Tipping the next customer on the shoulder? A segmentation study and discussion of targeted marketing to further plant-rich dietary transition

Jessica Aschemann-Witzel a,*, Maartje D.G.H. Mulders a, Meike Janssen b, Federico J.A. Perez-Cueto c,d

a MAPP - Centre for Research on Customer Relations in the Food Sector, Department of Management, Aarhus University, Fuglesangsalle 4, 8210, Aarhus, Denmark
b Department of Management, Society and Communication, Copenhagen Business School, Denmark
c University of Copenhagen, Department of Food Science, Rolighedvej 26, Frederiksberg C., 1958, Denmark
d Department of Food, Nutrition and Culinary Science, Umeå University, Sweden

ARTICLE INFO

Keywords:
Consumer behaviour
Plant based food
Sustainability
Segmentation
Social network
Tipping point

ABSTRACT

The agricultural sector is responsible for a large share of natural resource use and climate impact. A sustainable food system transition requires amongst others that a majority of consumers begins to eat more plant based. However, so far, only a niche or minority of consumers eats primarily plant based. With a conceptual background in positive tipping points in sustainability transitions and social network theory, this paper uses a segmentation analysis of representative consumer survey data in Denmark to characterize segments that differ in psychological drivers or barriers of meat reduction. From the eight segments found, three are already part of the niche, three emerge as opposed to plant-based, but two are potential next consumers. We discuss how to trigger behaviour change towards eating more plant-rich in ways that match the segments potential motivations and barriers and contribute to literature and work on sustainable food systems transitions.

1. Introduction

Natural resources are under immense pressure (Steffen et al., 2015). Human activities related to agriculture and food emit approx. 20–35% of greenhouse gas (GHG) emissions and the sector contributes majorly to freshwater withdrawal and global land use-change (Foley et al., 2011). Without drastic changes, the demand for agricultural and food production is projected to increase (Keating et al., 2014; Ruøs et al., 2017), not least due to inequalities in food distribution, population growth, and change in dietary preferences in emerging economies (Godfray et al., 2010). Meanwhile, climate change outcomes increase the risk of food insecurity (Hasegawa et al., 2021). A particularly decisive role in foods environmental impact can be attributed to the consumption of meat and animal-based products: Their GHG emissions are estimated to be twice those of plant-based foods (Xu et al., 2021), and there is a general hierarchy from low impact plant-based staple foods to high impact red meat (Clune et al., 2017). In Denmark, for example, animal-based foods constitute 30% of the average diet but contribute to 75% of the diet’s GHG emissions (Bruno et al., 2019). Overall, the livestock sector contributes to the pressure on our natural resources and the transgression of planetary boundaries (Bowles et al., 2019). A striking fact can be observed in the visualisation of the relative weight of biomass: wild mammals constitute only a tiny fraction of the mammals on earth, mainly due to the sheer numbers of livestock humans are rearing across the planet (Bar-On Yinon et al., 2018).

Therefore, shifting human consumption to predominantly plant-rich diets is recommended as among the most impactful demand-side actions that can be taken (Bajtelj et al., 2014; Keating et al., 2014; Poore and Nemecek, 2018; Springmann et al., 2018; Willett et al., 2019). Consumers’ individual choices are crucial in the transition to more sustainable food systems, and a switch to more plant-based diets could be beneficial in terms of greenhouse gas emission reduction of up to 50% (Aleksandrowicz et al., 2016; Hallström et al., 2015; Poore and Nemecek, 2018), but also to reduce land and water use and more diverse and regenerative sustainable agricultural production. Such huge potential has also been assessed for the case of Denmark (Prag and Henrikson, 2020). In Denmark, plant-based food and primarily plant-based diets currently constitute a market niche and are only followed by a smaller

* Corresponding author.
E-mail addresses: jeaw@mgmt.au.dk (J. Aschemann-Witzel), mamu@mgmt.au.dk (M.D.G.H. Mulders), mj.msc@cbs.dk (M. Janssen), armando.perez@umu.se (F.J.A. Perez-Cueto).

https://doi.org/10.1016/j.clrc.2023.100154
Received 6 July 2023; Received in revised form 16 November 2023; Accepted 19 November 2023
Available online 23 November 2023
2666-7843/© 2023 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).
share of the population (Reipurth et al., 2019). The recent years show, though, that there is a potential for change. In Europe, there is a growing consumer interest in reducing meat consumption and choosing plant-based foods – according to a survey by the project ‘SmartProtein’ in 2021 25% of respondents identify as flexitarians, and 46% state they eat less meat than they did a year ago (SmartProtein, 2021). In Denmark, the number of citizens that report eating lunch respectively dinner 3–4 times per week without meat (thus defined as flexitarian) by the Danish Vegetarian Society (DVFJ) has doubled from 8.2% to 16.8% between 2017 and 2021 (Dansk Vegetarisk Forening, 2021). Internationally, there are also more and more food market innovations that tap into this consumer trend (New Nutrition Business, 2021). European policy documents in the agriculture and food area increasingly call for a food system transition including dietary change towards more plant-rich diets (e.g. SCAR, 2021).

For plant-based diets to become ‘normal’ in the broader population, literature on transitions suggest that a more profound change of the current system needs to occur for the new innovation – the plant-based products and the behaviour of eating more plant-rich diets - to move out of the niche (Geels, 2004; Mylan et al., 2019; Schot and Geels, 2008). Sustainability transitions literature explores how to trigger transformation with intent. Societal tipping points play an important role in this; these are points at which an action can trigger large-scale change (Global Systems Institute, University of Exeter, 2022). In this literature stream, different consumer groups have mainly been described in terms of their degree of meat consumption and as differing in the degree of adopting more plant-rich diets along the diffusion of innovation curve (Food and Land Use Coalition, 2021). However, not all consumers indicating an interest are also already conducting respective behaviours or will move on to do so (Aschemann-Witzel et al., 2021; Sijtsma et al., 2021; Hielkema and Lund, 2021), and this can be due to a variety of reasons. A more in-depth, multi-dimensional exploration of the psychographics and socio-demographics that characterize different segments and their stance to meat reduction and plant-based food can provide more actionable recommendations on how best to appeal to and approach potential new plant-based consumer groups (Gonera et al., 2021). In other words, consumers differ widely, thus also the approaches of reaching out to them need to be diverse. In addition, social networking theory suggests that spreading of a new and more complex behaviour - such as a dietary habit change - happens in close social groups but does not as easily ‘spring over’ to other social groups, as do simple behaviours (Centola, 2021). It is therefore also of relevance how many close peers an individual knows, who have already taken up the new behaviour, and how important these persons and their opinion is for them. This study explores consumer segments among the Danish population that differ in attitudes, beliefs, and perceptions of the issue of meat production, reduction and more plant-based eating as well as their assessment of their peers’ behaviours. On the conceptual background of positive tipping points in sustainability transitions literature and social network theory, the aim of this research is to characterize the segments on multiple aspects so as to allow deriving targeted recommendations for policy and marketing that can help to move the plant-based trend from niche to mainstream. We discuss targeted marketing and policy approaches that can be actionable recommendations for market actors to reach out to these different segments. The research contributes to literature and work on sustainable food systems transitions using the case of the plant-based consumer in Denmark.

2. Background

2.1. Plant-based foods and diets

The Danish Vegetarian Society (Dansk Vegetarisk Forening, 2022) writes that a “plant-based diet consists of whole and unprocessed plants such as fruits, vegetables, legumes, nuts, grains, seeds and whole grains, possibly with the addition of small quantities of processed products and/or animal products”. However, some authors define ‘plant-based’ as excluding all animal-based foods (Ostfeld, 2017), and a recent survey indicates that consumers are more likely to interpret plant-based as vegan, that awareness of the term is lacking, and that it tends to be perceived as more favourable than vegetarian and vegan (Faber et al., 2020). The WHO acknowledges that diets “predominantly plant-based and low in salt, saturated fats and added sugars” are recommended as part of a healthy lifestyle (WHO, 2021, p. 1), and subsumes plant-based diets as “… dietary patterns that emphasize foods derived from plant sources coupled with lower consumption or exclusion of animal products”. We follow the definition of a plant-based diet as potentially including a minimal share of animal-based foods, given that this is also in line with the ‘planetary health diet’ (Willett et al., 2019), and we indicate that by using the phrasing ‘more plant-based’ or ‘plant-rich’.

2.2. Sustainability transitions and positive tipping points

Transitions in society through which new innovations are incorporated and become widespread have been conceptualized and modelled in transition and innovation management literature. The multi-level framework (Geels, 2004) suggests that there are different regimes such as the technological and the political regime, as well as different hierarchies of levels in society, from the niche to the regime and to the landscape. Profound system innovation likely involves change in all of these. Strategic niche management is concerned with exploring how new niche innovations are able to grow, as well as how a niche evolves in spite of the established ‘regime’ and then interacts with the regime until for example the first is incorporated in the latter, or changes the regime (Schot and Geels, 2008; Mylan et al., 2019). While technology and innovation transitions literature in the beginning often analysed the energy sector, there is now an increasing focus on also exploring the food area and more specifically the plant-based sector with the transitions framework in mind (e.g. Mylan et al., 2019; Saari et al., 2021; Tziva et al., 2020). In a marketing context, it has been found that there is an increasing conflict expressed in the marketing communication of plant-based versus animal-based drink and milk producers (Koch and Ulver, 2022). For an overview on transition heuristic frameworks for sustainability in the agricultural sector, see El Bilali (2020).

The sustainable transitions literature explores how to trigger change in systems with a more sustainable outcome as a result. It draws from the leverage point framework introduced in systems thinking, with a hierarchy of leverage points providing more ‘lever’ for change the more profoundly it changes the underpinnings of a system with its different feedback mechanisms, instead of the surface mechanism alone (Meadows, 2008). Recently, the wording of ‘bad tipping points’ known from the planetary boundaries (Steffen et al., 2015) have been transferred to the social sciences field, and researchers have begun to suggest that there can be positive tipping or ‘sensitive intervention’ points, at which “small interventions can trigger self-reinforcing feedbacks that accelerate system change” (Global Systems Institute, University of Exeter, 2022, p. 3).

Diffusion of innovation theory suggests that there can be a kind of ‘critical mass’ in terms of the rate of adoption among users, at which the adoption accelerates following an S-curve (Rogers, 2010). Such critical mass can be understood as the point where the development ‘tips’, and thus it is interesting to explore which kind of actions can support more adopters to change (Lenton, 2020). Where this is situated, and how easy the change is, depends amongst others on the characteristics of the innovation (Rogers, 2010) and the ‘social contagion’ potential of the innovation, the threshold at which different persons adopt the innovation, as well as the social structure in the population (Centola, 2021). Research and reports discuss that such a point might lie between 10 and 40% or at circa 25% of the population (Food and Land Use Coalition, 2021). However, citizens and consumers are neither well-described with uni-dimensional categorisations such as the degree of meat
3.2. Survey variables

For the identification of clusters, six psychographic constructs were chosen as segmentation variables (Table 2), on the grounds that psychographics are particularly important drivers of consumer behaviour. All constructs were measured using 7-point agree-disagree Likert scaled items, unless otherwise explained. You can find the full wording of the statements in Table 2.

A general environmental concern scale was used using four items
based on Haws et al. (2013). Knowledge and beliefs about meat production and consumption reduction were measured using variations of phrasings such as ‘Eating less meat is beneficial . . . ’ or ‘Meat can be produced . . . ’ and then referring to climate, environmental and health aspects. These six items mirrored aspects also asked in previous literature of the field (e.g. Markovina et al., 2015). For analysis, we distinguished between a three-state measure indicating the believed benefits of reducing meat consumption, and a three-state measure indicating beliefs about meat production and consumption, e.g. whether it is important for health and can be conducted in environmentally or climate friendly manner.

Further, we developed a range of statements describing the degree to which a conflict is perceived when it comes to meat-versus plant-based food and diets. This was newly developed given there was no scale measuring this, which might be due to the fact that it is a very recent development that the issue has become a subject of mainstream media as well as policy discussions. Inspiration was drawn from a media report (Foodnavigator, 2021), and the items were pre-tested among faculty members. Moreover, as it is known that social interaction and peer contact is relevant for adoption of new behaviours (Centola, 2021), a simple question was asked on how many persons the respondent knows who have reduced meat consumption or do not eat much meat, measured on a scale from 1 = none to 7 = nearly all I know, based on Randers et al. (2021). Lastly, respondents were asked to think of three persons they know who have reduced meat consumption during the last 10 years and asked the following questions for each: How much they are like this person, how important it is what this person thinks, and to which extent they trust that person’s judgement. These questions were also inspired by the book by Damon Centola (2021). On the assumption that the first person assessed must be most relevant, and given the answers to the three questions correlated, we based our measure of the ‘importance of others’ in this issue on an average of the three questions. Please find an overview of the items of these variables as explained above in Table 2. All items were checked in its translation to the survey language (Danish) by several authors to ensure agreement, and back-translated by a Danish-speaking research assistant.

After identification of the clusters through the psychographic variables explained above, we used further variables to profile and thus better understand the distinctions between the resulting segments. These variables are mainly sociodemographic variables, because these are variables of importance for operationalising targeted approaches in policy and marketing, such as gender, age, high versus low education and residing in a city versus a rural area. We also measured the degree of understanding oneself as a meat-eater with a simple question and various response choices from meat-eater over to flexitarian and to vegetarian or vegan (DCA, 2021) – a statement that is also used in the national dietary surveys in Denmark. Note that we did not include a food frequency questionnaire, which would allow to have an approximation of actual consumption of different types of animal-versus plant-based food categories. We decided against this both for reasons of space – it

<table>
<thead>
<tr>
<th>Table 1 Sociodemographic sample characteristics.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variable</strong></td>
</tr>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>Education</td>
</tr>
<tr>
<td>Region of country</td>
</tr>
<tr>
<td>Degree of urbanisation</td>
</tr>
</tbody>
</table>

| Note. n = 1121. |

<table>
<thead>
<tr>
<th>Table 2 Measurement items of the survey questionnaire.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measure</strong></td>
</tr>
<tr>
<td>Cluster identification: Environmental concern</td>
</tr>
<tr>
<td>Beliefs about benefits of meat reduction</td>
</tr>
<tr>
<td>Beliefs about meat production and consumption</td>
</tr>
<tr>
<td>Perception of conflict</td>
</tr>
<tr>
<td>Known number of persons to have reduced meat consumption</td>
</tr>
<tr>
<td>Importance of others who have reduced meat consumption</td>
</tr>
</tbody>
</table>

(continued on next page)
Table 2 (continued)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Question or items</th>
<th>Where relevant: Cronbach α or Pearson correlation, M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster characterisation (apart from sociodemographics):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-ascribed dietary identity: understanding oneself as a meat-eater or not</td>
<td>Choose the statement that best describes you:</td>
<td>75.6%</td>
</tr>
<tr>
<td></td>
<td>I see myself as a meat-eater.</td>
<td>18.9%</td>
</tr>
<tr>
<td></td>
<td>I see myself as a flexitarian.</td>
<td>2.3%</td>
</tr>
<tr>
<td></td>
<td>I see myself as a pescatarian.</td>
<td>1.8%</td>
</tr>
<tr>
<td></td>
<td>I see myself as a vegetarian.</td>
<td>1.3%</td>
</tr>
<tr>
<td></td>
<td>I see myself as a vegan.</td>
<td>0.5%</td>
</tr>
<tr>
<td>Cooking competences</td>
<td>I am able to prepare a hot meal without a recipe.</td>
<td>5.82 (1.47) α = 0.85</td>
</tr>
<tr>
<td></td>
<td>I am able to prepare soup.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I am able to prepare sauce.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I am able to bake cake.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I am able to bake bread.</td>
<td></td>
</tr>
</tbody>
</table>

Notes. n = 1121. If not indicated otherwise, the variable is measured on a 7-point likert agree-disagree scale following the question “To which extent do you agree or disagree with these statements?”. The Danish language version of the questionnaire can be supplied on request.

would use a lot of time in the survey and then reduce quality of responses – and because the focus of the study was on psychographic variables. Therefore, the variable we used on ‘consumption’ was about self-ascribed dietary behaviour. Of course, some respondents understanding oneself as flexitarian might in fact eat a lot of meat and not per se much plant-based, while some respondents understanding oneself as a meat-eater might just as well eat less meat than some self-ascribed ‘flexitarians’. However, the question was intentionally chosen to be more about identity than about behaviour, thus asking how they understand oneself, given this is one of the prerequisites for change. Lastly, we also used cooking competence, measured with five items adapted from the literature in the field (Kowalkowska et al., 2018; Lavelle et al., 2017; Hartmann et al., 2013) as a variable in characterisation of the resulting segments.

3.3. Cluster analyses

First, the data was subjected to a two-step cluster analysis procedure (following the procedure by Punj and Stewart, 1983) based on the six selected psychographic variables related to the issue at hand (perception of conflict about plant vs. meat, number of people one knows who have reduced their meat consumption, importance of other persons who reduce meat consumption, beliefs about the benefit of reducing meat consumption, beliefs about animal production, environmental concern). The first step was a hierarchical cluster analysis (average linkage method) to identify outliers and decide on the appropriate number of segments. Following the procedure suggested by Mazzaochi (2008), we identified and excluded further cases as outliers, resulting in a sample size of n = 1121. The optimal number of segments was determined based on the elbow criterion and inspection of the dendrogram, suggesting an eight-cluster solution. There was also a potential solution at four clusters, but we gave priority to more diversity and multiple dimensions to explore – similarly as Gonera et al. (2021) –, as well as for considerations of plausibility and manageability, we decided to favour the eight-cluster version. The second step encompassed a K-Means cluster analysis to establish the final clusters.

Afterwards, we characterized the clusters with sociodemographic variables using ANOVA (living in a rural area vs. in the city, education level high versus low, average age, gender as female or male) and whether they understood oneself as a meat-eater or not as well as the degree of cooking capabilities. All analyses were performed in SPSS 27.0. In all cases a p value < 0.05 was considered as statistically significant.

4. Results

4.1. Description of sample with regard to meat- and plant-based food and diets

Most consumers in the sample consider themselves meat eaters: over 75% self-ascribe as such, in turn, 1.9% or 1.3% consider themselves vegetarian or vegan, respectively, the rest chose flexitarians. More than half of respondents (i.e., 52.15%) report never having used plant-based replacement products (e.g., plant-based milk or meat). However, many respondents report eating vegetarian/vegan meals and dinners: 27.1% and 16.5% of respondents indicate eating vegetarian/vegan lunches or dinners, respectively, more than half the days of the week.

4.2. Identification and characterisation of consumer segments

The description of the clusters using the variables that were included in the cluster procedure can be seen in Table 3 in the upper part. The result of the characterisation of the clusters using further variables is shown in the lower part of the table. In the following, we first give an overview of the cluster results and the overall pattern of statistical differences or similarities. Then, we explain the grouping and visualisation of the results in Fig. 1. How each cluster can be understood as a consumer group is part of the implication, and thus this interpretation is described in the discussion. Each cluster has a number so that it can more easily be identified in the tables and figure. We retained the numbers that the clustering procedure randomly allocated to the resulting segments, to avoid that our numbering might appear to insinuate any segment being ‘better or worse’.

4.3. Overview of patterns of differences and similarities in the clusters

We first describe the cluster differences and similarities with regard to the psychographic variables used for the identification of clusters, before we move to describing the differences in the variables used for characterisation, including the sociodemographics. We focus in particular on the clusters with the significantly highest and lowest values.

Two clusters, 1 and 7, show a significantly higher environmental concerns compared to all other clusters except 6. The means for clusters 6 and 8 are also above the average of 4.57 of the whole sample. Clusters 2–5 are all significantly lower than the remaining clusters, with cluster 2 significantly lowest compared to all clusters except 3.

Cluster 1, with an average of 6.60, expressed a significantly higher belief in benefits of meat reduction compared to all other clusters. Cluster 8 shows also high respective beliefs, but not significantly different from cluster 6, which in turn is not significantly different from cluster 7, and 7 not different from 4. These clusters all have an average value of more than five. Clusters 3 and 5 are with 2.25 and 2.11 significantly lowest compared to all other clusters. Interestingly, cluster 1, in turn, shows the significantly lowest belief about meat production and consumption - that it can play a role for nutrition and that its production can be organised sustainably - compared to all other clusters, while the opposite is seen for cluster 5, which has the highest belief in this, compared to all other clusters. Clusters 6 and 7 are also above the average of 4.80 of the sample, significantly lower than cluster 5 but higher than all other clusters.

Cluster 5 is significantly highest compared to all other clusters in perception of conflict in the issue of ‘plant-based versus meat’ in the public and societal debate. Cluster 6 is second highest and also above the average of 4.55 of the whole sample, but this is not significantly different from 1, 2, 4, and 7. Clusters 3 and 8 show the lowest perception of conflict of all clusters, but only significantly different from clusters 5 and 6.
In terms of known number of persons who have reduced meat consumption, cluster 6 know most, significantly more than all other clusters, followed by cluster 1. Clusters 4 and 5 know the least, significantly different from all clusters except cluster 3, which is also below an average of two. Only cluster 1 and 6 but also cluster 8 show averages above the mean for the whole sample of 2.78, while all other clusters are below 2.5 or even two. Interestingly, importance of others who have already reduced meat consumption was significantly higher for cluster 8 compared to all other clusters, followed by cluster 6. This variable was significantly lowest for cluster 4, followed by 3 and 5. In cluster 4, a high share of the respondents indicated that the question of what others who have reduced consumption think of them, does not apply (coded 0 – not applicable, thus explaining the low average).

With regard to the variables characterising the clusters, we can see that the significantly lowest share of those who do not understand oneself as a meat eater is among cluster 1, compared to all other clusters, followed by 6 and 8. Cooking competences are rather similar except for cluster 7, in which they are significantly higher than cluster 2. The share of females is significantly highest in cluster 1, with 80%, but this is not significantly different from cluster 8, in which there are 65% females. There are fewest females in cluster 5 with 34%, but this is only significantly different from cluster 7, in which they are significantly higher than cluster 2.

### Table 3
Cluster description with identification and characteristic variables.

<table>
<thead>
<tr>
<th>Cluster identification</th>
<th>n = 1121</th>
<th>1 n = 82</th>
<th>2 n = 225</th>
<th>3 n = 81</th>
<th>4 n = 184</th>
<th>5 n = 121</th>
<th>6 n = 149</th>
<th>7 n = 131</th>
<th>8 n = 148</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental concern</td>
<td>4.57</td>
<td>5.55(1.98)</td>
<td>3.80(0.89)</td>
<td>3.37(1.43)</td>
<td>4.40(1.07)</td>
<td>3.87(1.10)</td>
<td>5.34(1.11)</td>
<td>5.58(0.70)</td>
<td>4.95(0.92)</td>
</tr>
<tr>
<td>Beliefs about benefits of meat reduction</td>
<td>4.74</td>
<td>6.60(0.59)</td>
<td>4.62(0.98)</td>
<td>2.25(1.02)</td>
<td>0.01(0.99)</td>
<td>2.11(0.94)</td>
<td>5.50(1.15)</td>
<td>5.18(0.86)</td>
<td>5.85(0.92)</td>
</tr>
<tr>
<td>Beliefs about meat production and consumption</td>
<td>4.80</td>
<td>2.31(0.87)</td>
<td>4.63(0.85)</td>
<td>3.38(1.27)</td>
<td>4.80(0.99)</td>
<td>6.22(0.72)</td>
<td>5.43(0.94)</td>
<td>5.62(0.80)</td>
<td>4.67(1.05)</td>
</tr>
<tr>
<td>Perception of conflict</td>
<td>4.55</td>
<td>4.42(1.13)</td>
<td>4.43(0.94)</td>
<td>4.01(1.31)</td>
<td>4.43(1.13)</td>
<td>3.58(1.04)</td>
<td>4.83(1.06)</td>
<td>4.49(0.99)</td>
<td>4.28(0.99)</td>
</tr>
<tr>
<td>Known number of persons to have reduced meat consumption</td>
<td>2.76</td>
<td>4.18(1.35)</td>
<td>2.48(0.94)</td>
<td>1.98(1.21)</td>
<td>1.73(1.01)</td>
<td>1.59(0.88)</td>
<td>5.34(0.97)</td>
<td>2.29(0.86)</td>
<td>3.01(0.92)</td>
</tr>
<tr>
<td>Importance of others who have reduced meat consumption</td>
<td>3.19</td>
<td>4.32(1.65)</td>
<td>3.73(0.92)</td>
<td>1.75(1.19)</td>
<td>0.33(1.01)</td>
<td>1.33(1.33)</td>
<td>4.82(1.10)</td>
<td>3.51(0.96)</td>
<td>5.69(0.70)</td>
</tr>
</tbody>
</table>

**Cluster characterisation**

| Understanding oneself as a meat-eater (%)                                           | .76(.43) | .35(.48) | .88(.33) | .89(.32) | .83(.38) | .95(.22) | .54(.50) | .86(.35) | .60(.49) |
| Cooking competences                                                                 | 5.82     | 6.12(1.47) | 5.47(1.51) | 5.50(1.66) | 5.59(1.75) | 6.05(1.38) | 6.09(1.21) | 6.19(1.21) | 5.91(1.44) |
| Female gender (%)                                                                   | .52(.50) | .80(1.20)  | .53(1.20)  | .42(1.16)  | .42(1.16)  | .34(1.17)  | .49(1.38)  | .47(1.38)  | .49(1.38)  |
| Age (years)                                                                          | 44.05    | 38.60(13.94) | 41.22(13.96) | 45.19(13.75) | 47.23(13.79) | 48.77(12.34) | 41.53(12.64) | 49.84(12.34) | 40.22(12.34) |
| High education level (%)                                                             | .56(.50) | .56(13.75)  | .50(13.75)  | .42(13.75)  | .57(13.79)  | .42(13.79)  | .62(13.86)  | .69(13.86)  | .65(13.86)  |
| City dwellers (%)                                                                    | .40(.49) | .50(13.75)  | .43(13.75)  | .25(13.75)  | .36(13.75)  | .22(13.79)  | .44(13.86)  | .40(13.86)  | .47(13.86)  |

### Notes
- n = 1121. If not indicated otherwise, the numbers are M (SD) on a 7-point scale. Superscript letters indicate significant differences according to Chi-square tests or Post-hoc tests (Scheffe).
- Clusters are ordered based on the mean score of the identified variable.

**Fig. 1. Groupings and visualisation of the findings.**

Note: Extent of environmental concern is measured on a 7-point agree disagree scale and the numbers indicate the mean of the cluster members. Percentages indicate the share of respondents in a cluster who self-ascribed as meat-eaters (versus a flexitarian, vegetarian, or vegan).
Source: Own.
city dwellers, this is highest in cluster 1 with 57%, but this is only significantly different from cluster 3 and 5 with 25% and 22%.

4.4. Grouping and visualisation of clusters

In Fig. 1 (see Fig. 1), the clusters are positioned in a two-dimensional space according to the extent of environmental concern and the share of respondents understanding oneself as a meat-eater, thus self-ascribing increasingly as flexitarian or vegetarian/vegan. Note that the extent of environmental concern was a variable used in conducting the cluster analysis and thus identification of the clusters, while the self-ascribed dietary profile is a variable that we first used in characterisation of the clusters. We chose this visualisation for the following reason: First, only two axes can be shown in a two-dimensional space. Second, we thus decided that for this visualisation, we use a clustering variable that emerged as a particularly relevant distinction between the clusters – environmental concern - and contrast this with a characterisation variable particularly important for the application of the findings to the market: the share of self-ascribed dietary profile. Note, however, that the choice of the environmental concern as one of the two axes does not mean this is the only motive for consumers – other motives such as e.g. health are discussed in the details of the cluster characterisation.

Based on the cluster results, it emerges that there are similarities in terms of the dietary profile - a high share of respondents identifying as flexitarian or vegetarian/vegan - between cluster 1, 6 and 8, and these are also clusters with a high or relatively high environmental concern. We mark these clusters in green. Clusters 2, 3 and 5 emerge as relatively lower in environmental concern while they also have a high share of self-ascribed meat-eaters, and we mark these in blue. Two of the eight clusters, clusters 4 and 7, however, we mark in yellow, as these have in common that environmental concern is moderate or high, but the share of self-ascribed meat eaters is high as well.

5. Discussion

5.1. Discussion of overall findings

This study was conducted on the rationale that it needs identifying segments based on multiple distinct dimensions in order to be able to develop recommendations for market and policy actions for fostering the dietary transition towards more plant-based foods and diets. Such market and policy actions are sought to accelerate the societal transition, potentially contributing to achieving societal tipping points in terms of dietary change.

From the data analysis, eight segments emerge. We cluster these more broadly in three groups – inspired by Verain et al. (2012) - by interpreting these as the current, the unlikely and the potential consumers. This classification also mirrors previous segmentation studies on green consumption, which often arrived at three broader groups (Verain et al., 2012), and it is in agreement with the overall picture provided by other segmentations (e.g. Malek et al., 2019; Brunin et al., 2022). However, similar to Gonera et al. (2021), we show that there are distinct groups within these broad classifications, which allow more in-depth recommendations for targeted approaches.

Societal transitions literature tentatively suggests that ‘tipping points’ might be achieved when between 10 and 40% of a population accept a new behaviour, with Centola (2021) even going so far and pinpointing 25% as the point of change across a diversity of cases. Considering transition in plant-based eating, the 2019 study by Hielkema and Lund had focused on the different stages of change and grouped consumers accordingly into four types. They underline the recommendation to promote reduction of meat (versus removing), given most respondents see themselves as ‘meat-eaters’. They also discuss a range of interventions, from communication to peer effects and choice architecture, as adequate for consumers at different stages. A further paper, Halkier and Lund (2023), explores the question of social practices further, and finds four clusters among Danish flexitarians; They propose that individuals shift from one cluster to the next over time while barriers to plant-rich eating are lessened, thus underlining that new norms or behaviours become routinized – which one can regard an example of a self-reinforcing feedback. Similarly, our discussion of the potential for self-reinforcing feedback leads us to conclude that mechanism of the ‘social kind’ have a particular potential for furthering a societal transition.

In this paper, we aimed to explore how consumer segments are characterized that might be the target group that ‘tips’ next towards the new behaviour – should this very general prediction turn out to hold true for the case of plant-based eating among consumers in Denmark. With tipping points defined as the place and time where ‘small interventions can trigger self-reinforcing feedbacks that accelerate system change’, the question that arises is a) which could be the small interventions, when applying this to the topic and the consumer segments in this study, and b) if and how this could trigger self-reinforcing feedbacks that accelerate uptake of plant-based foods and eating?

In the following, we describe each cluster and its characterisation, including the suggestion of a name that allows to grasp the potential consumer target group identified through the cluster. Thereafter, we discuss questions a) and b).

5.2. Cluster description and characterisation – the green segments

5.2.1. Cluster 1: the “concerned and radically engaged”

This cluster stands out with the highest belief in the benefits of reducing meat consumption while at the same time agreeing least with that meat can be produced sustainably or contribute to health. Further, the segment stands out as the one with the lowest share of self-ascribed meat-eaters. The cluster is characterized by high environmental concern. They know relatively more people who already have reduced meat consumption, and these others matter to them. It is characterized by consisting mostly of city dwellers, has the highest share of females, and the lowest mean age.

5.2.2. Cluster 6: the “green mainstream”

This cluster stands out as the group that knows the most people who already have reduced meat consumption. These others matter to them. The cluster is also characterized by high environmental concern. Compared to cluster 1, however, this group only moderately agrees to both that reducing meat has benefits and that meat can be produced sustainably. Further, this group has the second lowest share of self-ascribed meat eaters and a relatively high education level.

5.2.3. Cluster 8: the “others matter – don’t see the conflict”

This cluster stands out as the cluster to whom other persons who have reduced meat consumption matter most. They perceive a very low level of conflict surrounding meat and plant-based food consumption. The cluster has a moderate level of environmental concern and agrees that reducing meat has benefits. Further, this group has, together with cluster 6, the second lowest share of self-ascribed meat eaters, a relatively high share of females, and relatively higher education levels as well as a higher share of city dwellers, and is of relatively younger age.

5.3. Cluster description and characterisation – the blue segments

5.3.1. Cluster 5: the “disagree & perceive conflict”

The cluster stands out on that they agree the most with that meat can be produced sustainably, and they know, together with cluster 4, the least people who already have reduced meat consumption. They also stand out in that they perceive the highest level of conflict. They disagree the most, together with cluster 3, with benefits of reduced meat consumption. Respondents in this cluster are relatively less environmentally concerned. Those they know who have reduced meat consumption do not matter much to them. Further, this segment has the
least city-dwellers, the lowest education level, the least females and the highest age.

5.3.2. Cluster 3: the “disagree – don’t see the conflict”
This cluster stands out with the lowest environmental concern. Respondents in this cluster disagree the most, together with cluster 5, with that there are benefits of reduced meat consumption. They disagree that meat can be produced sustainably. They perceive, together with cluster 8, the lowest level of conflict. They know relatively few who have already reduced meat consumption. These do not matter much to them. Further, this group has a low education level, less city-dwellers, and relatively more men.

5.3.3. Cluster 2: the “uninvolved”
Respondents in this cluster are characterized by being relatively less environmentally concerned. They know less people who have already reduced meat consumption. The few people they know matter to them. The cluster stands out literally for not standing out - in any of the variables from the cluster procedure. However, among the characterisation variables, it can be seen that they stand out with the lowest cooking capability. We interpret the variables as indications of lower involvement with the issues of the survey and with food, hence the naming.

5.4. Cluster description and characterisation – the yellow segments

5.4.1. Cluster 4: the “moderates”
Respondents in this cluster see some benefit of reducing meat consumption. The group is characterized by that they know the least people who already have reduced meat consumption. Most respondents in this group stated that the question on whether other persons who have reduced meat consumption matter to them does not apply. Further, there are relatively more who live in the rural area, and the average age is slightly higher.

5.4.2. Cluster 7: the “concerned capable”
This cluster is characterized by, together with cluster 1, the highest environmental concern. They agree that reducing meat has benefits and also that meat can be produced sustainably. They do not know many who have already reduced meat consumption. Further, this group stands out with the highest age, highest education level, and highest cooking capabilities.

5.5. Interventions targeted to most relevant green, yellow or blue segments
Interventions for the four segments ‘in the middle’ are discussed in the following. While it is apparent that the yellow groups could be the potential next customers, one could also argue for that the groups with the yet lowest share of self-ascribed flexitarians among the current consumers could be relevant to target, or that the group among the unlikely consumers with the least apparent resistance expressed in the potential next customers, one could also argue for that the groups with the following. While it is apparent that the yellow groups could be the next customers, one could also argue for that the groups with the lowest level of conflict. They know relatively few who have already reduced meat consumption. These do not matter much to them. Further, this group has a low education level, less city-dwellers, and relatively more men.

5.5.1. The role of social norms, identity and peer effects
Segment 8 from among the ‘green’ clusters already contains quite a lot of respondents who do not see themselves as meat-eaters and are likely already consuming more plant-based, but the group might as well become more dedicated with regard to dietary change. Barriers are low, given respondents see the lowest conflict about the issue, and are convinced of the benefits of reducing meat consumption, in addition, living majorly in cities, there ought to be less availability barriers. The fact that this group is distinct in placing the highest importance on the opinion of significant others who have already reduced meat consumption, suggests that communication or activities that make use of social norms in favour of plant-based diets among the peers would be a good intervention.

Respondents in segments 7 but even more so segment 4 appear not to know many others who have already reduced meat consumption. Thus, activities that allow to meet or hear about similar others that have reduced meat consumption, or activities or communication that helps to envision one’s own peer group as part of this trend, would thus be useful to address social barriers.

5.5.2. The need for information and communication
A striking observation is that segment 7 is, together with segment 1, highest on environmental concern, but unlike segment 1, has a very low share of respondents not identifying as a meat-eater. It seems that this group might have a potentially strong motivator – environmental concern – that has not yet but could translate into behaviour change. This might be explained by the fact, as shown in other research, that many consumers are not aware of the relatively high impact of meat consumption (Hartmann and Siegrist, 2017). With relatively high cooking capability and education, it does not appear to be capability that constitutes a barrier. Communication that makes the connection between meat consumption and production and environmental issues more salient and stronger would thus be very important for this segment.

At a first glance, segment 4 appears very similar to segment 7, but the group differs clearly from segment 7 in that they exhibit much lower environmental concern. Therefore, communication should rather focus on increasing and strengthening the belief that reducing meat consumption has individual benefits such as for example health effects.

5.5.3. Creating favourable choice architecture and ease of access
Segment 2 from among the ‘blue’ group is among the unlikely consumers of plant-based products and diets. Generally, this group appears alike to segments that are uninvolved with food as they are typically found in food-related segmentation studies (Gonera et al., 2021; Verain et al., 2012), and this is underlined by the fact that this group has the lowest self-ascribed cooking capability. However, what is striking is that this group tends to agree that meat reduction can have benefits and does not pointedly disagree as the other blue segments 3 and 5, and that the stance of significant others who have reduced meat consumption is also not rejected. Thus, two interventions can make sense to consider for this group: First, further strengthening the belief in benefits of meat reduction as well as information underpinning that there is a reason for more environmental concern, and secondly, making it easy to choose plant-based given the group does not resist this trend, by for example nudging and choice architecture in canteens or supermarkets and products that easily replace animal-based food and are convenient to use.

For segment 8, expanding the degree of purchase by strengthening already beginning habits in loyalty programs and via price reductions – given price could be an issue for the on average lower age group – could be another intervention matching this segment.

5.6. Potential for self-reinforcing feedbacks in plant-based dietary transition
With regard to the question of if and how this could trigger self-reinforcing feedbacks that accelerate uptake of plant-based foods and eating, we posit that social interactions entail the best potential for self-reinforcing feedbacks. However, we suggest that the pattern of segments also points out that there are clear boundaries, which also can be barriers between the segments: The crucial question is how the new behaviour – i.e. adopting more plant-based diets – spreads from the
The 'green' segments to in particular the yellow segments (Schenk et al., 2018).

When segments are very different from each other, with little direct or indirect contact or overlap in social circles, it appears unlikely that adoption in one segment spreads to the other segment – even less, when they are also separated by location, and thus do not frequent the same stores. Considering the size of the segments, once the yellow segments will adopt the new innovation, an early majority will be achieved. Here, a potentially crucial barrier seems to be that the yellow groups do not yet know many who already have reduced meat consumption, thus a barrier in terms of social circles (Banyte et al., 2022; Schenk et al., 2018).

When looking further towards how the new behaviour might potentially spread also to the 'blue' segments, the potentially crucial barrier seems to be connected to sociodemographic variables, in particular living in the city versus in a rural area. Thus, there also seems to be a barrier in terms of location.

We thus conclude that in considering the identified segments and how an accelerated transition can be furthered, there is one important potential for self-reinforcing feedback, and one important barrier: Firstly, social interactions (such as through experiencing a change in dietary behaviours among peers) has the most potential of helping to 'spread' more plant-rich eating. Second, the observed division in sociodemographics might pose a barrier to more intense contact between social circles, especially considering that spreading of 'complex' behaviours such as diets need strong ties (Centola, 2021).

5.7. Implications for transitions of food systems

Coming back to the framework of societal transitions and the concept of potential positive tipping points, the question is what the results can contribute. How can a dietary transition be furthered and a potential tipping point be reached? We turn back to Fig. 1 for a discussion of this. We have suggested (social) marketing approaches for the four potential 'next' consumer groups – in Fig. 1, this is clusters 2, 4, 7 and 8. If the current niche is constituted by the 'green' two segments in the upper right corner, then it is only circa 20%. However, if a marketing and policy actions such as the discussed would be put into place, a further 61% of the market (the lower green, the yellow, and the upper right blue) would be approached. If only one out of 3 of these consumers changes behaviour, then it would have 'spread' to 40% of the population – according to literature, that should suffice for a 'tipping point' to have been reached. After such a tipping point, it should be easier for further consumers to change behaviour, because then it can expected that self-reinforcing feedbacks are at work.

While these calculations are purely hypothetical, they underpin that achieving a large-scale behaviour change needs firstly, diverse marketing and policy approaches, and secondly, that these need to be combined. Transitions literature suggest that various regimes, levels and environments should be involved (Geels, 2004; Mylan et al., 2019). It is important that policies are created which, by design, enable and trigger the 'tipping points' (Fesenfeld et al., 2022).

We discuss which could be targeted approaches for the 'next' consumer clusters, and these would involve communication about the benefits of meat reduction to the 'yellow' groups, marketing such as loyalty programs to the yet less committed 'green', and nudging and choice architecture for the uninvolved 'blue' group. The first can involve stakeholders from the wider public (NGO’s, media, private foundations), the second the commitment of business (producers and retailers), and the last favourable policy moves such as green public procurement or climate taxes. These thoughts show that collaborative efforts across stakeholders are needed to further the societal transition.

5.8. Limitations and future research

It has to be cautioned that names for clusters are chosen to allure to exaggerated examples for sake of a better understanding of the direction of the distinction. However, choosing such names involves a degree of stereotyping in the process and the danger of interpreting differences from the names that are not based in the data, because the reader adds own associations. We thus caution to keep that in mind when interpreting the discussion section.

Segmentation studies with regard to food and sustainability result in broad similarities (Verain et al., 2012). However, differences in the details are very much dependent on the selection of variables and thus dependent on the careful choice of the most relevant variables. Because these variables can widely differ, comparisons between studies need to be done with care. This holds in particular when variables used are not the same, as in the case of this study compared relevant other studies that we refer to. Previous segmentation studies on meat reduction and plant-based eating conduct the cluster identification using variables that measure degree of consumption in different ways in each study. In our research, we focused only on psychographics for the cluster identification, and first then characterized the clusters on amongst others dietary identity. Hielkema and Lund (2021) and Gonera et al. (2021) are more comparable to our study in that respect. We measure similar barriers and drivers as Hielkema and Lund (2021) in that we survey beliefs and the environmental concern, and we, similarly to Gonera et al. (2021), use a measure of belief of importance of meat reduction as well as measure - though only used for cluster characterization - cooking competence.

Not all scales that we used had been previously tested. Also, the interventions discussed above were not tested as part of this study. Particularly when it comes to meat reduction, it has been pointed out that information provision might not trigger behaviour change to the extent as for other food categories (Austgulen et al., 2018). We also acknowledge that our data is limited to Denmark and the results cannot be generalized to other countries with different food cultures. However, we suggest that the general pattern of clusters might be similar across countries with similar food cultures, while the cluster sizes might differ.

We recommend future research in this field should consider how to identify different consumer groups, and explore collaborative actions across stakeholders to support a more large-scale transition. Also, following up on the current study with a field-study recruiting consumers from the identified target groups would be very valuable to test the applicability of the findings. Given the state of art in research on the role of gender environmental behaviours (e.g. de Boer and Aiking, 2023), it is not surprising that clear gender differences emerge in the cluster results. Gender equality is high in Denmark, but, to give an example, there is nevertheless a difference in household tasks on the one hand and in representation in company board membership or entrepreneurial activity, on the other hand. Studying the interaction of gender and green transition processes move in detail could be interesting.

6. Conclusions

We, firstly, conclude that we can use psychographics to identify a pattern of eight distinct segments among consumers, roughly grouped into current, potential and unlikely plant-based consumers. This finding underlines the crucial role of psychographic variables. Secondly, we conclude that the pattern of psycho- and sociodemographic differences allows identifying potential interventions targeted to the segments, which can be used to trigger dietary change. Depending on the target segment, these interventions can focus on a) social norms, identity and peer effects, b) information and communication, and c) choice architecture and ease of access and use. This finding strengthens the importance of targeted approaches in social marketing. On the background of the societal transition literature, however, we conclude thirdly, that interventions drawing on social mechanisms (norms, identity, peer effects) have the most potential to trigger positive feedback effects and tipping points by connecting social ‘bubbles’ and thereby spreading plant-based dietary change.
Declaration of competing interest and acknowledgement of funding

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Jessica Aschemann-Witzel as well as all co-authors reports financial support was provided by Innovation Fund Denmark, PlantPro, grant nr 0224-00044B.

Data availability

Data will be made available on request.

References

Bun, M., Bravenboer, J., 2016. Consumer readiness to reduce meat consumption for the purpose of environmental sustainability: insights from Norway. Sustainability 10 (9), 3058.


