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Motives, propensities and consistencies among Swedish consumers in relation to the food choice concept of clean eating

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Abstract

Purpose – The purpose of this study is to explore how consumers apply clean-eating criteria to a range of food characteristics, and the extent to which individuals are consistent in how they apply clean-eating criteria across products. Further, this study investigates how the clean-eating approach relates to underlying food choice motives.

Design/methodology/approach – Data were collected in a consumer survey ($n = 666$) in Sweden, where participants were prompted about the importance of a set of intrinsic food attributes of the "free-from" and "added" types, for three different food product types (bread, processed meat, ready meals). Data were analyzed using latent class cluster analysis, to explore segments of consumers that place similar importance to the food characteristics and hold similar food choice motives.

Findings – Clean eating can be described by two distinctly different attainment strategies: avoiding undesirable characteristics or by simultaneously approaching desirable characteristics. Notably, individuals who apply clean-eating criteria in their food choices strive for healthy, natural and environmentally friendly food, but the clean-by-approach strategy implies a stronger focus on personal health in the form of weight control.

Originality/value – While claims and labels on food packages concerning clean eating are implemented by food manufacturers, it remains unregulated. This study provides information for future regulations on how consumers apply clean-eating criteria, and their motives thereof. Further, the results provide insights food manufacturers regarding motives for clean eating in different consumer segments.

Keywords Latent class cluster analysis, Naturalness, Regulatory focus theory, Food additive, Clean eating

Paper type Research paper

Introduction

The dietary concept denoted as "clean eating" is a major trend in the food industry (Shelke, 2020), with 60.8 million #eatclean and 48.1 million #cleaneating posts on Instagram (as of 2022–10–22). With the increased interest and demand among consumers, clean eating is a concept that has gained much attention in industry and in food research, as well as in policy and regulation (Ingredion, 2014; Asioli *et al.*, 2017; De Oliveira do Nascimento *et al.*, 2018; European Commission, 2019; Martínez-Zamora *et al.*, 2021; Roobab *et al.*, 2021; Trujillo-Mayol *et al.*, 2021). Importantly, the clean-eating concept is not clearly defined (Asioli *et al.*, 2017), although it is often described by terms such as naturalness, "real food", healthiness and absence of certain ingredients and additives that are perceived as harmful (Ambwani *et al.*, 2020; Chen *et al.*, 2022).

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Despite the increased interest and demand for clean labeling, there is not scientific evidence of such products holding higher levels of healthiness (Negowetti *et al.*, 2022). Thus, the concept of clean eating and clean labeling of products may mislead consumers and be interpreted to hold qualities other than those that the consumers are seeking (Chen *et al.*, 2022). Ultimately, unregulated clean labeling may even results in adverse health effects (Chen *et al.*, 2022; Negowetti *et al.*, 2022). This is a particular concern for vulnerable groups at risk of eating disorders (Allen *et al.*, 2018; Ambwani, 2019).

Given the lack of clear definition and regulation of clean eating, the concept is open for interpretation among food manufacturers and consumers. Existing research suggest that an avoidance approach serve as the main behavioral motive for clean eating, meaning that the focus is to select food by some exclusion criteria, and in doing so screen for what the product needs to be “free from” such (Asioli *et al.*, 2017). Other studies have documented avoidance of specific ingredients such as gluten, lactose, or palm-oil (Hartmann *et al.*, 2018). However, a review by Asioli *et al.* (2017) also identified that clean-eating can relate to an approach-based search (i.e. seeking the presence of certain product quality attributes) such as organic, while other studies have focused on the degree of naturalness, degree of processing, freshness, number of ingredients and familiarity with ingredients as food choice aspects of clean eating (Aschemann-Wtizel and Peschel, 2019; Maruyama *et al.*, 2021; Noguerol *et al.*, 2021).

As evidenced in the review by Asioli *et al.*, (2017), there is, to date, no study that characterize the concept of clean eating from a broader set of both presence and avoidance criteria, or which have investigated whether individuals in their role as consumers are consistent in applying the same search criteria for presence or absence of certain characteristics across food products. Therefore, the first objective of this study is to explore if there are underlying (i.e. latent) exclusive and exhaustive subgroups of individuals that adequately represent the heterogeneity in how they apply the presence and avoidance criteria. If so, what are these criteria and how large are these groups? A second, and related, objective is to investigate the extent to which individuals are consistent in applying the criteria across food products differing by their extent of processing.

Moreover, there is to our understanding no previous study investigating how the search behaviors related to avoidance and approach criteria match with consumers’ underlying food choice motives. Investigation of the motivational basis for the clean-eating approach may gain insights from the Regulatory Focus Theory (Asioli *et al.*, 2017), which proposes that there are two distinct motivational systems: promotion and prevention (Crowe and Higgins, 1997). An individual who is more prevention-oriented will then be expected to strive to attain a specific goal (such as healthiness) by avoiding unhealthy products or unhealthy characteristics in products. By contrast, individuals who are more promotion-oriented will strive to attain their goal by approaching healthy products or healthy characteristics in products (De Boer and Schösler, 2016). Therefore, a third objective of this study is to investigate how the search behaviors for presence or absence of certain characteristics across food products relate to underlying food choice motives. While reviews have identified healthiness as a key motivation for clean eating (Asioli *et al.*, 2022; Chen *et al.*, 2022), we investigate the heterogeneity in motives between the latent subgroups of individuals.

Currently, the concept of clean eating may disserve consumers, when used as a cue for healthiness, despite that there is not scientific support for this (Negowetti *et al.*, 2022). It has been reported that clean-eating behavior, if persistent, comes in risk of contradicting public guidelines for a healthy diet with a long-term potential of bringing adverse medical health consequences (Nevin and Vartanian, 2017). It remains an open question how the concerns with using clean eating as a cue for healthiness should be addressed. The main contribution of this study to the literature on clean eating as a food choice behavior goes to the characterization of how individuals apply this concept across food products. Thus, this study does not discuss clean labeling *per se*, but rather contributes with understanding of what it is consumers seek in terms of presence and avoidance criteria, and what motivates their search behavior with respect to clean eating. Findings of a consistent search pattern across product categories would allow for more general actions from health professionals and/or from concerned public authorities, whereas more product specificity would warrant a more differentiated health information approach. Furthermore, the understanding of the motives underlying the proneness of clean eating and the further categorization of consumer segments by their proneness to search for presence or avoidance criteria may guide efforts to tailor information to better resonate with consumers.

Methods

Participants

Participants were recruited from an Internet panel administered by a research panel firm (userneeds.com) in September 2020 in Sweden. Quotas were used for gender and age to match the distribution of the Swedish population. This type of study and data collection does not require approval according to the Swedish Ethical Review Authority (Swedish Ethical Review Authority, 2021). Descriptive statistics for our sample ($n = 666$) is presented in Table 1, alongside Swedish population statistics for comparative purposes. The sample is also representative of the population with respect to household size, while individuals with university level education were overrepresented in the sample.

Products and product characteristics

Three products were included in the study, selected to represent foods of varying extent and type of processing, while also being expected to be purchased and consumed regularly by many consumers in Sweden. Based on these criteria, we included bread, cooked meat (represented by sausages) and ready-meals (represented by a broccoli pie with eggs). Each product was displayed using a generic image showing the product in a standard type of packaging but with no presentation of brand or other labels.

Procedure

Participants responded to an online survey developed in Qualtrics with three parts. The first part included self-reported personal characteristics (gender, age and educational level). The second part included Food Choice motives (see Section 2.4), while the third and final part asked the participants to rate the importance of the product-related clean-eating

Variable	Sample	Population
Female (proportion)	0.50	
Age categories (proportions)		
18–34	0.28	0.28
35–49	0.28	0.24
50–64	0.22	0.23
65–	0.23	0.25
Household size	2.3	2.2
Education level (proportions)		
Elementary	0.07	0.17
high school	0.43	0.43
university level or similar	0.50	0.40

Note(s): Sample includes 666 individuals. Population statistics from Statistics Sweden (scb.se)

Table 1. Sociodemographic characteristics

characteristics. Only respondents who confirmed that they had purchased the specific product at least once in the past month were qualified to respond to the product-specific parts of the questionnaire. This resulted in 53 observations being excluded after indicating that respondents had not purchased any of these products in the past month. After this exclusion, the number of participants varied by product with $n = 626$ for bread, $n = 497$ for cooked meat and $n = 302$ for ready-meals.

Food choice motives. In the second part of the survey, to gain insights into the motives for clean eating, respondents indicated the importance of the central concepts of clean eating: healthiness and naturalness. Specifically, based on the food choice questionnaire (Steptoe *et al.*, 1995; Onwezen *et al.*, 2019), we included motives related to health (general healthiness and healthiness in the form of weight control) and naturalness, and following the interconnectedness between naturalness and environmental sustainability (Rozin *et al.*, 2004; Rozin, 2006), we also included environmental friendliness.

The importance of each of the motives was measured on scales from the Single Item Food Choice questionnaire (SI-FCQ) (Onwezen *et al.*, 2019), which includes 11 items to measure 11 food choice motives. The questionnaire is developed based on the Food Choice questionnaire (Steptoe *et al.*, 1995), which includes nine food choice motives (36 items). Respondents indicated their agreement with the statement "It is important to me that the food I eat on a typical day" on a seven-point scale ranging from "not at all important" (1) to "very important" (7).

Importance of the product-related clean-eating characteristics. In the third part of the survey, as applicable after the screening for product purchase, participants were prompted about the importance of a set of product-based intrinsic food attributes of the "*free-from*" and "*added*" types. These attributes were included in the study based on the existing literature (Bimbo *et al.*, 2017; Hartmann *et al.*, 2018; Aschemann-Wtizel and Peschel, 2019; Maruyama *et al.*, 2021; Noguerol *et al.*, 2021). The "free from" included eight characteristics: free from preservatives, colorants, palm oil, artificial sweeteners, added sugar, lactose and gluten, and finally, a more general cue for the free-from aspect by a short ingredient list. The free-from characteristics are avoidance-type qualities that consumers may use as cues to prevent harmful effects on their health. While there is no clear evidence that lactose-free and gluten-free food is healthier for non-intolerant individuals, some results suggest a perception that it is healthier and more natural to avoid lactose and gluten (Hartmann *et al.*, 2018). Similarly, there is a perception that palm oil is unhealthy and unnatural (Hartmann *et al.*, 2018). Furthermore, a second set of characteristics were included, in the "*added*" form: added vitamins, extra protein, or extra fiber. This reflects health attainment by enhancement, such that health is approached (Bimbo *et al.*, 2017). While we sought to include the same attributes for all three products, certain adjustments were made, such that added fiber/wheat was excluded from the cooked meat category, and added vegetables was only included for the cooked meat.

For each of the three products, the importance of each food characteristic was measured with the statement: "How does the following characteristic impact the extent to which you want to purchase this [product type] or not?" The rate of agreement was indicated on a five-point scale (1 = very negative impact, 5 = very positive impact). The order of presentation of the clean-eating characteristics was randomized for each product to avoid ordering effects. The full list of food characteristics for each product is available in Table S1 in Supplementary Material.

Data analysis

Based on the indicated importance of the quality attributes for each product type, we first explored whether there were sub-groups of individuals who among themselves place similar importance to the different food attributes related to the clean-eating concept, while being distinctly different from other sub-groups. For this purpose, we took an exploratory approach to investigate the concept of clean eating as a product-based latent variable. The latent class cluster (LCC) model is appropriate for such analysis (Masyn, 2013; Nylund-Gibson and Choi, 2018). For the LCC-analysis we transformed the indicators (importance scale) into a binary form, where positive impact (4) and very positive impact (5) gave a value of one and zero otherwise. Binary indicators are most commonly used in LCC analysis (Nylund-Gibson and Choi, 2018), and transformation to binary indicators is suitable when categorical variables include low frequency response categories (Masyn, 2013). Based on this transformation, we estimated separate LCC models for each of the products included.

We further explored whether the importance of the clean-eating qualities hold across product types, such that there is consistency in individuals' sub-group belonging across product types. Based on the product-specific LCC models, we assigned individuals to the class with the highest posterior class membership probability.

Finally, we examine how the product-specific latent class membership is explained using the importance of the four food choice motives (healthiness, weight control, naturalness and environmental friendliness) as covariates. The inclusion of covariates as predictors of class membership followed the approach from Lanza *et al.* (2007).

The LCC modeling approach includes a measurement and a structural model, where the former describes the relation between product-based clean-eating attributes and a latent class variable. LCC analysis makes it possible to identify the most suitable number of classes in the measurement data and assign a probability of each variable to each class. It further enabled us to assign class membership probabilities for each individual to each class. The LCC-models were estimated in Latent Gold 5.1 (Vermunt and Magidson, 2013). A detailed description of the method and model selection is available in the Appendix. Moreover, appendix includes details on robustness checks with alternative model specifications.

Results

Inferring clean eating from product characteristics

For each of the products, we identified four distinct and non-trivial latent classes. While there are some differences in these classes between the products, the overall patters are similar. Based on their patterns, we labeled the classes as: *Clean-by-avoidance*, *Clean-by-approach*, *Moderately engaged* (in clean eating) and *Unengaged* (in clean eating). Figure 1 shows the share of individuals in each latent class for whom each characteristics have a positive to very positive importance in their product choice.

Both the *clean-by-avoidance* and the *clean-by-approach* classes were characterized by being positively influenced in their purchase decisions by avoiding preservatives, colorants, sweeteners, palm oil, chemical pesticides (organic) and additives in general (short ingredient list). However, differences emerged between the clean-eating classes in terms of product characteristics that are in the approach form (added vitamins, added fiber/wheat, added vegetables and high protein). Contrary to individuals in the *clean-by-avoidance* class, individuals in the *clean-by-approach* class were positively influenced by such characteristics in their willingness to purchase a product. Furthermore, the two attributes gluten-free and lactose-free positively impacted some individuals in the *clean-by-approach* class, while individuals in the *clean-by-avoidance* class did not assign importance to these qualities. Together, the clean-related classes constituted approximately 40% of the respondents in each product.

For the remaining classes, the *moderately engaged* class was characterized by intermediate levels of positive importance for most of the characteristics. The *unengaged* class consisted of individuals who did not find that most of the characteristics included had a positive impact on their willingness to purchase the products.

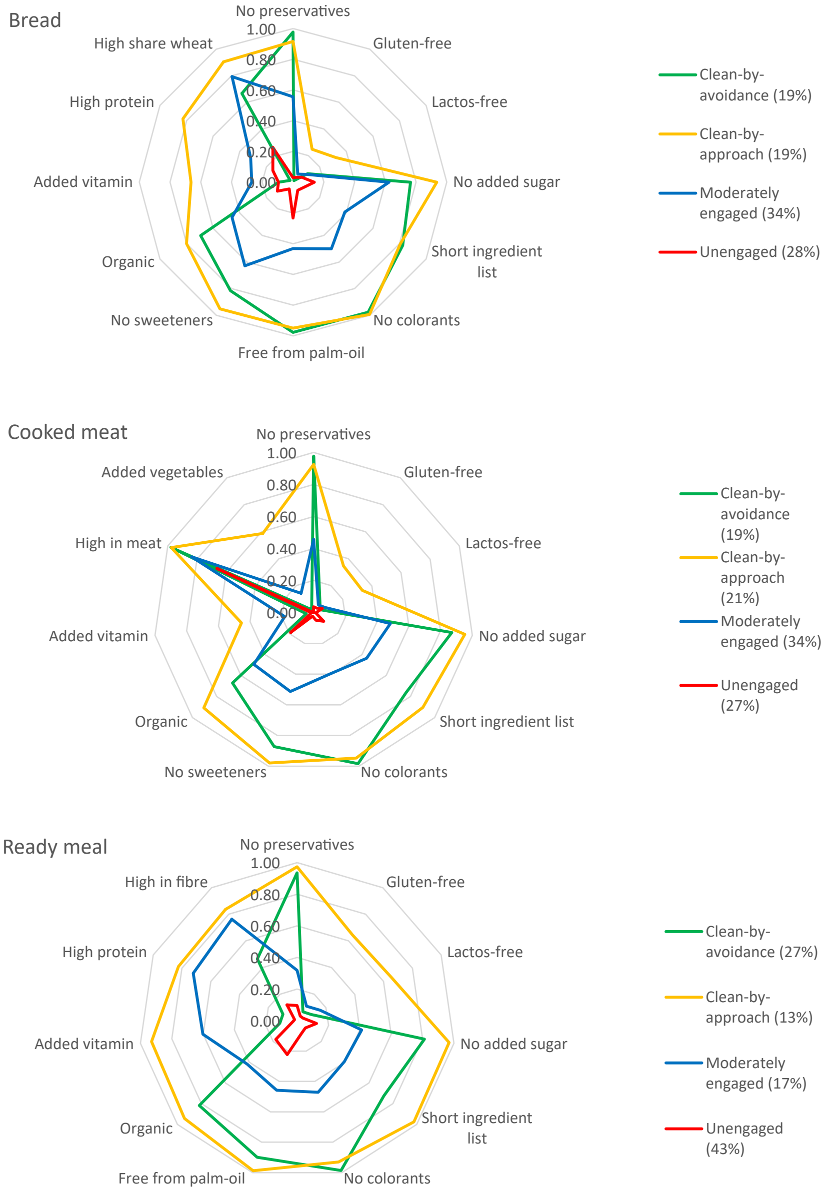


Figure 1.
Importance of food characteristics by latent classes for each type of food

Note(s): Proportion of individuals in each latent class is presented to the right for each product type. The score (0 to 1) represents the proportionof individuals for which each characteristic had a positive (4) to very positive (5) impact on their product choice

Is clean eating product-specific?

To explore whether the membership in a clean-eating class is consistent across products, respondents were assigned to the class with the highest membership probability in each of the product-specific models. Table 2 shows the correspondence of class membership for pairs of the products. Overall, there was movement between classes across products, which implied that many individuals were not in the same class for all products. However, some central patterns emerged. Importantly, individuals who were assigned to one of the clean-eating classes in one product model were often assigned to a clean-eating class in the other product models. For example, among individuals who were assigned to the *clean-by-approach* class in the bread model, 81% (6 + 75) were in a clean-eating class in the cooked meat model (Table 2a) and 87% (30 + 57) in the ready meal model (Table 2b). Furthermore, 80% (7 + 73) of the individuals in the *clean-by-approach* class in the ready meal model were in a clean-eating class in the cooked meat model (Table 2c). Similar patterns emerged for the *clean-by-avoidance* class membership in the bread model: 59% of the individuals were in a clean-eating class in the cooked meat model and 90% were in a clean-eating class in the ready meal model. Interestingly, while there was relatively high consistency in clean-eating class membership across products, the specific type of clean-eating class membership varies. For example, among the individuals in the *clean-by-approach* in the bread model, a large share (30%) was in the *clean-by-avoidance* in the ready meal model.

For the classes less engaged in clean eating, there was relatively high correspondence in class membership between the products: individuals who were in the unengaged class in one product model were typically also assigned to the moderately engaged or unengaged class in the other product models.

		Cooked meat				
	Panel A	Clean-by-avoidance	Clean-by-approach	Moderately engaged	Unengaged	Total
Bread	Clean-by-avoidance	10%	49%	2%	39%	100%
	Clean-by-approach	6%	75%	0%	19%	100%
	Moderately engaged	19%	15%	22%	45%	100%
	Unengaged	3%	3%	84%	11%	100%

		Ready meal				
	Panel B	Clean-by-avoidance	Clean-by-approach	Moderately engaged	Unengaged	Total
Bread	Clean-by-avoidance	86%	4%	0%	10%	100%
	Clean-by-approach	30%	57%	11%	2%	100%
	Moderately engaged	22%	3%	30%	45%	100%
	Unengaged	2%	0%	16%	82%	100%

		Cooked meat				
	Panel C	Clean-by-avoidance	Clean-by-approach	Moderately engaged	Unengaged	Total
Ready meal	Clean-by-avoidance	5%	48%	3%	45%	100%
	Clean-by-approach	7%	73%	0%	20%	100%
	Moderately engaged	16%	18%	32%	34%	100%
	Unengaged	8%	3%	70%	19%	100%

Note(s): An example to assist the interpretation. Among individuals who were assigned to the *clean-by-avoidance* class in the Bread model (top row in Panel A), 10% were in a *clean-by-avoidance* in the cooked meat model, while 49% were in the *clean-by-approach*, 2% in the moderately engaged class, and 39% in the unengaged class

Table 2. Correspondence in class membership between product types

Some noteworthy deviations from these patterns are present. Overall, cooked meat stands out by displaying that many individuals are in different classes than for the other products. Specifically, many individuals who were in the clean-by-avoidance class when selecting bread were unengaged when selecting cooked meat (39%, Table 2a), and 45% of individuals who were clean-by-avoidance in the ready meal model were unengaged in the cooked meat model (Table 2c). More detailed results for the class constituency across products are available in Table S5 in Supplementary Materials.

Motivations for clean eating

Figure 2 shows the average importance scores for the motives for each class and product. In line with prior expectations, food choice motives related to naturalness and health were important among the clean-eating classes. Both clean-eating classes found health (general healthiness and weight control), naturalness and environmental friendliness to be more important food choice motives compared to the less engaged classes.

A noteworthy difference between the *clean-by-approach* and *clean-by-avoidance* classes is the importance of weight control, where the approach-oriented individuals found this more important (differences are statistically significant in the bread and ready meal models). Hence, both clean-eating classes strived for healthy, natural and environmental friendly food, but the *clean-by-approach* class was more focused on the personal health in the form of controlling their weight. This was echoed in the impact from individual food product characteristic; individuals in the *clean-by-approach* class valued personal health-promoting characteristics such as added vitamins and protein. Health was also important for the *moderately engaged* class, as reflected in the higher importance on fiber, protein and vitamins compared to the clean-by-avoidance class (Figure 1).

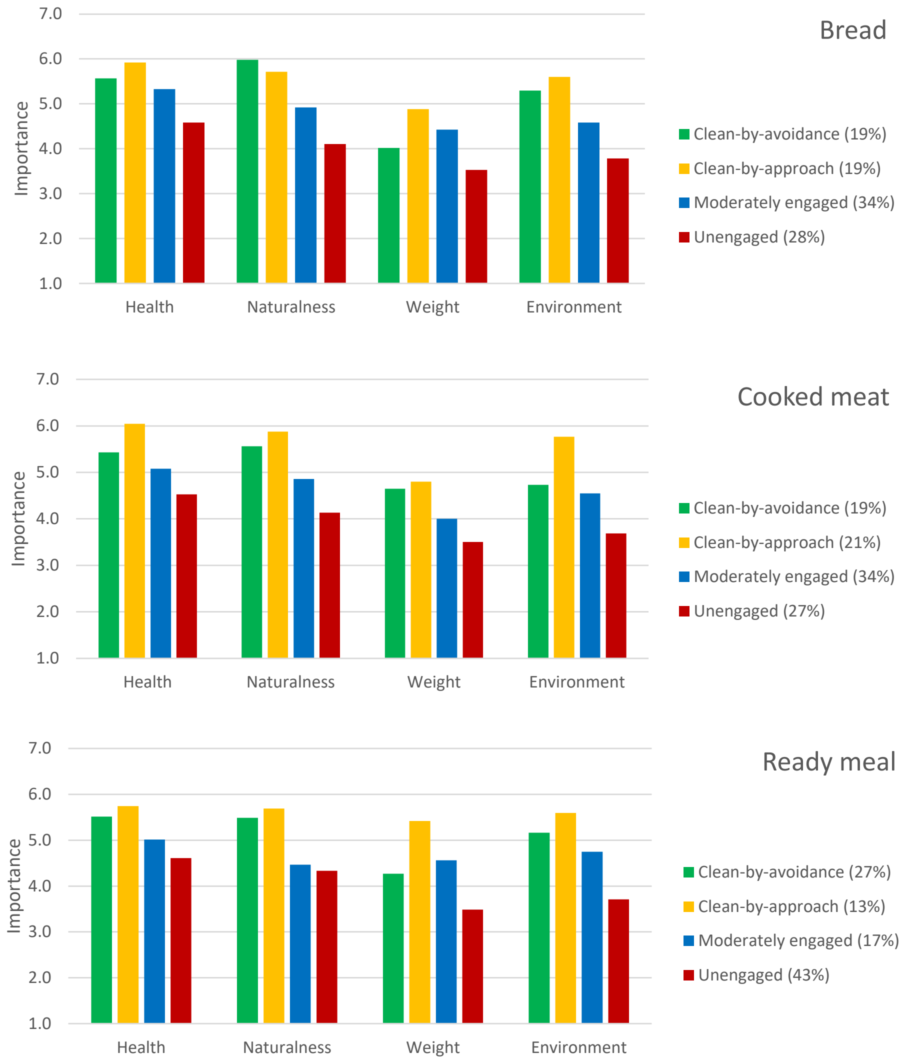
Discussion

Clean-eating is relatively stable across products-but there are two subgroups that apply different clean-eating criteria

A key contribution of this study is insights on how individuals apply clean eating across food product types. Three different product categories were included in this study, with varying degree of processing. We identified two subgroups of individuals that apply clean-eating criteria in their food choices. Together, the clean-eating classes constituted about 40% of the respondents in each product. In line with previous studies, avoidance of additives, pesticides, colorants and preservatives were important (Hartmann *et al.*, 2018; Aschemann-Wtizel *et al.*, 2019; Maruyama *et al.*, 2021; Noguerol *et al.*, 2021). Individuals in both subgroups found it important to avoid undesirable characteristics such as additives, preservatives, colorants and chemical pesticides (organic). However, contrary to the first subgroup, which achieved clean eating by avoidance, the second subgroup sought presence of added protein, fiber, vitamins, etc. This type of approach orientation rather fits with a related trend in the form of health promoting, or functional, food products, such as nutrition-enhanced products (Bimbo *et al.*, 2017). Interestingly, although many consumers are consistent in that they apply clean-eating criteria across different product types, it is not uncommon for consumers to apply different clean-eating criteria for different types of products. For the selected product types included in this study, cooked meat (such as sausages) is different in terms of their clean-eating criteria. Further studies that include a wider range of products are needed in order to shed light on the reason for such differences.

Motivations for clean eating

The results of this study suggest that individual who are prone to search for clean-eating attributes are motivated to make food choices that are healthy, natural and



Note(s): Paired comparisons testing for statistically significant differences between the latent classes are available in Table S6 in Supplementary Materials. The *Y*-axis indicates agreement with the statement "It is important to me that the food I eat on a typical day" for each of the motives on the *x*-axis on a seven-point scale ranging from "not at all important" to "very important"

Figure 2.
Food choice motives by product and by latent classes

environmentally friendly. While clean eating is centered around motives related to health and naturalness, we found that this applies to health in a broad sense, and only a segment of individuals are clean eaters in a strict sense, while another segment are more focused on personal healthiness. Thus, although both clean-eating groups strive for healthy, natural and environmentally friendly food, our results suggest that the *clean-by-approach* class have a strong focus on the personal health in the form of weight control. These findings imply that for a segment of consumers, applying clean-eating criteria as an avoidance strategy in their food choices does not contradict preferences for nutrition enhancements. Driven by a growing interest in clean eating among consumers, food manufacturers are adapting and reformulating their products towards ingredient lists that are more in line with the concept of clean eating (Noguerol *et al.*, 2021). The findings in this study suggest that this appeals to a segment of consumers who are highly concerned with healthiness and naturalness, but a share of these consumers simultaneously value efforts to enrich products with healthy characteristics.

Limitations and future research

There are several opportunities for future research. First, a wider range of product types could be included, to systematically investigate differences between food categories. For example, future research may explore if clean-eating criteria are more or less important for products that are perceived as healthy (for example, müsli) than for products that are perceived as less healthy (e.g. chocolate). Second, while this study explores the importance of clean eating-related attributes among a sample of Swedish consumers, future studies could include respondents from other countries, to shed light on potential variations across cultures in the clean-eating criteria and motivations.

Furthermore, an interesting extension to this study would be to relate the clean-eating motives to consumers' perceptions about specific food product attributes and to examine how this is related to knowledge levels on nutrition and environmental impact. For example, how do consumers interpret the different "free-from" attributes, and does this interpretation vary with the nutritional literacy?

Implications for regulators

Clean eating is a food-choice approach based on the sought presence or absence of certain food characteristics (Ambwani *et al.*, 2020). However, the clean-eating concept remains undefined, although it is typically described by absence of certain ingredients and additives, "pure" and "real" food, and naturalness (Asioli *et al.*, 2017; Grant *et al.*, 2019; Ambwani *et al.*, 2020). Importantly, while there is interest and demand among for clean eating among consumers, there is no scientific support for higher healthiness in such products, and the clean-eating concept may disserve consumers seeking a healthy diet (Chen *et al.*, 2022). Targeting the discrepancy between the qualities that the consumers may seek (e.g. healthiness) and the qualities that clean labeling implies can be targeted by different measures. ,

Clean labels are not well-defined or regulated, although many of the aspects of clean eating are covered by existing regulations on claims, particularly in the EU (Merten-Lentz, 2019; Mahy and Serve, 2020; Ghaderi, 2022; Negowetti *et al.*, 2022). Importantly, regulating the use of clean labeling is associated with challenges (Negowetti *et al.*, 2022), and it is not likely that misleading information on packages and websites can be eliminated (Ghaderi, 2022). Another venue for supporting consumers to identify products that are healthier is to increase nutrition literacy (Chen *et al.*, 2022; Ghaderi, 2022). This study suggests that in the context of clean eating, there are large segments of consumers that do not value clean eating aspects, particularly the *Moderately engaged* and *Unengaged* latent classes. We find that the food characteristics that typically describe clean eating are mainly valued by consumer segments that find healthiness, naturalness and environmental friendliness important, and to a lesser degree weight loss, and this result applies across product categories.

These findings could support the design and dissemination of educational efforts that aim to balance the present clean-eating claims and marketing with scientifically supported nutritional information.

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Appendix

When the LCC analysis is exploratory, as is the case in this study, the first step is to identify the model with the most appropriate number of classes. This should be guided by considering multiple measures of model fit and model diagnosis together with interpretability. Model fit can be evaluated by absolute model fit, where the likelihood ratio chi-square (L^2) goodness of fit test, where the null hypothesis states that the model adequately fits the data. A significant *p*-value indicates a lack of adequate fit. As for relative model fit, the likelihood ratio test (LRT) tests whether the addition of one latent class improves model fit significantly. The null hypothesis is that there is no difference in model fit between the model compared to the model with one less class. Hence, an insignificant *p*-value suggests that the addition of a class does not significantly improve model fit. Moreover, information criteria measures can be compared between models, including BIC and AIC3, where the model with the lowest value has the best relative model fit. Finally, in classification diagnostics, the model precision of assigning individuals to the different latent classes can be evaluated. The classification error (CE) is based on estimated posterior class probabilities, and it measures the proportion of individuals that are estimated to be misclassified, wherefore values closer to zero is better (Vermunt and Magidson, 2005). Classification measures are not used for model selection, but rather indicate whether there are concerns with over-extraction of latent classes (Masyn, 2013).

For the Bread model, we found the four-class model to be the most suitable. The relative LRT test suggests that the eight-class model is the most suitable model, but this model includes classes that are similar and very small, and in such cases it is recommended to include fewer classes for the cause of interpretation. Overall, the information criteria suggest that the four-class model provides the best model fit. The BIC is lowest for four classes. The AIC3 and SABIC are lowest for six classes, but the improvement in the information criteria for these measures is relatively small from four classes.

For the Cooked Meat model, we also found that the model with four classes is most suitable. The BIC is smallest for the three-class model, for AIC3 and SABIC it is five classes, but the rate of improvement is relatively small from four classes. The chi-square test suggests that the seven-class model provides adequate model fit, while the LRT test suggests that the model with six classes has the best model fit. However, similar to the case of bread, this model provides several small classes that are similar.

Finally, for the ready meal-model, we found that the four-class model is most suitable. All three information criteria (BIC, AIC3, SABIC) are lowest for the four-class model. The chi-square test suggests that the six-class model has a good absolute model fit (p-value>0.05), while the LRT test suggests the seven-class model.

Information regarding the absolute fit and relative fit statistics and classification diagnosis are presented in the Supplementary Material (Table S2). A central assumption in LCC analysis is local independence, which implies that, conditional on the latent variable, the observed indicators should be independent. The local independence assumption is assessed by examining the bivariate residuals among all pairs of indicator. BVR values above 30 are considered severe violations (Asparouhov and Muthén, 2015). For the selected models, there are no severe violations.

We proceed by estimating LCC models where the covariates are included. This procedure, of first finding the model with the most appropriate number of classes prior to including covariates, is recommended (Masyn, 2013) since it provides more stable results and is less sensitive to possible misspecifications from the covariates. The full model results, with parameters and *z*-values, are presented in Table S3in Supplementary Material. When interpreting results of the LCC-models, it is intuitive to interpret the within-cluster distribution of indicators and covariates. These results are illustrated in Figure 1, while detailed results are available in Table S4 in Supplementary Material.

When exploring the extent to which individuals belong to the same type of class for each of the products, we assign each individual to the class with the highest probability, based on their responses to the questions. The correspondence of predicted membership between classes is presented in Table S5.

Finally, we explored the importance of food choice motives for the different classes, in each of the product models. Summary results are presented in Figure 2, while statistical tests for differences across classes, in the form of paired comparisons for the covariates, are presented in Table S6.

For robustness, we estimated models in which all indicators for all three product types are included in the same model. These models include only the individuals that responded to all three products, providing a smaller sample than the separate models. This model specification, where all product indicators are included in the same model further implies a large number of parameters relative to the separate models for each product types, and consequently less statistically significant parameters. Moreover, the large number of parameters implies that it is only possible to estimate models with six classes or fewer. Results are available in Table S7 (class enumeration) and Table S8 (parameter estimates for the selected model). Overall, the results are in line with the findings from the separate models: two separate clean eating classes are identified, where one has an avoidance focus and one has an approach focus.

Supplementary Material

Table S1.
Categorization of food characteristics

	Bread	Cooked meat	Ready-meal
Free-from characteristics			
Lactose-free	✓	✓	✓
Gluten-free	✓	✓	✓
Free from palm oil	✓	✓	✓
Free from preservatives	✓	✓	✓
Free from colorants	✓	✓	✓
No added sugar	✓	✓	✓
Free from artificial sweeteners	✓	✓	✓
Short ingredient list	✓	✓	✓
Organic	✓	✓	✓
Added aspect			
Extra protein	✓	✓	✓
Added vegetables		✓	
Extra fiber/wheat	✓		✓
Added vitamins	✓	✓	✓

Note(s): In addition to the listed attributes, we asked respondents about labels and certificates. Domestically and locally produced (all products), and free-range eggs (ready meal)

# Classes	LL	BIC	AIC3	SABIC	K	L^2	*p*-val	CE	LRT
Bread									
1	−4,582	9,242	9,201	9,204	12	2,739	0.000	0.00	
2	−3,946	8,053	7,967	7,974	25	1,467	0.000	0.04	0.000
3	−3,860	7,964	7,833	7,843	38	1,294	0.000	0.11	0.000
4	−3,807	7,942	7,766	7,780	51	1,188	0.000	0.11	0.000
5	−3,770	7,951	7,731	7,748	64	1,114	0.000	0.13	0.000
6	−3,747	7,991	7,726	7,746	77	1,069	0.018	0.15	0.000
7	−3,729	8,038	7,728	7,752	90	1,033	0.008	0.14	0.018
8	−3,712	8,087	7,733	7,760	103	998	0.020	0.15	0.014
9	−3,698	8,143	7,744	7,775	116	970	0.006	0.16	0.120
10	−3,685	8,200	7,757	7,791	129	944	0.008	0.14	0.080
11	−3,667	8,248	7,759	7,797	142	908	0.028	0.16	0.004
12	−3,654	8,306	7,773	7,814	155	882	0.010	0.15	0.148
Cooked meat									
1	−3,082	6,233	6,197	6,198	11	1742	0.000	0.00	
2	−2,584	5,310	5,237	5,237	23	746	0.000	0.04	0.000
3	−2,528	5,274	5,162	5,163	35	635	0.000	0.11	0.000
4	−2,493	5,278	5,127	5,129	47	564	0.004	0.13	0.000
5	−2,469	5,305	5,116	5,118	59	517	0.020	0.11	0.020
6	−2,453	5,348	5,120	5,122	71	485	0.048	0.11	0.006
7	−2,440	5,396	5,130	5,133	83	459	0.108	0.11	0.108
8	−2,431	5,452	5,147	5,150	95	440	0.038	0.15	0.152
9	−2,417	5,499	5,156	5,160	107	413	0.084	0.18	0.074
10	−2,412	5,562	5,180	5,184	119	401	0.042	0.16	0.576
11	−2,403	5,619	5,199	5,203	131	384	0.084	0.15	0.224
12	−2,393	5,674	5,215	5,220	143	364	0.080	0.14	0.066
Ready-meal									
1	−2052	4,168	4,138	4,133	11	1,553	0.000	0.00	
2	−1,667	3,466	3,403	3,393	23	782	0.000	0.03	0.000
3	−1,601	3,402	3,307	3,291	35	650	0.000	0.05	0.000
4	−1,535	3,339	3,212	3,190	47	519	0.036	0.07	0.000
5	−1,521	3,378	3,218	3,191	59	489	0.022	0.07	0.040
6	−1,505	3,416	3,223	3,190	71	458	0.110	0.10	0.016
7	−1,491	3,456	3,231	3,193	83	430	0.030	0.08	0.036
8	−1,482	3,507	3,249	3,205	95	412	0.040	0.09	0.264
9	−1,473	3,557	3,267	3,217	107	393	0.056	0.10	0.206
10	−1,463	3,606	3,284	3,229	119	375	0.012	0.07	0.136
11	−1,455	3,657	3,302	3,242	131	357	0.056	0.08	0.096
12	−1,448	3,712	3,324	3,258	143	343	0.028	0.08	0.368

Note(s): LL = Log Likelihood, BIC=Bayesian information criterion, AIC3 = Akaike information criterion with 3 as penalty factor, SABIC = sample size adjusted BIC, L^2 = likelihood ratio chi-square, CE = classification error, LRT = *p*-value from bootstrapped Likelihood ratio test

Table S2.
Class enumeration

Table S3a.
Within class average (Bread)

	Moderately engaged	Unengaged	Clean-by-avoidance	Clean-by-approach
Class size	34%	28%	19%	19%
Indicators				
No preservatives	0.56	0.03	0.98	0.92
Added vitamin	0.27	0.09	0.09	0.66
Gluten-free	0.06	0.04	0.01	0.25
Lactose-free	0.10	0.07	0.11	0.32
Organic	0.46	0.12	0.69	0.80
High protein	0.32	0.15	0.02	0.83
No added sugar	0.62	0.14	0.76	0.93
Short ingredient list	0.39	0.07	0.82	0.81
No colorants	0.50	0.06	0.98	0.99
High share wheat	0.79	0.26	0.67	0.90
Free from palm oil	0.43	0.23	0.98	0.95
No sweeteners	0.63	0.05	0.82	0.95
Covariates				
Food motives				
Health	5.33	4.58	5.57	5.92
Naturalness	4.92	4.11	5.98	5.72
Weight	4.42	3.53	4.02	4.88
Environment	4.58	3.78	5.30	5.60

Note(s): $N = 626$

Table S3b.
Within class average (Cooked meat)

	Moderately engaged	Unengaged	Clean-by- approach	Clean-by-avoidance
Cluster Size	34%	27%	21%	19%
Indicators				
No preservatives	0.46	0.04	0.93	0.98
Added vitamin	0.18	0.01	0.45	0.05
Gluten-free	0.06	0.03	0.35	0.07
Lactose-free	0.08	0.06	0.33	0.04
Organic	0.49	0.19	0.91	0.67
No added sugar	0.48	0.01	0.95	0.87
Short ingredient list	0.44	0.08	0.90	0.76
No colorants	0.40	0.05	0.95	0.98
No sweeteners	0.51	0.02	0.98	0.87
High in meat	0.84	0.66	0.98	0.98
Added vegetables	0.14	0.00	0.59	0.02
Covariates				
Food motives				
Health	5.08	4.53	6.04	5.43
Naturalness	4.86	4.13	5.88	5.56
Weight	4.00	3.50	4.80	4.65
Environment	4.55	3.69	5.77	4.73

Note(s): $N = 497$

	Uninvolved	Clean-by-avoidance	Moderately engaged	Clean-by-approach
Cluster Size	43%	27%	17%	13%
Indicators				
No preservatives	0.10	0.93	0.32	0.97
Added vitamin	0.02	0.11	0.60	0.93
Gluten-free	0.04	0.07	0.11	0.65
Lactose-free	0.04	0.10	0.16	0.66
Organic	0.18	0.82	0.42	0.94
High protein	0.02	0.10	0.72	0.82
No added sugar	0.12	0.81	0.41	0.97
Short ingredient list	0.07	0.73	0.39	0.98
No colorants	0.09	0.99	0.47	0.93
High in fiber	0.12	0.46	0.76	0.84
Free from palm oil	0.22	0.90	0.46	0.99
Covariates				
Food motives				
Health	4.61	5.51	5.01	5.74
Naturalness	4.34	5.49	4.46	5.69
Weight	3.49	4.27	4.56	5.42
Environment	3.71	5.16	4.75	5.59

Note(s): $N = 302$

Table S3c.
Within class average (Ready meal)

	Moderately engaged		Unengaged		Clean-by-avoidance		Clean-by-approach			
	Coef	*z*-val	Coef	*z*-val	Coef	*z*-val	Coef	*z*-val	*p*-val	R^2
Indicators										
No preservatives	−0.48	−1.55	−4.23	−8.47	3.04	4.67	1.67	4.25	<0.001	0.55
Added vitamin	0.21	0.95	−1.05	−3.94	−1.05	−3.03	1.89	8.07	<0.001	0.23
Gluten-free	0.16	0.33	−0.36	−0.71	−1.58	−1.39	1.78	4.07	<0.001	0.09
Lactose-free	−0.26	−1.05	−0.74	−2.67	−0.17	−0.62	1.17	5.46	<0.001	0.07
Organic	−0.17	−0.95	−2.02	−8.92	0.81	3.88	1.38	5.98	<0.001	0.26
High protein	0.41	0.74	−0.55	−1.01	−2.59	−1.71	2.73	4.69	<0.001	0.34
No added sugar	−0.12	−0.58	−2.46	−10.02	0.55	2.20	2.03	5.71	<0.001	0.35
Short ingredient list	−0.45	−2.32	−2.52	−9.14	1.54	5.32	1.43	5.51	<0.001	0.37
No colorants	−1.57	−2.04	−4.32	−5.36	2.21	1.98	3.68	1.76	<0.001	0.57
High share wheat	0.53	2.44	−1.85	−9.78	−0.12	−0.56	1.44	4.96	<0.001	0.27
Free from palm oil	−1.60	−4.07	−2.51	−6.51	2.48	2.58	1.62	2.58	<0.001	0.40
No sweeteners	0.00	0.02	−3.45	−8.93	0.96	3.16	2.48	5.37	<0.001	0.47
Covariates										
Intercept	1.48	2.88	5.27	10.04	−2.89	−3.74	−3.85	−5.64	<0.001	
Food motives										
Health	0.12	1.21	−0.11	−1.20	−0.25	−2.26	0.24	2.12	0.030	
Naturalness	−0.29	−3.24	−0.51	−5.45	0.78	5.82	0.02	0.14	<0.001	
Weight	0.12	2.10	−0.17	−2.76	−0.12	−1.97	0.18	2.82	<0.001	
Environment	−0.11	−1.69	−0.28	−4.02	0.08	0.99	0.30	3.32	<0.001	

Table S4a.
Parameters LCC model (Bread)

Table S4b.
Parameters LCC model (Cooked meat)

	Unengaged		Clean-by-avoidance		Clean-by-approach		Moderately engaged			
	Coef	*z*-val	Coef	*z*-val	Coef	*z*-val	Coef	*z*-val	*p*-val	R^2
Indicators										
No preservatives	−0.87	−1.68	−3.96	−5.66	1.81	2.92	3.03	2.38	<0.001	0.55
Added vitamin	0.75	1.38	−2.05	−2.12	2.07	4.58	−0.77	−0.70	<0.001	0.19
Gluten-free	−0.49	−1.06	−1.01	−1.89	1.70	5.41	−0.21	−0.40	<0.001	0.14
Lactose-free	−0.23	−0.47	−0.48	−0.93	1.56	3.60	−0.85	−0.74	<0.001	0.12
Organic	−0.40	−1.65	−1.83	−6.50	1.90	3.78	0.33	1.14	<0.001	0.26
No added sugar	−0.20	−0.45	−4.44	−5.00	2.87	4.46	1.77	3.18	<0.001	0.52
Short ingredient list	−0.44	−1.78	−2.58	−7.12	2.04	4.39	0.98	2.95	<0.001	0.38
No colorants	−1.31	−2.17	−3.83	−5.74	1.98	2.67	3.17	1.97	<0.001	0.57
No sweeteners	−0.46	−0.94	−4.22	−6.07	3.27	2.81	1.41	2.36	<0.001	0.53
High in meat	−0.84	−1.82	−1.80	−4.60	1.25	1.41	1.39	1.32	<0.001	0.12
Added vegetables	1.42	1.01	−4.39	−1.19	3.56	2.68	−0.59	−0.27	<0.001	0.33
Covariates										
Intercept	2.08	3.74	5.00	8.29	−5.58	−6.13	−1.49	−1.98	<0.001	
Food motives										
Health	−0.05	−0.52	−0.16	−1.52	0.37	2.45	−0.15	−1.02	0.097	
Naturalness	−0.16	−1.65	−0.40	−3.97	0.12	0.85	0.44	2.90	<0.001	
Weight	−0.07	−1.05	−0.19	−2.76	0.06	0.64	0.21	1.81	0.022	
Environment	−0.02	−0.22	−0.29	−3.36	0.50	3.40	−0.19	−1.20	<0.001	

Table S4c.
Parameters LCC model (Ready meal)

	Uninvolved		Clean-by-avoidance		Moderately engaged		Clean-by-approach			
	Coef	*z*-val	Coef	*z*-val	Coef	*z*-val	Coef	*z*-val	*p*-val	R^2
Indicators										
No preservatives	−3.05	−5.17	1.85	2.53	−1.57	−2.66	2.76	1.71	<0.001	0.62
Added vitamin	−3.00	−5.34	−1.38	−3.09	1.11	2.64	3.27	4.40	<0.001	0.56
Gluten-free	−1.45	−3.27	−0.78	−1.82	−0.24	−0.53	2.46	6.56	<0.001	0.34
Lactose-free	−1.57	−3.77	−0.63	−1.62	−0.06	−0.13	2.25	6.34	<0.001	0.30
Organic	−2.13	−7.09	0.89	2.64	−0.94	−2.72	2.18	3.45	<0.001	0.39
High protein	−3.10	−4.97	−1.28	−2.92	1.89	4.15	2.48	4.86	<0.001	0.57
No added sugar	−2.62	−7.32	0.81	2.30	−1.02	−2.67	2.83	3.83	<0.001	0.47
Short ingredient list	−3.01	−4.93	0.57	0.95	−0.83	−1.35	3.27	2.01	<0.001	0.49
No colorants	−3.45	−5.79	3.17	2.03	−1.22	−2.00	1.50	1.96	<0.001	0.65
High in fiber	−2.17	−7.30	−0.31	−1.18	1.00	2.78	1.47	3.64	<0.001	0.34
No palm oil	−2.54	−4.38	0.88	1.37	−1.47	−2.34	3.12	1.88	<0.001	0.43
Covariates										
Intercept	4.69	7.25	−1.32	−1.97	0.78	1.02	−4.15	−3.90	<0.001	
Food motives										
Health	−0.05	−0.36	0.12	0.87	−0.06	−0.32	−0.02	−0.10	0.820	
Naturalness	−0.05	−0.42	0.31	2.34	−0.45	−3.06	0.18	1.02	0.008	
Weight	−0.37	−4.14	−0.18	−1.95	0.15	1.23	0.40	2.74	<0.001	
Environment	−0.44	−4.54	0.05	0.48	0.19	1.43	0.20	1.35	<0.001	

Bread	Cooked meat: Clean-by-avoidance	Clean-by-approach	Moderately engaged	Unengaged
Clean-by-avoidance	2.2%	11.1%	0.4%	8.9%
Clean-by-approach	0.9%	10.4%	0.0%	2.6%
Moderately engaged	5.9%	4.6%	6.7%	13.9%
Unengaged	0.9%	0.9%	27.2%	3.5%

Note(s): $N = 460$

Bread	Ready meal: Clean-by-avoidance	Clean-by-approach	Moderately engaged	Unengaged
Clean-by-avoidance	15.1%	0.7%	0.0%	1.7%
Clean-by-approach	5.5%	10.7%	2.1%	0.3%
Moderately engaged	6.5%	1.0%	8.9%	13.4%
Unengaged	0.7%	0.0%	5.5%	27.8%

Note(s): $N = 291$

Ready meal	Cooked meat: Clean-by-avoidance	Clean-by-approach	Moderately involved	Unengaged
Clean-by-avoidance	1.2%	12.8%	0.8%	11.9%
Clean-by-approach	0.8%	9.1%	0.0%	2.5%
Moderately engaged	2.5%	2.9%	4.9%	5.3%
Unengaged	3.7%	1.2%	31.7%	8.6%

Note(s): $N = 243$

Table S5. Correspondence of predicted membership between classes extracted from the food products. Sum of all percentages equals 100

	Moderately engaged (ME)	Unengaged (UE)	Clean-by-avoidance (C-av)	Clean-by-approach (C-ap)
Health	C-Av	C-Ap	ME, C-Ap	UE, C-Av
Naturalness	C-Av	C-Av, C-Ap	C-Ap	UE, C-Av
Weight	UE, C-Av	ME, C-Ap	ME, C-Ap	UE, C-Av
Environment	C-Ap	C-Av, C-Ap	UE	UE

Table S6a. Paired comparisons for covariates (Bread)

	Moderately engaged (ME)	Unengaged (UE)	Clean-by-approach (C-ap)	Clean-by-avoidance (C-av)
Health	C-Ap	C-Ap	ME, UE, C-Av	C-Ap
Naturalness	C-Av	C-Ap, C-Av	UE	UE
Weight		C-Av		UE
Environment	UE, C-Ap	ME, C-Ap	ME, UE, C-Av	C-Ap

Table S6b. Paired comparisons for covariates (Cooked meat)

Table S6c.
Paired comparisons for covariates (Ready meals)

	Uninvolved (UE)	Clean-by-avoidance (C-av)	Moderately engaged (ME)	Clean-by-approach (C-ap)
Health				
Naturalness	C-Av, ME	UE, ME	UE, C-Av, C-Ap	ME
Weight	ME, C-Ap	C-Ap	UE	UE, C-Av
Environment	C-Av, ME, C-Ap	UE	UE	UE

Table S7.
Class enumeration for models with all products included (bread, cooked meat, ready meal)

# Classes	LL	BIC	AIC3	SABIC	K	L^2	*p*-val	CE	Df	LRT
1	−4,840	9,865	9,781	9,757	34	7,207	0.024	0.00	201	
2	−3,907	8,190	8,021	7,972	69	5,341	0.092	0.01	166	<0.001
3	−3,693	7,954	7,698	7,624	104	4,914	0.212	0.03	131	<0.001
4	−3,549	7,856	7,514	7,416	139	4,625	0.148	0.02	96	<0.001
5	−3,463	7,876	7,448	7,324	174	4,454	0.100	0.02	61	<0.001
6	−3,387	7,915	7,401	7,253	209	4,302	0.080	0.02	26	<0.001

Note(s): LL = Log Likelihood, BIC=Bayesian information criterion, AIC3 = Akaike information criterion with 3 as penalty factor, SABIC = sample size adjusted BIC, L^2 = likelihood ratio chi-square, CE = classification error, LRT = *p*-value from bootstrapped likelihood ratio test

Table S8.
Within class average (All products)

	Moderately engaged	Uninvolved	Clean-by-avoidance	Clean-by-approach
Cluster Size	34%	27%	20%	19%
Bread				
No preservatives	0.39	0.05	0.98	0.89
Added vitamin	0.26	0.04	0.09	0.76
Gluten-free	0.09	0.03	0.00	0.37
Lactose-free	0.11	0.07	0.08	0.49
Organic	0.35	0.11	0.59	0.84
High protein	0.31	0.08	0.20	0.78
No added sugar	0.50	0.15	0.78	0.96
Short ingredient list	0.31	0.04	0.78	0.76
No colorants	0.45	0.06	0.91	0.98
High in fiber	0.70	0.22	0.66	0.86
Free from palm oil	0.38	0.20	0.81	0.98
No sweetener	0.57	0.05	0.79	0.95
Cooked meat				
No preservatives	0.40	0.10	0.85	0.95
Added vitamin	0.20	0.00	0.00	0.61
Gluten-free	0.09	0.05	0.02	0.44
Lactose-free	0.08	0.09	0.02	0.46
Organic	0.45	0.20	0.78	0.87

(*continued*)

	Moderately engaged	Uninvolved	Clean-by-avoidance	Clean-by-approach
No added sugar	0.45	0.05	0.81	0.91
Short ingredient list	0.39	0.03	0.77	0.87
No colorants	0.39	0.08	0.86	0.93
High in meat	0.82	0.74	0.96	0.98
Added vegetables	0.15	0.00	0.09	0.54
No sweetener	0.50	0.02	0.83	1.00
Ready meal				
No preservatives	0.29	0.06	0.91	0.95
Added vitamin	0.26	0.03	0.06	0.74
Gluten-free	0.06	0.05	0.04	0.50
Lactose-free	0.11	0.07	0.02	0.50
Organic	0.33	0.18	0.73	0.91
High protein	0.32	0.03	0.14	0.63
No added sugar	0.34	0.02	0.85	0.98
Short ingredient list	0.28	0.00	0.72	0.83
No colorants	0.36	0.05	0.95	0.93
High in fiber	0.49	0.03	0.39	0.89
Free from palm-oil	0.39	0.19	0.88	0.98
Covariates				
Food motives				
Health	4.61	5.51	5.01	5.74
Naturalness	4.34	5.49	4.46	5.69
Weight	3.49	4.27	4.56	5.42
Environment	3.71	5.16	4.75	5.59

Note(s): $N = 235$

Table S8.

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