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Will consumers substitute meat with legumes? - A clustered binational perspective

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Will consumers substitute meat with legumes? - A clustered binational perspective

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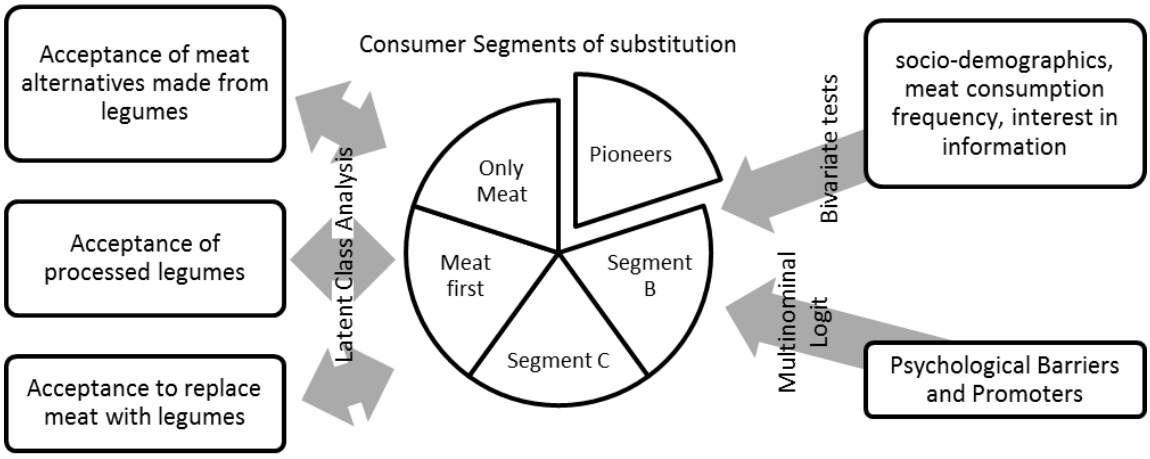
Highlights:

- *A two country analysis with analogue findings of the consumer segments: "Only meat", "Meat first" and "Pioneers"*
- *A combined analysis of the acceptance to replace meat with legumes, the acceptance of processed legumes and of meat alternatives*
- *Several consumers are open to meat alternatives, some only as an addition to meat, others prefer lowly processed legumes for substitution*
- *Helping relationship and self-efficacy are key concepts for belonging to segments open to substitution*

Graphical Abstract



Abstract

The substitution of meat with legumes is one way of making food consumption more sustainable. The substitution would ease the debate on food security and is aligned with the recommendations of climate change experts. The stagnation or decline of meat consumption in many developed countries and the emerging market for meat alternatives, point at shifting preferences from animal to plant based protein, such as legumes. While consumers' attitudes towards meat consumption are reasonably well researched, little is known about consumers' willingness to change their dietary habits from meat to plant based protein. This article explores consumers' acceptance of replacing meat with legumes, acceptance of meat alternatives made from legumes and acceptance of processed legumes in general. Consumer samples were drawn from Germany (GER: N=633) and New Zealand (NZ: N=445). The samples reflect the underlying age, gender and income distribution. Separate Latent Class Analyses revealed five consumer segments in each of the samples. In both countries, a large

segment has no intention to substitute, while one segment frequently substitutes. A third segment of both countries has no intention to substitute, but considers processed legume products, if not marketed as an alternative to meat. Other segments capture country specific preferences for meat alternatives, as well as a segment that rather substitutes meat directly with certain legumes than having processed meat alternatives. Self-efficacy, i.e. the perceived ability to reduce meat, is a key barrier that hinders substitution. We discuss segment specific findings and how to develop on consumer's acceptance of substitution.

Acknowledgements

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Introduction

Environmental research and life cycle assessments have highlighted the carbon footprint potential of increasing legumes' share in diets, while reducing the share of meat (Harwatt, Sabaté, Eshel, Soret, & Ripple, 2017; Hedenus, Wirsenius, & Johansson, 2014; Nijdam, Rood, & Westhoek, 2012; Stehfest et al., 2009). Two major arguments are put forward that give reason to recommend a shift towards less meat and more legumes. Firstly, the carbon footprint of livestock is alarming. Harwatt et al. (2017) have outlined the substantial potential of "bean for beef" to reach US climate change targets. Livestock farming is estimated to represent 14.5 % (Gerber et al., 2013) to 18 % (Stehfest et al., 2009) of human induced Green House Gas (GHG) emissions. The supply of protein is most climate friendly, if supply chains start with legumes and if they do not start with red meat (Nijdam et al., 2012). Legumes' ability to replace synthetic nitrogen fertilizers is a strong climate advantage. Nitrogen fertilizers consume roughly 2.5 times more energy than the all machinery on farm and 10 times more than Phosphor or Potassium fertilizers on an average US corn field (Pimentel & Pimentel, 2003). Secondly, the challenge to feed a growing population with limited agricultural land resources has strengthened an interest in an efficient calorie supply for human consumption. The meat supply chain, however, requires bulk quantities of feeding materials to produce edible meat, for example beef production requires roughly 36 (±13) times the feed mass than the edible meat generated (Shepon, Eshel, Noor, & Milo, 2016). Some of the land used for livestock farming is convertible to cropping land. The cropping land could then be used to produce protein crops, such as legumes, in order to lower land resources needed to feed the world's population. Currently, about 80 % of agricultural land is managed for livestock farming (Ripple et al., 2014). Nevertheless, the desired dietary shift from animal to environmentally friendlier food is only partially understood.

Despite the climate and food security potential, consumer research has not focused on the transition from meat to legumes. Although studies have addressed consumers' willingness to reduce the frequency of eating meat, e.g. (Schosler, Boer, Boersema, & Aiking, 2015; Tobler, Visschers, & Siegrist, 2011), there remains a call for concrete strategies to alter meat eating behavior (Boer, Schosler, & Aiking, 2014; Hartmann & Siegrist, 2017; Vinnari & Tapio, 2009). Further, a clustered perspective of different meat eating behaviors is rarely found, but could aid in developing targeted strategies. Looking into meat alternatives, a share of studies is dedicated to the ideas surrounding insect protein (Hartmann & Siegrist, 2017), which has yet to prove its relevance to GHG-emissions (Halloran, Roos, Eilenberg, Cerutti, & Bruun, 2016) and will need to compete with the climate impact of legumes and

other plant based protein sources. Additionally, substantial consumption barriers are to be expected. Legumes might be preferred, but are a rare topic in consumer research. A few quantitative studies have been concerned with the consumption frequency of legume types (Jallinoja, Niva, & Latvala, 2016) or the willingness to pay for processed legumes (Lemken, Knigge, Meyerding, & Spiller, 2017). This study adds a focus on the substitution process of meat with legumes. Further, we add a clustered behavioral perspective in order to understand consumer segments in substitution and to enable targeted marketing and intervention strategies.

Resembling other applications of the transtheoretical model (Prochaska & Velicer, 1997) in consumer research, we evaluate consumers' acceptance of legumes instead of meat. The model captures the gradual change process of consumers' who are asked to change their diets. The acceptance model will be explained further in the following. We drew a quoted consumer sample in two geographically diverse countries. Samples were drawn from New Zealand (NZ) and Germany (GER) (combined N= 1078). Both countries represent consumer markets which eat significantly more meat than the global average (World: 43.2, NZ: 101.4, Germany: 86, kg capita^{-1} year^{-1} in 2013)[1] and less legumes than is globally consumed (World: 8.73 kg capita^{-1} year^{-1}, NZ: 4.1, Germany: 1.6 kg capita^{-1} year^{-1} in 2013[2]) (FAOSTAT, 2016)[3]. The analysis was executed in 3 stages. The first stage is a latent class clustering approach to identify consumer segments with certain preferences for replacing meat, meat alternatives and processed legumes. The second stage further characterizes the segments. Socio-Demographics, meat consumption frequencies and interest in information on legumes are compared between clusters. The last stage of the analysis provides an understanding of key psychological barriers and concepts involved in the substitution of meat with legumes. A multinominal logit model regresses barriers and concepts on consumer segment membership in contrast to the consumer segments with meat preferences. We discuss general strategies to address segment specific consumer groups.

The transtheoretical model to accept legumes instead of meat

The transtheoretical model (TTM) has been derived by Prochaska and Velicer (1997) to explain health related behavior. The model builds on the idea that behavioral change happens gradually over a sequence of change stages. To recognize the stages is essential to develop strategies to accomplish the change. Five simple stages characterize the willingness to change: precontemplation (no intention to change), contemplation (still considering), preparation (intention to change), action (change implemented), and maintance (lasting change). It is a one of the most popular models in health behavior (Umeh & Sharps, 2012). The model resembles the stages of Rogers (2010) innovation adoption process, which emphasizes its additional value to describe attitudes towards the adoption of new products.

Building on the above stages, we designed 3 scales to evaluate consumer acceptance of legumes in contrast to meat consumption. (1) The first TTM scale deals with a general measure of consumers' willingness to replace meat with legumes, addressing the acceptance to reduce meat and enhance legumes consumption. Whether the consumer wants to replace meat by legumes on plate or in subsequent consumption is not specified in order to not limit consumers to a particular path of

[1] Beef: World: 9.32, NZ: 22.49, Germany: 13.16, kg capita^{-1} year^{-1} in 2013, mutton and goat: World: 1.91, NZ: 18.91, Germany: 0.73, kg capita^{-1} year^{-1} in 2013

[2] Legume consumption is calculated as sum of soybean and aggregated pulses consumption

[3] In New Zealand the agricultural sector causes 47 % of the country's total GHG emission (2010) FAOSTAT (2016)

substitution. (2) The second addresses whether legumes are a welcomed ingredient in processed food. This distinguishes aversions to legume from aversions to replacing meat with legumes. Due to good processing qualities, legumes can be included in many convenience products (Vaz Patto et al., 2015), e.g. hummus or falafel. More than one pathway for enhancing legume and reducing meat consumption is plausible. (3) The third TTM scale deals with processed legume products, explicitly intended to substitute meat. The measure captures the willingness to accept meat alternative products made from a legume. This TTM (TTM_subs) combines the interest in processed legume products and the thought of replacing meat with a legume. The TTM model and operationalized scales are summarized (Appendix Table A1).

The model stages are used in many behavioral research fields, including decision making on food (Mainvil, Lawson, Horwath, McKenzie, & Hart, 2010; Tobler et al., 2011; Umeh & Sharps, 2012; Wyker & Davison, 2010). More specifically, the transtheoretical model (TTM) has been applied on young adults drive to plant based diets (Wyker & Davison, 2010), fruit and vegetable consumption (Mainvil et al., 2010) or the willingness to reduce meat consumption (Tobler et al., 2011). The willingness to eat less meat divides participants in precontemplation and action oriented stages[4]. These stages were the dominantly observed ones (Tobler et al., 2011). The same holds for daily intake of fruit and vegetables, while the largest share is observed in maintenance (Mainvil et al., 2010). Although the technical applications of the TTM differ in the literature, prior studies have often observed a bimodal distribution of consumers across the stages. This study asks more of consumers than reducing meat consumption, but also enhancing legumes consumption in the process, which may lead to a lower share of consumers in the action stages.

Because consumers can be unfamiliar with the terms "legumes" or "pulses" and need to think of the same food during evaluation, we surveyed five specific and widely grown legume varieties, namely green pea, French bean, lentil, soybean and chickpea. The TTMs have been repeated for each of the legumes. Participants were asked to select the stage, best resembling their opinion on each TTM and each legume.

Prochaska and Velicer (1997) did also suggest a "process of change" that enables individuals to progress through the stages of behavioral change. While in later stages commitment and conditioning become more influential, the early stages are rather characterized by concepts or drivers that influence an evaluative process. Similar to Umeh and Sharps (2012), we examine some of the concepts of the process of change (Prochaska & Velicer, 1997) and investigate if they are associated with the acceptance of legumes instead of meat. The used concepts comprise: consciousness (awareness of an impact), dramatic relief (feelings such as fear or hope related to a behavior), environmental reevaluation (Assessing how one's actions affect the social or external environment) and helping relationships (finding social support). Hand in hand with the process of change goes self-efficacy (The belief that one can successfully complete a task) to implement the desired change. These concepts can add explanatory power and point out factors that prevent or enable progress of individuals. To apply the concepts, we operationalize them with specific diet and meat related content: Consciousness informs the awareness on meats' healthiness if consumed in bulk and how much a person thinks about his/her diet, dramatic relief deals with fear related to antibiotics and the fear or disgust of raw meat, environmental re-evaluation focuses on the link of diet and the natural environment and helping relationships questions if they have social contacts that renounce meat. Self-efficacy captures the belief in one's ability to substitute meat. To focus on the initial stages of the substitution process,

[4] Tobler et al. (2011) did not use a maintenance stage, so that action is highest stage.

we additionally evaluate barriers that may keep individuals from progressing. In particular the barriers comprise: meat symbolism (the image that eating meat makes you strong), a low carbohydrate dietary orientation that by definition favors meat over legumes, food neophilia (expressed openness towards new food products), a dietary protein focus that may for whatever reason prefer meat over legumes, and the sensitivity towards marketing which provides a first idea, if such consumers feel resistant to marketing campaigns on food. The concepts and barriers will be further discussed in the context of other findings of meat reduction studies.

Method

The analysis was executed in 3 stages. The first stage is a latent class mixture model approach to cluster consumers with certain preferences towards replacing meat, meat substitutes and processed legumes in general (the 3 TTMs). The second stage sharpens the understanding of the resulting segments. Socio-Demographic variables, meat consumption and interest in information on legumes are listed disaggregated for each cluster. Significant differences are marked. The last stage provides an understanding of barriers and concepts involved in the meat-legume change process. By the means of a multinominal logit model, we regress barriers and concept on consumer segment membership.

Latent Class Analysis on the acceptance of legumes instead of meat

Identifying smaller and more homogenous consumer segments is essential to develop marketing strategies (Bruwer & Li, 2017). Custom tailored promotion and product strategies allow for an advantage to address the needs and preferences of consumers. The designed TTM models (Appendix Table A1) allow for different preferences with respect to replacing meat with legumes (TTM_replace, Appendix Table A1), the processed meat alternatives made from legumes (TTM_subs, Appendix Table A1) or the plain preference for processed legumes (TTM_proc, Appendix Table A1). The consumer segments may also differ in preferences for the different legumes under research (lentil, green pea, French bean, chickpea and soy) or the TTM-stage within the change process that consumers most identify with. Each stage can require a different pricing, promotion, placing and product strategy. Facing these multidimensional segmentation possibilities, it is essential to identify segments of meaningful cluster size to prioritize marketing efforts. The approach is in line with Vinnari and Tapio's (2009) call for tailored intervention to reduce the meat consumption with various target groups.

Latent Class Analysis (LCA) is an applied analytical tool in the field of marketing, e.g. (Bruwer & Li, 2017; Taehyun & Hoon-Young, 2011)**.** LCA can identify subgroups in the data. Compared to other clustering tools, clinical data was found to be equally well understood with LCA, as with hierarchical clustering algorithms or k-means (Kent, Jensen, & Kongsted, 2014). For shopping behavior, LCA is a superior clustering tool (Taehyun & Hoon-Young, 2011). Yi, Kanetkar, and Brauer (2015) have used the approach to cluster consumer preferences for vegetable purchase. For the transtheoretical model, LCA offers noteworthy advantages. Rather than using an arbitrary similarity or distance measure, such as means, LCA provides a probabilistic model that captures the full distribution of the data, while being able to treat response levels as categorical. Therefore, LCA identifies consumer segments based on the specific stages within the transtheoretical model (Precontemplation, Contemplation and so on). The probabilistic model allows for statistical measures to assess the goodness of fit between varying n-cluster solutions and between models' general fit to the data. This enables a data supported decision for the number of clusters.

15 variables (5 (legumes) x 3 (TTM)) with 5 stages (process of change) are used to identify consumer segments. The Q professional software package was used. Theoretically, the LCA specification allows us to distinguish segments between types of legumes, as Jallinoja et al. (2016) found green beans and peas to be consumed more frequently than lentil or soy among Finnish citizens (Jallinoja et al., 2016). However, the identified clusters are defined rather by differences with respect to the 3 TTMs and the specific TTM-stage consumer identify with. Here, the LCA yields a 5 cluster solution in New Zealand (NZ) and Germany (GER). This was indicated by the Bayesian information criterion (BIC), as well as the corrected Akaike information criterion (CAIC) and the conventional AIC (Appendix Table A2). Noteworthy, the three information criteria are not always pointing towards the same number of clusters, so that we are pleased and confident to further work with the 5 cluster solution. The model fit reached with a 5 cluster solution, as indicated by McFadden R^2, is 0.254 in NZ and 0.316 in GER. We will discuss the clusters in the results.

Measuring tangible characteristics of the underlying consumer segments

The next step of the analysis reveals key differences between the identified consumer segments with respect to meat (or animal) consumption (chicken, pork, beef, lamb, fish, venison) and socio-demographics (age, gender, income, education classes, size of community they grew up in, size of the community they live in, social contacts in the field of agriculture, children). The variable groups allow for a comparison of the results with prior finding in meat reduction research. Meat consumption frequencies were evaluated on a scale ranging from never, to a few times a year, to a few times a month, to weekly, to a few times a week, to daily, and a few times a day (7 point scale). Additionally, we compare a behavioral measure of interest in legumes. Respondents were exposed to the voluntary option to open an external link in order to receive more information on legumes. In all segments less than half of the respondents chose to open the external link. The measure reveals interest in the topic superior to simply asking for respondents willingness to inform themselves on legumes, as respondents opened the link in despite of their time constraint.

Linking psychological concepts and barriers with the consumer segments

To inspire strategies to progress on consumer's substitution of meat with legumes, we simultaneously test the link between several concepts/barriers and cluster membership. The concepts include self-efficacy (ability to control a behavior) and the concepts related to the process of change: conscious on meat and health, conscious on diet, dramatic relief on antibiotics, dramatic relief on raw meat, environmental-reevaluation and helping relationships (see also the previous section: The transtheoretical model to accept legumes instead of meat). The barriers include: meat symbolism, food neophobia, low carb orientation, sensitivity to marketing and a protein focus. The concepts and barriers are briefly evaluated on a 5 point Likert-scale, ranging from totally disagree to totally agree. The wording of these variables is shown in the results.

One approach to identify links between variables and consumer segments is a multinominal regression, e.g. applied to identify variables related to attitudes towards meatless meals (Boer et al., 2014) or to identify variables related to stages of transtheoretical models for environmentally friendly behaviors (Tobler et al., 2011). Looking ahead into the LCA segments, the "Only Meat" segment is the baseline behavior that is to be altered. The "Meat first" segment is not different from the "Only Meat" in terms of replacing meat with legumes or acceptance of meat alternatives made from legumes. After running the initial model, i.e. concepts and barriers regressed upon the membership to belong to one of the other four segments rather than the "Only meat" segment, a Wald-Test for combining the

alternatives was executed. In NZ, the Test cannot reject the null hypothesis that "Only meat" and "Meat first" are significantly different from each other with respect to the model. Based on the test statistic (p>chi2=0.571), the clusters should be combined before estimating the final model. In GER, the test is less conclusive and would reject the null hypothesis for these two clusters at a 95% level, but not at a 99% level (p>chi2=0.031). To keep the analysis between countries balanced, we combined these consumer segments for both countries. The baseline comprises both segment with strong meat preferences. All other clusters appear significantly different from each other (p>chi2<0.012). Odds ratios are applied to interpret the model coefficients. Odds ratios can be interpreted as the relative probability to be in a specific consumer segment vs. a baseline segment with respect to a one-unit difference between individuals, e.g. an odds ratio of 0.5 implies a halved probability to be in this segment instead of the baseline segment, if the explanatory variable increases by one unit, while all other variables are kept constant. An odds ratio close to one suggests little odds change within the distributional range of a variable. To improve reporting of the results, we plotted the odds ratios and confidence intervals of each variable. The significance of the variables is quickly assessed by investigating the overlap of the confidence intervals (95%) with the odds-ratio 1 line. The plot allows for an improved evaluation of effect stability relative to stars indicating cut-off points at traditional significance levels. The analysis was executed with the Stata-software package

Results

Data

The first sample was collected in Germany (GER) in August 2017. The second sample followed in New Zealand (NZ) in November 2017. Market research companies supported the online distribution of the questionnaire without informing respondents on the meat-legume content prior to participation. Respondents were compensated with up to 1,50 € in GER and 2 NZ-dollars in NZ. The questionnaire took approximately 15 minutes. Data quality checks for both samples include completeness, duration, visual controls for systematic answering and streamlining. Streamlining ensured that participants use a minimum of 2 seconds per item on a set of items. If streamlining was violated twice, the participant was registered as speeder and dropped. Overall, 1487 consumers completed the survey and a sample of 1078 (NZ=445, GER=633) was left after data quality checks have been implemented (215 drops in NZ, 194 drops in GER).

The sample collection was subject to quotas on gender, age and income to improve external validity of the sample. The cutoff points for age classes are kept identical between countries and are informed by aggregated data from official statistical institutions. The cutoff points for the income classes should consider that income value can vary by the costs of living in each country. We consider the relative income distribution of each country and select cutoff points in a way to create equal income class sizes between GER and NZ. For example, I8 is the highest income class and has a higher income than 88% of the rest of the population in each country. This can enable a relative comparison of income effects between countries. The quotas in each country (GER and NZ stats), the cutoff points and the final sample are summarized in the following (Table 1).

The GER sample is older than the NZ sample, due to the quota settings. In GER, the oldest age class is slightly overrepresented. This is partially caused by drops, due to quality concerns, that have less affected the oldest age class. For the NZ sample, the quality checks were implemented parallel to collecting the data and steering the quotas. In NZ, the income class six (I6) is somewhat overrepresented. We felt the deviances are still within acceptable boundaries and decided to continue

with the data set at hand, as opposed to artificially drop observations from overrepresented classes, which may also cause concerns with well represented classes.

[Table 1 about here]

Looking into the TTM stages (15 variables =5 legumes x 3 TTMs), the data implies a left skewed distribution (Table 2). More than half of the consumers have no intention to replace meat with any of the legumes. For example, 64.1 % are in precontemplation to replace meat with soy beans in GER (Table 2). A similar resistance is found towards meat substitutes made from legumes. Only a slightly smaller share of consumers has no intention to use legumes in processed food. The share of consumers in action or mantainance stages is lower than for consumer studies that reported on the willingness to reduce meat consumption (Tobler et al., 2011) or enhance fruit and vegetable intake (Mainvil et al., 2010). The NZ sample reveals a lower share of precontemplation for the acceptance of meat alternatives than the GER sample. At first glance the differences between legumes are limited to a maximum of 10% in each stage. The acceptance to substitute meat with a legume is similar over all 5 varieties evaluated. An exception might be processed chickpeas in New Zealand, probably due to widespread product offerings of hummus (Table 2).

[Table 2 about here]

2x5 clusters for the substitution of meat with legumes

A Latent Class Analysis (LCA) for each national sample results in 5 consumer segments for each country (Appendix Table A2). The LCA allows for a probabilistic model that treats the TTM-stages as categorical. The final segments are characterized by different proportions within the stages of Precontemplation, Contemplation and the combined sum of the stages preparation, action and mantainance. Post modelling, the preparation, action and mantainance stage have been aggregated for an efficient presentation of the results. The 5 five legume varieties are condensed into mean values for the acceptance of legumes instead of meat, but the disaggregated data for the legumes is deposited (see footnote 5). A graphical illustration highlights the different shares of consumers in precontemplation, contemplation or beyond with respect to each segment (Figure 1 & 2). Strikingly, we observe three analogous segments in both countries.

Firtsly, the “Only Meat” segment is marked by precontemplation. In this cluster, more than 90% had no intention to replace meat with legumes (TTM_replace) or to buy meat alternatives made from legumes (TTM_altern). In GER over 85% and in NZ over 90% of the segment had no intention to buy processed legumes (TTM_proc) (Figure 1 & 2). “Only meat” describes a strong preference for meat, while rejecting legumes. “Only meat” comprises a large share of consumers in both consumers. Secondly, “Meat first” resembles the segment of “Only meat”, but a majority considers to eat processed legumes (NZ=55.8%, GER=74.5%). The share of consumers beyond contemplation (Pr, A, M) is higher than the share in precontemplation (Figure 1 & 2). “Meat first” rejects the direct substitution of meat with legumes, but is not opposed to using more legume products in their diet. Thirdly, the “Pioneers” present the segment with the strongest preferences to substitute meat with legumes. In NZ over 66% are beyond contemplation for all three TTM behaviors. In GER, this share is even higher. The “Pioneers” are the ones that frequently substitute their meat consumption with legumes. Noteworthy, we advise against a comparison of cluster sizes between countries. Although the three clusters resemble each nation’s counterpart, they are not equal. For example, the “Pioneers” in GER reveal even more commitment to the substitution of meat with legumes than the NZ ones (see above).

In NZ, we observe additional preferences for meat alternatives made from legumes (TTM_altern). The segment "Open, but wary to replace" includes consumers who accept processed legumes and meat alternatives made from legumes (TTM_proc=56.6%, TTM_altern=67.1%), while having a lower acceptance to replace meat (TTM_replace<40%). These consumers resemble the "Pioneers" openness to the substitution, but are not necessarily willing to lower meat consumption. Another segment "Seekers of meat alternatives" stands out with a majority of 79.6% stating that they would use meat substitutes made from legumes, but do not quite know how. In contrast, a majority of the segment rejects to replace meat (ttm_replace=50.8%). "Seekers of meat alternatives" are interested in meat alternatives, but are not drawn to meat alternatives by the idea of lowering their meat consumption (Figure 1).

In GER, we observe the "Contemplators" and the "Wary of processed" segment. The "Contemplators" are characterized by a majority being in the contemplation stage (>58% on all TTMs). The "Contemplators" consider to substitute meat with legumes. They resemble the "Pioneers", but are often still contemplating how to replace meat and use processed legumes and meat alternatives (Figure 2). Lastly, most clusters are well described by the aggregation of all five legume varieties. The proportions in each stage vary little between the different legume varieties. An exception is the "Wary of processed" segment in GER. Most segments are characterized by a higher acceptance of processed legumes and meat alternatives than the idea to replace meat with legumes. This segment is more accepting of the idea to replace meat. This preference becomes clearer if we look at the disaggregated figures. French bean, green peas and lentils are relatively well accepted to replace meat (>30% in Contemplation and >30% in Pr, A, M), while chickpeas and soy, typical ingredients in processed foods, are hardly accepted. The segment seems to prefer nationally grown legumes in their traditional form in retail. The disaggregated data for the different legume varieties is uploaded online[5], but the aggregated data will guide the further analysis.

[Figure 1 & 2 about here]

In a nutshell, the segments have a distinct preference for how to lower meat and enhance legume consumption. The segments can also be ordered to the degree they are willing to accept a lower meat and a higher legume consumption. The order is: NZ: "Pioneers" > "Open, but wary to replace" > "Seekers of meat alternatives" > "Meat first" > Only meat, GER: "Pioneers" > "Contemplators" > "Wary of processed" > "Meat first" > "Only meat". Several characteristics differ between these segments.

The segments are further described by sociodemographics, meat consumption frequencies and interest in information on legumes. Currently, the "Pioneers" are the only clusters that consistently consume meat less frequent than the "Only meat" and "Meat first" ("Meat first", "Only meat"). This holds for the major meats consumed in each country (GER: chicken, beef, pork, NZ: chicken, lamb, beef, pork). Other segments have not yet developed an unambiguously lower meat consumption frequency than the "Only meat" and "Meat first". Only Pioneers eat meat less frequent. In contrast, all segments seem to be more interested in additional information on legumes than the "Only meat" and "Meat first". The interest in additional information on legumes, indicated by the opening of an external URL-link within the survey, reveals that just the "Only meat" and "Meat first" appear reluctant to open the link (Table 3). In both segments, consumer wanted significantly infrequent to open the link than in most other segments (NZ over 82% and in GER over 78%, Table 3). The other

[5] We uploaded disaggregated tables & figures for the 15 TTM variables across all consumer segments. Available online: https://dlemken.wixsite.com/rawdata5cluster

segments were more curious. The interest in information on alternatives is not limited to the "Pioneers".

[Table 3 about here]

Regarding socio-demographics, we observe the share of women is significantly higher among "Pioneers" than "Meat first" or "Only meat" (Table 3). The Age relationship is less unambiguous. While "Only meat" is the oldest cluster in both countries, "Meat first" can be a younger cluster, particularly in GER. At a 5%-significance level the kwallis test indicates (Prob > chi^2) that income does not differ between all segments in both countries. In NZ, education levels are higher among "Pioneers" than the "Only meat"-segment. In GER, "Only meat" is the oldest cluster but does not differ significantly from Pioneers and most other segments. We will discuss these results in the context of prior findings on meat consumption.

Drawing on studies on pro-environmental behavior, we would have expected differences between rural & urban areas (Gifford & Nilsson, 2014). However, other descriptive variables are relatively even distributed among segments and will not be discussed further. Singular differences are still found on the amount of children or the connection to agriculture a respondent has.

Concepts and barriers associated with meat-legume substitution

Lastly, we were interested in psychological concepts and barriers associated with the segments, as they may help to develop strategies to strengthen supportive concepts and to address barriers. A multinominal model regresses the variables on cluster membership (Figure 3). The model is statistically significant with a sufficient model fit (GER: Prob>chi^2=0.0000, Pseudo R^2=0.19, NZ: Prob>chi^2=0.0000, Pseudo R^2=0.22). The baseline is given by the "Meat first" and "Only meat" segment. The results are graphically presented with odds ratios and confidence intervals. The graphical presentation aids a comparison of associations between segments. For example in NZ, we find a significant odds ratio of two between Pioneers and food neophilia (Figure 3), i.e. a consumer who increases her/his food neophilia score by one has twice the odds of being in the Pioneer than the baseline segments. A significant relationship with food neophilia is also apparent for the "Open, but wary to replace"-segment, but not for the "Seekers of meat alternatives" whose odd ratio is close to 1, i.e. unchanged odds over the distribution of food neophilia. Although the "Seekers of meat alternatives" predominantly consider meat alternatives, their acceptance of processed legumes is lower than for "Open, but wary to replace"-segment. In GER, food neophilia could not be linked to the segment membership (Figure 3). Other factors play a role here.

Looking into effects to be found in both countries, self-efficacy is a key concept to be in any segment, but the baseline segments. The odds ratios (effect size) reveal that the "Pioneers" are linked the strongest to self-efficacy (NZ: 2.8, GER: 2.9). Overall, self-efficacy reveals the strongest effect size among the tested variables. Self-efficacy comprises the perceived ability to substitute meat. Next, helping relationships are often positively linked with the segments under research, especially with the "Pioneers".

Other country specific effects in GER relate to meat symbolism, protein focus and environmental re-evaluation. Particularly, the disbelief that eating meat makes you strong is significantly linked with all segments. In NZ, we observe the consciousness on meat and health to be linked with two of the segments. This consciousness failed to achieve standard significant levels in GER, while being consistently positively related with all segments. Interestingly, the dietary goal low carb is associated

with the "Open but wary to replace"-segment. Given legumes carbohydrate content, legumes may not fulfil their dietary needs. We will discuss the addressed findings and the indications that follow.

[Figure 3 & 4 about here]

Discussion

The Substitution of meat with other protein sources is one way of making food consumption sustainable (Stoll-Kleemann & Schmidt, 2017). The study provides several insights into consumer behavior with respect to substitution. Consumers are predominantly found to have no intention eat less meat and, instead, more legumes. The current state of substitution of meat with legumes can be described as a beginning phase of this change process. Considerable efforts by marketers, researchers and politics will be needed to implement and support the change desired by climate and environmental advocates. Marketing strategies can build on the Pioneers and several other segments that have started to consider the substitution.

How to market the substitution of meat with legumes to different consumer segments

The identification of smaller and more homogenous segments allow for targeted marketing strategies (Bruwer & Li, 2017). Some studies have distinguished consumers by their use of meat alternatives (Hoek et al., 2011) or their BMI level (Boer et al., 2014). We chose to distinguish consumers by latent classes, i.e. non predetermined categories of consumer types with respect to substitution. The data driven approach has indicated five consumer segments in each country. Three segments are found in both countries: the "Pioneer" who frequently substitutes meat with legumes, the "only meat" segment which has a strong preference for meat, and "meat first" which equally prefers meat but considers processed legume products. The findings suggest such segments are found in many developed countries around the globe.

When designing marketing strategies for the different segments of substitution, it is crucial to recognize that the Pioneers stand as a role model for consumers to pursue. However, Pioneers need not be the primary target of campaigns. Their effort on substitution is commendable. The "Pioneers" need to feel relatable to, so other consumer segments are inspired to follow the example of "Pioneers". A marketing strategy should target the segments which consider the substitution, but have not implemented it.

Segments other than "Only meat" and "Meat first" consider meat alternatives and/or consider to replace meat. They are receptive to information and interventions to change their share of meat and legumes in the diet (Figure 5). The receptive segments can be convinced to buy more meat alternatives made from legumes. The rising interest in convenience has been a major influence on food purchase (Stoll-Kleemann & Schmidt, 2017). The development of better tasting products that are easy to implement into existing habits, may just work for many. The growing investment in start-ups to develop further meat alternatives will probably lead to more marketing and targeting of such consumers. Start-ups in Silicon Valley have begun to mimic red meat with plant protein, which is the most relevant meat from a GHG emission perspective (Nijdam et al., 2012), e.g. Impossible Burgers, Beyond Burger. The competitive prices of meat may still be a barrier of substitution (Stoll-Kleemann & Schmidt, 2017). In GER, a high meat consumption is not linked to higher incomes, anymore (Stoll-Kleemann & Schmidt, 2017). While the relative perception of meat prices may differ in each country, meat alternative prices need to compete. On the one hand, a meat tax would help to account for the costs related to GHG emissions of livestock. However, climate policy is not yet focused on dietary

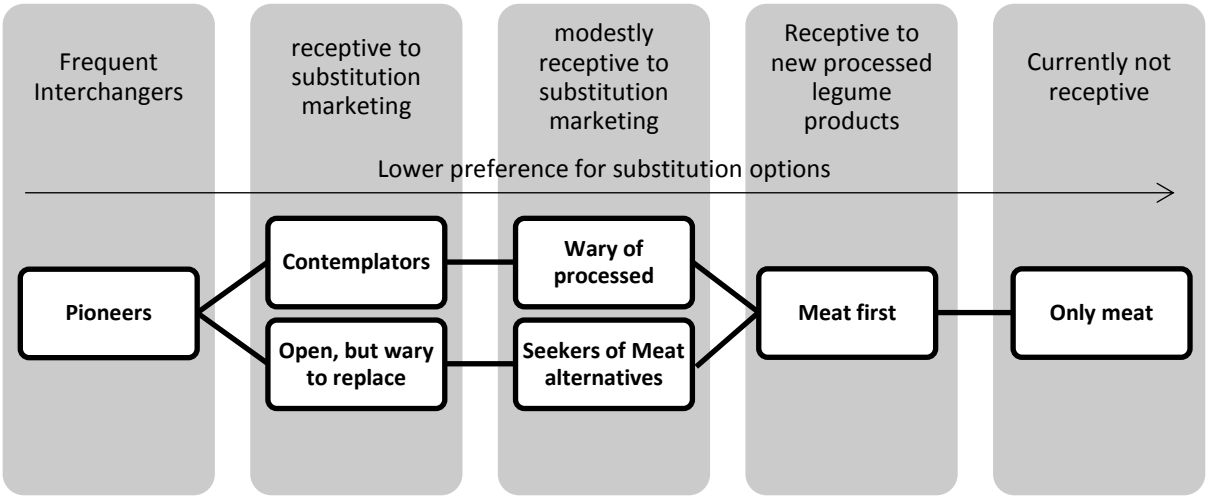
patterns (Harwatt et al., 2017). On the other hand, meat alternative companies are likely to expand production in order to realize economies of scale. Additionally, studies have addressed that clear environmental messages can increase the perceived product value of processed legumes, especially if combined with health messages (Lemken et al., 2017). These segments already consider to change and will be sensitive to the perceived relative price (cross price elasticity) of meat alternatives. The perceived price will matter to "Seekers of meat alternatives" that do not really want to replace meat, as well as for segments that intend to reduce meat consumption. An improvement of product characteristics, such as taste of meat alternatives, will also reach the "Contemplators" that are increasingly enabled to substitute their meat portion on the daily plate.

The "Wary of processed" segment is not overly interested in meat alternatives, but accepts somewhat that their meat consumption should be reduced in favour of traditional legumes (in GER: French bean, green pea, lentil). To address such preferences, the portion sizes and frequencies of meat and legumes consumption can be adjusted. Legume side dishes can be expanded. Some research has addressed the implementation of a "less but better" strategy for meat consumption (Boer et al., 2014). For legumes, it is essential to further develop the skills of preparation and strengthen their image, as nutritious, healthy and environmentally-friendly food (Jallinoja et al., 2016; Lemken et al., 2017).

The "Meat first" segment is to be distinguished from the "Only meat". Their consideration of processed legumes implies a potential to market new legume products, if the product and placement are less focused on the product's function to replace meat and rather emphasize other aspects. Surprisingly, "Meat first" is significantly smaller than the "Only meat"-segment in both countries. Conclusively, many consumers do not fancy legumes in processed products independent of whether these products are meant to substitute meat. Considerable efforts need to be given to the plain marketing of legumes, if society wants to progress on the substitution of meat with legumes.

[Figure 5 about here]

Figure 5 Receptiveness to the substitution of meat with legumes by segment



Prior findings have linked being male, older and belonging to a lower social class in terms of income and/or education with a higher and more rigid meat consumption (Stoll-Kleemann & Schmidt, 2017). Women and younger respondents are more likely to be heavy users of meat alternatives (Hoek et al., 2011). Comprehensively, we confirm a higher proportion of men in the "meat first" or "only meat" segment. Despite ambiguous findings on women's enhanced preference for legumes (Jallinoja et al., 2016; Lemken et al., 2017), we are confident that gender plays a role. Women are more likely to

engage in health, animal welfare and environmental arguments on meat eating behaviour (Tobler et al., 2011). Animal welfare or ethical arguments have been found to matter more to heavy users of meat alternatives, while non-users care more about improved sensory qualities of meat alternatives (Hoek et al., 2011). While women can have less faith in technological solutions (Stoll-Kleemann & Schmidt, 2017), men are receptive and will try new meat alternatives, if this market progresses.

Regarding Age, some studies have pointed towards a link to meat eating behaviour (Hoek et al., 2011; Stoll-Kleemann & Schmidt, 2017), other studies have also failed to establish a link (Tobler et al., 2011). The "only meat" segment is the oldest in both countries. Other segment's age groups are diverse. We conclude a heterogeneous relationship with a tendency of older participants to be in meat focused segments. Since health benefits have been found to motivate older participants to reduce meat consumption, campaigns may address health benefits of legume based diets (Stoll-Kleemann & Schmidt, 2017). Knowledge on plant based diets can be low among middle aged consumers (Stoll-Kleemann & Schmidt, 2017). Campaigns on legumes may emphasize the positive effect on the prevention of high blood pressure and type II diabetes (Afshin, Micha, Khatibzadeh, & Mozaffarian, 2014). Older consumers in receptive segments are likely interested in health arguments.

Concepts and barriers associated with meat-legume substitution and ideas to progress

Food choices are not always rational, but marketing has learned to guide irrational consumers, if the motivation for a behavior becomes clear. An absolute key factor is the perceived ability to control meat consumption. In the theory of planned behavior such a concept resembles perceived behavioral control, while in the transtheoretical model it is referred to as self-efficacy. It comprises the belief to be able to change a behavior. Although self-efficacy measurements vary in the literature, self-efficacy is frequently found to be a dominant concept to determine the stage of individuals (Umeh & Sharps, 2012). Additionally, many other concepts related to the process of change can strongly and positively correlate with self-efficacy (Umeh & Sharps, 2012). An increase in self-efficacy will influence other concepts and thereby add to its direct effect on substitution. Confirmatory, self-efficacy is a strong predictor of pro-environmental behavior (Gifford & Nilsson, 2014), as well as the adoption of plant based diets (Wyker & Davison, 2010). A large proportion of consumers feel it is not possible to replace meat in their daily life. This might be, due to social conventions, habit, lifestyles, being used to meat or other reasons. Nevertheless, a growing share of consumers deems meat substitution possible, which creates a starting point to motivate a meat reduced diet. Campaign can stress the role of "Pioneers" or vegetarian opinion leaders and help refusers of meat substitution to develop skills related to vegetarian cooking and eating. An integration into people's social life will enhance the perceived feasibility. The perceived feasibility can be improved if professional food outlets get involved, such as schools, canteens, cafeterias and bistros.

Several other concepts can be linked to the substitution of meat with legumes. Helping relationships are found as a linked concept with several segments, indicating the strong social context of food choices. Friend's and family's approval is an established factor in choosing plant based diets (Wyker & Davison, 2010). Hence, social conventions are needed in order to change the meanings and expectations of meat and legumes across several domains of daily life (Jallinoja et al., 2016). A diffusion of meat substitution is likely to follow an S-curve as observed in Rogers (2010) innovation adoption research, i.e. the frequency and number of adopters is low in the beginning, but increases rapidly once a critical mass of Pioneers is achieved, due to the widespread acceptance of the technology or behavior. It remains to be seen, if the current share of Pioneers is sufficient to present a critical mass or other receptive segments will need to follow first (Figure 5). In the early stages, where

only a few substitute, food neophobia is likely to be more frequent among the "Only meat" and "Meat first", as we observe for NZ. Neophiliac consumers are more open to adopt new products, which makes them a higher priority group in the marketing of new products. However, neophobic consumers will not ignore a widespread social acceptance of a product, which may help to win them over at a later stage of the diffusion process. In this context, the acceptance of meat alternatives, as a specific substitution, has already been linked to food neophobia (Hoek et al., 2011).

A particular interest was given to the symbolism of meat. Stoll-Kleemann and Schmidt (2017) suggested that meat may express human power and desire to dominate the natural world. This type of self-evaluation appears to a barrier for the "Only meat" and "Meat first"-segment in GER. To address the social image of legumes, while breaking non valid prejudices on meat, may enable individuals to redefine the role of meat in their life.

Prior research did also find a low awareness of meat consumption's impact on the environment relative to other food related behaviors (Lea & Worsley, 2008). Consciousness of concerns were strongly linked with environmental engagement (Gifford & Nilsson, 2014). Nevertheless, the awareness that one's diet affects the environment appears to be no concept strongly linked to a segment. Based on this finding, we do not recommend to overly stress environmental messages at this stage. Some segments are not willing to change a behavior based on an environmental argument. Most are aware, but the arguments matter mostly to segments that already substitute. Similar conclusions were derived for ethical arguments in the context of meat substitution (Hoek et al., 2011). This does not mean that consciousness and awareness of issues surrounding meat are no drivers of consumer behavior. They can still play a role in segment membership, e.g. consciousness of diet and health in NZ, but nowadays we believe it is not the core concept hindering change. In both countries over 50% agree and over 80% at least partially agree that their nutrition has an effect on the climate.

Interestingly, a low carb orientation is found among a segment "Open, but wary to replace". Proponents of change need to consider opposing dietary trends and establish one of their own. Multiplicators like food bloggers, nutritionists, specialized magazines can assist in such tasks and help to push for a Flexitarian lifestyle. The Flexitarian food trend might help to create a transition and lower barriers to reduced meat consumption (Jallinoja et al. 2016).

Limitations

The study is based on cross-sectional survey data and its limitations. The segments may change over time or inflate or deflate in size. A common bias in survey data is social desirability. Online surveys are less affected by the bias than personal interviews. The dominance of precontemplation in the sample in contrast to prior finding on meat reduction, imply a minimal social desirability bias. Nevertheless, data quality checks are essential to filter out speeders who want to earn compensation without answering the survey to the best of their knowledge.

The study offers a rich set of variables that are analysed between segments. The variables, including the ones of the multi-nominal model, are not suited for a causal analysis. The characteristics can be interpreted as associated or related to a segment. The results help to prioritize key differences between segments in order to develop marketing strategies. Nevertheless, the reader may expect additional variables on health, animal welfare, biodiversity or taste. The study does not offer the complete picture, but a reasonable model fit to explain the segments. Additionally, the health benefits of the processed meat alternatives remains to be seen and the communication of ethical aspects seems to convince mostly the ones that are already into alternatives (Hoek et al., 2011).

Furthermore, the study is designed for the substitution of meat with legumes, as it is desired by proponents of a more climate friendly nutrition. Legumes are the ideal case of substitution, but even the substitution of red meat with chicken would matter significantly to climate goals. Given red meats' outstanding impact on food security and GHG emissions (Gerber et al., 2013; Nijdam et al., 2012; Ripple et al., 2014), we advise future research to focus on any behavioural change away from red meat. Despite consumer research's interest in meat eating, we are not aware of studies addressing specifically red meat

Outlook.

Stakeholders need to consider the gradual process underlying the substitution of meat as outlined by the transtheoretical model. Meat eating behaviour is deeply rooted into the culture of western countries. The dominant target needs to be a "flexitarian lifestyle" that respects the gradual change process. Currently, legume consumption levels are low in most European countries (Jallinoja et al., 2016) and legumes are known as a trendy food. We provide ideas how to address different consumer segments and how to overcome psychological barriers of substitution. A segment, that has low preferences for processed legumes, needs a different approach than segments, that welcome processed meat alternatives. Consumers, who do not consciously accept the idea to replace meat, may still buy novel legume products, if they are not marketed as replacement. Reducing the perceived inability to reduce meat is a promising step forward. From a climate perspective, consumer researchers may want to focus their efforts not on meat, but on the high impact of red meat consumption.

Meat processors may want to diversify their portfolio and get involved in the growing meat alternative market. They need to keep an eye on shifting consumer preferences. They can rediscover the marketing to "Pioneers", a consumer group increasingly lost to them. They may also be able to fulfil better the needs of the other substitution receptive consumer segments. Such effort should not keep them from working on the sustainability of existing meat products. In GER, some meat processors are increasingly involved in meat alternative processing, headed by efforts of Ruegenwalder. In NZ, startups are offering non-beef products (http://altmeatco.com). New Zealand's board "beef and lamb" has published an extensive report on expected market changes, due to high investments in meat alternative products (Beef+Lamb, 2018). We confirm several consumer segments that consider to buy such meat alternatives. A targeted marketing mix of more frequent uptakes of meat alternatives, a decrease in meat portion sizes and a rediscovering of legumes, as an essential side dish and protein source, will lead to enhanced substitution.

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Appendix

Table A1 The Transtheoretical models to use legumes instead of meat

		Operationalized TTM		
Stage	Concept	Acceptance of meat replacement by legumes	Acceptance of legumes as an ingredient in processed food	Acceptance of meat alternatives made from legumes
Abbreviation		TTM_replace	TTM_proc	TTM_altern
1 Pc	no intention to change, lack of motivation or information to change	"I would never replace meat with ..."	"I do not want to buy any products that contain ... in processed form *"	I am unwilling to use meat substitutes from ... .
2 C	Intention to change, still considering	"I would replace meat with ..., but do not know how"	"I would like to buy products that contain ... in processed form * but do not pay attention"	I would use meat substitutes from ... but I do not know how
3 Pr	Intention to change with a concrete plan of action	"I will replace meat with ... at the next meal"	"I will buy products on the next purchase, which contain ... in processed form *."	I would like to use meat substitutes from ... for my next meal.
4 A	Behavior has changed	"I already replace meat with ..."	"I already buy products that contain ... in processed form *."	Sometimes I use meat substitutes from ...
5 M	Behavioral change is lasting	"I have been replacing meat for a long time with ..."	"I have already purchased products that contain ... in processed form * for a long time"	I regularly use meat substitute products from ...

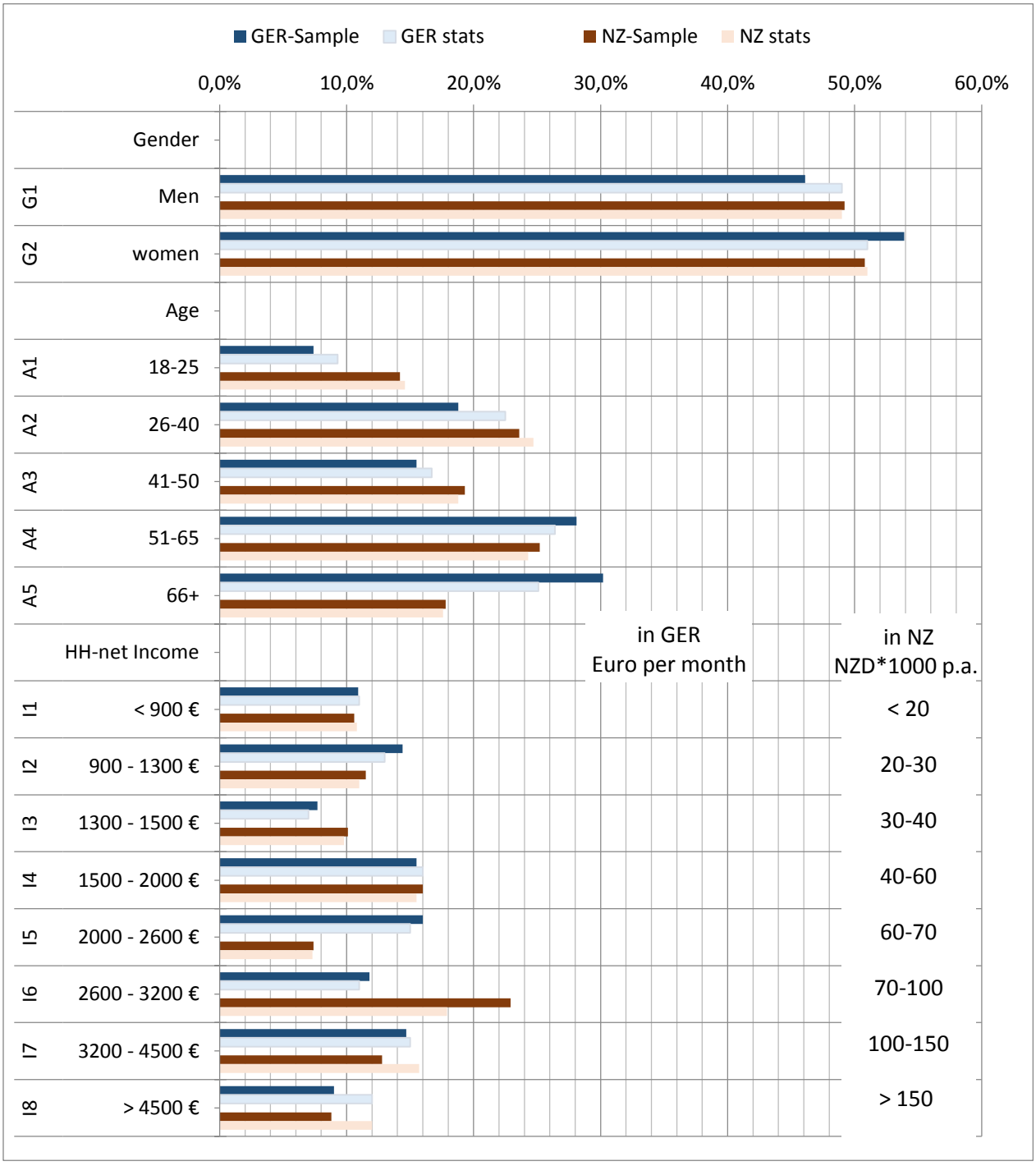
… = placeholder for green pea, french bean, lentil, chickpea and soy, processed products were explained in a footnote: "Products composed of several subproducts, for example hummus or various protein bars"

Table A2 Model fit of Latent class cluster solutions

	GER				NZ			
	LL	BIC	CAIC	AIC	LL	BIC	CAIC	AIC
Aggregate	-12150	24687	24687	24420	-8734	17834	17834	17588
2 classes	-9838	20457	20457	19919	-7506	15751	15751	15255
3 classes	-9076	19326	19327	18516	-7026	15163	15163	14417
4 classes	-8716	18998	18999	17917	-6806	15094	15095	14098
5 classes	-8314	18588	18589	17235	-6516	14886	14887	13640
6 classes	-8253	18860	18861	17236	-6464	15154	15155	13658

BIC=Bayesian information criterion, AIC= Akaike information criterion, CAIC= corrected Akaike information criterion

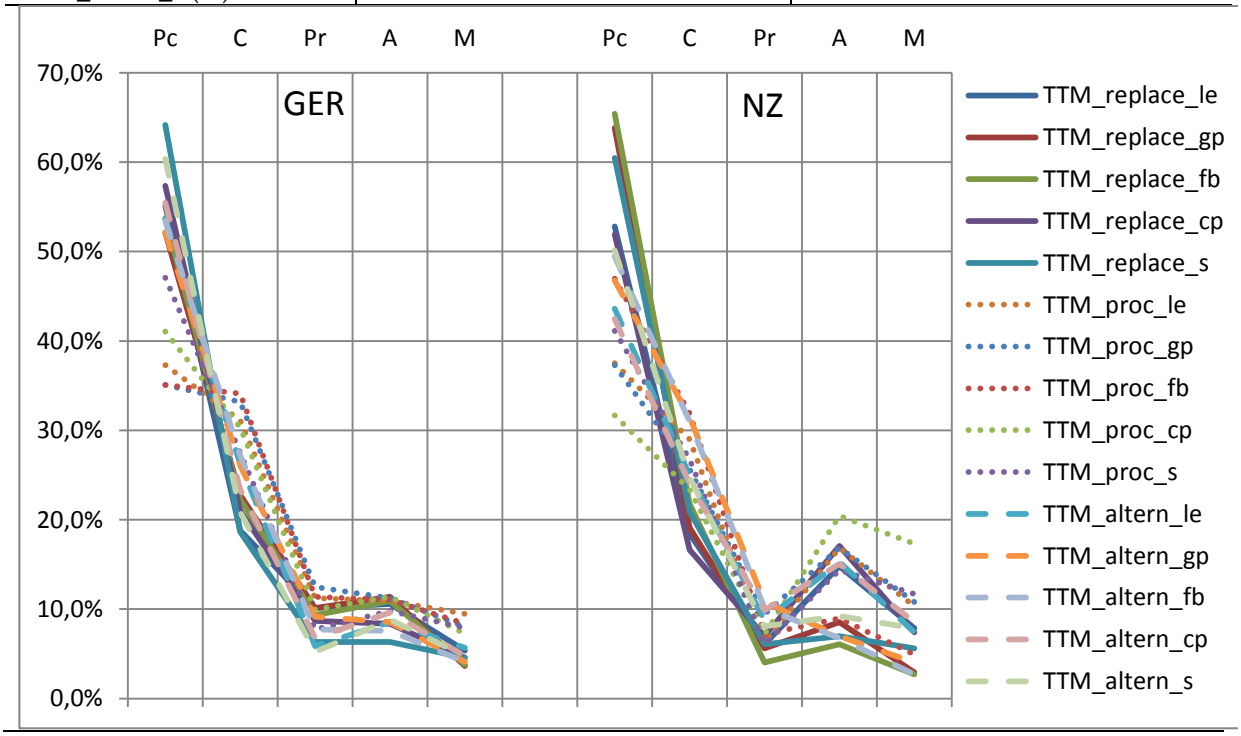
Table 1 German and New Zealand Consumer Sample



Source: GER- and NZ statistics are based on (DEStatis, 2011), (Statista, 2016) and (NZstats, 2013)

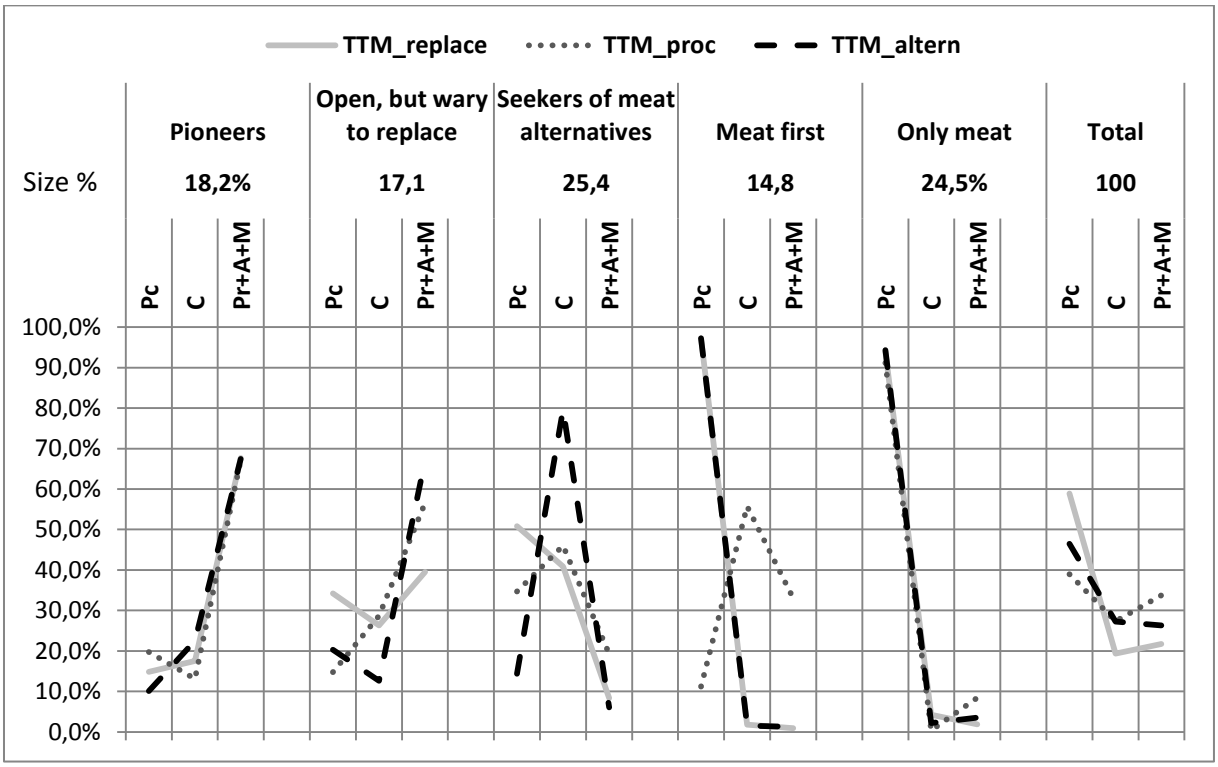
Table 2 The Transtheoretical models to use legumes instead of meat by stage and by legume type

	GER					NZ				
	Pc	C	Pr	A	M	Pc	C	Pr	A	M
TTM_replace_le (%)	55.1	18.8	10.1	10.6	5.4	52.8	18.4	6.1	14.8	7.9
TTM_replace_gp (%)	52.1	22.7	10.1	11.4	3.6	63.8	19.1	5.6	8.5	2.9
TTM_replace_fb (%)	53.7	22.3	9.3	10.9	3.8	65.4	21.8	4.0	6.1	2.7
TTM_replace_cp (%)	57.3	21.0	8.7	8.4	4.6	51.9	16.6	7.0	17.1	7.4
TTM_replace_s (%)	64.1	18.6	6.3	6.3	4.6	60.4	20.9	6.1	7.0	5.6
TTM_proc_le (%)	37.3	31.1	11.2	10.9	9.5	37.5	29.0	6.3	16.9	10.3
TTM_proc_gp (%)	35.1	33.2	12.5	11.2	8.1	37.3	25.6	9.4	16.9	10.8
TTM_proc_fb (%)	35.1	34.1	11.4	11.1	8.4	47.0	31.9	7.2	9.0	4.9
TTM_proc_cp (%)	41.1	30.3	10.0	11.4	7.3	31.7	23.4	7.2	20.4	17.3
TTM_proc_s (%)	47.1	27.5	7.7	9.8	7.9	41.1	26.7	6.1	14.4	11.7
TTM_altern_le (%)	53.7	26.2	5.8	8.5	5.7	43.6	24.9	8.8	15.3	7.4
TTM_altern_gp (%)	52.1	26.1	9.2	8.5	4.1	46.7	31.5	10.8	7.0	4.0
TTM_altern_fb (%)	53.4	27.2	7.7	7.6	4.1	49.4	31.0	10.1	6.7	2.7
TTM_altern_cp (%)	55.5	23.4	6.8	9.6	4.7	42.5	24.0	9.9	15.1	8.5
TTM_altern_s (%)	60.3	20.9	5.2	8.8	4.7	50.1	24.7	8.1	9.2	7.9



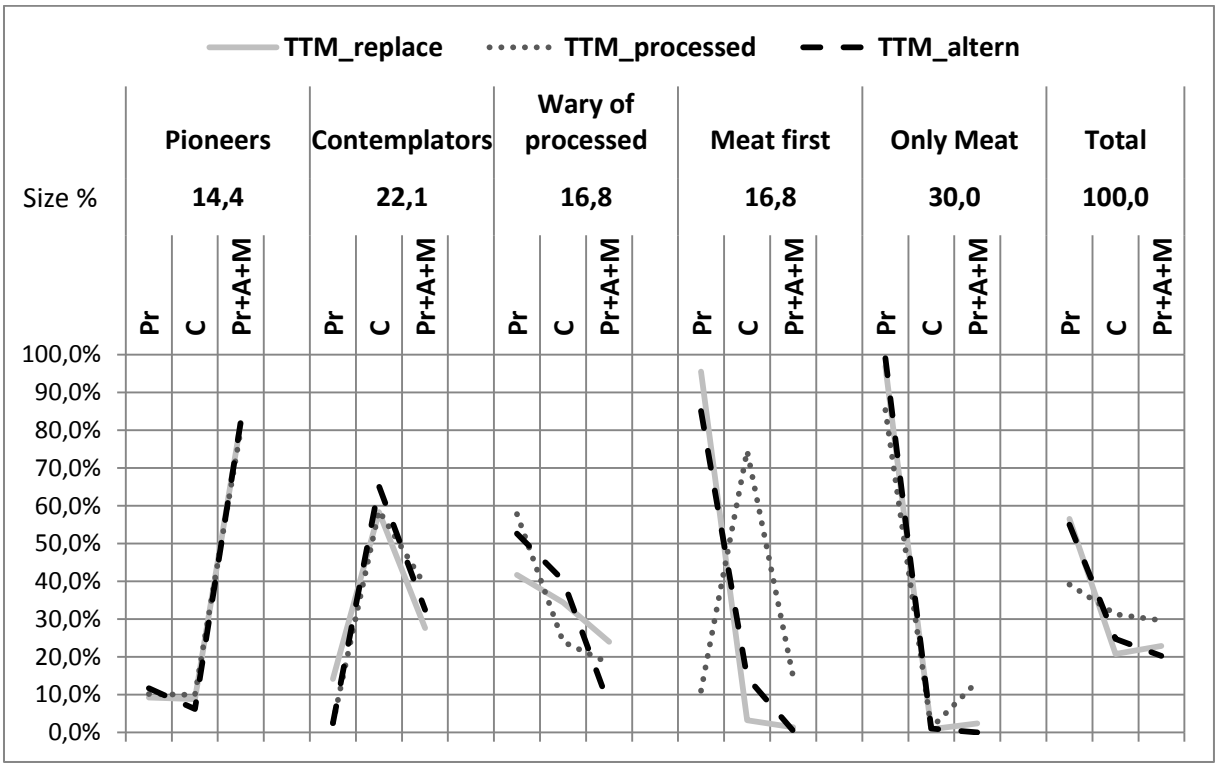
le=lentil, gp=green pea, fb=french bean, cp=chickpea, s=soy bean, Pc=Precontemplation, C=Contemplation, Pr=Preparation, A=Action, M=Maintenance

Figure 1 Five clusters related to legume instead of meat (average of 5 legume varieties) by stage and cluster in New Zealand



Pc=Precontemplation, C=Contemplation, Pr+A+M=Sum of Preparation, Action and maintenance stage, TTM_repace, TTM_proc, TTM_subs see Table A1)

Figure 2 Five clusters related to legume instead of meat (average of 5 legume varieties) by stage and cluster in Germany



Pc=Precontemplation, C=Contemplation, Pr+A+M=Sum of Preparation, Action and maintenance stage, TTM_repace, TTM_proc, TTM_subs see Table A1)

Table 3 Descriptive Variables of Clusters regarding legumes instead of meat (GER and NZ)

		Germany (GER)						New Zealand (NZ)					
Variable	Scale	A Pioneer	B	C	D Meat first	E Only Meat	Prob > chi^2-Kwallis	E Pioneer	B	C	D Meat first	E Only Meat	Prob > chi^{2-} Kwallis
N		91	140	106	106	190		81	76	113	66	109	
Gender	1=women	0.65^{de}	0.59^{e}	0.55	0.50^{a}	0.47^{ab}	0.0391	0.69^{bde}	0.53^{ae}	0.59^{e}	0.36^{a}	0.36^{abc}	0.0001
Age	->older	52.38^{be}	47.25^{ace}	53.87^{bde}	48.05^{ce}	57.44^{abcd}	0.0001	43.74^{e}	41.96^{de}	46.18^{e}	48.33^{a}	51.05^{ab}	0.0043
HH-Income	->higher calss	5.38	5.89^{e}	5.39	5.68	5.25^{b}	0.0823	5.62	5.91	5.42	5.89	5.46	0.3670
Education[1]	1=no conclusion 4=acad. degree	2.56	2.76^{ce}	2.52^{b}	2.60	2.44^{b}	0.0050	3.63^{cde}	3.47^{e}	3.38^{ae}	3.32^{a}	3.10^{abc}	0.0001
Origin-Size	1=community<500,	3.34	3.63^{c}	3.28^{b}	3.39	3.47	0.2266	3.93	4.28	4.09	3.91	3.94	0.2400
Living-size	5=city >100000	3.73	3.74	3.56	3.66	3.67	0.8061	4.04	4.18	4.19	3.95	4.15	0.6143
Connect Agr	1=farmer, 4=No	3.65	3.68	3.66	3.73	3.73	0.6174	3.48^{e}	3.45	3.63	3.47^{e}	3.67^{ad}	0.0844
children	1=No, 6= kids > 4	2.11	1.99^{e}	2.28	2.07^{e}	2.37^{bd}	0.0273	2.14^{e}	2.41	2.39	2.50	2.69^{a}	0.1290
Chicken_frq	7=a few times a day, 6=daily, 5=a few times a week 4=weekly, 3=a few times a month to 1=never	3.01^{bcde}	3.81^{ae}	3.78^{ae}	3.75^{ae}	3.44^{abcd}	0.0001	$3,88^{bcde}$	$4,51^{a}$	$4,44^{a}$	$4,55^{a}$	$4,44^{a}$	0.0984
Fish_frq		3.22	3.32	3.30	3.17	3.15	0.4817	$3,30^{b}$	$3,70^{ade}$	3,39	3,33	$3,32^{b}$	0.2273
Lamb_frq		1.74	1.76	1.79	1.74	1.66	0.4678	$2,67^{cde}$	$3,07^{a}$	2,84	$3,12^{a}$	3,06	0.0403
Venison_frq		1.64	1.81	1.82	1.86^{a}	1.71	0.1201	1,81	1,78	1,63	1,70	1,63	0.5378
Beef_frq		2.49^{bcde}	3.14^{a}	3.30^{a}	3.28^{a}	3.06^{a}	0.0001	$2,98^{bcde}$	$3,79^{a}$	$3,88^{a}$	$4,15^{a}$	$4,11^{a}$	0.0001
Pork_frq		2.65^{bcde}	3.34^{ade}	3.61^{a}	3.85^{ab}	3.78^{ab}	0.0001	$2,40^{bcde}$	$3,18^{a}$	$3,14^{a}$	$3,18^{a}$	$3,32^{a}$	0.0001
Open Link	1= open voluntary link on legumes, 2=no	1.62^{de}	1.61^{de}	1.67^{de}	1.87^{abc}	1.78^{abc}	0.0001	1.62^{ce}	1.68^{e}	1.78^{ae}	1.82^{a}	1.91^{abc}	0.0001

GER: Cluster B= "Contemplators", Cluster C= "Wary of processed", NZ: Cluster B= "Open, but vary to replace", Cluster C= "Seekers of meat alternatives", --- A T-test evaluates significant differences at $p<0.05$-level, except for Gender (Wilcoxon rank-sum test). Significant differences are marked with superscript letters of differing cluster. The non-parametric Kruskal-Wallis-Test with ties evaluates significant differences over all clusters. [1]the survey scales for education differ between countries, due to the different educational systems.

Figure 3 Multinominal Logit: concepts and barriers regressed on cluster membership (NZ)

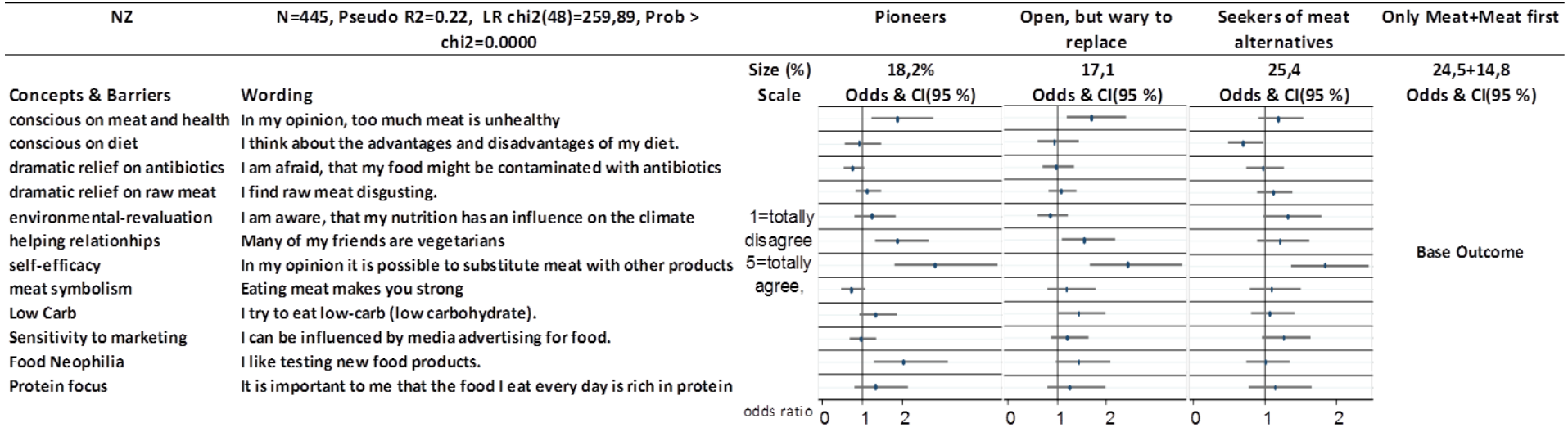
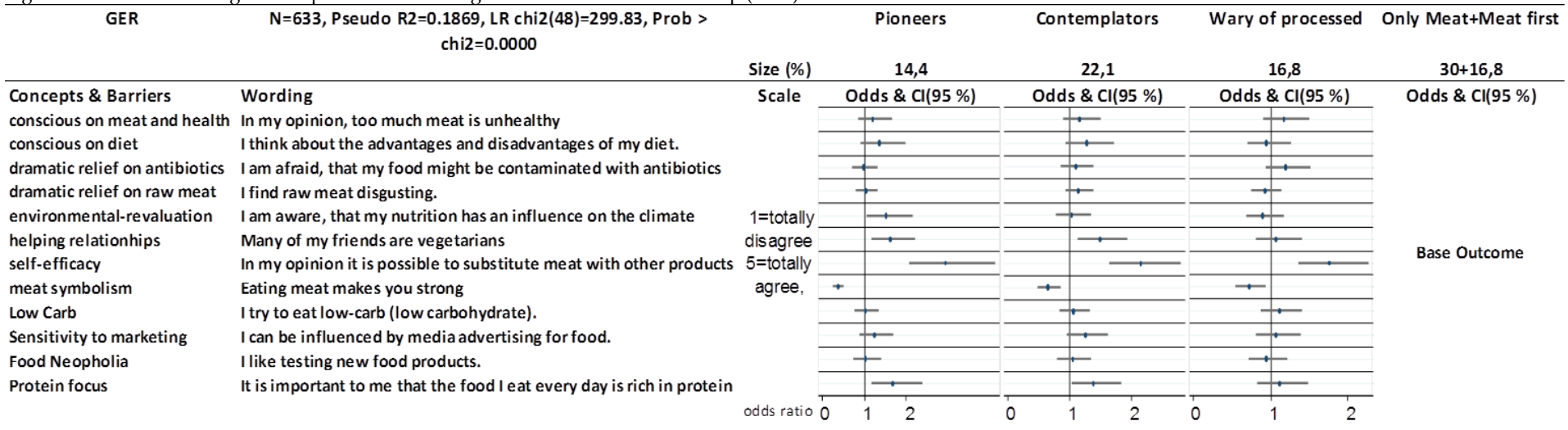


Figure 4 Multinominal Logit: concepts and barriers regressed on cluster membership (GER)



Graphical presentation shows odds ratios & confidence intervals (CI) at 95%-level