrolled participants who were subject to food waste measures varied from day to day with the sample size ranging from 218 participants (day 1) to 184 participants (day 4). The final sample included 216 volunteers who answered to the online questionnaire and were subject to at least one measure of their food waste over the 4 measurement days. Of these, women represented 53%, 45% were students and 55% were employees of the research center. 57% were between 18 and 35 years old and 43% were over 35 years old. A series of mean comparisons between the original (N=291) and final samples (N=216) revealed no significant differences with regard to any TPB measure (all $p > 0.05$). It was concluded that selective attrition was not likely to be a factor in this study.

3.2 Principal component analysis (PCA) of beliefs

For the 9 behavioral beliefs, results showed a structure with 3 factors: 2 items were deleted due to weak loading factors (see appendix A). Once omitted, the 3 factors accounted for 74% of the overall variance of the remaining behavioral beliefs. The first factor (32% of variance explained) reflected “consequences for the individual” (BB individual). The second factor (22%), represented the “consequences for the catering staff” (BB staff) and the third factor (20%), related to the “consequences for the society” (BB society). The three factors extracted were then modelled as exogenous latent variables of the attitude construct.

For the 7 normative beliefs, 3 factors were extracted accounting for 83% of explained variance. The first dimension (29%) related to "injunctive normative beliefs conveyed by catering staff" (IB staff), the second factor (26%) reflected "descriptive normative beliefs conveyed by peers" (DB peers) while the third (28%) concerned "injunctive normative beliefs conveyed by peers" (IB peers). Each factor was included as an exogenous latent variable of the subjective norms construct.

For the 7 control beliefs, 3 factors emerged from the analysis. One item was deleted because of poor loading values. The final solution resulted in 82% variance extracted. The first factor (31%) represented "control beliefs relating to knowledge" (CB knowledge), the second factor (29%) "control beliefs relating to choice and quality" (CB quality) and the last factor (23%) "control beliefs relating to quantity" (CB quantity). All three factors were then connected to the perceived behavioral control construct.

3.3 Descriptive statistics

The mean weight of food waste was 34.67 grams (SD = 39.33) with a wide range of values among participants. Almost 14% of the participants recorded 0 grams of waste and the first quartile of the sample was around 4 grams. In contrast, 25% of the sample exceeded 50 grams and the highest amount recorded was 225 grams. The intention not to leave edible food was high among the sample (M = 6.11, SD = 1.29). Respondents reported an attitude (M = 6.04, SD = 1.17) and moral norms (M = 5.79, SD = 1.30) broadly favorable to the absence of food waste. Subjective norms were just above the neutral point of the scale (M = 4.88, SD = 1.28) meaning that people did not feel strong social pressure, or at least in a moderately supportive sense. Similarly, respondents reported moderate perceived behavioral control just above the median point of the scale (M = 4.98, SD = 1.47).

Significant correlations (table 1) were found between food waste and intention, perceived control and attitude. Intention was significantly correlated to attitude, moral norms and

perceived control, but not with subjective norms. Moral norms were strongly correlated with attitude. Normative beliefs and control beliefs were more closely related to their respective constructs than with any other constructs. However, 2 behavioral beliefs (i.e. BB.Staff and BB. Society) were slightly more correlated with moral norms than with attitude. Gender was related to the amount of food waste, perceived control and only one behavioral belief and while professional status was correlated with one control belief.

Table 1: means (M), standard deviations (SD) and Spearman bivariate correlations between all variables (N=216)

		M	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	FW	34.67	39.33	1																
2	Intention	6.11	1.29	-.333**	1															
3	Attitude	6.04	1.17	-.162*	.274**	1														
4	BB. individual	19.81	11.31	-.003	.030	.282**	1													
5	BB. staff	33.94	10.20	-.076	.195**	.273**	.366**	1												
6	BB. society	26.94	11.34	.016	.151*	.308**	.499**	.282**	1											
7	Subjective norms	4.88	1.28	.016	.059	.166*	.090	.226**	.125	1										
8	IB. peers	21.85	10.09	-.092	.120	.207**	.221**	.275**	.281**	.465**	1									
9	IB. staff	26.90	12.00	-.032	.096	.261**	.187**	.494**	.233**	.412**	.618**	1								
10	DB. peers	13.69	8.62	.059	.045	.084	.139*	.083	.208**	.363**	.429**	.269**	1							
11	Perceived behavioral control	4.98	1.47	-.308**	.510**	.194**	.091	.194**	.071	.011	.023	.086	-.025	1						
12	CB. quantity	23.06	10.93	.048	.093	.061	.295**	.190**	.311**	.111	.217**	.205**	.123	.278**	1					
13	CB. quality	26.78	11.06	.016	.191**	.122	.299**	.313**	.174*	.039	.081	.089	.061	.290**	.324**	1				
14	CB. knowledge	16.02	11.53	-.043	.171*	.233**	.329**	.199**	.340**	.010	.190**	.169*	.060	.222**	.427**	.163*	1			
15	Moral norms	5.79	1.30	-.081	.349**	.518**	.286**	.361**	.427**	.161*	.273**	.271**	.122	.297**	.162*	.249**	.161*	1		
16	Gender	1.47	0.50	-.202**	.092	-.041	-.069	-.017	-.204**	-.130	.007	.024	-.046	.220**	-.046	-.027	-.042	-.026	1	
17	Status	1.44	0.50	.030	.017	.048	-.068	.000	.046	.052	.054	.015	.098	.002	.061	.149*	.018	.005	-.166*	1

*p<.05. ** p<.01, FW= mean amount of food waste (in grams); BB. = behavioral beliefs; IB. = injunctive beliefs; DB. = descriptive beliefs; CB. = control beliefs

3.4 Structural equation models

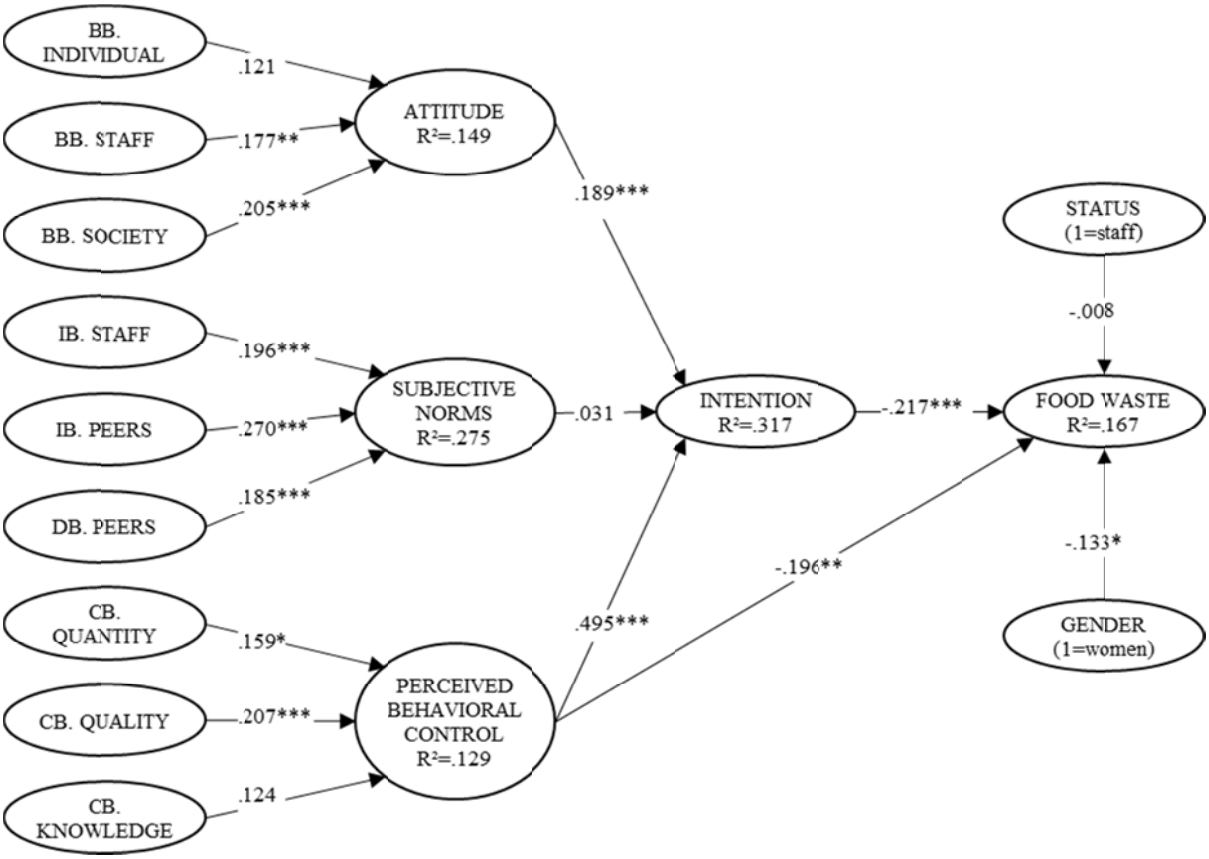
Model measurements

The model measurements supported the reliability and validity of the measurements (see table in appendix A). Each item had a significant loading value higher than 0.70 for its corresponding factors. Constructs had suitable composite reliability with values of between 0.827 and 0.959 (Chin, 1998). The average variance extracted (AVE) was well above the minimum required level of 0.50 (Fornell & Larcker, 1981). Thus, the internal consistency reliability and the convergent validity of the measures are validated. In addition to this, the discriminant validity was confirmed as the square root of each construct's AVE was larger than its highest correlation with any other construct (Fornell & larcker, 1981).

Structural models

The first structural model was performed with the core constructs of the TPB (model 1 in figure 2). A stronger intention and greater perceived behavioral control were both related to lower quantities of food waste. Gender emerged as a significant predictor over and above psychosocial factors (being a woman was associated with higher quantities of food waste). Attitude and perceived control were both significant predictors of intention whereas the subjective norms failed to make a significant contribution. Overall, the model accounted for 31.7% of variability in intention and 16.7% of variability in food waste.

Figure 2 Structural equation model of food waste with core constructs of the TPB (model 1)

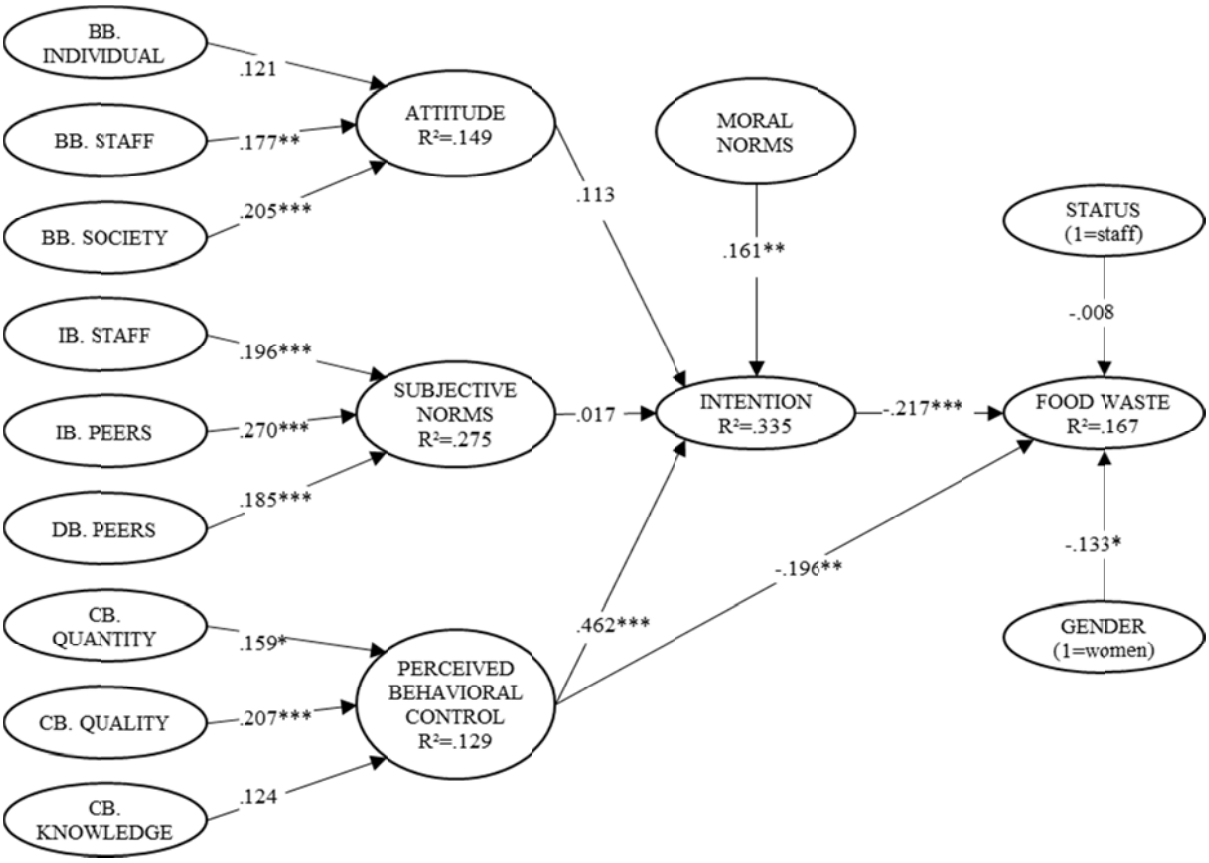


Note: *p<.10; **p<.05; ***p<.01. BB = behavioral beliefs; IB = injunctive beliefs; DB = descriptive beliefs; CB = control beliefs; ATT = attitude; SN = subjective norms; PBC = perceived behavioral control, INT = intention.

The model included the different sets of behavioral, normative and control beliefs derived from the prior principal component analysis. Due to the absence of a statistically significant link between subjective norms and intention, the normative beliefs are not examined below. The three behavioral beliefs accounted for 15% of the variance of attitude and two of them were significant: consequences for society and consequences for staff catering. Control beliefs accounted for 13% of the variance in perceived control and two of the three beliefs were significant: control beliefs related to quality and to quantity.

In the second structural model (model 2 in figure 3), the inclusion of moral norms as a direct predictor of intention added only 1.8% to the explained variance of intention while the path coefficient between attitude and intention became non-significant.

Figure 3 Structural equation model of food waste with core constructs of the TPB and moral norms (model 2)



Note: *p<.05; **p<.01; ***p<.001. BB = behavioral beliefs; IB = injunctive beliefs; DB = descriptive beliefs; CB = control beliefs; ATT = attitude; SN = subjective norms; PBC = perceived behavioral control, INT = intention; MN = moral norms.

4 Discussion

The present study investigated the psycho-social factors and their underlying beliefs which contribute to explaining food waste behavior. To avoid biases from self-reported estimation of food waste, a methodology was implemented to link the answers of a TPB questionnaire – extended to moral norms – with actual behavior (that is the quantity of edible food left by each participant). Below, predictors of intention and behavior are discussed in light of the results and the theoretical framework. Possible interventions targeting beliefs are then presented before highlighting some critical points of the present work.

In accordance with the TPB (Ajzen, 1991), the first hypothesis (1a and 1b) was confirmed: a greater intention not to leave edible food and a higher degree of perceived control over this behavior reduced the quantity of food waste. In addition, attitudes and perceived behavioral control contributed positively to the prediction of intention (H2a and c validated). Contrary to our expectations, even in a public consumption place like a canteen, subjective norms failed to contribute to the prediction of intention (H2b invalidated). It should be noted that, among the respondents, the mean of the subjective norms was close to the middle value of the scale. This suggests that individuals do not have a clear perception of the actions and opinions of others. One explanation could be that when eating in a canteen, the variety of behaviors (people who waste a lot, a little and nothing at all) causes difficulty in reporting a clear trend with regard to what most others are doing (Sebbane, Costa, & Sirieix, n.d.). Moreover, when having lunch with colleagues or friends in the canteen, people do not feel at ease to express their disapproval to someone who wastes food and prefer to keep their judgment to themselves, making the injunctive norm weakly salient (Sebbane et al., n.d.).

Gender and professional status (student versus employee) were also examined. Gender was a significant predictor of food waste (H5a validated) whereas status was not (H5b invalidated). Women were associated with greater quantities of waste than men. This same gender effect has been reported previously (Betz et al., 2015; Visschers et al., 2016). In the present study, one explanation might be the low perceived control reported by women. The mean value of perceived behavioral control was significantly weaker among women than men (t Test = 3.302; ddl = 214; $p<0.001$). However, no significant differences were found between men and women regarding the underlying control beliefs. Thus, it may be argued that some control factors other than those integrated in the questionnaire might play a specific role in the perceived control of women, which in turn leads to more food waste. Further studies are

needed to deepen our understanding of how gender plays a role in food waste in this specific context.

The inclusion of moral norms as an additional direct predictor of intention forced out the attitude from significance and added only 1.8% to the predictive power of the model in terms of intention. Moreover, a strong correlation between attitude and moral norms was found and two behavioral beliefs were more strongly correlated with moral norms than with attitude. Taken together, these results corroborate other research where the effects of moral considerations were at least partially mediated through attitude (Arvola et al., 2008; Raats, Shepherd, & Sparks, 1995; Sparks, Shepherd, & Frewer, 1995). Another explanation could be that the overall attitude toward food waste is mostly guided by moral considerations. This would mean that the general instrumental evaluation of attitude (e.g., positive; useful) reflects moral reasoning rather than utilitarian values. Two points give some support to this explanation. First, in the pilot study, the spontaneous answers to the question *"what would be the advantages/disadvantages of not wasting food"* led to behavioral beliefs based on altruistic dimensions such as consequences for catering staff and consequences for society. Second, these two beliefs contributed significantly to explaining attitudes while consequences for individuals were non-significant. However, since partial least square techniques do not provide criteria such as BIC or AIC to evaluate the degree of good fit of various structural models, it was not possible to compare the model presented here with models where moral norms would be an antecedent of attitude (mediation hypothesis), or with models where moral norms would replace attitude (evaluation hypothesis). Further investigations are needed to explore this theoretical question concerning the structure of attitudes and moral norms in greater detail.

4.1 Targeting beliefs to achieve a reduction in food waste

To obtain further insights about the underlying cognitive functions guiding behavior, behavioral, normative and control beliefs were integrated into the model. Following the TPB assumptions, it was expected that each category of beliefs would be more strongly correlated to its related construct than with any other construct. The assumption was verified for normative beliefs and subjective norms (hypothesis 4b validated), control beliefs and perceived behavioral control (hypothesis 4c validated), but only partially verified for behavioral beliefs and attitude as two beliefs were slightly more linked to moral norms (hypothesis 4a invalidated).

Since attitude was already largely positive and subjective norms were not a key determinant of intention, interventions aimed at increasing attitude or perceived social norms are likely to be less effective than targeting perceived behavioral control. The low perception of control among people indeed means that there is enough room to reinforce it and the strong impact of the construct on intention and behavior increases the probability that a modification to this determinant leads to behavioral change. Effective interventions should therefore aim to create conditions that facilitate the reduction of food waste and limit barriers that lead to food waste behavior. Two control beliefs are of particular importance: the quality of the meal and the adaptation of the quantities served. Improving the quality of the food might be seen as a challenge for managers who have to provide a large number of meals and deal with restricted costs. However, reducing food waste might create financial leeway to purchase better quality food products. With regard to the adaptation of portions to the needs and desires of each individual, it has been shown that reducing plate size in a free buffet service reduced food waste by 20% (Kallbekken & Sælen, 2013). However, reducing the size of plate for everyone runs the risk of consumers perceiving the intervention as a restriction. A better strategy could be to offer different plate sizes and let the consumer choose which plate would suit him or her

best. To accompany the consumer's decision and alter control beliefs, a targeted communication such as "*What is your appetite today? To suit to your appetite and limit food waste, the chef proposes two plate sizes: you choose"*. Future experimental work would make it possible to verify whether this type of intervention on actual control effectively leads to a change in control beliefs, a reinforcement of perceived behavioral control and, ultimately, a reduction in the amount of wasted food.

4.2 Critical remarks

Behavioral and control beliefs accounted for 15% of the explained variance of attitude and 13% of the perceived behavioral control. These rather low contributions mean that a substantial proportion of individuals' beliefs have remained in the shadows. The final questionnaire only integrated the most frequently mentioned beliefs of the pilot study. The cutoff point to establish the number of beliefs was based on a tradeoff between the need to incorporate relevant beliefs, maintaining a reasonable questionnaire length and limiting the risk of integrating beliefs that would not be shared by the majority of individuals – thus creating new beliefs among those people (Conner & Armitage, 1998). One issue that could be addressed in future research is the possibility of measuring individually salient beliefs instead of modally salient beliefs in a TPB questionnaire (Sutton et al., 2003).

Other limitations result from the way food waste was measured. First, food waste was weighed for 4 days, but due to different sample sizes from one day to another, taking into account only those respondents who were subject to every measurement would have dramatically reduced the size of the sample. Thus, mean food waste was calculated for each participant, despite the fact that this approach hides the intra-variability of behavior. Second, food waste measurements in grams provide a purely quantitative approach, according greater importance to certain food products depending on their natural weight. Leaving a whole portion of green salad is thus associated with a food waste behavior close to zero when only a

few spoons of mashed potatoes are associated with wasteful behavior. A more precise assessment would have been to identify the weight of each dish for every trays before consumption and to analyze the difference between leftovers and the quantities served for each sort of food. This kind of procedure is nevertheless very demanding both technically and in terms of human resources and would probably introduce a considerable focus on respondents' trays since a weighing phase is required before consumption.

5 Conclusion

The present study, conducted among customers of a worksite cafeteria, takes actual food waste behavior into account instead of self-reported food waste. It investigated modally salient beliefs to identify key factors in developing interventions aimed at reducing food waste in the institutional food sector. Findings indicate that efforts should be focused on perceived behavioral control. More specifically, two barriers should be targeted: improving the quality of the food and adapting portion sizes.

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Appendix A

Items per construct	Factor loadings	Composite reliability	AVE
Intention In the next few weeks in the canteen, I intend not to leave edible food at the end of my meals - *strongly disagree (1) to strongly agree (7)*		Single item	
Attitude In my opinion, not leaving edible food at the end of my next meals in the canteen would be:		**0.87**	**0.7**
Positive - *a little (1) to extremely (7)*	0.83		
Useful - *a little (1) to extremely (7)*	0.87		
Pleasant [for me] - *a little (1) to extremely (7)*	0.8		
Subjective norms In the canteen, most people who matter to me		**0.86**	**0.75**
Think that *I should not leave edible food (1) to I should leave edible food (7)*[*]	0.87		
Do *not leave edible food (1) to leave edible food (7)* [*]	0.87		
Perceived control : Not leaving edible food at the end of my next meals		**0.85**	**0.73**
depends entirely on me - *strongly disagree (1) to strongly agree (7)*	0.84		
Is - *extremely difficult (1) to extremely easy (7)*	0.87		
Moral norms : If I do not leave edible food at the end of my next meals:		**0.93**	**0.83**
I will feel that I respect my convictions - *strongly disagree (1) to strongly agree (7)*	0.92		
I will feel to do something morally right - *strongly disagree (1) to strongly agree (7)*	0.9		
I will have good conscience - *strongly disagree (1) to strongly agree (7)*	0.91		
Behavioral beliefs about the consequences for the individual		**0.9**	**0.74**
Eat quantities of food unsuitable for my needs [*] [**] [A]	-		
Reduce meal costs for the manager [A]	0.86		
Reduce the price of the meal I pay [A]	0.88		
Improve the quality of meals [A]	0.85		
Behavioral beliefs about the consequences for the catering staff		**0.85**	**0.75**
Show respect for the work of cooks [A]	0.96		
Facilitate the work of the staff who clean the dishes [A]	0.96		
Behavioral beliefs about the consequences for the society		**0.83**	**0.71**
Reduce inequalities in access to food worldwide [A]	0.89		
Preserve the environment and natural resources [A]	0.8		
Reduce waste at the canteen [**] [A]	-		
Injunctive normative beliefs conveyed by peers		**0.89**	**0.74**
Family and friends [B]	0.8		
General canteen customers [B]	0.86		
People with whom I usually have lunch in the canteen [B]	0.92		
Injunctive normative beliefs conveyed by catering staff		**0.96**	**0.92**
Kitchen staff [B]	0.96		
Staff who clean the dishes [B]	0.96		
Descriptive normative beliefs		**0.92**	**0.85**
General canteen customers [C]	0.9		
People with whom I usually have lunch in the canteen [C]	0.95		
Control beliefs related to quantities and portion size		**0.84**	**0.71**
I will have the opportunity to serve myself the quantities of food I wish [**] [D]	-		
The cook will serve me quantities suited to my appetite [D]	0.94		
I will have the choice between different sizes of portions [D]	0.74		
Control beliefs related to choice and quality		**0.91**	**0.84**
The meals will be tasty [D]	0.93		
I will have enough choice to eat what I like [D]	0.9		
Control beliefs related to knowledge		**0.94**	**0.88**
I will have information on the quantities of food thrown away in the canteen [D]	0.94		
I will have information on the consequences associated with the production of food waste [D]	0.94		

[**] Items deleted from the analysis

[*] Reversed items

[A] Items resulting from the multiplication of the likely consequence [very unlikely (1) to very likely (7)] and the importance of the consequence [not important at all (1) to (7) very important].

[B] Items resulting from the multiplication of the perceived expectation of the referent group* [I should not (1) to I should (7)] and the importance attach to the opinion of each referent [not important at all (1) to (7) very important]. Note that the perceived expectation was reversed.

[C] Items resulting from the multiplication of what the referent group is doing* [Do not leave edible food (1) to Leave edible food (7)] and the importance attach to what each referent group is doing [not important at all (1) to (7) very important]. Note that the scale for what the referent group is doing was reversed.

[D] Items resulting from the multiplication of the likely occurrence of the control factor [very unlikely (1) to very likely (7)] and the importance attach to the factor [not important at all (1) to (7) very important].

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