Consumer awareness campaign to reduce household food waste based on PLS-SEM behaviour modelling

Dávid Szakos, Barbara Szabó-Bódi, Gyula Kasza

National Food Chain Safety Office, Budapest, H-1024, Hungary
Keywords: household food waste, consumer behaviour, PLS-SEM, awareness raising
Presenting author email: kaszagy@nebih.gov.hu

Abstract

Purpose

The aim of this study is to explore behavioural patterns behind household food waste with partial least square structural equitation modelling (PLS-SEM). The results provided behavioural insights to a national level food waste prevention campaign in Hungary, called *Wasteless (Maradék nélkül)*.

Methods

Results are based on a quantitative consumer survey with personal interviews. Sample (n=1002) is representative to the adult population of Hungary in regard of sex, age and geographical distribution. Statistical analysis included descriptive tests, principal component analysis, factor analysis, variance analysis and PLS-SEM modelling. PLS-SEM was selected for its capability to combine observed variables to latent structures based on their influence on the target value, which was, in our case, food wastage related behaviour.

Results

Based on multivariate tests, income, age, education, residence and region were identified as the most influential socio-demographical factors. The first PLS-SEM model (normative model) validated that all three – cognitive, affective and conative – attitude components have effect on food wastage behaviour, but the conative component revealed to be the most important one. The second PLS-SEM model (explicative model), based on the same variable set, analysed the practical aspects of behaviour that lead to food waste. *Cooking too much food* was identified as the most prominent pattern, *careless food storage* was second. Contrary to anticipations, *unplanned food purchase* represented only minor significance.

Conclusions

PLS-SEM modelling has been proven to be an adequate tool to provide behavioural insights about household food waste generation. Results of the normative and explicative models were utilized in the design of the *Wasteless* campaign in Hungary.

Introduction and Aims

Food waste is generated in every stage of the food chain, from agricultural production to households. In economically developed countries, the most significant part of food waste derives from the households, which equals to 42% of total food waste in Europe (BIOIS, 2011; FAO, 2011).

While the effect of some socio-demographic factors, such as income and household type on food waste production seems to be well-known (Schneider & Obersteiner, 2007; Evans, 2011), many influencing factors hide silently behind routine household activities as attitude elements (Frohnmaier et al., 2015). In this study, factors determining the amount of household food waste are introduced on the basis of an attitude model as suggested initially by Allport (1935), who established the multidimensional interpretation of attitude. According to his attitude model theory, attitude consists of conative, affective and cognitive components, which are consistent in affecting the individual's general behaviour. Firstly, cognitive component influences the attitude through conscious and logical thinking. Secondly, affective component is connected to feelings. Thirdly, conative component has an effect on the attitude by habits and not conscious actions. Therefore, based on the multi-dimensional model of attitudes, every attitude is constructed of the previously listed three components. This view persisted throughout the 20th century and provided theoretical support for extensive research (Ostrom, 1969; Fishbein & Ajzen, 1977; Greenwald, 1989; Eagly et al., 1994), and can still be used in the light of recent developments of the attitude theory (Ajzen & Fishbein, 2005; Agapito et al., 2013). Considering the fact that household food waste depends heavily on socio-demographic background, we also examine the role of these factors in our study.

In recent times, several studies appeared that approached consumer level food waste production from the aspect of attitudes and behavioural elements (Evans, 2012; Koivupuro et al., 2012; Williams et al., 2012; Ganglbauer et al., 2013; Abeliotis et al., 2014; Graham-Rowe et al., 2014; Parizeau et al., 2015; Mallinson et al., 2016). Besides attitudes, lack of knowledge is also a significant problem, and even informed consumers have trouble with implementing their knowledge during their everyday activities (Porpino et al., 2016). Researchers tend to agree that changing consumer behaviour by raising awareness and putting routine activities in a different light are key factors in enhancing the sustainability of the food chain (Evans, 2011; Farr-Wharton et al., 2014; Stancu et al., 2016). The Hungarian National Food Chain Safety Office (NFCSO) started its household level food waste prevention programme, called *Wasteless (Maradék nélkül)* in 2016 based upon these principles. This communication programme has been supported by research elements from the beginning. To get an accurate picture of the

quantity of household food waste, a measurement was conducted in 2016 with the standardized EU methodology (FUSIONS, 2014), which is now integrated into the Supplementing Directive of EU (EC, 2019). As a result of this research, we found that an average Hungarian consumer generates 68 kg food waste annually, of which 49% could have been avoidable (Szabó-Bódi et al., 2018). The proportion of certain meals and food types in the wastage wase also measured, as well as the frequency of certain valorisation methods (such as composting and animal feed). This piece of information was essential in defining target indicators in food waste reduction, but it did not explain the roots of consumer behaviour that resulted in an excessive amount of food waste. For a better understanding, we formulated two hypotheses based on key findings from recent literature (Mondéjar-Jiménez et al., 2016) and tested them in another consumer research that used quantitative methodology:

H1: Apart from demographical factors, household food waste is significantly affected by attitudes, of which the conative component is the most prominent.

H2: Unplanned food shopping practices contribute to household food waste to a lesser extent than the preparation of unreasonable amount of food.

Methodology

For data collection, personal interviews were used, with respect to generally accepted preconditions (Babbie, 2014; Lourenço et al., 2016). During the designing of the questionnaire, we relied on experience from previous food waste related studies (Cox et al., 2010; Stefan et al., 2013; Jörissen et al., 2015). Interviews were conducted from 19th of November to 9th of December in 2016 (n=1002). In terms of sex, age and geographical distribution, the sample is representative to the adult population of Hungary, based on the latest population census result available at the time of the data collection (HCSO, 2012). For descriptive and multivariate statistical analysis, IBM SPSS Statistics 22.0 was used. For Structural Equation Modelling (SEM), we applied the Smart PLS software that is capable of second-generation data analysis. With the SEM method, two operations can be done simultaneously: a factor analysis that combines the influencing variables into new, so-called latent variables, and a regression analysis that examines the relationship between these newly created latent variables (Wong, 2013). This method is used to quantify the separate and cumulative effect of influencing variables on a target variable. Two types of SEM modelling are used widely: the covariance-based (CB) and the variance-based partial least square (PLS) method. For analysing household food waste, the PLS method is more appropriate considering that it handles ordinal scales and does not require normal distribution (Haenlein & Kaplan, 2004). PLS-SEM model consists of

an outer model, which demonstrates the connection between the observed variables and the constructed latent structures, and an inner model describes the regression routes between the latent variables (Henseler et al., 2012). The structure of the latent variables can be either reflective or formative. In case of reflective structures, there is a strong correlation between the explanatory variables, while in case of formative structures, multicollinearity can be problematic if it occurs, therefore we may find little or no overlap between explanatory variables (Petter et al., 2007; Henseler et al., 2009). In accordance with previous quantitative studies, we applied the reflective structure (Hair et al., 2016). Our PLS-SEM model was built up with two preparatory steps: 1) a target variable representing the food wastage of the respondent was composed with principal component analysis method; 2) the three attitude components were composed from a set of attitude variables that influenced the food wastage variable, as a result of a factor analysis.

Defining the target variable with principal component analysis

The aim of this study is to explore the behavioural reasons behind household food waste, therefore we had to compose a target variable representing the food wastage level of the certain consumers. In the survey, we examined the frequency of 16 potentially wasted food types with the help of a 1-5 Likert-scale (higher number indicates higher frequency). For the target variable, only the 5 most frequently wasted food types were selected (Table 1). The less frequently wasted food types did not deliver meaningful addition to this indicator, while significantly decreased the reliability of the combined variable.

The composed target variable was verified by Pearson correlation test (value of the coefficients were >0.0001 in all cases) and KMO-Bartlett test (0.778, the acceptable range is >0.6) (Osborne et al., 2008). The generated target variable contains 53% of the information content of the complete value set.

Table 1. Pearson correlation between variables used to principal component analysis

Food wastage categories		**Meals**	**Bakery products**	**Dairy products**	**Fresh fruits, vegetables**	**Meat products**
Meals (mean 1-5: 2.66)	Correlation	1	.584**	.439**	.276**	.411**
	Significance level (two-tailed)		.000	.000	.000	.000
Bakery products (mean 1-5: 2.48)	Correlation	.584**	1	.384**	.314**	.415**
	Significance level (two-tailed)	.000		.000	.000	.000
Dairy products (mean 1-5: 2.19)	Correlation	.439**	.384**	1	.369**	.421**
	Significance level (two-tailed)	.000	.000		.000	.000
Fresh fruits, vegetables (mean 1-5: 1.73)	Correlation	.276**	.314**	.369**	1	.474**
	Significance level (two-tailed)	.000	.000	.000		.000
Meat products (mean 1-5: 1.97)	Correlation	.411**	.415**	.421**	.474**	1
	Significance level (two-tailed)	.000	.000	.000	.000	

Description of the attitude components with factor analysis

Several attitude related variables were placed in the questionnaire to adequately support the 3-component attitude modelling. During the factor analysis, a strong linear correlation could be detected among them (KMO=0.819) (Table 2). The generated factors contain 55% of the information content of the complete value set, that can be considered to be satisfactory compared to the high number of explained variables (12).

Table 2. Descriptive result of attitude related questions and composed factors by Varimax rotation

Variable	**Mean (1-5)**	**Standard deviation**	**Factors**		
			1 (explained variance: 20.088%)	**2** (explained variance: 17.877 %)	**3** (explained variance: 16.961 %)
In my childhood, I was raised to discard food only if there was no other choice [V03]	4.40	1.119	.779	.178	-.040
I (will) try to raise my children not to discard food ever [V04]	4.34	1.098	.706	.117	-.071
For me, food represents an intangible value besides its monetary value [V05]	3.93	1.235	.825	.146	-.072
I would feel embarrassed if my friends/acquaintances saw me discarding food [V08]	3.59	1.413	.597	.274	-.054
Before going to the supermarket, we consider what kind of food we need in the household [V23]	4.00	1.157	.060	.809	-.073
I spend a remarkable amount of my income on food, so I always endeavour to waste less [V26]	3.74	1.203	.203	.660	-.065
We live an environmentally conscious life so we do not discard food [V27]	3.64	1.249	.323	.590	-.266
Usually we purchase food according to a previously written list [V20]	3.61	1.224	.220	.708	-.150
Sometimes it occurs that the food gets spoiled in my/our fridge [V06]	2.93	1.225	-.233	-.063	.480
In general, we cook more food than we need [V16]	2.66	1.254	.019	-.219	.656
After family events, we often discard a lot of food [V18]	2.11	1.223	.067	-.107	.780
In this fast-moving world, we have no time and occasion to discuss what kind of food to buy [V19]	2.34	1.347	-.110	-.033	.805

Results of factor analysis can be interpreted on the multidimensional attitude theory.

Factor 1 – Affective elements
- Emotional attitudes towards food (respect) [V08]
- Intrinsic motivation to prevent food waste generation [V04]
- Stigmatizing food waste as a social phenomenon [V05]
- Childhood emotional effects [V03]

Factor 2 – Cognitive elements
- Awareness of monetary damage of food waste [V23]
- Awareness of environmental problems associated with food waste [V26]
- Consciousness [V20]
- Planning and organization [V27]

Factor 3 – Conative elements
- Handling of food leftovers [V6]
- Food storage [V16]
- Cooking habits [V18]
- Meal as a family event / recreational activity [V19]

Validation of reflective PLS-SEM model

The outer model was verified by the following parameters.

1. Internal consistency

a. Cronbach's alpha values > 0.6, except in case of 1 component (it should be emphasised that this evaluation criterion is limited to the PLS-SEM model) (Hair et al., 2009; Henseler et al., 2015)

b. Composition reliability (CR) values > 0.6 in all cases (Nunally & Bernstein, 1994; Rossiter, 2002; Hair et al., 2016)

2. Convergence of structures

a. Outer loading (OL) values > 0.4 in all cases

b. Average variance extracted (AVE) values >0.5, except in case of 1 component, which did not influence the statistical reliability of the model significantly (Hulland, 1999; Hair et al., 2009; Hair et al., 2011; Hair et al., 2016)

3. Differentiation criteria: verified by Forner-Larcker test and by the cross-loading coefficient too (Forner & Larcker, 1981; Hair et al., 2011)

The inner model can be evaluated with bootstrap methods (beta values) in the aspect of the connection between latent structures, and based on the predicted information (R^2) (Davison & Hinkley, 1997; Chin, 1998; Tenenhaus et al., 2005; Hair et al., 2011; Hair et al., 2016). However, there are no minimum values accepted in the literature for this parameter, the graphical representation of the models contain the actual R^2 values.

Results and Discussion

Effect of demographical background

We have analysed the relation between the target variable that represents food wastage and a set of demographical variables (age, sex, place of residence, region according to NUTS1 classification, education level, income status, level of knowledge, living with child under the age of 6) with variance analysis.

We have found statistically significant results in regard of age, income, education level, place of residence and region (Table 3).

Table 3. Significant ($p<0.05$) demographic group mean differences related to food wastage target variable values according to variance analysis (higher number means higher food wastage)

Age	**Mean**	**Income**	**Mean**	**Education**	**Mean**	**Residence**	**Mean**	**Region**	**Mean**
Under 30 years	0.415	Low	-0.268	Primary school	0.055	Municipality	-0.186	Central Hungary	0.212
30-39 years	0.372	Average	-0.003	Vocational school	-0.460	Town	-0.051	Transdanubia	-0.043
40-59 years	-0.045	High	0.315	High school graduation	-0.048	Capital city	0.261	Great Plain and North	-0.130
Over 60 years	-0.553			Higher education	0.094				

Although statistically significant differences in regard of sex, level of knowledge and living with child under 6 years of age could not be detected, our results still indicate a likely relation between these variables and food wastage that may be validated by the increase of the sample size (Table 4).

Table 4. Not significant ($p>0.05$) demographic group mean differences related to food wastage target variable values according to variance analysis (higher number means higher food wastage)

Sex	**Mean**	**Level of knowledge**	**Mean**	**Child under 6 years**	**Mean**
Women	-0.0344	Low	0.0752	Yes	0.0948
Men	0.0393	Average	-0.0292	No	-0.0004
		High	-0.0331		

PLS-SEM behaviour modelling

The *normative* PLS-SEM model has revealed that food wastage is affected by the cognitive and the conative attitude components directly (endogen components of the SEM model), and influenced indirectly by the affective attitudes (exogen component of the model) (Figure 1).

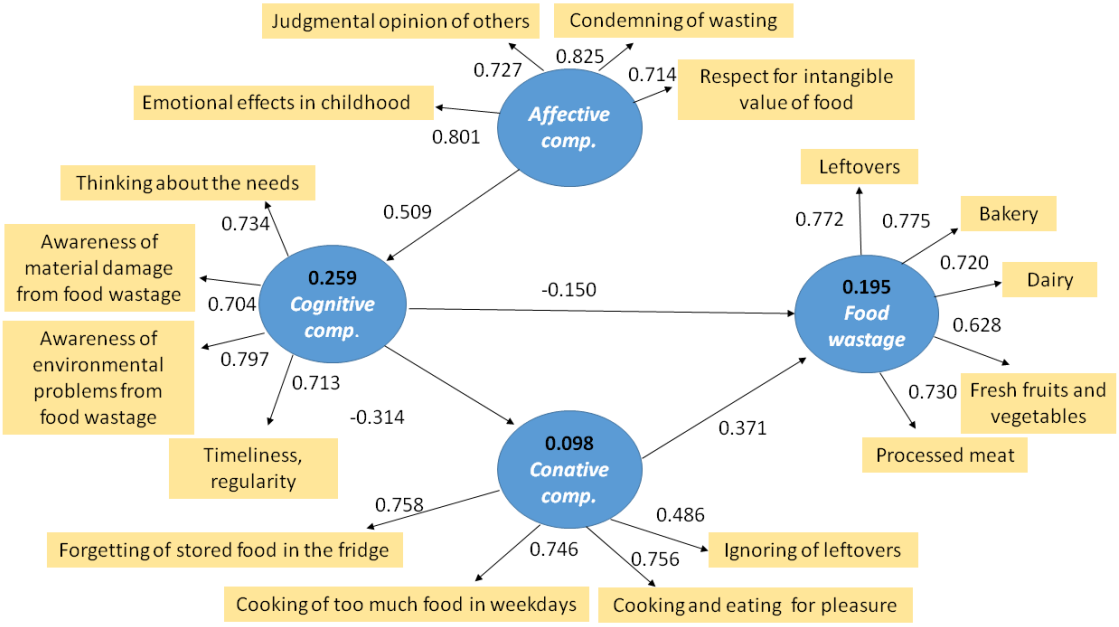

Figure 1. Normative PLS-SEM model of consumer food waste behaviour

The standard errors were bootstrapped by considering 5000 sub-samples. The results of direct structural relationships are statistically significant at 5% level (p-value<0.01). Based on the mathematical proof of the normative PLS-SEM model, we justified that the behaviour of Hungarian consumers towards food waste is determined by the affective, cognitive and conative attitude components, although their influences are different (Table 5). The conative component has the strongest direct influence (0.371) to the wastage target value. The affective component has an indirect effect, but it still has a significant direct and indirect effect on the forming of food wasting consumer behaviour.

Table 5. Value of aggregated effects of the attitude components to food wastage behaviour derived from the normative PLS-SEM model

Latent structures	Affective component	Cognitive component	Conative component	Wastage
Affective component		0.509	-0.160	-0.135
Cognitive component			-0.314	-0.266
Conative component				0.371

Although the *normative* PLS-SEM model gives an indication about the role of the different attitudes that can be targeted during an awareness raising campaign, communication actions usually need more definite information to construct effective messages. For this reason, by using the same set of variables that the normative model was constructed of, we have created an *explicative* model also. In this model, we paid attention to those variables that deliver more practical information to communication experts (Figure 2).

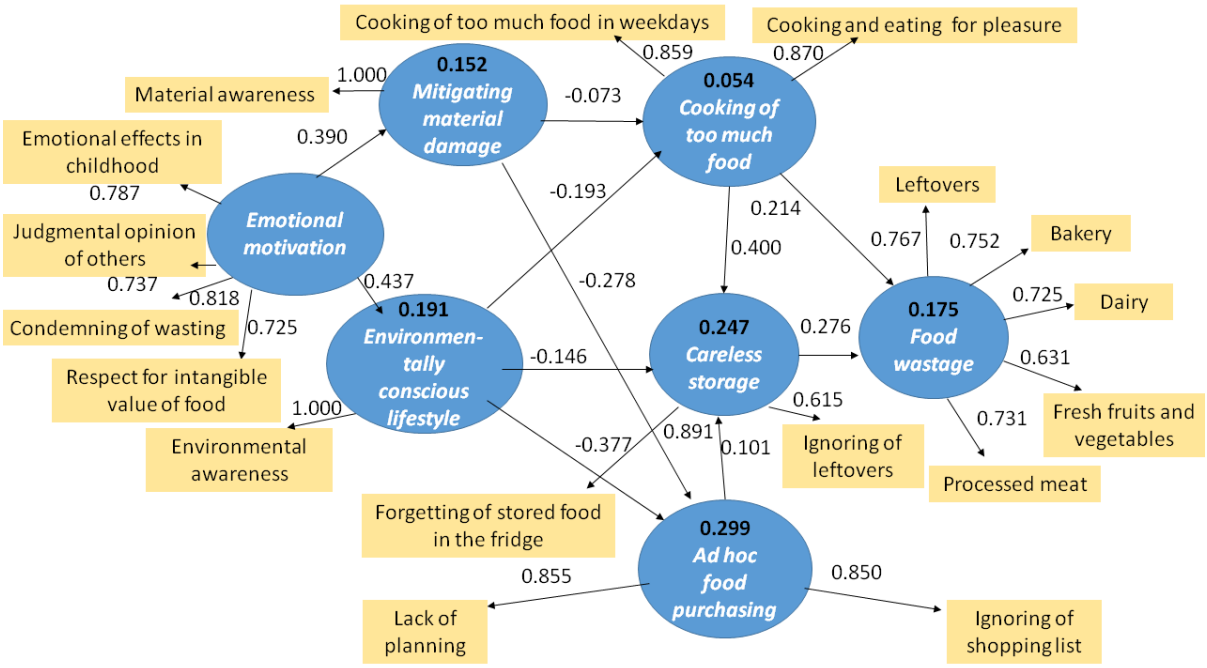

Figure 2. Explicative model of consumer food waste behaviour

The standard errors were bootstrapped by considering 5000 sub-samples. The results of direct structural relationships are statistically significant at 5% level (p-value<0.01). Through the explicative model, we proved the existence of such latent structures that are important from a practical point of view and affect household food waste either directly or indirectly. These factors show a tight correlation – even on their own – with the extent of waste (Table 6).

Table 6. Value of aggregated effects of latent structures to food wastage behaviour derived from the explicative PLS-SEM model

Latent structures	**Wastage**
Cooking of too much food	0.314
Careless storage	0.264
Environmentally conscious lifestyle	-0.132
Ad hoc food purchasing	0.086
Emotional motivation	-0.076
Mitigating material damage	-0.047

Based on the overall effects of structures, it is clear that preparing excessive amount of food is responsible for the majority of food waste in households. Second to that, careless food storage was identified as a possible target for the food waste preventive campaign. Unplanned purchase of food has a less significant role according to the results, but it is still important to mention when touching upon the issue.

Conclusion

In this study, we summarised the research results that served to plan a household food waste prevention campaign that considers behaviour insights. The findings of the explicative model are utilised in the Hungarian *Wasteless* programme to aim at key attitudes, used in communication actions and later became a part of the Hungarian primary school education.

List of references

1. Abeliotis, K., Lasaridi, K., & Chroni, C. (2014). Attitudes and behaviour of Greek households regarding food waste prevention. *Waste Management & Research 32*(3), 237-240.
2. Agapito, D., Oom do Valle, P., & Júlio da Costa Mendes, J. (2013). The cognitive-affective-conative model of destination image: A confirmatory analysis. *Journal of Travel & Tourism Marketing 30*(5), 471-481. https://doi.org/10.1080/10548408.2013.803393
3. Ajzen, I., & Fishbein, M. (2005). *The Influence of Attitudes on Behavior*, in: D. Albarracín, B. T. Johnson & M. P. Zanna (Eds.), The Handbook of Attitudes, 173-221, Erlbaum, New Jersey.
4. Allport, G. W. (1935). *Attitudes*, in: Murchison, C. (Ed.) A Handbook of Social Psychology, 789-844, Clark University Press, Massachusetts.
5. Babbie, E. (2014). *The practice of social research* (14th ed.) Boston, MA: Cengage Learning.
6. BIO Intelligence Service (BIOIS) (2011). Preparatory study on food waste across EU 27, available at: http://ec.europa.eu/environment/eussd/pdf/bio_foodwaste_report.pdf (accessed 14 May 2019)
7. Chin, W. W. (1998). The partial least squares approach to structural equation modelling, in: G. A. Marcoulides (Ed.), Modern Methods for Business Research, 295-358. Mahwah: Erlbaum.
8. Cox, J., Giorgi, S., Sharp, V., Strange, K., Wilson, D. C. & Blakey, N. (2010). Household waste prevention – a review of evidence. Waste Management & Research 28(3), 193-219.
9. Davison, A. C., & Hinkley, D. V. (1997). *Bootstrap methods and their application. Cambridge*, UK: Cambridge University Press.
10. Eagly, A. H., Mladinic, A. & Otto, S. (1994). Cognitive and affective bases of attitudes toward social groups and social policies. *Journal of Experimental Social Psychology 30*(2), 113-137. doi: 10.1006/jesp.1994.1006
11. European Commission (2019). Supplementing Directive 2008/98/EC of the European Parliament and of the Council as regards a common methodology and minimum quality requirements for the uniform measurement of levels of food waste, available at: http://ec.europa.eu/transparency/regdoc/rep/3/2019/EN/C-2019-3211-F1-EN-MAIN-PART-1.PDF (accessed 14 May 2019)
12. Evans, D. (2011). Blaming the consumer–once again: the social and material contexts of everyday food waste practices in some English households. *Critical Public Health, 21*(4), 429-440.
13. Evans, D. (2012). Beyond the Throwaway Society: Ordinary Domestic Practice and a Sociological Approach to Household Food Waste. *Sociology 46*(1), 41-58.
14. Farr-Wharton, G., Foth, M., & Choi, J. H. J. (2014). Identifying factors that promote consumer behaviours causing expired domestic food waste. *Journal of Consumer Behaviour, 13*(6), 393-402.
15. Fishbein, M., & Ajzen, I. (1977). Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research. *Philosophy and Rhetoric 10*(2), 130–132.
16. Food and Agricultural Organisation (FAO) (2011). Global food losses and food waste, available at: www.fao.org/docrep/014/mb060e/mb060e.pdf (accessed 14 May 2019)
17. Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. *Journal of Marketing Research 18*(3), 382-388. doi: 10.2307/3150980

18. Frohnmaier, D., Brandstetter, P. & Gehring, F. (2015). Report about Food Waste Statistics In Europe. Plas Carb - Innovative plasma based transformation of food waste into high value graphitic carbon and renewable hydrogen.
19. FUSIONS (2014). Report on review of (food) waste reporting methodology and practice, available at: www.eu-fusions.org/phocadownload/Publications/Food%20waste%20quantification%20manual%20to%20monitor%20food%20waste%20amounts%20and%20progression.pdf (accessed 13 February 2019).
20. Ganglbauer, E., Fitzpatrick, G., & Comber, R. (2013). Negotiating Food Waste: Using a Practice Lens to Inform Design. *ACM Transactions on Computer-Human Interaction (TOCHI) 20*(2), 11-25. doi: 10.1145/2463579.2463582
21. Graham-Rowe, E., Jessop, D. C., & Sparks, P. (2014). Identifying motivations and barriers to minimising household food waste. *Resources, Conservation and Recycling 84*, 15-23. doi: 10.1016/j.resconrec.2013.12.005
22. Greenwald, A. G. (1989). *Why Attitudes are Important: Defining and Attitude and Attitude Theory Twenty Years Later*, in: Pratkanis A. R., Breckler S. J. & A. Greenwald (Eds.). Attitude Structure and Function, 429-430, Earlbaum, New Jersey.
23. Haenlein, M., & Kaplan, A. M. (2004). A Beginner's Guide to Partial Least Squares Analysis. *Understanding Statistics*, *3*(4), 283-297.
24. Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2009). *Multivariate Data Analysis*, 7th edition. Prentice Hall. Upper Saddle River.
25. Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice*, *19*, 139-151.
26. Hair, J. F., Hult, G. T. M., Ringle, C., Sarstedt, M. (2016): A primer on partial least squares structural equation modeling (PLS-SEM). Sage Publications.
27. Henseler, J., Ringle, C. M., & Sinkovics, R. R. (2009). The Use of Partial Least Squares Path Modeling in International Marketing. *Advances in International Marketing (AIM), 20*, 277-320. doi: 10.1108/S1474-7979(2009)0000020014
28. Henseler, J., Ringle, C. M., Sarstedt, M. (2012). Using partial least squares path modeling in international advertising research: Basic concepts and recent issues, in: S. Okazaki (Ed.), Handbook of research in international advertising, 252-276. Cheltenham, UK: Edward Elgar.
29. Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the academy of marketing science, 43*(1), 115-135. doi: 10.1007/s11747-014-0403-8
30. Hungarian Central Statistical Office (HCSO) (2012). Population census 2011 - Preliminary data, available at: http://www.ksh.hu/docs/eng/xftp/idoszaki/nepsz2011/enepszelo2011.pdf (accessed 14 May 2019)
31. Jörissen, J., Priefer, C., & Bräutigam, K. R. (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. doi:10.3390/su7032695
32. Koivupuro, H. K., Hartikainen, H., Silvennoinen, K., Katajajuuri, J. M., Heikintalo, N., Reinikainen, A., & 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. doi: 10.1111/j.1470-6431.2011.01080.x
33. Lourenço, J. S., Ciriolo, E., Almeida, S. R., & Dessart, F. J. (2016). Behavioural Insights Applied to Policy-Country Overviews 2016 (No. JRC100547). Joint Research Centre (Seville site).

34. Mallinson, L. J., Russell, J. M., & Barker, M. E. (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
35. Mondéjar-Jiménez, J. A., Ferrari, G., Secondi, L., & Principato, L. (2016). From the table to waste: An exploratory study on behaviour towards food waste of Spanish and Italian youths. *Journal of Cleaner Production, 138*, 8-18.
36. Nunally, J. C., & Bernstein, I. (1994). *Psychometric theory*. New York: McGraw-Hill.
37. Osborne, J. W., Costello, A. B., & Kellow, J. T. (2008). *Best practices in exploratory factor analysis. Best practices in quantitative methods*. Sage Publications.
38. Ostrom, T. M. (1969). The relationship between the affective, behavioral, and cognitive components of attitude. *Journal of Experimental Social Psychology 5*(1), 12-30. https://doi.org/10.1016/0022-1031(69)90003-1
39. Parizeau, K., von Massow, M., & Martin, R. (2015). Household-level dynamics of food waste production and related beliefs, attitudes, and behaviours in Guelph, Ontario. *Waste Management 35*, 207-217. doi: 10.1016/j.wasman.2014.09.019
40. Petter, S., Straub, D. W., & Rai, A. (2008). Specifying Formative Constructs in Information Systems Research. *Management Information Systems Quarterly, 31*(4), 623-656.
41. Porpino, G., Wansink, B., & Parente, J. (2016). Wasted positive intentions: the role of affection and abundance on household food waste. *Journal of food products marketing, 22*(7), 733-751.
42. Rossiter, J. R. (2002). The C-OAR-SE procedure for scale development in marketing. *International journal of research in marketing, 19*(4), 305-335.
43. Schneider, F. & Obersteiner, G. (2007). Food waste in residual waste of households – regional and social-economic difference, in Cossu RR, Diaz LF & Stegmann R (Eds.), Proceedings of the Eleventh International Waste Management and Landfill Symposium, in S. Margherita di Pula - Cagliari, Sardinien, 469–470.
44. Stancu, V., Haugaard, P., & Lähteenmäki, L. (2016). Determinants of consumer food waste behaviour: Two routes to food waste. *Appetite, 96*, 7-17.
45. Stefan V, van Herpen E, Tudoran AA & Lähteenmäki L (2013) Avoiding food waste by Romanian consumers: The importance of planning and shopping routines. *Food Quality and Preference, 28*(1), 375-381. doi: 10.1016/j.foodqual.2012.11.001
46. Szabó-Bódi, B., Kasza, Gy., & Szakos, D. (2018). Assessment of household food waste in Hungary. *British Food Journal, 120*(3), 625-638.
47. Tenenhaus, M., Esposito Vinzi, V., Chatelin, Y. M., & Lauro, C. (2005): PLS path modeling. *Computational statistics & data analysis, 48*(1), 159-205.
48. Williams, H., Wikström, F., Otterbringb, T., Löfgren, M. & Gustafsson, A. (2012). Reasons for household food waste with special attention to packaging. *Journal of Cleaner Production 24*(1). 141-148. doi: 10.1016/j.jclepro.2011.11.044
49. Wong, K. K. K. (2013). Partial least squares structural equation modeling (PLS-SEM) techniques using SmartPLS. *Marketing Bulletin, 24*(1), 1-32.

Acknowledgements

This research is co-funded by European Union's LIFE Programme, identification number: LIFE15 GIE/HU/001048