What makes meat substitutes (un)attractive for Dutch consumer segments?

A Stated Choice Experiment

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A Stated Choice Experiment

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Foreword

At the start of my master thesis, all I was sure of was willing to focus on sustainability. When I think back, I could not imagine how I would manage to find a relevant research topic, define a research proposal, execute the proposal and report my findings. Now at the end of my thesis, I can proudly say that I exceeded my own expectations. The last few months I enjoyed the process of exploring this topic and put many hours and effort into my final thesis report for the master Engineering and Policy Analysis. I had a tremendous amount of support throughout the process, and I am very thankful for all the wonderful and inspiring people around me. I would like to take the opportunity to express my gratitude to a few people.

I would like to express my deepest gratitude to my committee without whom this thesis would not have been possible. I would like to thank the chair of my committee, Eric Molin, for his constant support and availability throughout my project. His insights and knowledge about choice modelling steered me through this research. To Gerdien de Vries, thank you for taking the time to read my report and always giving positive and helpful feedback. Her eye for detail and sharp comments resulted in an improved version of my report. Moreover, I want to thank Prescilla Jeurink for helping me throughout this research from a food and nutrition perspective. She was always enthusiastic and willing to help and provided me with a lot of relevant literature and advances in the field of meat alternatives. In addition, I would like to thank everyone who filled in my survey and spread it along, without them this research would not have succeeded. Furthermore, I would like to thank my family and partner for their continuous support and their invaluable advice during my research. Lastly, I am deeply grateful to my sweet roommates and dear friends for showing constant interest in my thesis progress and believing in me.

The process of graduating was quite an experience in itself and I am very satisfied with how it went when I look back on it. My time at the TU Delft is over, and I am very grateful for everything I learned here and for the great time I had.

L.E. Liu
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Summary

The livestock sector accounts for 14-15% of the global greenhouse gas emissions. Furthermore, the current meat consumption patterns are associated with multiple health risks and are unsustainable in the long term. Therefore, the shift to a more plant-based diet and reduced animal-source intake is desired from a societal perspective. One attempt to fuel this evolution is the new wave of meat alternatives that are designed to successfully replace meat in everyday meals. However, the current market share of meat alternatives in the Netherlands remains around 4.5%. Section 1 demonstrates that in-depth knowledge about the heterogeneity of Dutch consumer preferences regarding meat alternatives is currently lacking. This thesis contributes to identifying the sources of consumer heterogeneity regarding meat alternatives, focusing on both product-related attributes and person-related characteristics. In addition, this thesis explores and proposes strategies for the manufacturers of meat alternatives with the knowledge of consumer heterogeneity in the Netherlands. The main research question defined for this thesis is:

What are the consumer profiles of the sub-segments within the potential meat alternative adopter segment, and what trade-offs do those segments make when choosing between meat and meat alternatives?

As explained in Section 2, A Latent Class Choice Model (LCCM) is estimated to examine the trade-offs made when choosing between meat alternatives and conventional meat by individuals from the different consumer segments of Dutch society. Sociodemographics and psychographics are included in this model to identify the consumer profiles of these segments. The LCCM is estimated using data derived from an online stated choice experiment. In this experiment, respondents were asked to choose between two vegetarian mince options that varied in Eco-score, Nutri-score, price, taste, texture, appearance and animal-welfare label. These attributes were identified through a literature review presented in Section 3 and validated by means of a focus group. To examine the trade-offs that are made when choosing between conventional mince and vegetarian mince, one base alternative was added to each choice set that represented the average conventional mince. The person-related characteristics were selected based on the literature review of Section 3 and measured using 5-Point Likert-scales. The product-related attributes were combined to present unique alternatives based on an experimental design, as demonstrated in Section 4. The choice situations were designed to be as real as possible by presenting them as online shopping experiences. Filter questions were added to ensure that the sample population consisted of only potential adopters of meat alternatives. In total 260 complete valid responses were collected as demonstrated in Section 5. The psychographics were aggregated into 9 factors through explanatory factor analysis. The 9 resulting factors are pro-meat attitude, foodneophilia, pro-meat-alternative attitude, sustainable behaviour, foodneophobia, health consciousness, environmental concern, pro-animal attitude and preparation skills.

By comparing the LCCM estimation with a multinomial logit model that completely ignores consumer heterogeneity as shown in Section 6, there can be concluded that heterogeneity exists in meat alternative preferences. Heterogeneity was best captured by estimating a three-class LCCM. The resulting classes presented in Section 7 are *Price Sensitive Consumers*, *Health and Environment Lovers* and *Taste Driven Consumers*. The *Price Sensitive Consumers* segment is unique due to the high relative importance of the price and the non-linear relationships of utility with both the Eco-score and the Nutri-score. The individuals from this segment are generally meat avoiders, students and do not have a pro-animal attitude. The preferences of the *Health and Environment Lovers* segment stand out because of the high importance of the Eco-score and the Nutri-score, and the low importance of taste. Individuals from this segment tend to be meat avoiders or reducers, have a university Master's or PhD background, have a pro-animal attitude, have high objective knowledge and score low on foodneophobia. The last segment is the *Taste Driven Consumers* segment, this segment is only sensitive to the taste and appearance of an alternative. This segment consists predominantly of omnivores with lower educational backgrounds, individuals with low objective knowledge, foodneophobic individuals and individuals who disagree with a pro-animal attitude.

In Section 8, product alteration strategies and marketing advice is proposed. In addition, a threefold of foreseeable futures are explored with expected market shares, revenues and environmental impact. If the *Price Sensitive Consumers* segment is chosen as the target segment, it is advised to keep the selling prices low, keep the Nutri-score above C and the Eco-score above D. In addition, it is advised to produce products that qualify for a future animal-welfare label. Marketing experts should focus on tailoring their marketing to reach the student population and aim marketing at improving objective knowledge. When targeting the *Health and Environment Lovers*, it is advised to optimize both the Eco-score and the Nutri-score. In addition, it is advised to keep the price low. Marketing strategies should aim at highlighting what makes a certain alternative unique as compared to other alternatives. Furthermore, it is advised to frame the alternatives as exciting and new and accentuate the animal-friendly benefits of the product. When deciding on the *Taste Driven Consumers* segment, it is advised to focus on producing alternatives that taste and look similar to meat. As for marketing strategies, it is advised to take the foodneophobic character of this segment into account and aim at familiarizing the individuals with meat alternatives.

To conclude, there are three segments within the Dutch potential adopters of meat alternative segment. All three segments have different preferences when it comes to meat alternatives. Therefore, manufacturers of meat alternatives should decide on which of the three segments they want to target and alter their products and marketing strategies accordingly. Further research recommendations based on the current study are 1) further investigating the influence

of psychographic characteristics on consumer heterogeneity regarding meat alternatives, 2) identifying the potential adopters of meat alternatives segment in the Netherlands 3) determining the generalizability of these findings to other meat alternatives and 4) developing detailed marketing strategies based on the finding of this research.

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List of abbreviations

GHG	Greenhouse gas
CO2	Carbon dioxide
SCE	Stated Choice Experiment
DCE	Discrete Choice Experiment
LCCM	Latent Class Choice Model
RUM	Random Utility Maximization
AIC	Akaike information criterion
BIC	Bayesian information criterion
WtP	Willingness-to-Pay
PAF	Principal Axis Factoring
MNL	Multinomial Logit
FCQ	Food Choice Questionnaire
IQR	Inter Quartile Range

1 Introduction

Limiting climate change is one of the biggest challenges that is faced today. Even the slightest global temperature increase has an immense amount of impact in the form of extreme heat, rising sea levels, declining biodiversity, melting arctic sea ice, at-risk coral reefs, declining global fisheries, rising poverty and health impacts (Lieberman, 2021). Further climate change will negatively impact the air quality, drinking water quality, food production and secure shelters (WHO, 2021).

Climate change is being driven by large amounts of carbon dioxide (CO2) and other greenhouse gasses (GHG) released by human activities (S. Solomon et al., 2007; The Royal Society, 2020; United States Environmental Protection Agency, 2022). One big source of human-caused GHG emissions is the livestock sector. This sector accounts for around 14%-15% of the global GHG emissions (BBC News, 2021; Marteau, 2017; Wellesley, 2020). The livestock sector does not only impact GHG emissions but also requires a lot of fresh water, land, electricity, fuels for transport etc. (Elzerman et al., 2021; Modlinska & Pisula, 2018; Wellesley, 2020). Furthermore, the conversion of plant protein into meat proteins is a very inefficient process (Elzerman et al., 2011).

The world population is growing rapidly and will reach a global population of approximately 10 billion people by the year 2050 (Sexton, 2020; The World Counts, 2022). Without dietary change, the world population in 2050 will be too big to feed. Yielding enough food to feed the whole population cannot be reached by increasing production alone (Colombo et al., n.d.; Wellesley, 2020). Therefore, attention has to be paid to reducing resource footprints by for example dietary changes and reducing food waste (Colombo et al., n.d.; Sexton, 2020). Targeting meat consumption instead of reducing food waste is the most desirable because meat consumption is responsible for more than ten times the emissions as compared to food waste Marteau (2017). The need to shift to a more sustainable dietary pattern can also be seen back in the 12th Sustainable Development Goal defined by the United Nations. This goal states: "Ensure sustainable consumption and production patterns"(United Nations, 2022).

To achieve a more sustainable diet, a shift towards low animal-source intake and high plant-based food is recommended. As mentioned, one of the most important aspects is the decrease in meat consumption due to a reduction in portion size or substitution with meat alternatives (Marteau, 2017; Sexton, 2020; van den Berg et al., 2022). Dangerous climate change is deemed unavoidable with the current consumption patterns (Wellesley, 2020). A reduction of average meat consumption is not only more sustainable for the environment, but also from a health perspective (Profeta et al., 2020; Wellesley, 2020). Over-consumption of processed meat is for example associated with obesity and an increased risk of non-communicable diseases (Wellesley, 2020).

According to scientists, dietary changes can reduce global CO2 emissions by up to eight billion tonnes per year (Schiermeier, 2019). For sake of comparison, this equals the reduction in CO2 emissions of approximately 4 billion people that stop driving their cars for one year (Climate Neutral Group, 2022). Other researchers also argue that reducing meat consumption can have a significant impact on reducing carbon and equivalent emissions (Marteau, 2017; Vetter, 2021). As already mentioned, reducing meat consumption will also have positive consequences from a health perspective and animal welfare perspectives. One example is the finding of sustainable diets lead up to a 19.3% reduction in the risk of diabetes in adults (Jarmul et al., 2020).

The most popular strategy to reduce meat consumption by Dutch consumers is to replace meat with alternative plant-based products (Verain et al., 2022). Plant-based meat alternatives such as tofu, tempeh, dry beans, peas and lentils have been enjoyed for over 2000 years (Craig & Berardy, 2023). A new, growing sector is the meat substitutes that are aimed to look, taste and feel like meat to successfully replace meat in everyday meals (Jahn et al., 2021). Those products are designed to make the transition from eating meat to a more plant-based diet easier (Craig & Berardy, 2023). These products could make the transition easier because of the reduced need for new behaviour, meat can just be swapped with its plant-based counterpart instead of cooking with vegetables only or reducing meat. Even though advanced technologies are used to create plant-based meat-like alternatives, the market share of meat substitutes in the Dutch meat market is around 4,5% (Menkveld, 2020). Besides, Dutch citizens eat way much more meat than other European citizens, they eat between 76,7 and 79,1 kilos of meat per year as compared to an average of 66,4 kilos in other countries (Sarijoen, 2022). Krom et al. (2020) also agree that the average Dutch citizen currently does not eat healthily and sustainably. They argue that the impact of consumption on the environment can be decreased by 1) Sustainable eating patterns, 2) Less food waste and 3) Buying products that are produced in a more environmentally friendly manner. According to them, sustainable eating patterns and specifically more plant-based food can contribute relatively much to decreasing the pressure on the environment. Meat alternatives are still relatively new, and there is still a lot of progress being made in the field of developing new meat alternatives. Therefore, it is interesting to study what these developments should look like so the Dutch population can be motivated to decrease their meat consumption and increase their plant-based meat alternative consumption.

1.1 Knowledge gap

Additional research is necessary to build a stronger evidence base regarding sustainable food choices in the Netherlands (Wellesley, 2020). In specific, this research focuses on studying the food choices regarding meat and meat substitutes to determine how meat alternative consumption can be increased to decrease meat consumption due to substitution. Multiple actors can play a role in motivating Dutch consumers to make more sustainable food choices. Examples are governmental agencies, environmental organizations, supermarkets, restaurants and meat alternatives producers. To determine which actor this research should focus on, the existing literature was reviewed to identify consumer motivations and barriers regarding meat consumption reduction and ways to cope with those motivations and barriers.

Reasons, why people decide to reduce their meat consumption, are health concerns, animal welfare and environmental concerns (Jahn et al., 2021). Furthermore, they mention several barriers to meat substitute consumption such as inconvenience, newness, high costs, limited selection, food neophobia, social norms and rituals, conflicting eating goals and unnaturalness. Food neophobia is a relatively unknown term that may need some explaining, this phenomenon refers to the reluctance to eat new foods. Jahn et al. (2021) propose solutions such as product improvement, sparking curiosity through marketing, creating new norms and rituals through campaigns and challenges, food fortification and targeted communication. Schenk et al. (2018) add improving perceived convenience. Ways to do this are providing knowledge on how to prepare vegetarian meals, broadening the vegetarian options, information campaigns and more ready-made vegetarian meals. Furthermore, injunctive norms are of great influence on meat avoidance. Injunctive norms refer to what one believes is approved or disapproved by others. This can positively be influenced by information campaigns, either by canteens and restaurants or by suppliers and retailers. The last determinant of diet choice mentioned by Schenk et al. (2018) is vegetarian self-identity. The first strategy imposed is for food manufacturers, marketers and retailers to rebuild their brands to resonate with vegetarian self-identities. Another strategy mentioned is for marketers and policymakers to weaken the link between diet choice and identity by highlighting potential extrinsic benefits such as saving money.

As explained above, motivations and barriers can be targeted through multiple strategies and by multiple actors. The actor with the broadest range of strategies available are the food manufacturers and marketers or in other words the companies behind the meat alternatives. They can alter the product by modifying the nutritional values, the production process, the available products or the ease of use. But, they can also change their packaging and marketing strategies such as different information campaigns, branding, marketing campaigns and prices. Actors such as policymakers and environmental agencies can deploy campaigns, but they have little to no means to influence meat alternatives. The only thinkable product attribute that policy can influence is the price of meat, due to the introduction of a meat tax (van der Hoek, 2022). Therefore, if the price of meat and meat alternatives is included in the research, it may lead to valuable insights for policymakers. Actors such as supermarkets and restaurants have the possibility of information campaigns, product purchasing environments or altering the product presentation or menu. However, they heavily rely on what is available on the market. Furthermore, in general, supermarkets and restaurants do not necessarily benefit much from the shift of meat to meat substitutes apart from a few front runners. The need to focus on meat substitute manufacturers and marketers complies with the finding stated by Beacom et al. (2022): 'The future lies in developing innovative, advanced and authentic plant-based products with the desired sensory properties and sustainability credentials for specific target markets.'. Even though the product manufacturers and marketers are chosen for this research it is worth mentioning that the shift to more sustainable food consumption in the Netherlands asks for an integrated and joint approach (Bartels et al., 2009).

From now on, there will be a focus on meat alternatives brands that sell their products in Dutch supermarkets. Manufacturers and marketers can try to influence consumer decisions through three main strategies: changing the product, changing the purchasing environment or changing messages (Szejda & Parry, 2020). How the products, purchasing environment or messages should be designed strongly depends on the target segment of the producers or marketers. This is true under the hypothesis that there is unobserved heterogeneity in society which is reflected in multiple consumer segments that differ behaviorally from each other due to different motivations, tastes or decision protocols. A multitude of researchers stresses that thoroughly considering your target segment and profiling those segments is highly important. Dean et al. (2022) explains that advertisements focusing on the similarity of meat alternatives with meat will be efficient for some segments but has the opposite effect for other segments. Götze and Brunner (2021) add that knowledge of consumer segments could efficiently raise the success rates of product development. Their research also showed that consumers have very diverse needs when it comes to meat alternatives. Emke Kieffer, head of product development at Vivera, agrees with the idea of diverse needs. According to her, the current market for meat alternatives is divided into two groups: 'creative alternatives' and 'meat imitation products' (Witte, 2021). Product developers focused on the first segment have more freedom in terms of form, structure and taste. Product developers focused on the second segment target consumers that eat meat but want to reduce consumption by replacing it with meat-imitating products. The question however is whether these two main groups of meat alternatives fit in well with the existing segments in Dutch society.

According to Szejda and Parry (2020): "Understanding the complexity of meat-consumption choices and applying a

concise consumer segmentation strategy is vital to developing an evidence-based approach to accelerating adoption of plant-based meat.". This makes it clear that for producers and marketers to influence Dutch meat(substitutes) consumption behaviour, knowledge is needed about the complexity of their meat- and meat alternative consumption **choices** and the Dutch consumer **segmentation**.

Consumers make choices between food products every day. Those products can be described based on their product-related attributes. Onwezen et al. (2021) provided a comprehensive literature overview of the drivers that determine the acceptance of alternative proteins for Western consumers. Examples of identified product-related attributes that function as motives or barriers to acceptance are health, taste, environment, appearance and price (Onwezen et al., 2021). Hoek, Luning, et al. (2011) explain that trade-offs have to be made when choosing between two alternatives in order to decide which product best meets the need of the consumer. This need for making a trade-off can be seen back in the phenomenon that meat substitutes received high scores on ethical aspects such as the environment, but respondents did not actually choose the product. In many cases, consumers must decide what product satisfies their needs the most while sacrificing other goals.

A lot of research has been done that focuses on consumers' preferences for attributes of meat and meat alternatives. This is often done by studying the choices that consumers make and eliciting attribute preferences from those choices. One common finding is a negative correlation between the price of a product and utility, utility being the benefits someone derives from a choice (Loo et al., 2020; Profeta et al., 2020). But researchers found that not only price plays a role in choices, but also protein, organic label, local production, taste, texture, smell and environmental impact has been suggested as influential attributes (Hoek, van Boekel, et al., 2011; Profeta et al., 2020; Weinrich & Elshiewy, 2019). Weinrich and Elshiewy (2019) however did not only research the influence of product attributes on consumer preferences, but also the impact of person-related drivers. This led to the insight that there is a large variety of preferences among consumers driven by a multitude of intrinsic characteristics and beliefs. Examples of such influential characteristics are education level, environmental concern, food neophobia and health interest (Hoek, Luning, et al., 2011; Slade, 2018). What can be concluded is that food choices depend on both product-related attributes and person-related factors.

Segmenting the highly varied consumer population in multiple segments to develop tailored pro-environmental behaviour interventions is gaining support (Lacroix & Gifford, 2019). Producers and marketers of meat alternatives will mainly benefit from targeting the most promising consumer segment with tailored products and marketing. Researchers have attempted to segment consumer populations into segments based on attitudes, motivations and consumption patterns derived from measuring scales (Götze & Brunner, 2021; Verain et al., 2022). Respondents were grouped based on responses, leading to an overview of consumer segments. Examples of such segments are meat lovers, unconscious flexitarians and potential flexitarians. It should be noted that this type of segmentation solely focuses on person-related characteristics while the influence of product attributes is disregarded. In other words, this leads to an overview of multiple segments based on person-related characteristics with no detailed information about their attribute preferences or trade-offs when choosing between meat and meat alternatives. As already said, consumers who indicate to understand and appreciate the ethical aspects of plant-based meat still choose conventional meat products. Therefore, segmentation based on self-reported person-related characteristics may not lead to the detailed information needed about how to influence the consumer choices of different segments.

Research that includes both person-related attributes as person-related characteristics is rare. When segmenting consumers based on their meat alternative attribute preferences, detailed advice can be given on how to alter the product to best fit a specific consumer segment. When also including person-related characteristics, profiles can be developed of the multiple consumer segments to gain deeper insights into the motivations, drivers and attitudes behind the preference. Two examples of researchers that do include both are the research by Apostolidis and McLeay (2016) and by Czine et al. (2020). They both segmented their respondents based on their attribute preferences, elicited through the choices that they made. By also including questions regarding the person-related characteristics of the respondents, profiles could be developed of the identified segments. Knowledge of the consumer segment profile and the attribute preferences of the segment allows for comprehensive advice about targeted product alteration and marketing.

While there is some research that includes both product-related attributes and person-related characteristics, there is still insufficient knowledge to give comprehensive advice to the producers and marketers of meat alternatives sold in the Netherlands. First of all, the person-related characteristics included in the research that could be found that also included product-related attributes are very limited and solely demographic characteristics. Demographic characteristics are deemed less effective than psychographic characteristics for consumer segmentation and targeted design development (Cabriales et al., 2016; Funk et al., 2021). Examples of such psychographic characteristics are habits, attitudes towards meat and meat alternatives, environmental concerns and the need for familiarity. It is unknown whether those psychographic characteristics also function as significant predictors of class membership. In other words, knowledge is lacking about whether it can be predicted to which class an individual belongs based on their psychographic characteristics.

Furthermore, from the research that could be found that did elicit consumer preferences by studying choices, only one study also included a conventional meat option. Not including conventional meat does not lead to any knowledge about the trade-offs that are made between meat and meat alternatives. Precisely this knowledge is needed for producers to be able to compete better with conventional meat and ultimately lower meat consumption because of substitution.

Another knowledge gap that needs to be filled is that the research focused on the attribute preferences of multiple consumer segments did not focus on the Dutch consumer population. Results from studies executed in other countries do not necessarily apply to the Dutch population as been demonstrated by multiple researchers (Escribano et al., 2021; Grunert et al., 2018; Merlino et al., 2018). Another problem with the target population of the research is that research usually focuses on the whole population, including heavy meat eaters, vegetarians, reduced meat eaters etc. However, it is a much more efficient use of resources to focus solely on the potential adopters of meat alternatives alone (Szejda & Urbanovich, 2019). After reaching them, the late majority and laggards will eventually follow when meat alternatives become more socially accepted. The potential adopter segment can be identified by examining who is likely to pay more for plant-based meat than for conventional meat and who is likely to purchase plant-based meat. According to the research by Szejda and Parry (2020), developing consumer profiles of the sub-segments within the potential plant-based meat adopter segment is a key research need.

To summarize, the producers and marketers of meat alternatives have the widest range of strategies available to influence Dutch meat alternative consumption behaviour. They can both change the product and change their marketing strategies to fit their targeted consumer segment. To advise them about product alteration strategies, more knowledge is needed about which segments exist in Dutch society and how those segments differ in the trade-offs that they make when choosing between meat and meat alternatives. To also give advice about how to tailor marketing strategies more knowledge is needed about the profiles of these Dutch consumer segments. This research will include both product-related attributes and person-related characteristics as this will lead to valuable segmentation based on consumer preferences and detailed consumer segment profiles. Person-related characteristics that reach further than sociodemographic characteristics are included to examine their competence as class membership predictors. More effective marketing design can be given based on the combination of sociodemographics and psychographic characteristics that are proven to be significant predictors. The focus will be on the sub-segmentation of the potential adopters of meat alternatives instead of the whole population, considering this segment is the most effective use of resources for producers and marketers.

The main research question this research aims to answer is:

'What are the consumer profiles of the sub-segments within the potential meat alternative adopter segment, and what trade-offs do those segments make when choosing between meat and meat alternatives?'

To answer the main research question, a set of sub-questions is defined:

1. Which product-related attributes influence Dutch consumers' preferences regarding meat and meat alternatives?
   Identifying the product-related attributes to include in this research will be done through a *literature review*, followed by a validation step by means of a *focus group*. Determining which attributes are of influence will be done through estimating the LCCM

2. Which person-related characteristics influence Dutch consumers' preferences regarding meat and meat alternatives?
   Identifying person-related characteristics to include in this research and finding suitable measuring scales will be done through a *literature review*. Determining which person-related characteristics are of influence will be done by estimating the LCCM.

3. What are the characteristics of the potential plant-based meat alternative adopter segment in the Netherlands?
   The characteristics of the respondents will be analysed using *Python*, in specific the *Pandas* module.

4. What consumer sub-segments within the potential meat alternative adopter segment can be distinguished based on attribute preferences and what are the profiles of those segments?
   The classes, profiles and attribute preferences will be identified by estimating a *Latent Class Choice Model* using the software *Apollo*, in specific the *"Icpars"* package.

5. How are the product-related attributes traded off by Dutch consumer segments?
   The attribute weights will be compared by calculating the relative importance of attributes and *Willingness-To-Pay*.

1.2 Problem definition and societal- and scientific relevance

The current meat consumption behaviour of the average Dutch consumer is unsustainable and unhealthy. This has negative consequences for individual health but also has a massive impact on the environment. In the Netherlands, meat is responsible for 40% of the GHG emissions released by the production of food for an average Dutch citizen

(Milieu Centraal, n.d.-a). Reduced meat intake is therefore desirable for the health of Dutch society and for achieving the set climate goals to combat climate change. In the Netherlands, the consequences of climate change are rising sea levels, extreme weather, greater risks of flooding and loss of species and land (Milieu Centraal, n.d.-b). The Dutch meat consumption behaviour is only a small part of a much bigger worldwide problem. The livestock sector accounts for around 14-15% of the global GHG emissions (BBC News, 2021; Marteau, 2017; Wellesley, 2020). Globally, climate change will lead to among other things flooding, food shortages, drinking water shortages and forest fires (Milieu Centraal, n.d.-b). Poorer, densely populated countries and the elderly will be the most vulnerable and impacted by climate change.

One possible solution is plant-based meat alternatives that are designed to make the transition from meat to meat alternatives easier by imitating conventional meat. Plant-based meat alternatives seem to be a promising solution for Dutch society considering replacing meat with alternative plant-based products is the most popular strategy among meat reducers (Verain et al., 2022). However, consumers are still hesitant to swap their conventional meat for plant-based meat alternatives as can be seen back in the market share of 4.5%. A better understanding of the motivations behind choosing meat and meat alternatives is beneficial for motivating meat reduction. Some efforts have been done to gain a better understanding of these motivations but not yet focused on Dutch consumers and more importantly not yet including both product-related attributes and person-related characteristics that go beyond demographics.

This research will provide insights into the trade-offs that consumers make when choosing meat or meat alternatives and the person-related characteristics that lead to heterogeneity in consumer preferences. More specifically, this research will focus on the preferences and consumer heterogeneity among the potential meat alternative adopter segment in The Netherlands. Targeting this segment is considered to be the most efficient use of resources and will lead to effective strategies for consumers most receptive to dietary change. To the best of the author's knowledge, this will be the first study that focuses on consumer segmentation regarding meat alternative preferences that test the potential of psychographic characteristics as segment membership predictors. This will be done by including psychographic variables as covariates in Latent Class Choice model that will be estimated based on a data set containing choices between meat and meat alternatives. With this knowledge, future consumer segmentation studies regarding choices between meat and meat alternatives may be improved through the inclusion of psychographic characteristics. With knowledge of whether and which psychographic characteristics function as class membership predictors, marketing strategies can capitalize on these traits rather than sociodemographic characteristics. Characterizing food consumers based on psychographic characteristics can help improve the quality and accountability of marketing campaigns (Morgan et al., 2002). The aim of this research is to advise the manufacturers of plant-based meat alternatives on how to alter their products and marketing strategies based on the preferences of consumer segments. Using surveys together with statistical analysis, this research will measure the Dutch consumer segment preferences and the corresponding consumer profiles.

The results of this research are initially of great relevance for the producers and manufacturers of meat alternatives. However, indirectly, more attractive meat alternatives and tailored marketing will lead to easier meat reduction and therefore contribute to decreased health risks for Dutch society and achieving the set climate goals. This research will also be relevant for further research in other countries. It will offer insights into which product-related attributes are of significant influence and more importantly add to the existing knowledge of the role of psychographic- and behavioural characteristics in consumer heterogeneity regarding plant-based meat alternative preferences. Using these more in-depth characteristics instead of socio-demographics could lead to more effective marketing strategies in the world of plant-based meat alternatives.

1.3 Report structure

In the next Section, the methods used in this research will be explained in detail. A literature review focused on identifying an appropriate meat alternative product, relevant meat alternative attributes, suitable attribute levels and influential and relevant person-related characteristics can be read in Section 3. In Section 4, the construction of the survey will be explained. Subsequently, the data collected by means of the survey will be analysed and explained in Section 5. The LCCM estimation procedure will be explained in Section 6 and the results will be thoroughly elaborated on in Section 7. The results will be applied to the real-world context in Section 8. The research will be finalized with the conclusions and discussion in Section 9, including an in-depth exploration of the results, limitations and recommendations.

2 Methodology

In this Section, an overview of used methods are provided. First, Discrete Choice Modelling is generally introduced. Subsequently, the development of a Choice Experiment is elaborately explained together with the needed methods. Lastly, the methods used to derive estimations from the gathered data are explained.

2.1 Discrete Choice Modelling

Discrete Choice Modelling is used to explain or predict the choice of a decision-maker between two or more alternatives in a choice set (Bernasco & Block, 2013). According to Train (2009), the choices of the decision-maker depend partly on factors observable to the researcher, and partly on unobserved factors. The underlying theory assumed to derive the discrete choice model was the Utility-Maximization Theory. This means that the decision-maker will choose the alternative that leads to maximum utility gain. When the decision-maker chooses between two alternatives, more often than not, trade-offs have to be made. Discrete Choice Modelling is used to study these trade-offs and determine the weights of the attributes of the alternatives. Those attributes vary among the alternatives that the decision-maker has to choose from. When varying those attributes efficiently, a limited number of choice sets can lead to enough knowledge of these attribute weights to estimate reliable choice probabilities. Varying those choices is done based on an Experimental Design, and the choice sets constructed are presented through a Discrete Choice Experiment (DCE). There are two data collection paradigms, stated preference and revealed preference. Collecting data through Stated Choice, as compared to Revealed Preference, means that decision-makers are confronted with hypothetical choice situations. Stated preference can especially be useful when exploring trade-offs that consumers make using choice experiments (Barton, 2016). Therefore, the stated preference paradigm can be useful to advise producers and marketers on how to change their products to gain a bigger market share.

As explained, choices do not solely depend on product attributes. Another important influence is person-related factors. This means that one person can value a certain attribute differently than another person. The characteristics underlying this difference in preferences can be studied by means of segmentation. Characterizing consumer groups based on segmentation is often used to identify target markets of potential customers (Gazdecki et al., 2021). Segmenting potential consumers of meat alternatives is widely suggested in order to develop more target-adapted strategies (Dean et al., 2022; Pointke et al., 2022; Rombach et al., 2022; Spendrup & Hovmalm, 2022). The most popular segmentation model for choice-based data is the Latent Class Choice Model (LCCM). The theory underlying the LCCM assumed that choice behaviour depends on both attributes and on latent heterogeneity that varies with person-related factors usually unobserved by the researcher (Greene & Hensher, 2003). This heterogeneity can be studied by sorting all respondents into a set of classes based on their attribute preferences. When including person-related characteristics in the SCE, profiles of these classes can be sketched based on these characteristics. LCCM can therefore lead to a better understanding of potential target segments. In the following Sections, the necessary steps to undertake when developing a Stated Choice Experiment will be discussed. Thereafter, the LCCM will be explained in more detail.

2.2 Discrete Choice Experiments

DCE's present the decision-maker with choice sets consisting of two or more alternatives that are described by a number of attributes. To reduce the number of required respondents, the respondents are usually asked to make a series of choices between the presented choice sets. DCE's are constructed based on an Experimental Design that ensures sufficient variation across choice sets to estimate the intended utility function if developed properly.

For this study, there was decided to make use of a DCE because (1) multiple attributes of meat alternatives can be valued simultaneously, leading to relevant advice for producers (Broeckhoven et al., 2021), (2) choice experiments resemble a choice situation similar to the real-world choice situation when choosing between two food products (Mangham et al., 2009) and (3) food choices do not only impact personal health and well-being but also the environment, social interactions and society in general. Therefore, trade-offs have to be made. DCE are a suitable tool to elicit the preferences for attributes based on the trade-offs made (Lizin et al., 2022).

The goal of the research was to better understand the trade-offs that are being made between meat and meat alternatives made by consumers from different potential consumer segments. It was important to include both meat and meat alternatives because the societal goal is to better understand the trade-offs that are being made between meat and meat alternatives. With this knowledge, advice could be given on how to make the choice probabilities for the meat alternative higher to make the substitution of meat with meat alternatives more attractive. Knowledge of these trade-offs by different consumer segments leads to more targeted and efficient marketing strategies to also increase the probability of meat alternatives being chosen. The research focused on the producers and marketers of meat alternatives that are sold in Dutch supermarkets. Therefore, the choice situation should resemble the choice situation of a consumer choosing between products from a Dutch supermarket. Considering the DCE will be spread via an online survey, the most realistic way of presenting the choice situation is by simulating an online shopping experience. According to E. J. Molin (2014), the more realistic an DCE is, the more valid the observed choices are. This does not only apply to the choice context but also applies to the chosen attributes and the chosen attribute levels.

According to Lizin et al. (2022), the DCE process exists of three phases: 1) Designing the DCE, 2) Conducting the DCE and 3) Analyzing the DCE. These three phases consist of multiple sub-activities per phase. In this research, the 3 phases as presented by Lizin et al. (2022) were adopted from the paper and evaluated. Using knowledge from other researchers, those phases were adapted and supplemented where needed.

2.3 Designing the DCE

In the case of this research, the design of the DCE took place in four different stages. The first stage was the development of attributes and the corresponding levels. The second stage was the selection of person-related characteristics that were to be included in the survey to be used as profiling variables for the consumer segments. The third stage was the construction of the experimental design used to develop the DCE. The last stage was the actual design of the survey that was spread among respondents.

2.3.1 Attribute and level development

There is a lot of literature on defining attributes and attribute levels for DCE's (Coast et al., 2012; Kløjgaard et al., 2012; Lizin et al., 2022; Obadha et al., 2019). Most researchers agree that attribute and attribute-level development is a multi-stage process. The multiple stages suggested by different researchers were analyzed and compared to determine a suitable strategy for this research. Based on the comparison of multiple stages, there was concluded that a combination of the available strategies led to the most comprehensive strategy for attribute and attribute-level development. Therefore, the final strategy used is a combination of all relevant stages mentioned by Coast et al. (2012), Kløjgaard et al. (2012), Lizin et al. (2022), and Obadha et al. (2019). Overlapping stages were merged and unique stages were assigned to an appropriate place in the process. For the translation of multiple strategies into the final strategy used in this research, see Figure 1. There will be elaborated on the different stages in the remainder of the Section.

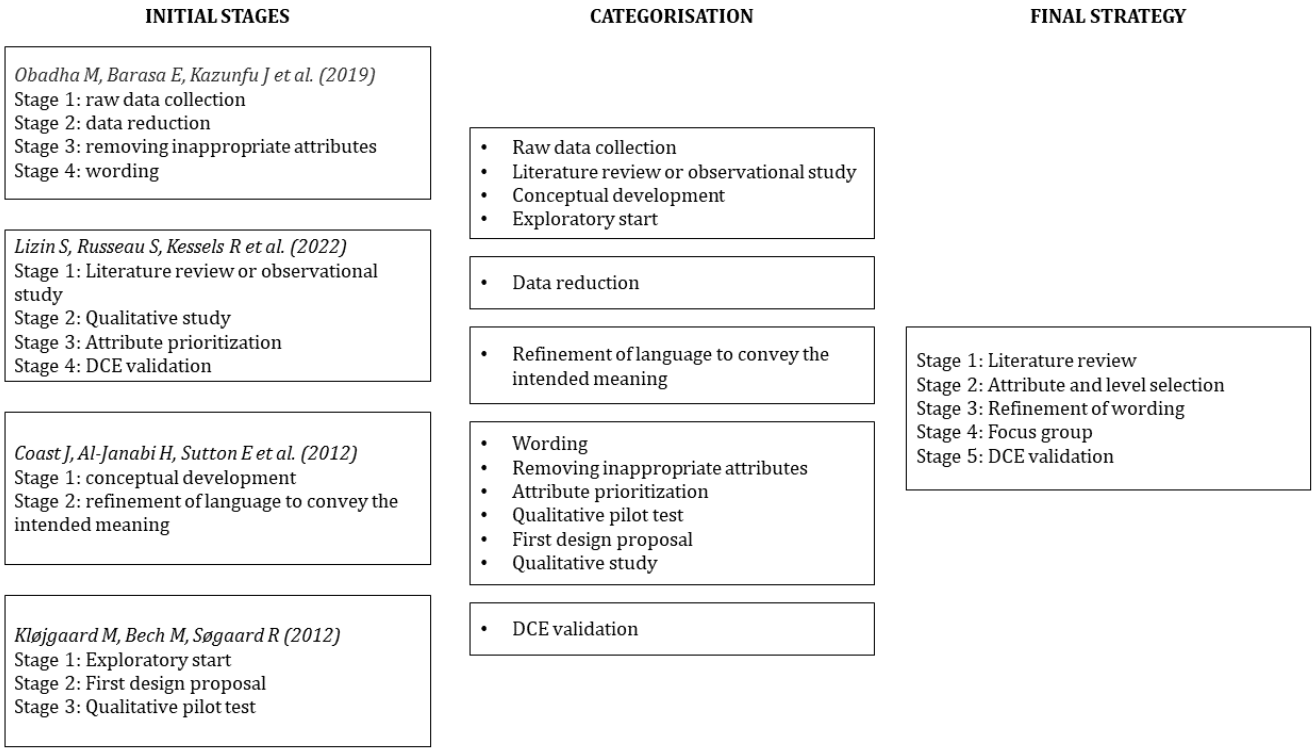

Figure 1: Attribute and attribute level development strategy

Stage 1: Literature review
For the identification of potential attributes to be included, the systematic literature focused on consumer acceptance of alternative proteins by Onwezen et al. (2021) was used as a starting point. They systematically reviewed available studies that focus on the acceptance of several alternative proteins and include product-related attributes as well as psychological factors, external attributes and interventions. Their research took place in June 2020, so their findings were supplemented with articles published after their research. To find those articles, the same keywords were used as used in their research. It is worth mentioning that the articles found while searching for potential attributes were also scanned for possible person-related characteristics of influence. These characteristics were useful later in the design process when characteristics to include in the DCE were identified.

Stage 2: Attribute and level selection
The next step was to reduce the potential attributes found in the literature into a list of attributes and levels that had

to be incorporated in the DCE. This was done with a few criteria in mind. According to Molin (2022c), attributes that are included in the DCE should be (1) The most important attributes for respondents and (2) Relevant for policy or design. Coast et al. (2012) add to this that attributes should (3) not overlap with other attributes, (4) be measurable, (5) be describable in a single way and (6) be limited to no more than eight. The six criteria mentioned above were used to guide the process of selecting attributes to be included.

Stage 3: Refinement of wording
The next step was translating the attributes and attribute levels into meaningful terms for respondents of the survey. The goal was to make sure that attributes and attribute levels were interpreted the same way as intended by the researcher and were understood by all respondents. This was done by adopting the same wording that has already been used in other DCE's and this did not lead to any interpretation problems among respondents.

Stage 4: Focus group
A focus group is a method used to gain more knowledge and understanding of participants' beliefs, perceptions and attitudes related to a specific topic (O.Nyumba et al., 2018). Hosting a focus group was of added value to validate the attributes that were to be included in the survey. As a result of the focus group, there was more certainty that no attributes of great importance were forgotten and that people were able to understand the attributes and attribute levels. It should be stressed that a minimum of three to four focus groups is recommended for simple research topics, however, due to the time span and the available resources for this research this was not feasible. Therefore, one focus group was executed. This limitation will be further discussed in section 9.4. Focus groups are more often used for developing questionnaires (O.Nyumba et al., 2018). For this particular research, the goal of the focus group was two-folded: (1) to check whether all important attributes were included in the DCE and (2) whether all terms and levels were well defined.

For the focus group, approximately 6 people who buy meat alternatives sometimes or regularly were invited. The participants were recruited by means of convenience sampling while aiming to include a variation of consumers with different backgrounds. A variation of consumers with different backgrounds was desired considering the respondents of the survey were also expected to have a wide variety of sociodemographic backgrounds. With a varied focus group, the chances of forgetting important attributes for certain sociodemographic groups or defining attributes and levels in an incomprehensible way for certain sociodemographic groups decreased. The characteristics used to select varied participants were characteristics that are proven to have a significant influence on attribute importance and characteristics that are insensitive in nature. The latter had the benefit of people not being hesitant to share the information. The feedback and opinions of the participants of the focus group were analyzed and processed into a new set of validated attributes and attribute levels.

One of the main disadvantages of focus groups is that the method is susceptible to all biases that are commonly encountered in group settings (O.Nyumba et al. 2018). Examples of such biases are when a dominant participant shapes the discussion, when the status of one participant influences the discussion and when all the participants agree to think the same due to group cohesion. The first form of bias mentioned can be reduced by the facilitator of the focus group by guiding the focus group in such a way that everyone gets a chance to speak and asking other respondents for opinions when hesitation is noticed. The second bias was not expected to arise because no experts in the field were invited, only general consumers with no specific knowledge about the topic. Furthermore, the last form of bias was countered by highlighting that there are many different motivations for choosing or not choosing meat alternatives. In this way, participants were motivated to share their deviating opinion and not feel ashamed.

The focus group was held online due to the higher chance of finding respondents with different backgrounds that were willing to join the focus group when it was online. In addition, because the focus group was held online, it could be recorded. Therefore, it was possible to analyze the recording to gain a better understanding of the terms used by respondents and to analyze the body language of participants.

The topic schedule of the focus group was the following:

1. Introduction of MSc Thesis subject and goal of the focus group
2. Introduction of selected attributes and their description
3. Discussion about missing or redundant attributes
4. Introduction of selected attribute levels
5. Discussion about selected attribute levels and whether they are understandable

Stage 5: DCE validation
A large part of the content validity of the DCE was already done by means of the focus group. This validation step consisted of validating whether all important attributes were included and all attribute levels were well defined.

Another possible validation step was the spreading of a pilot test, as suggested by Kløjgaard et al. (2012). Due to limited time, the pilot test was spread among a very small number of respondents. The goal of this small pilot test was to validate the response time needed to fill in the survey, to test whether respondents understood all questions correctly and to determine whether one of the attributes had a very dominant impact. The pilot test that was distributed was the complete survey, including the questions related to person-related characteristics. The constructed DCE was also validated during the mid-term meeting of the research by gathering feedback from an expert in the field of Discrete Choice Modelling, an expert in the field of the psychology behind sustainable behaviour and an expert in the field of health, lifestyle and nutrition. Their feedback about the developed attributes and attribute levels was also included and processed to determine the final set of attributes and attribute levels.

2.3.2 Selection of person-related characteristics

As explained, an LCCM was used in this research to study the heterogeneity in consumer preferences across the Dutch potential meat alternative consumer population. The classes were determined based on the observed response pattern of the respondents. To derive meaningful information from the formed classes, characteristics of interest had to be included. Based on these characteristics, profiles could be sketched of the multiple classes. Furthermore, the probability of a respondent belonging to a specific class could be estimated based on his/her characteristics.

The multiple classes that were derived from applying the LCCM had their own attribute weights and their own profiles. The attribute weights were determined based on the trade-offs that were made during the choice experiments. The profiles were determined based on the person-related characteristics of the decision-makers. For the profiles to be of relevance for producers and marketers of meat alternatives, relevant person-related characteristics had to be included in the survey. Furthermore, for the segments to significantly differ in their person-related characteristics, the characteristics had to be of influence the choice between meat and meat alternatives.

To ensure that the characteristics that were included in the survey were of relevance for the producers and manufacturers, the possible intervention strategies were studied beforehand. Subsequently, the characteristics needed to determine the suitability of an intervention for a specific segment could be defined. To increase the chances of including characteristics that influence the choice between meat and meat alternatives, the existing literature was consulted. Based on the existing interventions and the promising characteristics, a relevant and well-grounded selection of characteristics was made.

In order to determine the sociodemographic and psychographic profiles of the derived segments, the person-related characteristics had to be measured. Measuring sociodemographic characteristics was straightforward, considering this is for example age, income and gender. Measuring psychographic characteristics, however, was more complicated. Reliable scales had to be identified to measure intended variables. Directly asking respondents about their environmental consciousness for example would have led to less consistent measurements than the use of multi-item scales. Such multi-item scales have multiple items that are used to measure the same variable (Robinson, 2018). To examine whether the multiple items actually measured the same latent factor, exploratory factor analysis was executed. This led to multiple sets of scales. One set of scales for example measures the pro-animal attitude of an individual. The average score on the scales within the same factor was taken to determine how one individual scored on a certain factor.

2.3.3 Constructing the Experimental Design

The experimental design of a DCE presents the allocation of attribute levels to choice tasks (Rose & Bliemer, 2009). According to Rose and Bliemer (2009), many different methods can be chosen to construct the experimental design and the constructed experimental design used to develop the experiment may have a big impact on the statistical power of the experiment. A few considerations related to constructing an experimental design are labelled or unlabelled alternatives, attribute level balance or not, the number of attribute levels, the attribute level range, the design type, the number of choice sets and whether or not to include interaction effects (Rose & Bliemer, 2009).

Respondents were asked to choose between two meat alternatives and a conventional meat product. They were introduced to the context of the experiment. The context was that the respondents wanted to buy a mince product that could be either based on conventional meat or plant-based meat. Why mince was chosen is further explained in Section 3.1. The conventional mince product stayed the same throughout all the choice sets considering the producers and manufacturers have no means or interest in changing conventional meat products. The conventional mince product took on the attribute levels of an average meat mince product. The two meat alternatives that the respondents had to choose from consisted of the same attributes, in other words, the attributes were generic. Therefore, the alternatives could stay unlabeled. This was preferred because, with unlabeled alternatives, sequential choice set construction can be applied. Sequential construction as compared to simultaneous construction leads to a smaller number of choice sets. As a result, fewer respondents were needed. In many DCEs, a no-choice option is added to each choice set to offer respondents the chance to not choose any of the products. However, in this DCE, the context was that someone needed a certain product for the dish they wanted to make and therefore there was assumed that they would not

choose the no-choice option. According to Weinrich and Elshiewy (2019), a no-choice option should be added to avoid forcing respondents to choose because this can lead to biased preferences. However, in this experiment a product was chosen that is often used and widely known, and realistic attributes were chosen to decrease the chances of non of the choice options being a reasonable option. The advantage of not including a no-choice option is that the precision of parameters increases due to respondents always choosing one of the products.

Attribute levels balance means that each attribute level appears an equal number of times across all choice sets. Attribute level balance is a desirable property because it ensures full coverage of the attribute level range (Rose & Bliemer, 2009). The Experimental Designs was generated using the Software program Ngene. This program can ensure that attribute level balance is maintained. To limit the number of choice sets while guaranteeing attribute level balance, it is desirable that the attributes have all even numbers or all odd numbers of attribute levels (Rose & Bliemer, 2009). This had to be kept in mind while defining attribute levels.

The design type, the number of choice sets and whether or not to include interaction effects depended on the attributes and the attribute levels that were included in the DCE. These choices will be further explained in the Sections where the attributes are selected and the attribute levels are determined (Section 3.2).

2.4 Pilot test

After the survey was constructed using the experimental design and the selected scales, a pilot survey was spread among a small number of respondents. The goal of the pilot survey was to validate the time needed to fill in the survey, to check whether all questions and tasks were well understood by respondents and to see if one attribute had a very dominant influence on respondents' choices.

2.5 Conducting the Discrete Choice Experiment

The DCE could be filled in by everyone who bought or buys meat alternatives, and by people who were open to buying meat alternatives. In the Netherlands, all different age groups indicate that they consume meat alternatives sometimes. Younger consumers are the front-runners with a percentage of 69% of the people between 18 and 34 indicating that they eat meat alternatives once per month or more. The age group of 35 to 44 follows with 51% and of the people above 55 years of age, 44% indicate eating meat alternatives once per month or more. This shows that the target group for this research was very broad. Respondents who were not open to purchasing meat alternatives and will always choose meat instead of meat alternatives would not lead to helpful information and were therefore not recruited. Excluding these respondents was done by including a set of filter questions at the beginning of the survey. The aim was to distribute the DCE in such a way that best resembles the true population of people who consume or are open to consuming meat alternatives. However, knowledge about what this true population looked like was missing and therefore there was assumed that the sample size resembled the true population. This last assumption will be further discussed in Section 9.4.

2.6 Analyzing the DCE

The choice model that was used to study the consumer preferences of different segments in the population was the Random-Utility Based Latent Class Choice Model (LCCM). First, the Random Utility Theory will be explained in more detail, followed by an explanation of the LCCM.

2.6.1 Random Utility Theory

The estimations done using the LCCM in this research were based on the Random Utility Maximization (RUM) theory. According to the RUM theory, individuals assign utilities to each choice alternative in a choice set and choose the alternative which maximizes their utility (Dillingham, 2016; Fujiwara et al., 2003). The total utility that is derived from choosing an alternative consists of systematic utility and an error term (ϵ) (Chorus, 2022). The systemic utility is the utility gained from all the factors included in the experiment. The error term (ϵ) includes everything else that influences the individual's choice (Chorus, 2022). The utility Equation looks the following:

$$U_{i,j,k} = V_{i,j,k} + \epsilon_{i,j,k}$$

$U_{i,j,k}$ denotes the total utility of individual i for alternative j in choice set k. $V_{i,j,k}$ is the systematic utility and $\epsilon_{i,j,k}$ is the error term. The systemic utility $V_{i,j,k}$ is a function of the attribute levels and the attribute level weights β. Therefore, the total utility function can be rewritten the following:

$$U_{i,j,k} = \beta' x_{i,j,k} + \epsilon_{i,j,k}$$

Where β is a vector of unknown attribute weights associated with respondents' preferences and $x_{i,j,k}$ is a vector of attributes levels based on choices by individual i and the jth alternative in choice set k.

2.6.2 Latent Class Choice Model

In order to capture individual heterogeneity, a LCCM was used. If individual heterogeneity is not captured, and equal preferences among all consumers are assumed, average consumer preferences may be estimated for consumers who do not actually exist (Paetz et al., 2019). To validate the existence of consumer heterogeneity, first, the aggregate Multinomial Logit (MNL) model was estimated. This model assumes homogeneous preferences among all consumers, or in other words, 1 class of consumers is assumed.

LCCMs assume that the population can be segmented into a finite number of groups, according to some combination of characteristics. Each group is similar in its traits, while dissimilar from those in other groups. LCCMs consist of two components: a class membership model and a class-specific model. The class membership model formulates the probability that a decision-maker belongs to a particular class as a function of the characteristics of the individual (Sfeir et al., 2022). Assume that the individuals are grouped into Q different classes. The equation to determine the probability that person i from class Q chooses alternative j looks the following:

$$P_{j,iq} = \frac{exp(\beta'_q X_{j,i})}{\sum j{=}1^{I_n} exp(\beta'_q X_{j,i})}$$

$P_{j,iq}$: the probability of person i from class q choosing alternative j.

$exp(\beta'_q X_{j,i})$: the chance that alternative j is chosen by person i, based on the β' of class q.

$\sum_{j=1}^{I_n} exp(\beta'_q X_{j,i})$: the summation of chances of all alternatives j being chosen individually by person i, based on the β' of class q.

The class-specific choice model describes the class-specific choice behaviour based on the attributes of an alternative. From this, the attribute preferences per class can also be determined. For a conceptual model of the LCCM see Figure 2 below.

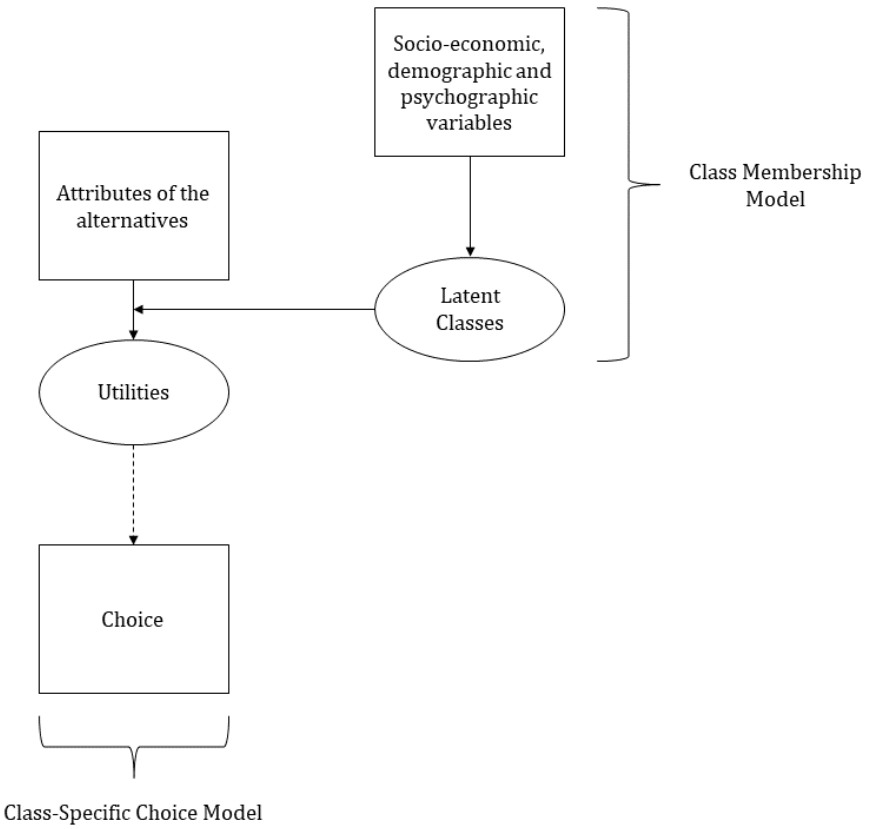

Figure 2: Conceptual latent choice model
Source: Sfeir et al. (2020)

Model estimation based on the data retrieved by the DCE was done using the Apollo software. The model determines in what class an individual most likely belongs to but does not rule out the possibility that the individual belongs to another class. These different classes all have their own attribute weights and Willingness-to-Pay (WtP). It is possible to determine the possibility that an individual belongs to a class based on the demographic, socioeconomic or psychographic characteristics of the individual (Dillingham, 2016). However, not all characteristics will have a significant effect on the segmentation of individuals.

One of the advantages of LCCMs is that it is able to explain the heterogeneity within a population instead of just capturing it. This makes LCCMs particularly useful for the segmentation of customers and describing those clusters based on respondents' demographics, socioeconomic characteristics and psychographics (Magidson & Vermunt, 2002). The process of LCCM will be explained in detail below.

First, the number of classes that makes the LCCM fit the data best had to be found. This decision is usually based on the Akaike information criterion (AIC) and the Bayesian information criterion (BIC) (Czine et al., 2020). The aim is to minimize both the AIC and BIC values when choosing the number of classes (E. Molin & Maat, 2015).

After determining the number of classes to be included in the model, the attribute weights of those classes could be investigated. The attribute weight (β) is the importance of an attribute. This weight is estimated relative to the other attributes and random errors (Molin, 2022c). The β is estimated in such a way that it makes the observed data the most likely. The attribute weight β should be interpreted as the following: 'the gain or loss of utils by 1 unit increase of an attribute', where util is the measure of utility. Whether the utility decreases or increases depends on the sign of the attribute weight. An attribute weight of 0 means that the attribute does not influence the choice behaviour of the respondents. When an attribute has a large β, this means that this attribute is very important for respondents when making a choice. Those attribute weights cannot be compared directly due to different units but can be compared by calculating the WtP. This can be calculated by dividing the attribute weight of the attribute under consideration by the weight of the price attribute. The value of WtP shows how much a respondent is willing to pay for a one-unit increase of the concerning attribute. Based on the attribute weights and their signs, the classes could be assigned an informative name. Examples in the scope of meat and meat alternatives are *meat lovers*, *meat alternative lovers* or *potential flexitarians*. Those names are completely based on the attribute weights.

There could be determined what percentage of the respondents belongs to which class, and therefore it became clear what class was the biggest and also what class was the smallest. What's more interesting is that there could be determined who belonged in which class based on the demographic-, socioeconomic- and psychographic characteristics of the respondents in that class. To be able to do this, it is important to have significant respondent characteristics as predictor variables. This indicates the importance of thorough and well-thought-out characteristics selection.

3 Literature review & conceptual model

3.1 Meat alternatives

A common way to distinguish between different meat alternatives is on one hand meat substitutes based on plant material and the other hand meat substitutes based on animal-produced protein (Smetana et al., 2015). In the case of plant-based meat alternatives, one can think of soy, peas, wheat, nuts, legumes and vegetables (Scherer et al., 2023; Smetana et al., 2015). Examples of animal protein-based products are milk-based substitutes, egg-based substitutes, cultured meat and lab-grown meat (Scherer et al., 2023; Smetana et al., 2015).

Plant-based meat alternatives cause less GHG emissions than when animal ingredients are used (Fresán et al., 2019; Scherer et al., 2023; Smetana et al., 2015). This GHG emission increase is due to the GHGs released during the production of animal-sourced proteins (Fresán et al., 2019). Fresán et al. (2019) concluded this based on a Life Cycle Assessment that included the emissions released during growing the raw ingredients, transporting these ingredients, processing these ingredients and packaging the final products. Onwezen et al. (2021) also agree that focusing on plant-based meat alternatives is very promising from an environmental impact aspect, but also from a societal acceptance perspective. Besides plant-based meat alternatives being more interesting to study due to lower GHG emissions, the majority of meat alternatives sold in Dutch supermarkets are plant-based. The goal is to advise producers of meat alternatives that are sold in Dutch supermarkets, so therefore the focus will be on plant-based alternatives. Within the category of plant-based meat alternatives, no distinction will be made between alternatives based on different plant proteins. There is little difference in GHG emissions between different plant-based meat alternatives (Fresán et al., 2019).

Besides the choice between plant-based alternatives and animal-based alternatives, a decision has to be made about the sort of product used in the DCE. Hoek, Luning, et al. (2011) did research on the categorization of meat and meat substitutes and found that plant-based meat substitutes are members of the category of processed meat products and should therefore be presented as such. Examples they give of processed meat products are burgers, minced meat, pieces, sausages and satay. They argue that processed meat substitutes are more likely to be taken into consideration while choosing and that the product form becomes more important than the product ingredient source. Therefore, when letting respondents choose between processed meat and their plant-based alternatives, the product attributes may be of higher importance as compared to letting them choose between a regular steak and a vegetarian steak. Also, because the research of Hoek, Luning, et al. (2011) suggests that product brands should focus on developing processed meat substitutes, it is most useful to focus on processed meat substitutes in this research. Michel et al. (2021) also agree that producing products that resemble highly processed meat products is a very promising strategy. The processed meat that is consumed the most in the Netherlands is red meat mince (vlees.nl, 2022). The reason for picking mince as the product of this study is twofold. First of all, it is the most sold product so understanding the trade-off between this product and its plant-based alternative can contribute relatively much to GHG reduction related to meat consumption. In addition, according to research conducted by Proveg International et al. (2021), Dutch consumers specifically wish that they could buy plant-based mince. Secondly, because it is the most sold product and the product is very versatile a lot of respondents will be very familiar with the product. Therefore, it will be easier to find respondents and it will be easier for respondents to fill in the DCE.

3.2 Meat alternative attributes

On the first of April 2021, Onwezen et al. (2021) published an article with the results of a systematic literature review on consumer acceptance of alternative proteins. They identified 91 articles available on Scopus that focus on the drivers of consumer acceptance of alternative proteins. The results of this research will be analyzed and discussed. The literature review by Onwezen et al. (2021) was conducted in June 2020, so the Scopus database will be scanned to see if additional articles were published using the same search query as was used before. For an elaborated explanation of the literature review, see Appendix A.1.

185 new articles have been published since the review of Onwezen et al. (2021) in June 2020. From those articles, the titles and abstracts were scanned to determine whether the articles were relevant to the current research. Based on the titles and abstracts, 15 articles were selected to include in this research. The main findings by Onwezen et al. (2021) and the additional findings from the new articles are scanned to determine which attributes meet the criteria as stated in Section 2.3.1. As a reminder, the attributes should be the most important attributes for respondents, relevant for policy or design, measurable and describable in a simple way. Only those attributes that meet the stated criteria will be discussed below. A short summary of the first selection of attributes will be discussed below, for a elaborate explanation see Appendix A.3

A large number of the attributes mentioned by Onwezen et al. (2019) and other researchers are environment-related attributes. One attribute particularly suitable for this research is 'the degree to which meat substitutes are less environmentally impactful than meat'. Communicating the environmental impact can be done most efficiently by means of colour-coded labels (Erdem & Campbell, 2022; Mudgal et al., 2012). Such labels are easy-to-understand

for consumers as compared to physical values. The colour-coded environmental label used in this research is the Life Cycle Analysis based Eco-score. This Eco-score takes the environmental impacts throughout the whole life-cycle into account such as the impact resulting from growing, processing, packaging, transporting and consuming products. There are 14 environmental impact indicators that are taken into consideration while calculating the Eco-score:

- Climate change
- Carbon footprint
- Ozone depletion
- Ionizing radiation
- Land
- Water use
- Energy use
- Air pollution
- Marine pollution
- Freshwater pollution (particulate matter, acidification, eutrophication)
- Resource depletion

Additional bonuses and malus can be assigned based on the production method, the origin of ingredients, endangered species and packaging. Based on the calculated environmental impact, a product gets assigned an Eco-score from A (least impact) to E (highest impact). The scores included in this DCE are the scores A to D because there are no plant-based minced examples with an Eco-score of E. The conventional meat mince that is also presented as an option does get assigned an E, based on the average Eco-score of conventional mince. For a visualization of the Eco-Score see Figure 3 below.

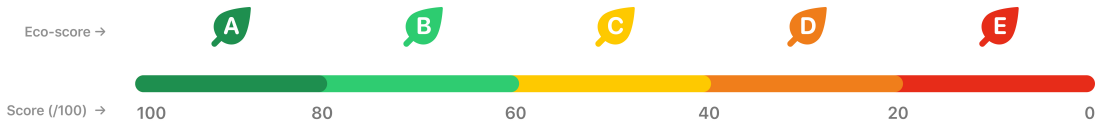

Figure 3: Eco-Score

Source:https://www.foodnavigator.com/Article/2021/01/12/Eco-Score-New-FOP-label-measures-the-environmental-impact-of-food

The environmentally friendly aspects of meat alternatives are usually positively correlated with the utility gained from choosing meat alternatives. However, meat alternatives still own a small market share compared to conventional meat. This is due to the trade-offs that have to be made when choosing between meat and meat alternatives (Hoek, Luning, et al., 2011). The product that maximizes the consumer's utility is chosen, and this does not solely depend on environmental aspects.

The second aspect that is of significant influence on the preference for meat alternatives is the beneficial health aspect of meat alternatives. All the identified health-related attributes can be divided into three categories: health claims, nutritional claims and food safety. For this research, there is decided to focus on nutritional claims as deemed most relevant and feasible to include. Nutritional claims refer to the nutrients within a certain product (Talati et al., 2016). Meat alternatives are seen as a possibly better choice than conventional meat due to more fibre, less fat and less energy. A list of possible nutritional claims and the conditions that have to be met to use to claim are determined by the European Parliament. From this list, three claims related to the three mentioned nutrients could be selected based on which conditions were feasible and realistic. For the full list of existing nutritional claims, see Appendix A.2. The three chosen claims will be shortly explained below.

To highlight the energy-related benefits, the 'energy reduced claim' is selected. This claim may be stated when the energy value of the product is reduced by at least 30%. For meat alternative producers, altering a product to deserve this claim is realistic and feasible. For the lower fat benefits of meat alternatives, the 'low saturated fat claim' is selected. There is decided to use a claim that focuses on saturated fat instead of unsaturated fat because limiting saturated fat has priority over limiting total fats (Moll, 2022). The 'low saturated fat claim' applies to products from which the sum of saturated fatty acids and trans-fatty acids do not exceed 1.5 grams per 100 grams of solid product. There are plant-based meat alternatives that already meet this condition, so, therefore, this claim is a realistic and feasible goal for producers of meat alternatives. Lastly, the claim referring to increased fibre is the 'high fibre claim'. The condition that has to be met to state the high-fibre claim is that a product contains at least 6 grams of fibre per 100 grams. To summarize, the three claims that will be included are the energy-reduced claim, the low saturated fat claim and the high fibre claim.

Another indispensable aspect of influence on food choices are the economic aspects. It is widely agreed that price has a significant influence on food choices. The operationalization of price is straightforward considering products in supermarkets all have their selling price. To determine the price range the current meat alternative prices from supermarkets can be studied. A range will be chosen that is slightly wider than the current existing range. This allows for room to predict the influence of cheaper prices or more expensive prices in the future while maintaining realistic

levels. The existing range will be based on the current prices of the 6 biggest supermarkets in the Netherlands. The price range resulting from studying the supermarket prices is €1.48 to €4.89. There is decided to operationalize the price attribute through 4 attribute levels. It is desirable to maintain equidistance between the price levels because this assures orthogonality between attributes (Molin, 2022c). Equidistance means that the distance between the levels is equal. Orthogonality means that there is no correlation between attributes and therefore estimating the separate parameters is possible. The four chosen levels that range wider than the current existing range and preserve equidistance are €1.30, €2.60, €3.90 and €5.20.

Furthermore, there are intrinsic properties of plant-based meat alternatives. The intrinsic properties are inherent within the product such as taste, texture and preparation time. One challenge that many different producers are currently working on is creating meat alternatives that very closely resemble conventional meat. However, from the literature, there can be derived that there is no consensus on whether meat alternatives should resemble conventional meat or be a product of their own (Elzerman et al., 2013; Hoek, Luning, et al., 2011). Knowledge of these preferences per consumer segment is valuable for the producers and marketers of meat alternatives to determine where they should be aiming for in product development. For simplicity's sake and because of lacking methods to measure sensory preferences there is decided to operationalize this attribute using two understandable levels: mimics the taste of meat or does not mimic the taste of meat. The same goes for texture and appearance. The texture is defined as the properties of food that are sensed by touch in the mouth (Dahl, 2020).

The last attribute that will be included in the first proposition of attributes is the preparation time. According to Elzerman et al. (2022), a short preparation time is not necessarily perceived as a positive trait of a meat alternative. This is due to possible satisfaction derived from a long time spent on cooking. By including this attribute, there can be determined whether products should be developed in such a way that it is quick and ready to go or whether slow-cook products are preferred more. Again, the preparation times of different mince alternatives that currently exist are analyzed to determine the current range. Subsequently, a preparation time range consisting of 4 levels is determined where equidistance is kept between the levels. The current range of preparation time varies from 3 minutes to 15 minutes. A range wider than the current existing range will be chosen to make sure all possible preparation time levels are included. Therefore, the four levels chosen to include in the DCE are 2 minutes, 7 minutes, 12 minutes and 17 minutes.

In the DCE, the alternatives will all be presented as a combination of these attributes and different attribute levels. The attributes will be dummy coded in this research. This code is used later on when constructing the experimental design. With dummy coding, the utility estimated using the LCCM should be interpreted as the difference in utility with the reference. The reference in this case is the attribute that is assigned coding level 0. The respondents will be asked to choose between two meat alternatives and one conventional meat option. By also including meat, the trade-offs that are being made when choosing between meat and meat alternatives can be studied instead of only the trade-offs between multiple meat alternatives. Knowledge about these trade-offs leads to more valuable advice on how to compete with conventional meat. The ultimate goal is to reduce GHG emissions by substitution of meat with meat alternatives. The attribute levels of the conventional meat will be fixed based on the current average attribute values of mince. For an example of how conventional meat will be composed out of the chosen attributes, see 1 below.

Table 1: Proposed attribute levels of conventional mince

Environmental impact	
Energy-reduced claim	Product does not have the energy-reduced claim
High fibre claim	Product does not have the high fibre claim
Low saturated fat claim	Product does not have the low saturated fat claim
Price	€3.69
Taste	Mimics the taste of meat
Texture	Mimics the texture of meat
Appearance	Mimics the taste of meat
Preparation time	5 minutes

For an overview of the selected attributes through literature review, their descriptions and the selected attribute levels, see Table 2 below. For a translation of the table below to Dutch that will be used in the questionnaire and during the focus group, see Appendix A.4.

Table 2: Attributes and attribute levels

Attribute definition	Attribute levels
Environmental impact: this attribute refers to the overall environmental impact of a product. This overall environmental impact is calculated based on a Life-Cycle Analysis together with additional quality criteria. Examples of included elements are production method, packaging, origin, transport, processing and water use.	
Energy-reduced claim: this claim applies to products from which the energy value is reduced by at least 30%.	Product has the energy-reduced claim Product does not have the energy-reduced claim
High fibre claim: this claim applies to products that contain at least 6 grams of fiber per 100 grams.	Product has the high fibre claim Product does not have the high fibre claim
Low saturated fat claim: this claim applies to products from which the sum of saturated fatty acids and trans-fatty acids do not exceed 1.5 grams per 100 grams of solid product.	Product has the low saturated fat claim Product does not have the low saturated fat claim
Price: this attribute refers to the price of a product.	€1.30 €2.60 €3.90 €5.20
Taste: this attribute refers to whether a meat alternative mimics the taste of meat or not.	Mimics the taste of meat Dissimilar to the taste of meat
Texture: this attribute refers to whether a meat alternative mimics the texture of meat or not. The texture is defined as the properties of food that are sensed by touch in the mouth.	Mimics the texture of meat Dissimilar to the texture of meat
Appearance: this attribute refers to whether a meat alternative mimics the appearance of meat or not.	Mimics the appearance of meat Dissimilar to the appearance of meat
Preparation time: this attribute refers to the preparation time presented on the packaging of a meat alternative product.	2 minutes 7 minutes 12 minutes 17 minutes

3.3 Focus group

The list of attributes, attribute levels and attribute descriptions was validated by means of a focus group. For an elaborate explanation of the focus group process and the results, see Appendix A.5. In this Section, a summary of the focus group process will be given, and the main results will be discussed. The participants of the focus group were selected in such a way that a wide range of socio-demographic characteristics was involved. The socio-demographic characteristics of the people invited to join the focus group can be seen in Table 3.

Table 3: Socio-demographic characteristics focus group attendees

Attendees	**Age**	**Gender**	**Highest level of education**	**Current Employment**	**Diet**
Attendee 1	21	Female	Bachelor's Degree	Student	Pescetarian
Attendee 2	23	Female	Higher Professional Education (HBO)	Technical documentation officer	Omnivore
Attendee 3	58	Female	PhD	Project Health, Safety and Environment Manager	Vegetarian
Attendee 4	20	Male	Bachelor's Degree	Student	Pescetarian
Attendee 5	29	Male	Master's Degree	Data Scientist	Omnivore
Attendee 6	35	Male	Higher Professional Education (HBO)	Domain Manager	Vegan at home, flexitarian outdoors

3.3.1 Missing or redundant attributes

As a result of the focus group, three alterations were made. Firstly, the aggregation of the three nutritional claims into the nutri-score. Secondly, the addition of animal welfare using a self-designed animal welfare label. And lastly, the elimination of preparation time. All three alterations will be elaborated on shortly and the new attributes that will be included will be presented.

The participants of the focus group agreed that the three separate nutritional claims were not used during decision-making between meat and meat alternatives. Making a decision based on the nutri-score is more realistic due to the better overview that the nutri-score offers. Therefore, the nutri-score is included. The appropriate levels of the nutri-score to include were levels A to D, and levels E could be left out due to no occurrence.

One of the participants that had been vegetarian for long term criticised the missing of animal welfare. The participant argued that the most important reason not to eat meat for vegetarians is animal welfare. The validity of this statement was studied, and there was concluded that 34% of the Dutch meat reducers indeed reduce meat consumption due to animal welfare. Therefore, there can be concluded that animal welfare is of great relevancy in decision-making between meat and meat alternatives. The implementation of an EU-wide animal welfare label is already being investigated and based on the research already carried out, such a realistic label as possible has been designed to include this research.

Lastly, all participants agreed that preparation time was not taken into consideration during the decision between meat and meat alternatives. To determine the validity of this statement, the literature where the inclusion of preparation time was based on was revisited. After carefully re-reading this research there can be concluded that preparation time plays a role with other meat alternative categories but not with processed meats. Therefore, preparation time can indeed be eliminated from the list of attributes.

3.3.2 Operationalization and understanding of attribute levels

Besides adding and removing attributes, suggestions for attribute-level alterations have also been done. One necessary alteration of attribute levels that all participants agreed on was making the environmental impact attribute levels more tangible or more suitable for comparison. They expressed the need for understanding the impact of choosing meat alternatives versus meat better. Therefore there is decided not only to include the eco-scores A to D, but also the numerical score that leads to the higher categorization of A to D. In this way, consumers can see that one product scores twice as low as another product for example.

For the final attributes and attribute levels that will be included in the DCE, see Table 4 below. For the attribute levels assigned to conventional mince, see Table 5 below. For the Dutch translation of these attributes and attribute levels that are used in the DCE, see Table 26 in Appendix A.5.

Table 4: Final attributes and attribute levels

Attribute definition	Attribute levels	Level coding
Environmental impact: this attribute refers to the overall environmental impact of a food product. This overall environmental impact is calculated based on a Life-Cycle Analysis together with additional quality criteria. Examples of included elements are production method, packaging, origin, transport, processing and water use. Products are given a score from 0 to 100, with 0 being the worst score from an environmental perspective and 100 being the best score.		0
		1
		2
		3
Nutri-score: this attribute refers to the general nutritional value of the product. Products that get scored an A have the highest nutritional value and products that get scored a D have the lowest nutritional value.		0
		1
		2
		3
Price: this attribute refers to the price of a product.	€1.30	0
	€2.50	1
	€3.70	2
	€4.90	3
Taste: this product mimics the taste of meat.	Yes	0
	No	1
Texture: this product mimics the texture of meat. The texture is defined as the properties of food that are sensed by touch in the mouth.	Yes	0
	No	1
Appearance: this product mimics the appearance of meat.	Yes	0
	No	1
Animal-welfare: the EU official animal welfare label applies to products that are guaranteed to be Animal Welfare Approved throughout animal's entire lifespan.	No label	0
		1

Table 5: Attribute levels of conventional mince

Attribute	Attribute level	Level coding
Environmental impact	E	4
Nutri-score	C	2
Price	3.69	3.69
Taste	Mimics the taste of meat	0
Texture	Mimics the texture of meat	0
Appearance	Mimics the appearance of meat	0
Animal-welfare	No animal-welfare label	0

3.4 Socio-demographic-, behavioral- and psychographic characteristics

Latent Class Choice Modelling (LCCM) is used to identify individuals who can be grouped together based on their choices. The four main types of market segmentation are socio-demographic segmentation, psychographic segmentation, geographic segmentation and behavioural segmentation (M. Solomon et al., 2012; Yieldify, 2020). In this research, geographic segmentation will not be executed because the segmentation strategy is not very relevant for the producers and marketers of plant-based mince alternatives that sell their products in the Netherlands. This strategy is usually applied when products or marketing campaigns are very climate-, time-zone- or region-bound (M. Solomon et al., 2012; Yieldify, 2020). This is not the case with meat alternatives in the Netherlands, and therefore this segmentation strategy will be disregarded. Based on someone's socio-demographic-, behavioural- and psychographic characteristics, the probability that an individual belongs to a certain class can be determined. On the other way around, those characteristics can be used to define the classes derived from the LCCM.

A selection of which socio-demographic-, behavioural- and psychographic characteristics to include has to be made. First, explanations and definitions of socio-demographic-, behavioural- and psychographic characteristics will be given. Secondly, the selection procedure and selection criteria will be elaborated on. Lastly, the selected characteristics will be presented and there will be explained why and how those will be incorporated into the DCE.

Socio-demographics are measurable traits of people such as age, gender, education, income and race. In some cases, socio-demographics can lead to relevant consumer segments. However, the use of psychographic characteristics as compared to socio-demographic characteristics for consumer segmentation and targeted policy and design development has been suggested as potentially more effective (Cabriales et al., 2016; Funk et al., 2021). Nonetheless, including some socio-demographics is useful for describing different consumer segments (Funk et al., 2021). Therefore, still, some socio-demographics will be included as profiling variables. In this research, the demographics that will be included are the same as for the focus group because those socio-demographics are proven to be of significant influence in some research. The socio-demographic employment will be replaced with the yearly income to keep the responses more general and give more insight into what people earn and may spend on food. Asking for the yearly income for the focus groups was perceived as too personal and sensitive considering the focus group was not anonymous. Asking directly how much people spend on food may be too difficult for respondents to estimate. Psychographics are personality traits, values, attitudes, opinions, beliefs and lifestyles (M. Solomon et al., 2012; Yieldify, 2020). These can be used to understand the reasoning behind consumers' decisions. Lastly, there is behavioural segmentation. Behavioural segmentation divides the market based on consumer behaviour. Examples are spending habits and purchasing habits.

As with the attribute selection, the systematic review by Onwezen et al. (2021) together with the additional article found after the last search date of the systematic review are scanned for indicator variables. First, a list of all socio-demographic-, behavioural- and psychographic characteristics was made, this list can be seen in Appendix B.1.Only 11 out of 91 articles reviewed by Onwezen et al. (2021) focuses on researches choice behaviour regarding plant-based meat alternatives. The great majority focused on other alternative proteins such as legumes, seaweed, algae, insects and cultured meat. There is decided not to only focus on literature regarding meat and plant-based meat alternatives because a lot can be learned from research on for example insects and seaweeds as sources of protein (Onwezen et al., 2021). The characteristics that will be selected to include for this research should closely align with the goal of the research.

The goal of this research is to advise manufacturers and marketers of meat alternatives on how to make their products and marketing more attractive to certain consumer segments. Onwezen et al. (2021) also discussed interventions aimed at increasing meat alternative consumption or reducing meat consumption mentioned in the articles they reviewed. Interventions that they mention are for example health and environmental claims, highlighting societal benefits, price interventions and increasing familiarity due to tasting. Those interventions give insights into which variables are interesting for producers and marketers of meat alternatives. So, therefore, first, the list of interventions will be

expanded by means of a literature review. This list of interventions will give a broad overview of the options producers and marketers have to alter their product or marketing strategy. Thereafter, a selection of relevant indicator variables will be made based on the available interventions.

3.4.1 Suggested interventions

Articles focusing on the barriers and drivers of meat alternative consumption were studied to define a list of suggested interventions to increase meat substitute consumption. For an extensive list of suggested interventions, see Tables 27, 28 and 29 in Appendix B.2. The most efficient and suitable interventions differ by consumer segment, and therefore should be tailored to the target segment (Götze & Brunner, 2021; Lacroix & Gifford, 2019; Szejda & Parry, 2020). The interventions could be grouped based on the socio-demographic, behavioural and psychographic characteristics of the consumers they were focused on. For example, interventions focused on emphasizing on health could be grouped, and interventions focused on the environment could be grouped. Based on the focus of the group of interventions, a list of relevant person-related characteristics needed to determine the suitability of this intervention group can be identified. For the health-related interventions group, this could be characteristics such as 'health consciousness' and 'perceived health benefits of meat' would be relevant characteristics to determine suitability.

First, the interventions were grouped into a set of themes. The themes resulting from the found interventions are health, environment, ease of preparation, animal welfare, sensory properties, familiarity, knowledge and habits and social norms. For a complete overview of the interventions per theme see Appendix B.2. In the next Section, the selection of the characteristics based on these identified themes will be explained.

3.5 Selection of characteristics and scales

The earlier identified person-related characteristics presented in Appendix B.1 were assigned to one of the themes if they were usable to determine the suitability of the interventions within the theme. In case of too many characteristics per theme, there must be determined which to include. According to Jenkins et al. (2021), it is suggested that different segmentation variables should be combined to provide a meaningful profile of the population. Therefore, there will be aimed to include both behavioural and psychographic characteristics as indicator variables.

The person-related characteristics have to be measured. Many different scales have been suggested to measure multiple characteristics related to food choices. One example is the multi-item Food Choice Questionnaire (FCQ), a questionnaire consisting of 36 items (Steptoe et al., 1995). Onwezen et al. (2019) developed and tested a single-item FCQ because long questionnaires tend to decrease the quality of the respondent's answers and lead to among other things high drop-out rates. They concluded that their shorter FCQ is a more reliable alternative for predicting food intake. Their scale consists of 11 items that need to be scored based on a 7-point Likert scale. The proposed single items will be compared with other more elaborate scales, and only if the more elaborate scales lead to more useful insights for producers and marketers, the more elaborate scales will be chosen. The reason for tending to keep the scales as simple as possible is the same as with the long questionnaires. Too many questions in the DCE will decrease the quality of respondents' answers due to fatigue and will lead to dropouts. It is not recommended to use different point Likert-scales in one research if not necessary because this will lead to potential confusion and survey fatigue (Botha, 2012). Therefore, one Likert scale will be chosen and applied to all questions.

It is a non-consensus on how many points should be included when using a Likert scale. There is decided to use a scale with uneven numbers to give the respondents the chance to express a neutral opinion. Subsequently, there is decided to use a 5-point Likert-scale for multiple practical reasons. A 5-Point Likert scale as compared to a 7-Point Likert scale takes less time and effort and fits mobile devices better (worktango, 2022). There is decided to choose a 5-point Likert-scale instead of a 3-point Likert-scale because respondents will be able to communicate the direction of their opinion (agree/not agree) and the intensity of their opinion (Sauro, 2019). The scales will vary from 1 = Strongly disagree to 5 = Strongly agree. If this is not the case with the original scale adopted from another research, the scale or statements will be altered to fit this scale. A summarized overview of the identified intervention themes alongside the corresponding needed characteristics to determine the suitability of interventions will be presented below. For an elaborated explanation of the selection of characteristics and measurement scales and the adaption of those scales if necessary see Appendix B.4. The survey will be spread among Dutch consumers, therefore the scales that will be used will be translated into Dutch. For the translated scales, see Appendix B.5.

Focus on health
To determine the importance of health for multiple segments, 7 items are included that all need to be scored from 1 to 5. Using these items, health-related behaviour, general health consciousness and health concerns related to food can be measured to use as profiling variables. The items including scales that will be used are:

I exercise regularly	1 = Strongly disagree; 5 = Strongly agree
It is important to me that the food I eat on a typical day is healthy	1 = Strongly disagree; 5 = Strongly agree
It is important to me that the food I eat on a typical day helps me control my weight	1 = Strongly disagree; 5 = Strongly agree
Eating meat is necessary for obtaining beneficial nutrients	1 = Strongly disagree; 5 = Strongly agree
Meat is an important part of a healthy diet	1 = Strongly disagree; 5 = Strongly agree
Meat substitutes have various benefits for health	1 = Strongly disagree; 5 = Strongly agree
Meat substitutes consist of nutrients that are beneficial to health	1 = Strongly disagree; 5 = Strongly agree

Focus on environment
To measure the characteristic considering the concern for the environment and the environmental-related behaviour, 8 items are included in the DCE. The items that will be included to account for the environmental theme are:

I choose food that is produced in an environmentally friendly way	1 = Strongly disagree; 5 = Strongly agree
I buy locally produced foods	1 = Strongly disagree; 5 = Strongly agree
I try not to throw away food	1 = Strongly disagree; 5 = Strongly agree
I eat seasonal fruit and vegetables	1 = Strongly disagree; 5 = Strongly agree
When humans interfere with nature it often produces disastrous consequences	1 = Strongly disagree; 5 = Strongly agree
The Earth is like a spaceship with very limited room and resources	1 = Strongly disagree; 5 = Strongly agree
The so-called "ecological crisis" facing humankind has been greatly exaggerated	1 = Strongly disagree; 5 = Strongly agree
Humans are seriously abusing the environment	1 = Strongly disagree; 5 = Strongly agree

Focus on ease of preparation
There are three items that will be included to determine the influence of ease of preparation. Those three items focus on the ability of respondents to use meat alternatives, their desire to use novel products and their desire for convenient cooking. The items that will be included are:

I know how to prepare meals with meat substitutes	1 = Strongly disagree; 5 = Strongly agree
I like to try new recipes	1 = Strongly disagree; 5 = Strongly agree
It is important to me that the food I eat on a typical day is convenient in preparing	1 = Strongly disagree; 5 = Strongly agree

Focus on animal welfare
The importance of animal welfare is included in the DCE through one item. This item is the following:

It is important to me that the food I eat on a typical day is animal friendly	1 = Strongly disagree; 5 = Strongly agree

Focus on sensory properties
What respondents wish for regarding taste, texture and appearance can be elicited from the choice they make during filling in the DCE. Therefore, not many scales concerning the sensory properties will be included. One item that is included to determine the general importance of sensory properties to a respondent is:

It is important to me that the food I eat on a typical day provides me with pleasurable sensations (e.g., texture, appearance, smell and taste)	1 = Strongly disagree; 5 = Strongly agree

Focus on familiarity
The influence of familiarity on choices between meat and meat alternatives have been widely proven. This theme includes both the desire and reluctance to eat novel foods, as the familiarity with meat alternatives. The 8 items that are included to measure those characteristics are:

New food eating experiences are important for me	1 = Strongly disagree; 5 = Strongly agree
I am afraid to eat things I have never had before	1 = Strongly disagree; 5 = Strongly agree
I don't trust new foods	1 = Strongly disagree; 5 = Strongly agree
New foods mean an adventure for me	1 = Strongly disagree; 5 = Strongly agree
I like to challenge myself by trying new foods	1 = Strongly disagree; 5 = Strongly agree
It is exciting to try new foods when travelling	1 = Strongly disagree; 5 = Strongly agree
Foods from other cultures look too weird to eat	1 = Strongly disagree; 5 = Strongly agree
Foods that look strange scare me	1 = Strongly disagree; 5 = Strongly agree
It is important to me that the food I eat on a typical day is familiar	1 = Strongly disagree; 5 = Strongly agree

Focus on knowledge
Another big influence on the choice between meat and meat alternatives is knowledge. A distinction has to be made between subjective and objective knowledge. Subjective knowledge is what individuals think they know, and objective knowledge is what is actually memorized. The items that are included to measure subjective knowledge about the difference between meat and meat alternatives are:

I know pretty much about plant-based meat alternatives	1 = Strongly disagree; 5 = Strongly agree
Compared to most other people, I know less about plant-based meat alternatives	1 = Strongly disagree; 5 = Strongly agree
When it comes to plant-based meat alternatives, I really don't know a lot	1 = Strongly disagree; 5 = Strongly agree

The items that are included to measure objective knowledge about meat and meat alternatives are:

Plant-based meats generally have fewer calories and less saturated fat than animal-based meat.	1 = Strongly disagree; 5 = Strongly agree
Swapping conventional animal meat for plant-based meat can lower cardiovascular disease risk factors and be more conducive to a healthy weight	1 = Strongly disagree; 5 = Strongly agree
Replacing conventional meat with plant-based meat substantially reduces every environmental impact measured, even after the processing required to turn plants into plant-based meat.	1 = Strongly disagree; 5 = Strongly agree
Using all cropland to grow food for humans instead of animals would allow farmers to feed more than twice as many people.	1 = Strongly disagree; 5 = Strongly agree

Focus on habits and social norms
The last items that will be included in the DCE focus on the habitual nature of consuming meat. This will lead to insights into which segments act out of habit and which segments act out of goal-directed behaviour. The items included to measure habit strength are:

Eating meat is something I do without thinking	1 = Strongly disagree; 5 = Strongly agree
Eating meat is something that would cost me effort not to do	1 = Strongly disagree; 5 = Strongly agree
Eating meat is something that is part of my daily/weekly routine	1 = Strongly disagree; 5 = Strongly agree
Eating meat is something I would find hard not to do	1 = Strongly disagree; 5 = Strongly agree

4 Survey design

4.1 Operationalising the DCE

All the parameters that have to be estimated are determined. Based on this, the complete model can be specified and the experimental design can be generated. Based on this experimental design, the survey can be developed and spread among respondents.

4.1.1 Model specification

The chosen attributes, attribute levels and model type are already explained. The last decision that has to be made before constructing the experimental design is whether or not to include interaction effects. Interaction effects should be included when the attribute level value of one attribute modifies the weight attached to another attribute (Molin, 2022c). With the attributes included in this research, such effects cannot reasonably be expected. Furthermore, including interactions may result in more choice sets, which is undesirable because of the aim to keep the number of choice sets as small as possible (Molin, 2022a). Therefore, there is decided to disregard interaction effects in this research. The next step is to construct the experimental design.

4.1.2 Experimental design

As explained in Section 2.3.3, some decisions about the Experimental Design have already been made. Those decisions are the use of unlabelled alternatives and the aim for attribute level balance. The number of attribute levels and the attribute level ranges are already determined and can be read back in Section 3.2. Based on these attributes and attribute levels, a type of design has to be chosen. There is decided to use a fractional factorial design, as opposed to full factorial designs or efficient designs. Full factorial designs are not chosen because full factorial designs lead to a very big number of choice situations. In the case of the attributes and attribute levels included in this research, a full factorial design would lead to 1024 alternatives. Instead of full factorial designs, fractional factorial designs will be used. In the case of fractional factorial designs, a respondent is confronted with s subset of choice situations from the full factorial design. Two strategies for selecting those subsets in a way that sufficient variation across choice sets and attribute level balance is maintained are *efficient designs* and *orthogonal designs*. Efficient designs aim to generate parameter estimates with standard errors as low as possible (ChoiceMetrics, 2018). However, to do so prior parameter estimates are necessary, for example from existing literature or from a pilot study. In the case of this research, such prior estimates are not available. In case no priors are available, orthogonal designs are deemed efficient. With orthogonal designs, there is ensured that attribute levels do not correlate across all choice sets. By using orthogonal designs, the influence of each attribute can be estimated independently (ChoiceMetrics, 2018).

The software Ngene can be used to generate an orthogonal fractional factorial design. The number of choice sets aimed for has to be specified by the researcher. This number can be derived from orthogonal arrays. One example is the orthogonal arrays designed by Taguchi. To determine the number of rows, an orthogonal array that fits the number of attributes and the number of attribute levels included in the research. Therefore, the orthogonal array should fit 3 attributes with 4 attribute levels and 4 attributes with three attribute levels. A suitable Taguchi array was found and the number of rows needed is 16. For more explanation about orthogonal arrays and the Taguchi design used, see Appendix C.1. The desired number of choice situations per respondent is +/- 10 choice sets (Molin, 2022c). Because the number of choice sets is 16 and the respondents already have to fill in many other questions regarding person-related characteristics, there is decided to divide the total number of choice sets into two blocks. The Ngene Syntax used to construct the Experimental Design can be seen back in C.2. Before constructing the choice sets, the Experimental Design has to be checked for dominant alternatives.

Dominant alternatives are alternatives that outperform the other alternatives in the choice set on all attributes. The attributes taken into account to check for alternative dominance are environmental impact, Nutri-score, price and animal welfare. Taste, texture and appearance are not taken into consideration because it is not known what attribute level is more desirable for all respondents. One row is deleted from the design because it included a dominant alternative. After the removal of this alternative, the correlations between attributes were checked considering these weren't 0 anymore due to the removal of one row and therefore the loss of orthogonality. The highest within-alternative correlation that arose was -0.14, this is so low that it will not cause any trouble in estimating parameters. The Experimental Design is now ready and validated to use for the development of the survey. For a complete explanation of the Experimental Design construction process, see Appendix C.3.

4.2 Presentation of choice alternatives

To imitate real-world choice situations as well as possible, the choice alternatives will be presented via an online shopping format. Creating choice situations that resemble real-world choice situations helps to mitigate hypothetical bias. Hypothetical bias points out that respondents are confronted with hypothetical situations, not real-world situations. Therefore, it is not sure whether the choices that respondents make would have also been made in the real world. The

online shopping app of the biggest Dutch supermarket is used as inspiration to visualize the choice alternatives. The different components and their placement are inspired by the design of the Albert Heijn app. For an example of a choice alternative see Figure 4 below.

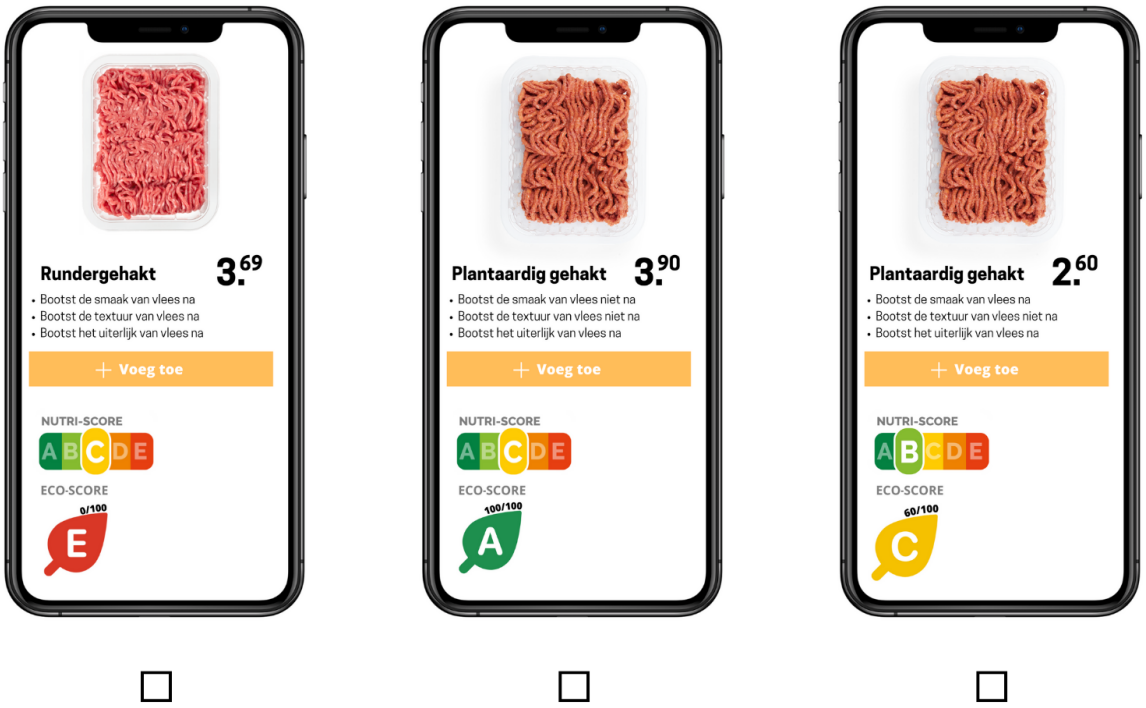

Figure 4: Example of choice set

4.3 Survey structure

The survey is constructed with the software Qualtrics. The respondents of the survey will remain completely anonymous and no potentially personally identifiable information will be collected.

- **Introduction**
  The respondents were first introduced to the goal of the survey and the research. Little attention will be given to the sustainable aspect of this research, as this will possibly influence the responses of the respondents. This phenomenon is also called information bias (Lizin et al., 2022). There will be explained that the survey is completely anonymous and how long the survey will approximately take. Besides the privacy-related benefits of making the survey anonymous, anonymity also partially mitigates social desirability bias (Cleave, 2021; Spiker, 2019). This means a reduced chance that people will choose the alternative that is more socially desirable. Social desirability bias is also partly mitigated due to the survey being hosted online instead of face-to-face. Then, an overview of the survey will be given to provide respondents with some indication of what they could expect. There is aimed to reduce hypothetical bias by creating choice situations as real as possible by visualizing the choice situations to imitate an online shopping experience.

- **Target population check**
  The target population of this survey are consumers who consume meat alternatives or are open to the idea of consuming meat alternatives. Furthermore, the respondents should be the ones to determine to consume meat alternatives therefore they should be in charge of determining what products are bought at the store. Another important question that determines the relevancy of respondents is whether they ever buy mince (either conventional or vegetarian). If they do not, this survey is not suitable for them. Lastly, the survey is restricted to respondents above 18. The respondents will be asked whether they are currently or in the near future open to buying or consuming meat alternatives. If the respondents answer this question with a no, they will be directed to the end of the survey because their responses won't be of use in this research. Also, they will be asked how frequently they are in charge of groceries, if the answer is never, they will be redirected to the end of the survey. Lastly, they will be asked to fill in their age, if this is below 18, respondents will be redirected to the end of the survey.

- **Current consumption patterns**
  The current consumption pattern regarding meat and meat alternatives is mentioned as behavioural variable of significant influence on meat or meat alternative preferences. The questions in this Section were about the frequency of meat consumption and the frequency of meat alternative consumption.

- **Covariates**
  Due to a large number of person-related characteristics, this part will be split up into two pieces. These two parts will be divided by the DCE. A variety of question styles will counter respondent fatigue. The first part of the derivation of person-related characteristics will include questions that are not expected to influence the responses of respondents. The questions about the health aspects, the environmental aspects and the animal welfare aspects could influence respondents to choose the meat alternative option more often. Therefore, the questions that will be presented before the choice experiment are the questions within the following themes: ease of preparation, sensory properties, familiarity and habits and social norms. In addition, this part will include the subjective knowledge questions. Peschel et al. (2016) recommends separating the subjective knowledge questions from the objective knowledge questions to prevent carryover effects between the two.

- **Choice experiment**
  This Section will start with an explanation of what the respondents are expected to do. This is followed by an explanation of the different attributes included in the DCE. The respondents are assigned to one of the two blocks of the choice experiment. The choice sets will be randomly shuffled in such a way that each respondent receives the choice sets in random order. The reason behind the randomization is that respondents possibly lose focus after a few choice sets. If the order is always the same, the last choices of the DCE will always be done with less focus leading to biased results.

- **Covariates**
  In this part, the remainder of the questions regarding person-related characteristics will be asked. The remaining themes are health, environmental impact and animal-welfare. Also, the objective knowledge questions will be presented in this part of the survey.

- **Socio-demographic characteristics**
  In this Section, a small number of sociodemographic characteristics will be asked. This includes gender, highest education, yearly income and diet.

- **Expression of gratitude**
  At the end of the survey, the respondents will be thanked for their participation and effort. The email address of the author will be provided in case any of the respondents are left with questions or comments.

4.4 Pilot test

The survey was piloted among a very small number of respondents to validate the length of the survey, to check whether respondents understand the questions correctly and to check whether one of the attributes has a very dominant impact on the choices of respondents. five individuals were recruited through convenience sampling. After they filled in the pilot survey, they were asked about their opinion on the survey and whether they had any comments or feedback. Based on those evaluations, there could be concluded that the respondents indeed need between 10 to 15 minutes to fill in the survey. Furthermore, one notable finding is that the attribute level of €5.20 is never chosen by any of the respondents. This indicates that this level is very dominant and that respondents may not pay any attention anymore to other attributes. The lowest price level of €1.30 does not have this impact considering respondents do not always choose the alternative with the price level of €1.30, but sometimes they do. Therefore, there is decided to reduce the highest price level a little bit to prevent high prices from becoming too dominant. Therefore, the price levels will be changed to €1.30, €2.50, €3.70 and €4.90. Lastly, respondents had no difficulties understanding the questions from the survey. Therefore, the survey is deemed fit for the purpose.

4.5 Survey distribution

As mentioned in Section 2.5, the goal is to distribute the survey in such a way that it best resembles the population of consumers who consume or are open to consuming meat alternatives. To do so, the survey will be randomly spread among personal and professional contacts of the researcher. The channels used are LinkedIn, Instagram, Facebook and Whatsapp groups. LinkedIn is used as a more professional channel and hopefully leads to spreading the survey outside of personal circles. Instagram, Facebook and Whatsapp groups will be used to reach personal contact first. Those contacts are asked to further spread the survey among their own personal circles. This convenience sampling is applied due to the limited time and resources available to spread the survey more randomly. However, the downside of convenience sampling is high risk for a biased sample. This limitation will be discussed in Section 9.4 in more detail. People outside of the target group will be excluded through the filter questions at the start of the survey. When spreading the survey attention will be paid so that not only students are targeted, but also working people. The same goes for gender and highest education. There will be asked if people would be willing to forward the survey to their professional and personal circles.

5 Descriptive statistics

5.1 Data cleaning and preparation

The survey was made accessible for 16 days from December 12th until December 28th. A total of 427 people opened the survey, from which 309 finished the survey either by completing the full survey or getting redirected to the end. The number of complete responses is 260, and 49 (15.9%) people were redirected to the end because they did not fall within the target group. 2 respondents fell outside the target group because they were younger than 18. Another 17 respondents got redirected because they were not open to consuming meat alternatives. Furthermore, 17 respondents were directed because they were never in charge of the groceries. Finally, 13 respondents fell outside the target group because they never bought mince and never will. The respondents who did not finish the survey or got redirected will be deleted from the data set that will be used to estimate the LCCM. Therefore, the remaining data set contains the responses of 260 respondents.

The average time it took to complete the survey was 2308 seconds or approximately 38,5 minutes. This was much higher than the expected 10-15 minutes. The completion times of respondents were plotted in a box plot to check for outliers. The box plot indicated that there were indeed a few extreme outliers of for example more than 41 hours. The most commonly used method to detect outliers in the research field is the Inter Quartile Range (IQR) approach (Sharma, 2021). For an explanation of the IQR approach and visualization of the data cleaning regarding duration outliers, see appendix D.1. The outliers were removed to calculate the mean duration time needed to complete the survey, but the results were used for estimating the LCCM. A possible explanation for the extremely high duration is that respondents opened the survey, and decided to complete the survey at a later moment in time. Besides controlling for the extremely high duration times, the IQR approach also ensures removing responses with extremely low duration times. After removing the outliers, the mean time needed to complete the survey was 652 minutes or 11 minutes.

Another important thing to check was whether both of the blocks of the DCE were completed almost an equal amount of times. The distribution had to be almost equal to maintain low correlations between attributes. Correlation between attributes leads to less reliable estimates and is therefore undesired. Block 1 of the DCE was completed 127 times, and block 2 was completed 133 times. Therefore there could be concluded that there is no worrisome difference between the distribution of block 1 and block 2.

Lastly, the data was checked for two things that could possibly indicate unreliable responses. The first problem was non-trading behaviour. Non-trading behaviour is the phenomenon where respondents choose the same alternative throughout all choice sets. This could result from extreme attribute preference or respondents being too bored, too tired or too disinterested in the topic of the survey. The data was analyzed to determine whether there were respondents for who there were good reasons to suspect non-trading behaviour. The answers of the respondents who chose the same alternative during the whole experiment were gathered and examined. There were very few respondents who demonstrate possible non-trading behaviour. They only demonstrated non-trading behaviour during the DCE questions and not during answering the other questions. It is impossible to tell whether the similarity in answers was due to non-trading behaviour and therefore there was no well-founded reason to delete the answers from the data set.

Another step executed to determine the reliability of the responses was to examine whether there were respondents who indicated to be vegan or vegetarian but still chose the conventional meat alternative. If this was the case, this would indicate that the respondents did not fully understand the choice task. No respondents were found that indicated to be vegetarian or vegan and still chose the conventional meat choice. Therefore, this step did not lead to the deletion of any respondents.

5.2 Sample description

5.2.1 Demographic variables

The sociodemographics age, income and meat-eating behaviour are divided into a set of categories instead of including all possible answers separately. This will ensure that each category has enough members and collapsing multiple response options into a smaller number of options makes it easier to interpret classes when estimating the LCCM. All sociodemographic levels will also be assigned a code, this is needed for estimating the LCCM.

In the LCCM, age is included as a continuous variable. For the examination of the impact of age on the survey answers in section 5.2.4, age is split into 3 categories: youth (18-24), young adults (25-54), and middle-aged adults (55+). The income categories used are adapted from the report by van den Brakel and Ament (2010) for the Central Bureau of Statistics. They defined the high-income category as the 20% highest income households, the low-income category as the 40% lowest income households and the middle-income category as the remaining 40% of the households. Considering their research was executed in 2010, the up-to-date high-income, middle-income and low-income thresholds will be calculated. Based on the data of the Central Bureau of Statistics and the responses that were given by the respondents, the following income categories were determined: low-income (below €20.000 per year), middle-income

(between €20.000 and €40.000) and high-income (above €40.000). The meat-eating behaviours will be categorized into meat avoiders, meat reducers (or flexitarians) and omnivores. The meat avoiders are the individuals who never consume meat, so vegans, vegetarians or pescetarians.

Table 6: Sociodemographic characteristics of the sample

Person-related characteristic	**Coding**	**Frequency**	**Percentage**
Age	0 = Youth (18-24)	116	44.6%
	1 = Young-adults (25-54)	101	38.8%
	2 = Middle-aged adults (55+)	43	16.6%
Gender	0 = Male	90	34.6%
	1 = Female	168	64.6%
	2 = I would rather not say	2	0.8%
Education	0 = High school	14	5.4%
	1 = Intermediate vocational education	9	3.5%
	2 = Higher vocational education	44	16.9%
	3 = University Bachelors degree	78	30.0%
	4 = University Masters degree	97	37.3%
	5 = University PhD degree	18	6.9%
Income	0 = Low-income	124	47.7%
	1 = Middle-income	73	28.1%
	2 = High-income	63	24.2%
Meat-eating behaviour	0 = Meat avoiders	38	14.6%
	1 = Meat reducers	97	37.3%
	2 = Omnivor	125	48.1%

There is no information available about the sociodemographic characteristics of the Dutch consumers of meat alternatives and/or who are open to the idea of consuming meat alternatives. As a result, it is not possible to determine whether and to what extent the sample is skewed or not. For the sake of this research, there will be assumed that the sample represents the true population. There will be examined whether different sociodemographic groups gave significantly different responses. If this is the case, the differences between the sociodemographic groups will be explained and the impact of a true population deviating from the sample of this research will be illustrated.

5.2.2 Exploratory factor analysis

A great part of the survey was aimed at measuring person-related characteristics using a set of 5-point Likert-scales. To identify which measuring scales actually measure the same underlying latent factor, Principal Axis Factoring (PAF) with oblique rotation was applied. The goal is to aggregate the measuring scales that measure the same latent factor to arrive at a better estimation of the latent factor. Variables with high intercorrelations probably fall under the same factor. There are two types of factor rotations, orthogonal and oblique rotation. In orthogonal rotation, no correlation between underlying factors is assumed and with oblique rotation, correlation is assumed (Kootstra, 2004). In this research, the oblique rotation was applied first because the underlying factors in this research were expected to be related. Subsequently, there was examined whether Orthogonal Rotation is preferred by examining whether a simple structure was also approximated using orthogonal rotation without deleting additional variables. There was concluded that a simple structure could be derived by applying Orthogonal Rotation without deleting additional variables. As a result, factors remain uncorrelated leading to easier interpretation. The oblique rotation and orthogonal rotation are done using the Software SPSS. For and detailed explanation of the process of the PAF, see Appendix D.2. The results of the PAF will be discussed below.

After executing the PAF method, 7 distinct factors were derived. The names assigned to those factors are 'pro meat attitude', 'food neophilia', 'pro meat alternatives attitude', 'sustainable behaviour', 'food neophobia', 'health consciousness' and 'environmental concern'. Two separate statements were added that did load high on any of the factors. The reason for including those statements was to make sure all intervention categories were covered. The two statements that were added were "It is important to me that the food I eat on a typical day is animal friendly" and

"I know how to prepare meals with meat substitutes". For an overview of the 9 factors that will be included as the psychographic covariates, see Table 7.

Table 7: Factors resulting from Principal Axis Factoring

Factor 1: pro meat attitude		
habit3	Eating meat is something that is part of my daily/weekly routine	0.84
health5	Meat is an important part of a healthy diet	0.80
habit4	Eating meat is something I would find hard not to do	0.79
habit2	Eating meat is something that would cost me effort not to do	0.76
habit1	Eating meat is something I do without thinking	0.74
health4	Eating meat is necessary for obtaining beneficial nutrients	0.73
Factor 2: food neophilia		
fam5	I like to challenge myself by trying new foods	0.79
fam4	New foods mean an adventure for me	0.67
fam6	It is exciting to try new foods when travelling	0.64
prep2	I like to try new recipes	0.62
fam1	New food eating experiences are important for me	0.55
fam2	I am afraid to eat things I have never had before	0.42*
Factor 3: pro meat alternatives attitude		
health6	Meat substitutes have various benefits for health	0.93
health7	Meat substitutes consist of nutrients that are beneficial to health	0.58
Factor 4: sustainable behaviour		
env4	I eat seasonal fruit and vegetables	0.72
env2	I buy locally produced foods	0.65
Factor 5: food neophobia		
fam8	Foods that look strange scare me	0.73
fam7	Foods from other cultures look too weird to eat	0.63
Factor 6: health consciousness		
health2	It is important to me that the food I eat on a typical day is healthy	0.55
health3	It is important to me that the food I eat on a typical day helps me control my weight	0.54
health1	I exercise regularly	0.46
Factor 7: environmental concern		
env8	Humans are seriously abusing the environment	0.54
env6	The Earth is like a spaceship with very limited room and resources	0.51
env5	When humans interfere with nature it often produces disastrous consequences	0.51
Factor 8: pro-animal attitude		
Qenv9	It is important to me that the food I eat on a typical day is animal friendly	+
Factor 9: preparation skills		
prep1	I know how to prepare meals with meat substitutes	+

[1] * Item is reverse coded

5.2.3 Psychographic characteristics of sample

Based on the factors derived in the previous section, the psychographic characteristics of the sample can be explained. For an overview of the psychographic characteristic distribution of this sample, see Tables 8 and 9. The results will be shortly discussed below.

Table 8: Psychographic characteristics of the sample (1/2)

Factor	Coding	Frequency	Percentage (%)
Pro meat attitude	1.00 to 1.99	56	21.5
	2.00 to 2.99	88	33.9
	3	16	6.2
	3.01 to 3.99	71	27.3
	4.00 to 5.00	29	11.2
Food neophilia	1.00 to 1.99	0	0
	2.00 to 2.99	13	5
	3	10	3.9
	3.01 to 3.99	100	38.5
	4.00 to 5.00	137	52.7
Sustainable behaviour	1.00 to 1.99	8	3.1
	2.00 to 2.99	63	24.2
	3	61	23.5
	3.01 to 3.99	60	23.1
	4.00 to 5.00	68	26.2
Pro meat alternatives	1.00 to 1.99	2	0.8
	2.00 to 2.99	30	11.5
	3	118	45.4
	3.01 to 3.99	48	18.5
	4.00 to 5.00	62	23.9
Environmental concern	1.00 to 1.99	0	0.00
	2.00 to 2.99	14	5.4
	3	28	10.8
	3.01 to 3.99	100	38.5
	4.00 to 5.00	118	45.4
Foodneophobia	1.00 to 1.99	71	27.3
	2.00 to 2.99	137	52.7
	3	29	11.2
	3.01 to 3.99	13	5.0
	4.00 to 5.00	10	3.9
Health consciousness	1.00 to 1.99	0	0.0
	2.00 to 2.99	14	5.4
	3	23	8.9
	3.01 to 3.99	72	27.7
	4.00 to 5.00	151	58.1
Animal welfare	1.00	1	0.4
	2.00	19	7.3
	3.00	62	23.9
	4.00	130	50.0
	5.00	48	18.5

Table 9: Psychographic characteristics of the sample (2/2)

Factor	Coding	Frequency	Percentage (%)
Ease of preparation	1.00	2	0.8
	2.00	25	9.6
	3.00	12	4.6
	4.00	151	58.1
	5.00	70	26.9
Objective knowledge	1.00 to 1.99	0	0.0
	2.00 to 2.99	30	11.5
	3	46	17.7
	3.01 to 3.99	133	51.2
	4.00 to 5.00	51	19.6
Subjective knowledge	1.00 to 1.99	6	2.3
	2.00 to 2.99	80	30.8
	3	23	8.9
	3.01 to 3.99	78	30.0
	4.00 to 5.00	73	28.1

The results for the pro-meat attitude factors show that the potential meat alternative adopter segment includes slightly more individuals who disagree with the pro-meat attitude. Furthermore, the results show that most individuals either agree or disagree, and not many people have a neutral opinion regarding this statement. The high number of individuals with no pro-meat attitude could be reasonably expected because the respondents who were not open to the idea of meat alternatives at all are already filtered from the responses.

The distribution of food neophilia clearly suggests that the sample is pretty food neophilic. Only 5% disagree with the statements, and over 90% agree with the statements. The remainder of the individuals indicates to maintain a neutral opinion. The high number of respondents that are foodneophilic could be the result of these individuals being more drawn to a survey about food choices than non-foodneophilics. As expected, the sample does not have many foodneophobic individuals. Approximately 80% of the sample disagrees with the foodneophobic statements and 9% agrees with the statements.

The distribution of the sustainable behaviour factor shows that there are relatively few individuals who strongly disagree with the sustainable behaviour factor. All the other answer options were chosen almost an equal amount of times. Therefore there can be concluded that the sample is not particularly unsustainable in behaviour, but also not remarkably sustainable. The environmental concern factor distribution however is more skewed towards the increased environmental concern side. Almost 85% of the individuals from the sample indicate agreement with the environmental concern statements while only 5.38% indicates disagreement with the statements. This shows that the sample is to a certain degree concerned about the impact of humans on the environment, but they do not act on it to the same extent.

The results also clearly show that the biggest share of the sample has a neutral opinion about meat alternatives. They do not disagree with the meat alternative statements but also don't agree with the statements. The reason behind this high frequency of neutral opinions could be that meat alternatives are still relatively new as compared to conventional meat, and therefore individuals did not have the time to form an opinion.

Regarding health consciousness the sample seems to be fairly health conscious. Approximately 85% of the sample agrees with the health-conscious statements as compared to only 5% who do not agree with the statements. The biggest share of the sample even strongly agrees with the health consciousness statements. Based on this, there can be expected that the Nutri-score will play a role for many of the individuals in the sample. Furthermore, half of the sample indicates to agree with the animal welfare statement. The second biggest share has a neutral opinion, followed by a fraction that strongly agrees with the statement. This shows that most people agree with the statement to some extent or have a neutral opinion, and only a very little share disagrees with the statement. This suggests an animal-friendly potential adopter of meat alternatives segment.

The potential adopters of meat alternatives segment also has a high concentration of individuals who know how to cook meals with meat substitutes. 85% of the individuals indicate to know how to cook with meat alternatives, 5%

maintain a neutral opinion and the remaining 10% do not know how to cook with meat alternatives. This is not surprising considering the biggest share of the respondents answered that they did cook with meat alternatives before, and most of them do it one or more times a week.

The last comparison will be between objective knowledge and subjective knowledge. This shows whether people who think they know much about meat alternatives actually know a lot. The results show that the objective knowledge of the sample is quite high. This means that many people answered the objective questions correctly. The subjective knowledge however is lower. This shows that people who do seem to know a lot about the environmental and health consequences of meat and meat alternatives are not confident about their own knowledge.

5.2.4 Impact of sociodemographics on results

A ANOVA one-way test was executed to determine whether different sociodemographic groups scored significantly different on the scales used to measure person-related psychographic characteristics. This is done for age, gender, educational level, income and meat-eating behaviour. The results of this section can be used to determine possible changes in class sizes if the true population of potential meat alternative adopters were to be different.

Age
The results show that when respondents are older, the value attached to animal welfare generally increases. Furthermore, when respondents get older more sustainable behaviour is performed and health consciousness increases. The youth category tends to be more food neophobic than the young adults and middle-aged adults category. So if the true population were to exist of more older individuals instead of the current high presence of individuals from the youth category, the sample would be more animal friendly, perform more sustainable behaviour, have increased health consciousness, and be less food neophobic.

Gender
Women generally score higher on the pro-animal attitude factor and the food-neophilia factor. Men on the other hand tend to score higher on the pro-meat factor. Therefore, if the distribution of men and women was more equal, the sample would be less animal friendly, less food neophilic, and more pro-meat. This effect would be enhanced if there were to be more men than women in the true population.

Educational level
The results indicate that higher-educated individuals generally score higher on the preparation skills factor. Lower-educated respondents generally score higher on the pro-animal attitude factor. Furthermore, higher-educated respondents tend to score lower on the pro-meat attitude than lower-educated respondents. Therefore, if the true population is lower educated than the sample, there would be less knowledge of preparation, more animal friendliness and an increased pro-meat attitude. This would be the other way around if the true population were to be higher educated.

Income
Higher-income respondents tend to score higher on the pro-animal attitude factor and on the sustainable behaviour factor. The lower-income respondents generally scored lower on the health-conscious factor. One detail to keep in mind is that in this research, the individuals who indicate to have lower incomes were generally students. It could well be that lower-income individuals other than students have different attitudes and opinions. The findings suggest that a higher income true population would be more animal friendly, would perform more sustainable behaviour and would be more health conscious.

Meat-eating behaviour
The results for the meat-eating behaviour category clearly show that a true population with more meat avoiders and reducers would mean more knowledge on how to prepare meals with meat substitutes, higher animal friendliness, an increased pro-meat alternative attitude, more sustainable behaviour and an increased environmental concern. Furthermore, food neophilia, and subjective- and objective knowledge would also increase. The only factor that would decrease is the pro-meat attitude. These findings are in line with the expectations of the meat reducers and -avoiders categories versus the omnivores.

6 Choice Model Estimation

In this section, the estimation procedure of the MNL model and the LCCM will be explained. First, there will be shortly repeated why there is chosen to estimate an LCCM. Thereafter, the MNL model estimates are presented to compare the LCCM. Subsequently, the process of estimating the LCCM is thoroughly described.

When estimating an MNL model, homogeneous consumer preferences are assumed, or in other words, one set of general preferences for all respondents is estimated. As explained in section 1.1, consumer preference heterogeneity is expected when it comes to meat alternatives. Because of this consumer heterogeneity, different consumer segments within the population are assumed to exist. Knowledge of the motivations and profiles of those consumer segments is of great relevance for the producers of meat alternatives.

The LCCM is the most popular segmentation model for choice-based data. The choice-based data was derived from the survey that was spread among the potential adopters of meat alternatives. The respondents were segmented into a chosen number of classes based on the attribute preferences derived from their choices. Those classes were profiled using the person-related characteristics of the respondents that were also obtained through the survey.

6.1 Model specification

In order to do model estimations, the choices of the respondents and the person-related characteristics had to be coded. The choices of the respondents were coded as followed:

Table 10: Alternative coding

Alternative	**Coding**
Alternative 1 (base alternative)	1
Alternative 2	2
Alternative 3	3

The systematic utility functions of the alternatives were defined as follows:

$$V_1 = 0 \tag{1}$$

$$V_j = delta\_alternative + \beta_{env} * env_j + \beta_{envQ} * env_j^2 + \beta_{nutri} * nutri_j + \beta_{nutriQ} * nutri_j^2 + \beta_{price} * price_j + \beta_{taste} * taste_j + \beta tex * tex_j + \beta_{app} * app_j + \beta_{AW} * AW_j \tag{2}$$

V_1	= the systematic utility of alternative 1 (the base alternative)
V_j (j = 2,3)	= the systematic utility of meat alternative j
delta_alternative	= the base utility (constant) of choosing a meat alternative
β_{env}	= parameter of the environmental impact attribute
β_{envQ}	= parameter of the quadratic environmental impact attribute
β_{nutri}	= parameter of the nutri-score attribute
β_{nutriQ}	= parameter of the quadratic nutri-score attribute
β_{price}	= parameter of the price attribute
β_{taste}	= parameter of the taste attribute
βtex	= parameter of the texture attribute
β_{app}	= parameter of the appearance attribute
β_{AW}	= parameter of the animal welfare attribute

6.2 MNL model estimation

First, an aggregate MNL model was estimated. When estimating the aggregate MNL model, respondent heterogeneity is completely ignored, or in other words, the number of classes is 1 (Paetz et al., 2019). For the Syntax of the

Apollo code that was used to estimate the MNL model, see Appendix E.1. The MNL model is used to compare the LCCM with and to determine whether accounting for respondent heterogeneity leads to better model estimates. The statistical criteria used for examining what model to select are the Log-Likelihood, the ρ^2 the BIC and the AIC.

The Log-Likelihood indicates the model's explanatory power, where less negative values indicate a greater ability of the model to explain the data (Hauber et al., 2016). The Log-Likelihood is can be used to compare models but can not be used as a stand-alone Goodness-of-Fit statistic. As with the Log-Likelihood, McFaddens' ρ^2 can also be used to assess the model's fit with the data. The McFaddens' ρ^2 should also be used in a relative sense, and for this measure, it also goes that the higher the better the fit (Chorus, 2022). It is recommended to use the Adjusted R-Squared as compared to the R-squared because the adjusted R-squared adds precision and reliability (Potters & Eichler, 2022). Lastly, AIC and BIC are measures often used to determine the plausibility of models (Hauber et al., 2016). The plausibility is evaluated by focusing on minimizing information loss. Lower AIC and BIC measures are preferred over models with higher AIC and BIC measures. A rule of thumb is that only a difference in BIC values larger than 10 suggests that the more complex model is superior (Paetz et al., 2019).

The Log-likelihood, ρ^2, AIC and BIC values of the MNL model are presented in Table 11 below. As explained above, the criteria cannot be used as stand-alone Goodness-of-Fit statistics but can be used to compare the LCCM model. The results of estimating the MNL model are discussed in the next section 7.

Table 11: Statistical criteria MNL model

Statistical criteria	**Output**
Loglikelihood	-1823.23
Adjusted McFadden's ρ^2	0.1456
AIC	3666.45
BIC	3722.23

6.3 LCCM estimation

Bertrand and Hafner (2012) recommend fitting the LCCM without covariates, or person-related characteristics, to determine the optimal number of classes. Subsequently, the covariates can be added to fit the LCCM with a specified number of classes. For the syntax of the Apollo code used to estimate the LCCM, see Appendix E.2. To determine the number of classes for which the model performs the best, the same statistical criteria as mentioned for the MNL model were inspected. The number of respondents in the smallest class was added to these criteria because classes that are too small are not worth addressing because that is not theoretically meaningful. According to Paetz et al. (2019), a rule of thumb is a minimum of 30 respondents per segment. Weller et al. (2020) adds to this that the sample size needs to be considered when deciding on whether a class size is too small. Lastly, Weller et al. (2020) suggest keeping the model fit statistics and whether small classes make conceptual sense in mind when deciding on class sizes.

Table 12: Estimating of number of classes for the LCCM

Classes	**Log-Likelihood**	**Parameters**	ρ^2	**BIC**	**AIC**	**Smallest class**
1 (MNL)	-1823.23	10	0.1456	3722.23	3666.45	100%
2	-1518.26	21	0.2826	3195.63	3078.51	37.1%
3	-1426.23	32	0.3204	3094.93	2916.46	12.0%
4	-1353.33	43	0.3492	3032.48	2792.66	8.7%

One thing that immediately stood out was that the 1 class model, the MNL model, scored worst on all criteria. Therefore, it could be concluded that allowing for consumer heterogeneity indeed led to better model estimates. Subsequently, the statistical criteria of the 2-class, 3-class and 4-class LCCM were compared to decide which model fits the best.

As can be seen in Table 12, the higher the number of classes, the higher the Log-Likelihood and the higher the ρ^2. This was not unexpected because a higher number of classes and the increased number of parameters lead to an increased model complexity (Paetz et al., 2019). A more complex model with more parameters can accommodate the peculiarities of the sample which a simpler model cannot accommodate, leading to a better model fit (Chorus, 2022). Therefore the information criteria BIC and AIC played a big role in penalizing for a more complex model.

The model that was considered to be the model with the best fit is the 3-class model. The 3-class model being better than the 2-class model was supported by both the AIC value and the BIC value. The reason for choosing the 3-class

model instead of the 4-class fitting model is not as straightforward. The BIC and AIC values of the 4-class model were lower, however, the smallest segment of the 4-class model was 8.7% of the respondents, which equals 22 respondents. This was below the earlier mentioned 30 respondents as a minimum per segment. Considering the minimum of 30 respondents is already perceived to be low according to other researchers (Paetz et al., 2019), it was decided to stay above this minimum. Furthermore, the interpretability of segment solutions also played a big role in determining the optimal number of segments (Paetz et al., 2019). The parameter estimates for the fourth class were difficult to interpret and did not lead to a well-defined fourth segment to base product and targeting strategies on. Therefore, the 3-class LCCM was studied further and the other models were not considered anymore.

The next step was to add the covariates to the model in order to profile the segments with the goal to inform the manufacturers of meat alternatives. All covariates are added to the model. Age was included as a continuous variable in the model and not as a categorical variable as was done in section 5.2. After adding all covariates to the model, the results suggested that the texture parameter was not statistically significant in any of the segments and was therefore removed from the model. Both the covariates that were significant predictors of class membership and the covariates that were not are presented. Only the impact of the more significant covariates is discussed. The results of the LCCM estimation are discussed in the next section 7.

7 Identification of consumer segment preferences and profiles

In this section, the results of estimating the MNL and the LCCM will be discussed. First the results of estimating the MNL model will be interpreted, followed by a comparison with the LCCM results.

7.1 MNL model results

When estimating the MNL model there is assumed that all respondents have the same taste parameters. In Table 13 below, the parameter estimates are presented. The parameter estimates should be interpreted as the following: the amount of utils gained or lost by 1 unit increase of the attribute. The parameter estimates are presented together with the t-value and the 95% confidence interval. In research, the t-value is often used to examine whether an estimate is significantly different from zero. A t-value of |1.96| is commonly used in research, where a t-value smaller than |1.96| indicates that an estimate is not significantly different from 0 and estimates with a t-value above |1.96| are significantly different from zero. However, multiple researchers stress the importance of not basing conclusions solely on t-values of for example |1.96| (Amrhein et al., 2019; McShane et al., 2019). Therefore, the 95% interval is also considered while interpreting the parameter estimates. The 95% interval shows a range of values around the parameter estimate β where there is 95% confidence that this range contains the true value of β in the population.

Table 13: Beta estimates MNL model

	Estimate	**Rob. s.e.**	**Rob. t. rat. (0)**	**CI 95%**	
BETA_env	0.02	0.09	0.17	-0.16	0.19
BETA_envQ	-0.09	0.03	-3.14	-0.15	-0.03
BETA_nutri	-0.17	0.11	-1.54	-0.39	0.05
BETA_nutriQ	-0.04	0.04	-1.10	-0.12	0.03
BETA_price	-0.58	0.04	-12.96	-0.67	-0.49
BETA_taste	-0.33	0.07	-4.77	-0.47	-0.20
BETA_tex	0.12	0.09	1.37	-0.05	0.29
BETA_app	-0.35	0.09	-4.12	-0.52	-0.19
BETA_AW	0.00	0.06	0.06	-0.12	0.13
Meat alt. constant	3.30	0.25	13.21	2.81	3.79

[1] Gray-coloured estimates are statistically insignificant

The 95% confidence interval is calculated using the standard errors that are displayed in the third column. This interval can be calculated for each β by: $\beta \pm 1.96$ * s.e. (Bevans, 2022). The 95% confidence interval consists of a lower limit and an upper limit between which the true β of the population is likely to lie with 95% confidence. The β's that are coloured grey have a relatively broad confidence interval, with the lower limit being a negative value and the upper limit a positive value. The parameter estimate is just above or below 0, but there is little certainty about the impact of the two parameters on the utility. The linear component of eco-score (β_{env}) is not statistically significant, but the quadratic component (β_{envQ}) is. This finding suggests that the utility gained from a product decreases more rapidly when the eco-score decreases. To be more precise, a difference between Eco-score A and B impacts the utility derived from a product to a much lesser extent than a difference between B and C. As can be seen, the confidence intervals of β_{envQ} and β_{price} are relatively smaller than the intervals of β_{taste} and β_{app}. A smaller confidence interval indicates a more precise estimate and therefore leads to a more accurate understanding of the actual population value (Frost, 2022). Both the lower limits and upper limits of the confidence intervals of β_{envQ}, β_{price}, β_{taste} and β_{app} are negative. Therefore, there can be concluded that the probability is high that an increase in the corresponding parameters has a negative influence on the utility.

In the fourth column, the robust t-ratio is presented. As explained, a high t-ratio suggests that the parameter is significantly different than zero in the population. The smallest t-ratio of the white-coloured rows is |3.14|. This means that the white-coloured parameter estimates differ from 0 at the 99.9% confidence level.

As can be seen in Table 13, there is also a constant estimate. This estimate of 3.30 indicates a certain base preference for vegetarian mince compared to the conventional meat option. The magnitude of this preference can be calculated by comparing the utility derived from a conventional mince product and a vegetarian mince product with exactly the same attribute levels. As mentioned before, the utility derived from a conventional mince product is fixed to

zero. The utility derived from a vegetarian mince product with exactly the same attribute levels can be calculated by multiplying the beta estimates from Table 13 with the attribute level codings. For the attribute level codings of conventional mince, see Table 5 in section 3.3.2. Thereafter, the meat alternative constant 3.30 is added to this outcome.

$$V_{vegetarianmince} = 3.30 + 0.02 * 3 - 0.09 * 3 - 0.17 * 2 - 0.04 * 2 - 0.58 * 3.69 - 0.33 * 0 + 0.1 * 0 - 0.35 * 0 + 0.00 * 0 \quad (3)$$

The utility of vegetarian mince as calculated above is **0.53**. This utility is higher than the 0 utils derived from conventional mince and therefore there can be concluded that there is a slight base preference for vegetarian mince. This increased utility is determined by all attributes and perceptions related to vegetarian mince that are not varied in the experiment.

For the majority of the parameters, either a positive or negative sign was expected based on common sense. Those expectations were negative signs for β_{env} and/or β_{envQ}, β_{nutri} and/or β_{nutriQ} and β_{price} and a positive sign for β_{AW}. This means that it was expected that a worse environmental impact score leads to less utility, that a worse Nutri-score leads to less utility and that a higher price leads to less utility. An animal welfare label on the other hand was expected to lead to increased utility. For the parameters of taste, texture and appearance, there was no prior expectation about the sign.

Furthermore, the relative importance of the attributes was inspected. The relative importance indicates to what extent the attribute levels and the attribute level range chosen for this research influences the utility derived from a product. This importance was calculated by calculating the attribute utility range per attribute and dividing this by the total attribute utility range of all attributes together. As can be seen in Figure 5 below, price is the attribute that most strongly influences utility in this experiment, followed by appearance and taste in third place. Thereafter, the quadratic component of the environmental impact comes in fourth place in terms of relative importance and the Nutri-score, texture and animal welfare are of negligible importance. The MNL estimates will not be further elaborated on for now given that there is expected that the LCCM will lead to improved results.

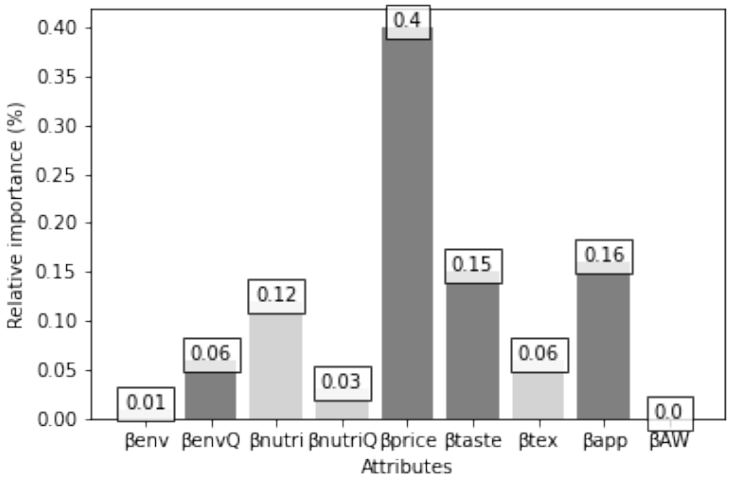

Figure 5: Relative importance of attributes MNL model

7.2 Estimation results final LCCM

In this section, the parameter estimates and the class membership estimates are discussed per segment. The parameter estimates are shown in the upper part of Table 14, and the class allocation probabilities in the lower part. The parameter estimates indicate the impact of the corresponding attribute on the utility. The class membership estimates explain which respondents are more likely to fall within a certain class.

The parameter estimates are presented together with the t-value and the 95% confidence interval. The white-coloured estimates in Table 14 are the estimates that are the most precise based on the confidence interval and have the most significant impact on utility based on the t-value. The grey-coloured rows show the parameter estimates that provided little useful information to base advice on. The meat alternative constants refer to a certain base preference for vegetarian mince. The meat alternative constant estimate for the *Health and Environment Lovers* segment is the largest positive estimate. This indicates that individuals from this segment have the highest base preference for vegetarian mince as compared to the other two segments. The second largest meat alternative constant estimate is the estimate

for the *Price Sensitive Consumers* segment. This suggests that individuals from this segment also have a certain base preference for vegetarian mince as compared to conventional meat, but a less strong base preference than the *Health and Environment lovers*. The meat alternative constant of the *Taste Driven Consumers* segment is negative. The Robust t-ratio is not particularly high and the confidence interval also indicates that there is relatively high uncertainty about the constant of this segment. This high uncertainty is reflected in the lower limit being negative and the upper limit being positive, and the interval is relatively broad. Therefore, the sign of the impact and the magnitude of the impact is uncertain. Based on the data, the *Taste Driven Consumers* segment is expected to have a slight base preference for conventional meat or no base preference.

The estimated constants of the class membership model indicate the probability of belonging to a segment regardless of the characteristics. The higher the estimate, the higher the probability of falling within that segment and the larger the size of the segment. This is in line with the findings of segment *Health and Environment Lovers* being the largest segment with a class weight of 47.5%. The constant estimate for segment 1 is also positive, but smaller, which is reflected in the smaller class weight of 39.8%. The smallest segment is the *Taste Driven Consumers* segment with a class weight of 12.7%. The *Taste Driven Consumers* segment is taken as the reference segment, which means that the covariate estimates of the other segments are estimated in comparison to the *Taste Driven Consumers* segment. The estimates should be interpreted the following: the estimate for education is statistically significant and positive in the *Price Sensitive Consumers* segment, therefore there is expected that individuals with higher educational backgrounds have an increased likelihood of belonging to segment 1 as compared to segment 3. More generally spoken, significant estimates provide evidence of being predictors of class membership (Lanza et al., 2007).

In addition to Table 14 below, the parameter estimates were plotted to visualize the differences between the MNL estimates and the estimates for the three identified classes. The *Price Sensitive Consumers* segment is presented as class 1, the *Health and Environment Lovers* as class 2 and the *Taste Driven Consumers* as class 3. In the remainder of this section, the most remarkable and differentiating findings per class are discussed. This is done based on the parameter estimates of Table 14, Figure 6 and based on the relative importance of attributes that are shown per class.

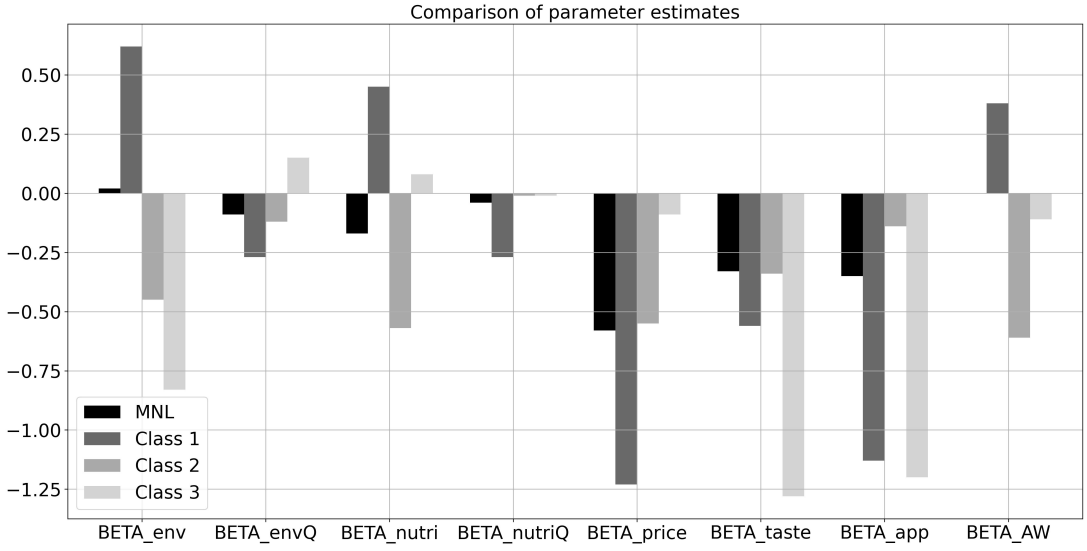

Figure 6: Comparison of parameter estimates

Table 14: Parameter estimates LCCM

	Price Sensitive Consumers		**CI 95%**		**Health and Environment Lovers**		**CI 95%**		**Taste Driven Consumers**		**CI 95%**	
	Est.	**Rob. t. rat. (0)**	**LL**	**UL**	**Est.**	**Rob. t. rat. (0)**	**LL**	**UL**	**Est.**	**Rob. t. rat. (0)**	**LL**	**UL**
BETA_env	0.62	3.56	0.28	0.96	-0.45	-1.95	-0.90	0.00	-0.83	-1.20	-2.20	0.53
BETA_envQ	-0.27	-4.48	-0.39	-0.15	-0.12	-2.12	-0.24	-0.01	0.15	0.67	-0.28	0.58
BETA_nutri	0.45	1.62	-0.10	0.99	-0.57	-2.48	-1.02	-0.12	0.08	0.10	-1.50	1.65
BETA_nutriQ	-0.27	-3.12	-0.45	-0.10	-0.01	-0.16	-0.13	0.11	-0.01	-0.02	-0.49	0.47
BETA_price	-1.23	-11.23	-1.44	-1.01	-0.55	-5.98	-0.73	-0.37	-0.09	-0.41	-0.51	0.33
BETA_taste	-0.56	-2.21	-1.06	-0.06	-0.34	-3.16	-0.56	-0.13	-1.28	-2.89	-2.14	-0.41
BETA_app	-1.13	-5.42	-1.54	-0.72	-0.14	-0.93	-0.44	0.16	-1.20	-2.75	-2.06	-0.34
BETA_AW	0.38	2.05	0.02	0.74	-0.61	-0.81	-2.10	0.87	-0.11	-0.24	-1.01	0.79
Meat alt. constant	4.95	11.37	4.09	5.80	8.24	10.73	6.74	9.75	-0.80	-1.23	-2.06	0.47
Class membership												
Constant	0.26	0.09	-5.28	5.80	15.28	5.44	9.78	20.78	0.00	reference		
γ_{age}	-0.10	-0.23	-0.98	0.77	0.02	0.02	-1.77	1.80	0.00			
$\gamma_{meatreducers}$	3.90	1.84	-0.25	8.04	-9.13	-4.41	-13.20	-5.07	0.00			
$\gamma_{omnivores}$	2.49	1.19	-1.61	6.58	-12.77	-7.30	-16.20	-9.34	0.00			
$\gamma_{education}$	0.38	2.12	0.03	0.73	0.17	0.52	-0.48	0.82	0.00			
γ_{female}	-0.14	-0.23	-1.34	1.05	0.16	0.21	-1.37	1.69	0.00			
γ_{income}	-0.50	-1.04	-1.45	0.45	0.28	0.45	-0.94	1.50	0.00			
$\gamma_{preparation}$	0.39	1.20	-0.25	1.04	0.87	0.92	-0.99	2.74	0.00			
$\gamma_{proanimal}$	-0.83	-2.25	-1.55	-0.11	-0.66	-1.24	-1.70	0.38	0.00			
$\gamma_{promeat}$	0.22	0.42	-0.81	1.26	-1.52	-1.37	-3.69	0.66	0.00			
$\gamma_{foodneophilia}$	-0.06	-0.14	-0.96	0.83	-0.38	-0.67	-1.47	0.72	0.00			
$\gamma_{promeatalt}$	0.00	0.00	-0.90	0.90	0.39	0.57	-0.94	1.72	0.00			
$\gamma_{Sus.Behaviour}$	-0.03	-0.06	-0.82	0.77	0.10	0.10	-1.71	1.90	0.00			
$\gamma_{foodneophobia}$	-0.92	-2.12	-1.77	-0.07	-1.27	-2.20	-2.39	-0.14	0.00			
$\gamma_{EnvConcern}$	0.39	0.67	-0.74	1.52	-0.63	-0.40	-3.71	2.46	0.00			
$\gamma_{HealthConsc}$	-0.64	-1.62	-1.41	0.13	-0.21	-0.32	-1.49	1.08	0.00			
$\gamma_{ObjKnow}$	0.50	0.91	-0.58	1.57	1.41	1.96	0.00	2.82	0.00			
$\gamma_{SubjKnow}$	0.29	0.78	-0.43	1.01	0.17	0.35	-0.80	1.14	0.00			
Class weight	**39.8%**				**47.5%**				**12.7%**			

[1] Gray-coloured estimates are statistically insignificant

7.2.1 Class specific preferences and covariates

Segment 1: Price Sensitive Consumers

There are four remarkable findings that differentiate this segment from the other two segments. First of all, the relation between utility and the Nutri-score is negative quadratic. The impact of a worsening Nutri-score is visualized in Figure 7. The linear term of the Nutri-score should be interpreted as a correcting factor for the impact of the quadratic term. The plot shows that the utility does not decrease between Nutri-scores A and B. However, when the Nutri-score worsens further to a score of C or D, this significantly lowers the utility derived from the product.

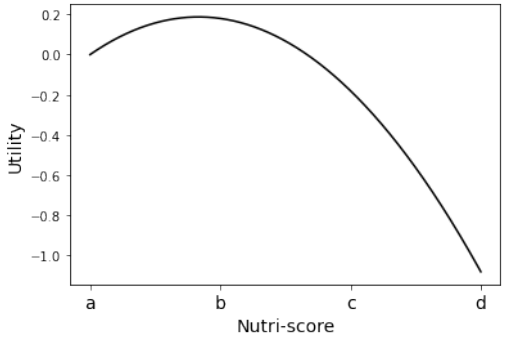

Figure 7: Impact of Nutri-score on utility for segment 1

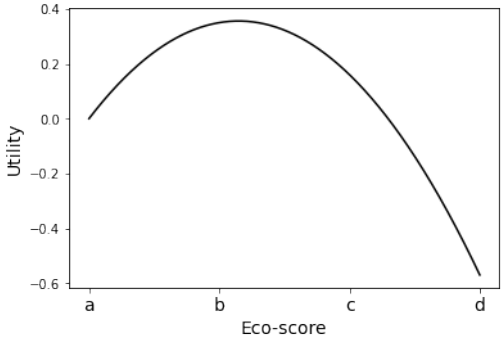

Figure 8: Impact of Eco-score on utility for segment 1

Secondly, in this segment the quadratic component of the environmental impact attribute is statistically significant. This indicated that there is also a non-linear relationship between utility and the Eco-score. The impact of a decreasing Eco-score on the utility derived from a product is visualized in Figure 8. Again, the linear estimate of the environmental impact attribute should be interpreted as a correcting factor for the quadratic component. The plot shows that the utility derived from a product with Eco-score A is 0. When the Eco-score changes to B, the utility does not decrease yet, according to the estimates utility even increases. When the Eco-score changes to C, the utility also does not start decreasing yet relative to A. Only when a product has an Eco-score of D, this will negatively impact the utility derived from the product. So therefore there can be concluded that the difference between Eco-scores A, B and C do not lead to big utility differences, but an Eco-score of D does lead to a decrease.

The third finding is related to the relative importance of attributes as presented in Figure 9. When compared with the other classes, this Figure shows that this is the only segment where the price was clearly the far most important attribute. For segment *Health and Environment Lovers*, the price is just as important as Eco-score and Nutri-score and for segment *Taste Driven Consumers* price is not of influence. From this together with the magnitude of the parameter estimate, there can be concluded that the individuals from this segment are the most price sensitive.

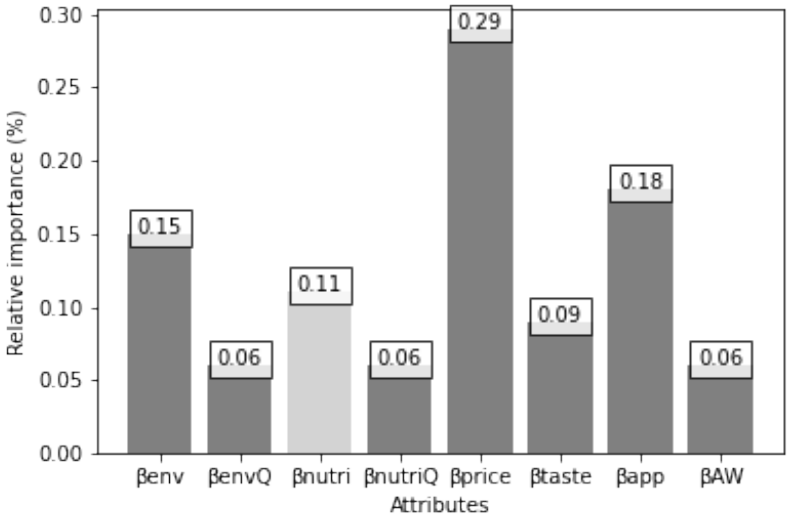

Figure 9: Relative importance of attributes LCCM class 1

Lastly, this is the only segment where the animal welfare labels seem to influence the utility derived from products. The estimate is positive, indicating that more utility is derived from a vegetarian mince product with an animal welfare label as compared to a product without this label. This is in line with the effect that was expected. This finding is in contrast with one of the findings from the class membership model. The class membership model presents a negative estimate for the pro-animal attitude covariate. The statement underlying this covariate is "It is important to me that the food I eat on a typical day is animal friendly". This sign being negative indicates that individuals who (strongly) agreed with this statement have a decreased likelihood of belonging to the *Price Sensitive Consumers* segment. Based on the significant influence of the animal welfare label, it was expected that the individuals from this segment would have a pro-animal attitude. No reasonable explanation could be found for this unexpected finding.

The class memberships estimates also indicate that foodneophobia, educational background and identifying as a meat reducer are significant predictors of membership in the *Price Sensitive Consumers* segment. The positive estimate for $\gamma_{meatreducers}$ has to be interpreted relative to meat avoiders and compared with the *Taste Driven Consumers* seg-

ment. Therefore, this positive estimate indicates that meat reducers have a higher likelihood of belonging to the *Price Sensitive Consumers* segment than the *Taste Driven Consumers* as compared to meat avoiders. The estimate for the education covariate is positive, this suggests that individuals with higher educational backgrounds have an increased likelihood of belonging to the *Price Driven Consumers* segment as compared to the *Taste Driven Consumers* segment. Lastly, the negative estimate for the foodneophobia covariate indicates that individuals who are more foodneophobic have a smaller likelihood of belonging to the *Price Sensitive Consumers* as compared to the *Taste Driven Consumers*. This finding will be further discussed during the description of the *Taste Driven Consumers* segment. A more clear overview of the characteristics of each segment will be presented in section 7.2.2.

Segment 2: Health and Environment lovers

There are four findings that distinguish this segment from the other two. The first remarkable finding is that the quadratic component of the environmental impact attribute is significant and negative. This again shows a non-linear relationship between utility and the Eco-score in this segment, as was observed for the *Price Sensitive Consumers* segment. The impact of the Eco-score on the utility derived from a product by individuals from the *Health and Environment Lovers* segment is visualized in Figure 10. In this segment, the correcting linear term is also negative. The negative linear and quadratic term results in a very strong decrease in utility when the Eco-score deteriorates. Because of the linear term and the magnitude of the estimate, a difference between Eco-score A and B already heavily impacts the utility. However, because of the quadratic term, the utility decreases even more rapidly once the Eco-score worsens to C or D.

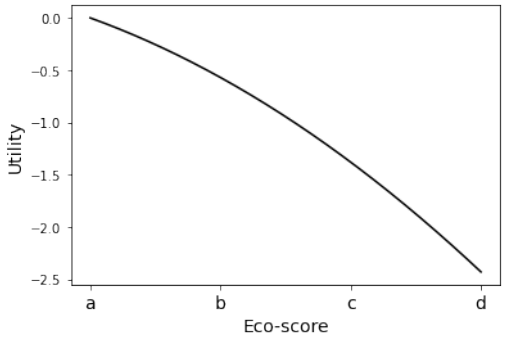

Figure 10: Impact of Eco-score on utility for segment 2

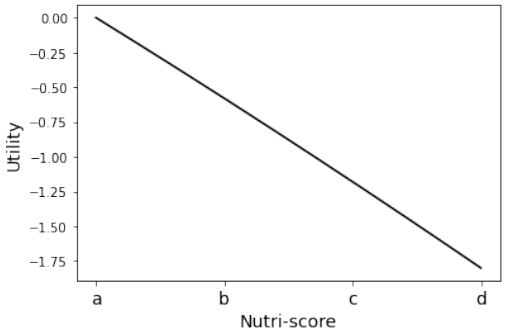

Figure 11: Impact of Nutri-score on utility for segment 2

Another finding that differentiates this segment from the other two is that the results suggest a near-linear relationship between utility and Nutri-score. The linear component of the Nutri-score attribute is significant and of great magnitude, and the quadratic component is very small and not significant. Still, the estimate for the quadratic component is the best guess. The relationship between utility and the Nutri-score for individuals from the *Health and Environment Lovers* segment is visualized in Figure 11. This shows that a decrease from Nutri-score A to B leads to a utility decrease almost the same as when the Nutri-score decreases from B to C. This differs from what was observed for the *Price Sensitive Consumers* segment, where the utility started to get significantly smaller when the Nutri-score got worse than B. The difference between A and B was of less importance. The relative importance of the Nutri-score also makes this segment unique. The Nutri-score is equally important as the price, as can be seen back in Figure 12. This differs from the *Price Sensitive Consumers* segment, for which was observed that price was the far most important attribute. Furthermore, Eco-score is also almost equally important as the price.

The last remarkable finding that makes this segment unique is the lacking impact of appearance on utility. This is the only segment for which the appearance of a vegetarian mince product does not impact the utility derived from a product. A vegetarian mince product that tastes similar to meat is preferred, but it does not necessarily have to look like it. The taste however plays a much smaller role than Eco-score, Nutri-score and price.

The class membership estimates suggest that identifying as a meat reducer or omnivore, foodneophobia and objective knowledge are significant predictors of membership of the *Health and Environment Lovers* segment. The negative estimates for both $\gamma_{meatreducers}$ and $\gamma_{omnivores}$ indicate that individuals with either of these meat-eating behaviours have a smaller likelihood of belonging to this segment than the *Taste Driven Consumers* segment as compared to meat avoiders. Therefore, a relatively high concentration of meat avoiders can be expected in this segment. Furthermore, the foodneophobia estimate is negative, indicating that foodneophobic individuals have a reduced likelihood of belonging to this segment as compared to the *Taste Driven Consumers* segment. The last significant predictor is objective knowledge. The estimate for the objective knowledge covariate is positive, this indicates that individuals with a higher educational background have an increased likelihood of belonging to segment the *Health and Environment Lovers* segment as compared to the *Taste Driven Consumers* segment.

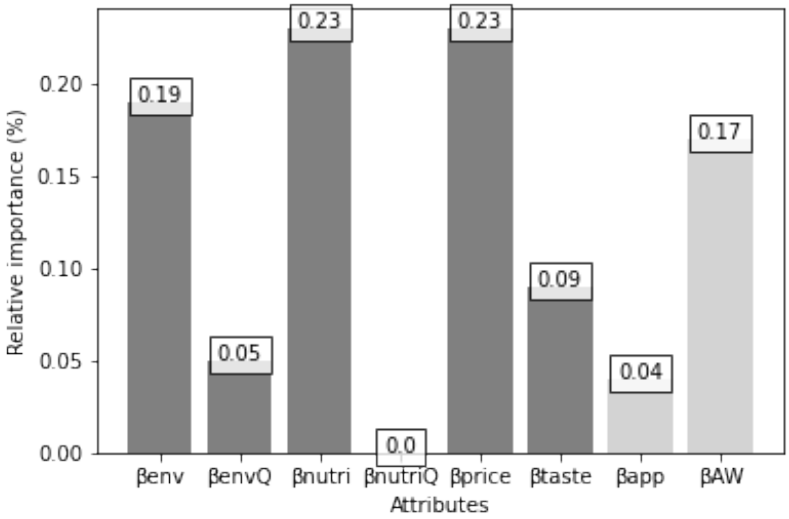

Figure 12: Relative importance of attributes LCCM class 2

Segment 3: Taste Driven Consumers

What immediately stands out when analyzing this segment is that only taste and appearance are of significant influence on the utility derived from a vegetarian mince product. Both the estimate for taste and appearance are negative and of great magnitudes, indicating that the individuals from this segment strongly prefer meat alternatives that taste and look like conventional mince. Both the taste and appearance of a product are of high relative importance as can be seen back in Figure 13. Another finding that makes this segment unique is that the price of a product is not of significant influence. The estimate for the price is very low, and the expected impact of a price increase is very uncertain. This indicates that the individuals from this segment have a very low sensitivity to price.

Besides insensitivity to price, the estimates of this segment also suggest that the utility derived by the individuals is not impacted by the Eco-score or Nutri-score of a product. Their choices in the product are merely driven by taste and appearance and not by other ethical aspects of food choices. The estimates for the foodneophobia covariate are negative for both other segments. Therefore, it is expected that this segment consists of relatively many foodneophobic individuals. This foodneophobic characteristic ties in well with the preference for products that mimic the taste and appearance of conventional meat. The individuals from this segment might still struggle with the newness of more exotic or innovative meat alternative products. The profile of the *Taste Driven Consumers* segment will be explained in more detail in the following section 7.2.2.

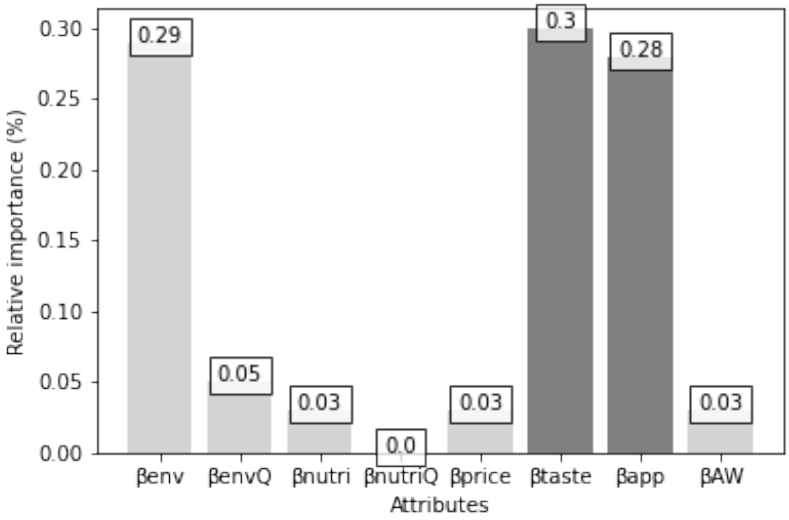

Figure 13: Relative importance of attributes LCCM class 3

7.2.2 Posterior class allocation

A feature of the LCCM is the possibility to determine the posterior probability of an individual of a class having a specific characteristic. For example, the percentage of women and men per class can be estimated. This will be calculated for all significant predictors of class membership. First, the apollo_lcConditionals function is used to calculate the posterior class allocation probability of an individual i for a certain class q. The posterior class allocation probability of an individual depends on the observed choices of the individual and the likelihood of the observed choices conditional on class q. These probabilities can be used to produce a profile for each class.

If $\pi_{i,\hat{1}}$ is the posterior class allocation probability of individual i for class q, the probability of an individual in class q having a certain characteristic can be calculated by using:

$$P(Z_{c,\hat{q=k}}) = \frac{\sum_{i=1}^{I} \pi_{i,q}^{\hat{}}(z_{c,i} == k)}{\sum_{i=1}^{I} \pi_{i,q}^{\hat{}}} \tag{4}$$

Where Z_c is the characteristic and k is a chosen value. $(z_{c,i} == k)$ will only be equal to 1 if $z_{c,i}$ equals k. The posterior class allocation probabilities of the individuals with the set value k for characteristic Z_c are summed and divided by the total class allocation probability of that class. The calculation of these posterior values for all significant covariates leads to the results presented in Table 15.

The distribution of each characteristic per class must be compared against the sample average. By comparing the characteristics of the classes with the sample average, a conclusion can be made about whether individuals with a specific characteristic are expected to be more likely to fall into a certain class. Based on the results presented in Table 15, profiles will be sketched for the three classes identified in section 7.2.

Profile of the price sensitive consumer segment
As can be seen in Table 15, the individuals in this segment are more likely to be omnivores as compared to meat reducers or meat avoiders. The price-conscious segment as identified by Apostolidis and McLeay (2016) also consisted mostly of meat eaters and to a much smaller extent of meat reducers. Meat avoiders especially have a low representation in this price-sensitive consumer segment.

When analyzing the educational background distribution from the price-sensitive consumer segment, there is no immediately clear pattern. However, when comparing the distribution with the distributions of the other segments, an explanation for the distribution was found. The distribution of educational background of this segment seems to represent mainly students who are still studying. There are relatively many individuals whose highest degree is either high school, intermediate vocational education or a university Bachelor's degree. A big share of this group will continue studying by either starting their bachelor, starting their master or continuing with higher vocational education. Those individuals being students still also explains the high sensitivity to price, considering students generally have lower incomes than working people.

The statement used to measure the pro-animal attitudes of individuals was: "It is important to me that the food I eat on a typical day is animal friendly". As can be seen in table 15, there are relatively many individuals who disagree with this statement or have a neutral opinion. The share of individuals that agree or strongly agree with this statement is below the sample average. This again shows that the individuals from this segment do not attach a lot of value to the animal friendliness of their food consumption pattern. As already mentioned before, this finding is somewhat in contrast with the animal welfare label being of positive influence on the utility derived from the product. One reason could be that the pro-animal attitude is not measured accurately enough considering it was done using one individual statement. Future research could focus on measuring the pro-animal attitude more accurately to determine whether the same results are found. This will be further discussed in section 9.4.

The food neophobia distribution of this segment is quite similar to the sample average. There is a relatively low concentration of individuals who strongly disagree with the foodneophobia statements, but a fairly big share of individuals who disagree with the statements. However, there is also a relatively high representation of individuals who do agree with the food neophobia statements. Therefore, it can be concluded that this segment cannot be distinguished based on its foodneophobic tendencies. The objective knowledge distribution of the *price sensitive consumers* also largely corresponds to the average sample distribution. The number of individuals with low objective knowledge is slightly higher than was observed for the sample, but the differences are fairly small.

Profile of the health and environment lovers
The meat-eating behaviour distribution observed for the health and environment lovers segment is clearly different from the other two segments. Both the share of meat avoiders and meat reducers is very high and the concentration of omnivores is remarkably low. Apostolidis and McLeay (2016) split this class up into two separate segments, the green segment and the healthy segment. Both identified segments consist of a higher number of meat reducers than

Table 15: Characterization of the three classes

Covariates	Levels	Class 1	Class 2	Class 3	Sample average
Meat-eating behaviour	Meat avoiders	2.8	30.0	1.4	14.6
	Meat reducers	20.9	60.0	8.9	37.3
	Omnivores	79.1	10.0	91.1	48.1
Education	High school	5.6	4.6	6	5.4
	Intermediate vocational education	4	2.6	6.1	3.5
	Higher vocational education	11.2	15.3	39	16.9
	University Bachelors degree	41.5	21.7	27.4	30
	University Masters degree	29.9	47	21.3	37.3
	University PhD degree	7.7	8.8	0.1	6.9
Pro animal attitude	1 (Strongly disagree)	0	0.9	0	0.4
	2 (Disagree)	14.9	1.7	6.1	7.3
	3 (Neutral)	36.1	15.8	22.2	23.8
	4 (Agree)	43.9	51.7	56.7	50
	5 (Strongly agree)	5.1	29.9	15	18.5
Foodneophobia	From 1.00 to 1.99	20.1	36.7	15.1	27.3
	From 2.00 to 2.99	62.2	48.4	39.5	52.7
	3 (Neutral)	7.9	6.9	33.3	11.2
	From 3.01 to 4.00	9.8	7.9	12.1	8.8
	From 4.01 to 5.00	0	0	0	0
Objective knowledge	From 1.00 to 1.99	0	0	0	0
	From 2.00 to 2.99	15.3	8.2	12.2	11.5
	3 (Neutral)	18.4	11.7	36.3	17.7
	From 3.01 to 4.00	61.5	68.8	51.6	63.5
	From 4.01 to 5.00	4.8	11.3	0	7.3

the price-conscious segment they identified. According to their research, these two segments have no vegetarian individuals, the reason behind this is that they have a separate segment called 'Vegetarians'. All vegetarians from their research fall within that segment, so therefore no vegetarians are observed in any of the other segments.

When examining the educational background distribution of the *health and environment lovers*, it clearly shows that this segment generally has a higher educational background. Both the concentration of individuals who obtained a University Masters's degree and a University PhD degree is higher than the sample average. The concentrations of all other educational background categories are lower. Therefore there can be concluded that this segment constitutes mostly of well-educated individuals with either a University Masters's degree or a PhD degree. This high frequency of higher-educated individuals seems to be reflected in the high levels of objective knowledge. Individuals with (very) high objective knowledge are prevalent in this segment and individuals with a neutral stand or with less objective knowledge are less common. An interesting observation is that this is the only segment where the objective knowledge is high and also the only segment with a high concentration of meat reducers and meat avoiders as opposed to omnivores. This leads to the belief that people with high objective knowledge about the sustainable and health aspects of meat alternatives tend to shift to meat-reducing or -avoiding diets. It is an option that this relationship works the other way around, however, it is expected that the high objective knowledge motivates individuals to shift to a reduced meat diet.

The pro-animal attitude results suggest that there are higher concentrations of individuals who (strongly) agree with the pro-animal statements. This shows a certain affinity with animal welfare, but this is not reflected in the animal welfare label being of significant influence. What is interesting is that there is also a slightly higher concentration of individuals who strongly disagree with the statement. This finding is only observed for this segment. These could be the individuals who prefer meat alternatives solely because of the environmental impact or health benefits, but do not attach any value to the animal welfare benefits of consuming less meat.

Lastly, this segment has a remarkably high frequency of individuals who strongly disagree with the foodneophobia statements. This means that the individuals from this class do not have an aversion to new foods or a desire for familiarity. This ties in well with the high meat alternative constant that shows their increased base preferences for the still relatively new meat alternatives.

Profile of taste driven consumers
The meat-eating behaviour distribution shows that this segment has the highest concentration of omnivores of all three segments. Where the *Price Sensitive Consumers* segment still had a reasonable number of meat reducers, this segment has a remarkably low frequency of both meat avoiders and meat reducers. Apostolidis and McLeay (2016) also identified a taste-driven segment during their research. According to them, this segment consists solely of meat eaters. These findings correspond closely with the findings of this study.

In contrast with what was observed for the previous segment, the individuals of this segment tend to have generally obtained a relatively low educational degree instead of University degrees. The concentration of individuals with a higher vocational education degree is particularly high. The prevalence of lower-educated individuals is also reflected in the low objective knowledge. Results suggest that this segment is the segment with the lowest objective knowledge of all segments. The high number of omnivores in this segment is expected to be partially caused by low objective knowledge. The low objective knowledge indicates that individuals from this segment have no or a reduced understanding of the link between meat consumption and health or the environment. As a result, there is less motivation to become a meat reducer or avoider, as can be seen back in the distribution of meat-eating behaviour.

Furthermore, the distribution of the pro-animal attitude does not differ a lot from the sample distribution. This segment is expected to have a slightly smaller share of individuals who (strongly) disagree with the statements but also a smaller share of individuals who strongly agree with the statement. However, agreement with the statement is most prevalent in this segment. This agreement can also not be seen back in the significant influence of the animal welfare label. This will be treated as a limitation of this study and will be further discussed in section 9.4.

When examining the foodneophobia distribution, results suggest a low concentration of individuals who (strongly) disagree with the foodneophobia statements in this segment. This is in contrast with the findings for the *Health and Environment Lovers* segment. The biggest share of individuals from this segment indicated taking on a neutral stand, but the share of individuals who indicates to agree with the foodneophobia statements is also higher than was observed for the sample. Therefore, it can be concluded that this segment is slightly foodneophobic as compared to the other segments. This could also partially explain the high number of omnivores. Foodneophobia could form a barrier to reducing meat intake by replacing meat with 'new' meat alternatives.

7.2.3 Willingness-to-Pay

As already explained in 2.6.2, β estimates cannot be compared directly due to differences in units. Calculating the Willingness-to-Pay (WtP) is therefore more informative. The WtP shows the price that consumers are willing to pay for a 1 unit increase/decrease in an attribute.

The WtP for the attributes with a linear relation with utility is given by the ratio of the attribute under consideration and the price parameter. For example, to calculate the WtP for a product that mimics the taste of meat the β estimate of taste is divided by the β estimate of the price, resulting in €0.46. The WtP for attributes with a non-linear relation with utility, the WtP is calculated differently. when the relation between an attribute and the utility is quadratic, the utility depends on both a linear term and a quadratic term. For the Eco-score for example, the utility contribution looks the following:

$$\beta_{eco} * Eco + \beta_{ecoQ} * Eco^2 \tag{5}$$

The first step of calculating the WtP for such an attribute is determining the first derivative. The first derivative of 5 looks the following:

$$\beta_{eco} + 2 * \beta_{ecoQ} * Eco \tag{6}$$

The WtP can be calculated by dividing Equation 6 by the derivative of the utility contribution of price. Considering the relation between utility and price is linear, the derivative equals β_{price}. So the formula used to calculate the WtP of the Eco-score attribute looks the following:

$$\text{WtP Eco-score} = \frac{\beta_{eco} + 2 * \beta_{ecoQ} * Eco}{|\beta_{price}|} \tag{7}$$

Based on the β estimates for the *Price Sensitive Consumers* segment as presented in Table 14, the WtP for the Eco-score attribute looks the following:

$$\text{WtP Eco-score} = \frac{0.62 + 2 * -0.27 * Eco}{1.23} = 0.50 - 0.44 * Eco$$

The same calculation can be done for calculating the WtP for the Nutri-score attribute. If the WtP is negative, this means that a price discount is needed in order for consumers to buy the product. The WtP's are calculated for all parameters and will be explained below. The WtP's of the non-significant parameters are presented in italics and coloured grey.

Table 16: Willingness-to-Pay LCCM

Product attributes	**Willigness-to-Pay**		
	Price Sensitive Consumers	Health and Environment Lovers	Taste Driven Consumers
Improved Eco-score	0.50 - 0.44 * Eco	-0.82 - 0.44 * Eco	*-9.22 + 3.33 * Eco*
Improved Nutri-score	0.37 - 0.44 * Nutri	-1.04 - 0.04 * Nutri	*0.89 - 0.22 * Nutri*
Product that mimics taste of meat	0.46	0.62	14.22
Product that mimics appearance of meat	0.92	*0.25*	13.33
Product with animal welfare label	0.31	*1.11*	*1.22*

[1] Italic gray coloured estimates are statistically insignificant

Price Sensitive Consumers

The estimates for the taste, appearance and animal welfare label attributes are quite straightforward. Individuals are willing to pay €0.46 more for a product that mimics the taste of meat, €0.92 more for a product that mimics the appearance and €0.31 more for a product with an animal welfare label.

The WtP for an improvement in the Eco-score and Nutri-score is more difficult to interpret straight from Table 16 because of the linear and quadratic term. Therefore, these WtP's are visualized as shown in figures 14 and 15. From Figure 14, there can be concluded that the individuals from this segment are willing to pay more for a change from Eco-score A to B, and the WtP for a change from B to C is approximately 0. The positive WtP for a change from Eco-score A to B is not very plausible and could also be interpreted as a WtP of 0, indicating that the difference between Eco-scores A and B does not matter. Only when the Eco-score changes from C to D, the WtP is negative, indicating that a price discount is needed for the consumers of the *Price Sensitive Consumers* segment to buy a product with an Eco-score D instead of A, B or C. The discount needed to buy a product with an Eco-score D instead of C is -€0.38.

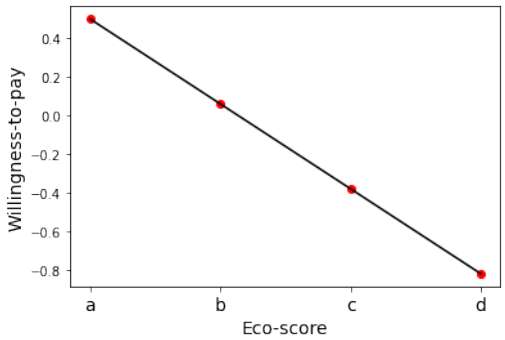

Figure 14: WtP Eco-score segment 1

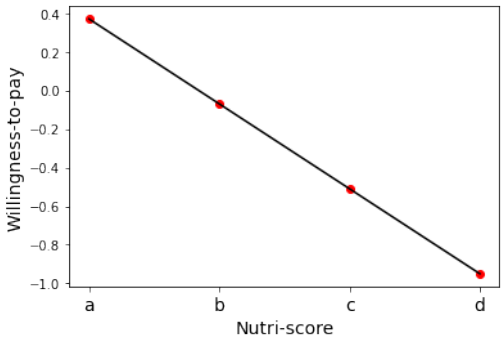

Figure 15: WtP Nutri-score segment 1

The WtP visualization for the Nutri-score attribute can be seen in Figure 15. This Figure also shows that the estimated WtP for a change from Nutri-score A to B is positive, indicating that individuals are willing to pay more for a product with Nutri-score B than for a product with Nutri-score A. This finding is also somewhat counter-intuitive, but a conclusion that can be drawn from this is that the difference between Nutri-score A and B is not very likely to negatively impact the utility derived from a product. Only when the Nutri-score gets worse than B, individuals require a price discount in order to still choose the product with the worse Nutri-score. The results suggest that a discount of the magnitude of -€0.07 is needed when the Eco-score changes from B to C, but a discount of -€0.51 is needed when it worsens from C to D.

Health and Environment Lovers

The results for this segment suggest that individuals are willing to pay €0.62 more for a product that tastes like conventional meat. Furthermore, the WtP for a change of Eco-score or Nutri-score is visualized and can be seen back

in Figures 16 and 17.

Both Figures suggest a negative WtP for a change from score A to score B. This again shows that every change in Eco-scores and Nutri-scores matters for the individuals from this segment. The discount needed rapidly increases when the scores further decrease. Where a change from Eco-score A to B requires a discount of -€ 0.82, a change from C to D asks for a discount of -€ 1.70. For a Nutri-score change from A to B, a -€ -1.04 discount is needed to compensate for the worsening of the Nutri-score. When the Nutri-score worsens from C to D, the discount increases slightly to -€ 1.12.

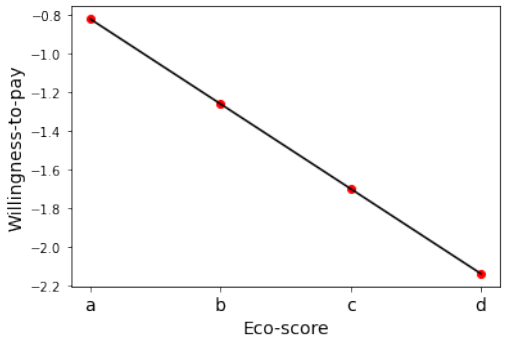

Figure 16: WtP Eco-score segment 2

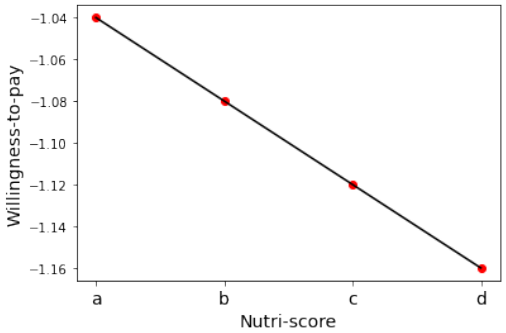

Figure 17: WtP Nutri-score segment 2

Taste Driven Consumers

The attributes of significant influence on utility for individuals from this segment are taste and appearance. The Wtp's that are estimated are € 14.22 and € 13.33, for taste and appearance respectively. These estimates are extremely high. High WtP estimates are a common result of a hypothetical setting where real economic commitment is lacking. This limitation of the stated preference paradigm will be further discussed in section 9.4. What can be concluded is that the individuals from this segment are willing to pay relatively much for alternatives that mimic the taste and appearance of meat.

8 Application of results

In this section, the results of the previous section 7 will be translated into advice for producers of meat alternatives. First, product-enhancing strategies based on the preferences of the segments will be proposed for the producers of vegetarian mince. Which strategy to choose depends on the target segment of the producers. Besides advice for product alteration based on choice behaviour, marketing strategy advice is given based on the profiles of the segments as described in section 7.2.2. Considering the technical and analytical background of this research and the expertise of the author of this research, the marketing strategy advice will be limited to observations that will serve as starting points for professionals in marketing and retail.

Subsequently, three foreseeable future scenarios will be sketched to determine the influence of autonomous developments on the market share of meat alternatives per segment. These scenarios are developed to quantify and understand the impact of future changes on the meat alternative industry and the environment. Based on this, there can be determined whether the producers of meat alternatives can expect to benefit a lot from future innovations or not. The results of these future scenarios will be presented in terms of revenues, market share and environmental impact. The situation after the autonomous developments will be compared with the current situation, the base scenario.

8.1 Proposed strategies per target segment

For each of the three segments concise advice will be given on how to alter vegetarian mince products to suit the preferences of the individuals from the target segment. These proposed product alterations are based on the attribute weights presented in Table 14 in the previous section. Thereafter, advice for marketing experts will be given based on the sociodemographic and psychographic characteristics of the segments as presented in Table 15 of the previous section.

8.1.1 Advice for the 'Price Sensitive Consumers' as target segment

The individuals from this segment are clearly most sensitive to price. Therefore, with this segment as the target segment, it is advised to keep the selling prices of products low. Furthermore, appearance is also of relatively high importance. Based on this, it is suggested that priority should lie on developing alternatives that look like meat and subsequently attention should be paid to mimicking the taste of meat. As for the Nutri-score, the results suggest that manufacturers should aim at keeping the Nutri-score at A or B. When the Nutri-score worsens to C or D, this will negatively impact the utility and therefore the sales. For the Eco-score, it is important to produce products with an Eco-score above D, but efforts of improving the Nutri-score further to an A will most likely not lead to significant positive utility differences. Lastly, if there were to arise an animal-welfare label, it is advised to put effort into receiving the label.

After examining the educational backgrounds of this segment, it became clear that this segment constitutes mostly students. Therefore, it is advised to tailor marketing in such a way that it reaches the student population. This can relate to where you advertise, through which channels you advertise or to the content of campaigns. When determining where to advertise, one could for example think of on-campus advertisements. Other examples of marketing strategies specifically aimed at students are student discounts. In terms of channels, social media is a great example of a suitable medium to spread campaigns and advertisements.

Furthermore, the results suggest that objective knowledge is slightly lower than the sample average. This indicates that the individuals from this segment do not fully understand the benefits of reducing meat consumption. Therefore, it is also advised to develop strategies that are specifically aimed at increasing the objective knowledge of this segment. The Eco-score and the Nutri-score already of significant negative impact on the utility derived from vegetarian mince. This shows that the individuals from this segment are not fully ignoring information about the healthiness or environmental friendliness of the meat alternatives. Therefore, efforts aimed at transferring information to individuals from this segment have reasonable chances of succeeding.

8.1.2 Advice for 'Health and Environment Lovers' as target segment

As for the previous segment, the price also plays a relatively important role for individuals from this class, and therefore it is advised to keep the selling prices low. However, the Nutri-score and Eco-score of a product play an approximately equally important role. Therefore, with this segment as the target segment, it is advised to try and improve both the Eco-score and Nutri-score of products to an A. This differs from the advice given for the previous segment. Mimicking the taste of meat is way less of a priority considering the relatively low importance of this attribute. As opposed to the advice for the previous segments, efforts to mimic the appearance of meat will not result in higher sales. The same goes for receiving the animal-welfare label.

One remarkable characteristic of this segment is the high concentration of meat reducers and meat avoiders as opposed to the other two segments. Furthermore, the segment consists of many individuals with high educational backgrounds

and high objective knowledge. Because the segment consists of many meat avoiders and meat reducers, the competitors are mainly the other meat alternative manufacturers and to a lesser extent conventional mince. The individuals of this segment already have sufficient objective knowledge of the impact of meat and meat alternatives on health and the environment, but they have to be convinced about which vegetarian product is best.

Considering their good objective knowledge, marketing strategies should focus on being more informative about what makes a specific meat alternative more environmentally friendly than another meat alternative. This means stepping away from comparing the benefits of meat alternatives with conventional meat and diving deeper into detail. This information could focus on highlighting the environmental friendliness of the main ingredient, the production or the packaging. The same goes for informing about the nutritional benefits of a specific meat alternative. Highlight the unique nutritional traits of the product, not the general nutritional benefits of meat alternatives.

Another interesting aspect is the disagreement with foodneophobia statements in combination with the lacking impact of appearance on utility. New products do not scare the individuals from this segment and meat alternatives do not necessarily have to mimic the appearance of meat. The high concentration of individuals who score low on the foodneophobia factor indicates that the majority of the individuals do not scare away from 'strange' looking foods or foods from other cultures. Therefore, a step in the right direction could be to frame products as exciting, new and exotic.

Lastly, the results suggest that individuals from this research have a certain affinity with animal welfare. However, the animal welfare label did not significantly impact the choice behaviour of the individuals from this segment. It may be interesting to investigate whether other efforts to highlight the animal friendliness of a product do succeed. So, therefore, including animal welfare in marketing strategies in another way than an animal welfare label is advised. Further research is needed to determine how to best communicate the animal-friendliness of a product.

8.1.3 Advice for 'Taste Driven Consumers' as target segment

The only two attributes that significantly influence the utility derived from a product for individuals from this segment are taste and appearance. Therefore, it is suggested to focus on developing meat alternatives that mimic the taste and appearance of meat as closely as possible. Because of price insensitivity, it is less of a problem if products become a bit more expensive because of for example more expensive production processes or ingredients.

This segment is characterized by predominantly omnivores who tend to be a bit more foodneophobic and have relatively little objective knowledge. In this segment, very few individuals are actively reducing their meat intake or avoiding meat consumption. As mentioned before, this lack of motivation to reduce meat intake could be the result of low objective knowledge. One strategy would be to try and increase the objective knowledge of the individuals in this class. As a result, individuals may better understand the link between on the one hand meat consumption and on the other hand the environment and personal health. Subsequently, a gradual shift towards more meat alternatives could take place. The aforementioned strategies for increasing objective knowledge are information campaigns, either focused on the health aspects associated with shifting to a more plant-based diet or focused on the environmental aspects. However, the impact of this strategy is questionable considering the individuals of this segment are not impacted by the Eco-score or Nutri-score of a product. This shows a certain disinterest in the environmental and health aspects of products. This increases the chances of the information not reaching the relevant individuals or the chances of the information not sticking.

A probably more effective strategy is to create products that mimic the taste and appearance of meat and familiarize the respondents with the product. In this way, the foodneophobic character of this segment is taken into account. A multitude of familiarization techniques is suggested, as can be seen back in Appendix B.2. Examples of interventions are: 'introducing alternative proteins in recognizable dishes', 'organising activities that include trying out plant-based meat alternatives' or 'highlighting the properties of plant-based meat that are similar to those of conventional meat'.

8.2 Future scenario's

In the remainder of this chapter, a few plausible future scenarios will be explored. These future scenarios arise because of autonomous developments. One example of such an autonomous development is the general improvement of eco scores due to sustainable fuels and sustainable production processes. The second scenario that will be discussed is the wide availability of meat-like mince alternatives due to the rise of cultured meat. The third future scenario that will be discussed is the price reduction of meat alternatives due to cheaper production processes. First, the current base scenario will be sketched. Subsequently, the future scenarios will be compared to the base scenario.

8.3 Base scenario

The base scenario is defined in a simplified manner. There is assumed that consumers have to choose between either vegetarian mince or conventional mince. There is one vegetarian mince option and one conventional mince option. In

the base scenario, the vegetarian mince option is assigned the current general meat alternative attribute levels. The conventional mince option is also assigned the current general conventional mince attribute levels.

The general meat alternative attribute levels are derived from the websites of the 6 biggest supermarkets in the Netherlands. The current Eco-scores of vegetarian mince are generally quite good en differ between A and B. The Nutri-score differs between A, B and C per vegetarian mince product. The average price of vegetarian mince is approximately €3.30 per 300 grams package. The producers of meat alternatives are still working hard on the process of creating meat alternatives that truly resemble the taste, texture and appearance of meat. While some people may say that there are products on the market that closely mimic real meat, the majority feel that this is not yet achieved. Therefore, the taste, texture and appearance of meat alternatives in the base scenario will be set to 1, indicating that they do not mimic real meat. Lastly, considering that the animal-welfare label does not exist yet, the meat alternative products will have no animal welfare label. For an overview of how the meat alternatives will be composed during the base scenario, see Table 17 below. Conventional mince options will remain to have the same composition as used during the DCE. For an overview of the attribute levels of the current conventional mince products, see table 5.

Table 17: Attribute levels of meat alternatives in base scenario

Attribute	**Attribute value**
Eco-score	B
Nutri-score	C
Price	€3.30
Taste	Does not mimic the taste of meat
Texture	Does not mimic the texture of meat
Appearance	Does not mimic the appearance of meat
Animal welfare	No animal welfare label

To estimate the increase in revenues as a result of autonomous developments, the size of the consumer market had to be determined. The consumer market of this research consisted of the Dutch potential consumers of meat alternatives. No information about the current size of this market could be found. Therefore, a rough estimation had to be done. According to Proveg International et al. (2021), 39% of dutch consumers wish that they could buy plant-based minced meat in supermarkets. This is 39% of Dutch consumers above 18, which equals approximately 5.58 million potential consumers of vegetarian mince based on the assumption of 14.3 million adult Dutch citizens. The number of potential consumers has to be converted into the number of mince consumptions. According to vlees.nl (2022), mince is the most popular product with a share of 17%. Assuming that the average potential consumer eats either a meat alternative or conventional meat 6 days a week, this would come down to approximately 5.7 million consumptions of mince weekly by the potential consumers of vegetarian mince. Assuming that 1 package is shared by 3 people on average this comes down to 1.9 million products being bought by the potential consumers of vegetarian mince per week, and 98.8 million products per year. It must be stressed that this is a rough estimation.

Based on the attribute levels and the attribute weights that resulted from the previous section, the market shares of vegetarian mince and conventional mince can be calculated per segment. First, the utility derived from vegetarian mince must be determined per segment. The same goes for the utility derived from conventional mince, but this will be the same for each segment considering the utility of conventional mince is fixed to 0. The utility of vegetarian mince can be calculated by applying the estimated attribute weights to the utility function. When calculating the utility, the insignificant parameter estimates will be fixed to 0 because of the unreliability and uncertainty of the parameters. However, if either the linear or the quadratic term of the Eco-score or Nutri-score is significant, the other term will also be included in the utility function because the linear and quadratic components should never be interpreted separately. The utility function used to calculate utility is presented in section 6 and the attribute weights used to calculate utility can be seen back in Table 14.

The utility (U) derived from vegetarian mince in the base scenario is -0.63 for the *Price Sensitive Consumers*, 4.34 for the *Health and Environment Lovers* and -2.48 for the *Taste Driven Consumers*. The market share (MS) of vegetarian mince can be calculated using the following equation 8:

$$MS_{vegetarian} = \frac{e^{U_{vegetarian}}}{e^{U_{vegetarian}} + e^{U_{conventional}}} \tag{8}$$

The market share of vegetarian mince in the *Price Sensitive Consumers* segment for example is calculated as follows:

$$MS_{class1} = \frac{e^{-0.63}}{e^{-0.63} + e^{0.00}}$$
$$MS_{class1} = 34.8$$

The market share of vegetarian mince for the *Health and Environment Lovers* and the *Taste Driven Consumers* can be calculated the same way. The market share of conventional mince can be calculated by subtracting the market share of vegetarian mince from 100. So in the case of the *Price Sensitive Consumers segment*, the market share of conventional mince equals 100 - 34.8, which is 65.2%.

Lastly, the market shares can be converted to annual revenues by multiplying the market share with the number of products sold (98.8 million) and the price of those products. It is important to take the class size into account when calculating the revenues per class. The total number of products per year is first multiplied by the class size. Subsequently, this value is multiplied by the market share of vegetarian mince within that class. Lastly, the resulting number of products is multiplied by the selling price of the product.

$$\text{Revenues} = 98.8 * \text{class size} * \text{MS vegetarian mince} * \text{price} \tag{9}$$

In the case of the *Price Sensitive Consumers* segment, the class size is 39.8%. In the base scenario, the product price is vegetarian mince is 3.30 as explained at the beginning of the section. Therefore, the revenues derived from vegetarian mince products for the *Price Sensitive Consumers* segment:

$$Revenues_{class1} = 98.8 * 0.398 * 0.348 * €\,3.30$$
$$Revenues_{class1} = €\,45.12 \text{ Million anually}$$

Calculations for conventional mince are similar. The market share per class and per product can be seen back in Table 18, as well as the revenues. The revenues are presented to demonstrate the impact of autonomous developments from a financial perspective, and the market shares are presented to highlight the effectiveness from a societal perspective. Market shares can be used to highlight the societal perspective because it can be inferred how much meat consumption decreases as a result of autonomous development. This decrease in meat consumption will be translated into environmental impact to make the societal impact better understandable. The environmental impact per future scenario is visualized to highlight the societal impact of a strategy and make it more tangible.

Table 18: Market shares per class in the base scenario

	39.8%		**47.5%**		**12.7%**		**100%**	
	Price Sensitive Consumers		Health and Environment Lovers		Taste Driven Consumers		All segments	
	Vegetarian mince	Meat mince	Vegetarian mince	Meat mince	Vegetarian mince	Meat mince	Vegetarian mince	Meat mince
Market share (%)	34.8	65.2	98.7	1.3	7.7	92.3	61.7	38.3
Revenues (Million €)	45.12	94.64	152.87	2.24	3.20	42.72	201.19	139.61

In the following sections, multiple foreseeable future scenarios will be sketched.

8.4 Scenario 1: improvement of Eco-scores

The first plausible future scenario that will be discussed is the general improvement of Eco-scores due to more sustainable production processes and fuels. The impact of the average Eco-score increasing from B to A will be examined whilst keeping all other attribute levels constant. The estimated market shares and revenues in all segments in this future scenario can be seen back in Table 19.

If the average Eco-score of vegetarian mince products were to improve from B to A, the total market share of vegetarian mince would decrease from the former 61.7% to 59.0%. The overall decrease in market share results from the decrease in market share observed for the *Price Sensitive Consumers* segment. This is because the utility only starts decreasing when the product has an Eco-score of D, so the improvement from B to A won't positively impact utility. Whether the utility actually increases when a product has an Eco-score of B or C instead of A as is currently observed is questionable. However, the utility is not expected to increase when the Eco-score improves from B or C to A. The

Table 19: Improve Eco-score to A

	39.8%		**47.5%**		**12.7%**		**100%**	
	Price Sensitive Consumers		Health and Environment Lovers		Taste Driven Consumers		All segments	
	Vegetarian mince	Meat mince	Vegetarian mince	Meat mince	Vegetarian mince	Meat mince	Vegetarian mince	Meat mince
Market share (%)	27.3	72.7	99.3	0.7	7.7	92.3	59.0	41.0
Revenues (Million €)	35.44	105.47	153.73	1.27	3.20	42.72	192.37	149.47

market share and revenues in the *Taste Driven Consumers* segment remain the same considering the individuals from this segment are not influenced by the Eco-score of a product. The market share and revenues from the *Health and Environment Lovers* segment do increase, as was expected based on the preferences of this segment. Based on this, there can be concluded that the producers of meat alternatives do not benefit much from the emergence of sustainable fuels in terms of market share or revenues.

If the utility does not actually increase when a product has an Eco-score of B or C but stays 0 instead, this strategy would only influence the individuals from the *Health and Environment Lovers* segment. The market share of this segment increases by 0.6%, and when corrected for the class size this equals a 0.3% increase in market share in the total market. When multiplying this difference with the number of mince products being sold yearly, this means a decrease of 296 thousand conventional mince products. Assuming that one package contains 300 grams of mince, this results in a reduction in the size of approximately 89 kg. According to the data from Resink and Rijsbosch (2021), this equals -767 tonne CO2eq, -6440 m3 water and -0.45 km2 of land use per year. To make this more understandable, this reduction in mince consumption is equivalent to 7.2 million KM less being driven and 8788 hours less shower time. There is still some environmental impact that comes along with the increase in meat alternative consumption, however, vegetarian mince is estimated to be 78% less impactful than conventional mince. For a visualization of the environmental benefits of this future scenario, see 18 below.

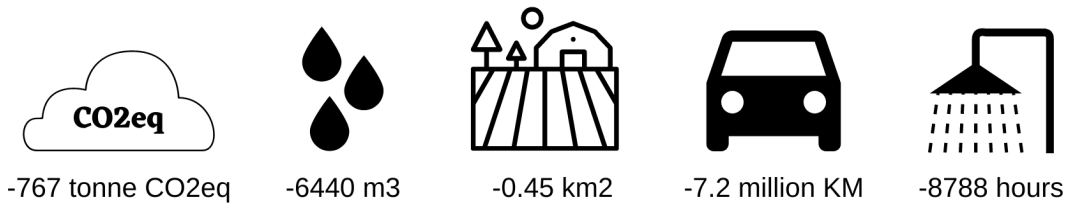

Figure 18: Environmental impact reduction scenario 1

8.5 Scenario 2: meat-like meat alternatives

The second future scenario that will be discussed is the wide availability of meat that fully mimics the taste and appearance of meat. This is a plausible future because of the rise of cultured meat. The results of a future scenario where meat-like meat alternatives are widely available are shown in Table 20.

Table 20: Producs that mimic the taste and appearance of meat

	39.8%		**47.5%**		**12.7%**		**100%**	
	Price Sensitive Consumers		Health and Environment Lovers		Taste Driven Consumers		All segments	
	Vegetarian mince	Meat mince	Vegetarian mince	Meat mince	Vegetarian mince	Meat mince	Vegetarian mince	Meat mince
Market share (%)	74.3	25.7	99.1	0.9	50.0	50.0	83.0	17.0
Revenues (Million€)	96.40	37.31	153.44	1.60	20.70	23.15	270.54	62.06

As a result of the rise of realistic vegetarian mince, the market share of vegetarian mince will increase in all three

segments. The market share in the *Price Sensitive Consumers* segment increases the most from 34.8% to 74.3%. This increase makes up for a €51.28 Million increase in revenues annually. The revenues will also increase in the *Taste Driven Consumers* segment and the revenues will rise to €20.70 Million. This is an increase in the size of €17.50 Million as compared to the base scenario. The market share also increases a lot from the former 7.7% to 50%. Smaller increases are also observed for the *Health and Environment Lovers* segment. Therefore, there can be concluded that this future scenario is desirable for the manufacturers of meat alternatives from a financial perspective.

This future scenario also brings about a very large reduction in environmental impact. For an overview of the decrease in environmental impact, see Figure 19. This shows that this scenario is not only desirable from a financial perspective, but also from a societal perspective. This future scenario shows that the efforts put into developing meat-like alternatives could lead to great financial and environmental benefits for the meat alternative industry in the future.

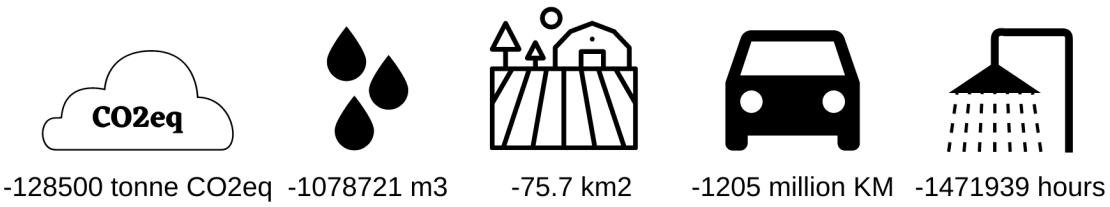

Figure 19: Environmental impact reduction scenario 2

8.6 Scenario 3: price reduction

Thirdly, the impact of a price reduction of vegetarian mince due to cheaper or more efficient production processes will be examined. The estimated market shares and revenues in this future scenario are presented in Table 21.

Table 21: Price reductions of 10%, 20% and 30%

	39.8%		**47.5%**		**12.7%**		**100%**	
	Price Sensitive Consumers		Health and Environment Lovers		Taste Driven Consumers		All segments	
	Vegetarian mince	Meat mince	Vegetarian mince	Meat mince	Vegetarian mince	Meat mince	Vegetarian mince	Meat mince
10% price reduction								
Market share (%)	44.4	55.6	98.9	1.1	7.7	92.3	65.7	34.3
Revenues (Million €)	51.91	80.61	137.88	1.87	2.88	42.72	192.66	125.20
20% price reduction								
Market share (%)	54.6	45.4	99.1	0.9	7.7	92.3	69.8	30.2
Revenues (Million €)	56.64	65.94	122.78	1.56	2.56	42.72	181.97	110.22
30% price reduction								
Market share (%)	64.3	35.7	99.2	0.8	7.7	92.3	73.7	26.3
Revenues (Million €)	58.41	51.79	107.59	1.31	2.24	42.72	168.24	95.82

A few interesting observations about the impact of the price reduction of vegetarian mince are worth mentioning. First of all, the market share and revenues within the *Price Sensitive Consumers* segment both increases. Therefore, in this future scenario, vegetarian mince becomes more attractive for individuals from the *Price Sensitive Consumers* segment.

Second of all, the future scenario also leads to slightly increased market shares within the *Health and Environment Lovers* segment. This means that more individuals from the *Health and Environment Lovers* segment shift from con-

ventional mince to vegetarian mince due to the price reduction. However, the results suggest that the revenues derived from this segment decrease when the price reduction gets higher. The reason for this is that the individuals from this segment are not very price sensitive and that many individuals were already buying vegetarian mince in the base scenario. As a result, the amount of individuals buying a product does not increase a lot after a price reduction of 10%. Instead, the individuals that were already buying the product pay less for the product and therefore the revenues from the cheaper alternative decrease. However, the reason for the price reduction scenario is cheaper production processes, so, therefore, meat alternatives are still expected to be profitable in the future scenario. The magnitude of the price reduction depends on how much cheaper the production processes will become.

The individuals from the *Taste Driven Consumers* segment are not influenced by the price reduction. Therefore, the market shares stay the same. However, because the price of the product decrease, the revenues also decrease. The revenue decreases of the *Health and Environment Lovers* segment and the *Taste Driven Consumers* segment combined are larger than the revenue increases from the *Price Sensitive Consumers* segment. Therefore, the total revenues derived from vegetarian mince products decrease when in this future scenario. The total market share on the other hand does increase with the price reductions, as can be seen in Table 22.

Table 22: Overview in changes of market share and revenues due to price reduction

	Total market share change	**Total revenue change**
10% price reduction	+ 3.95	-8.53
20% price reduction	+ 8.06	-19.22
30% price reduction	+ 12.01	-32.95

Whether this future scenario is desirable from a financial perspective depends on how much cheaper the production processes become and how much the selling price of products is reduced. What is desirable is the rapid growth in the market share of vegetarian mince in this future scenario. Because of this growth in market share, the strategy is certainly desirable from a societal perspective. This finding could be interesting for the long going debate about a possible meat tax. When vegetarian alternatives get cheaper, a bigger market share is expected. The same is expected when vegetarian alternatives get relatively cheaper, or in other words, when meat gets more expensive. To make the societal benefits of this future scenario more comprehensible, it is translated into tonne CO2eq, water usage decrease, and land use decrease. To make the environmental benefits even more tangible, the same benefits will be expressed in how many hours of showering would be saved in terms of water usage or how many kilometres driven by a car would be saved in terms of emissions.

The market share of conventional meat mince decreases from the former 38.3% to 26.3%. This decrease in market share can be translated into environmental impact, as was done for the previous scenario. The environmental benefits as discussed above are also shown in Figure 20 below.

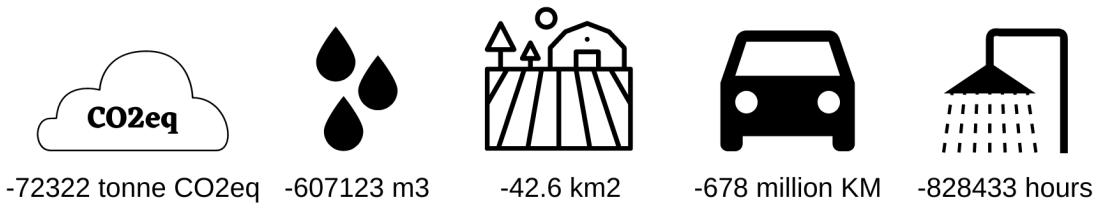

Figure 20: Environmental impact reduction scenario 3

9 Conclusion and discussion

The meat industry is a major contributor to carbon dioxide and greenhouse gas emissions. Besides the emissions, the livestock sector also requires a lot of fresh water, land, electricity and fuels, among other things. Shifting towards a more sustainable diet can contribute greatly to being able to feed our population in 2050 and combating climate change with all its consequences. Shifting towards low animal-source intake and high plant-based food is a highly effective strategy when aiming to reduce the environmental impact of the human diet. Furthermore, shifting towards a more plant-based diet is not only beneficial for altruistic reasons, but it also reduces health risks such as obesity or non-communicable diseases. This research focused on motivating the dietary shift in Dutch society, where meat is responsible for 40% of the GHG emissions released during the food production of one average citizen. The most popular meat reduction strategy in the Netherlands is the replacement of meat with meat alternatives. The new wave of plant-based meat alternatives is designed to guide the transition from meat to meat alternatives, by imitating the texture, appearance and taste of conventional meat. Unfortunately, meat alternatives are not thriving in today's society and only make up for 4.5% of the Dutch market share.

The actor with the most means and power to respond to the wishes and motivations of consumers are the manufacturers of meat alternatives. They can alter the product, the packaging and their marketing strategies. Earlier research showed that thoroughly considering the target segment of your meat alternative and profiling those segments is important when developing strategies. To effectively accelerate the adoption of meat alternatives in the Netherlands, more knowledge is needed about who the potential adopters are and how this sub-group can be segmented into multiple target segments. Each target segment can be distinguished by differences in product preferences, choice behaviour, motivations and person-related characteristics. Using this knowledge, advice can be given on how to alter products and marketing strategies to fit the needs of one specific segment within the potential adopters of meat alternatives population in the Netherlands. The main research question aimed to answer with research reads 'what are the consumer profiles of the sub-segments within the potential meat alternative adopter segment, and what trade-offs do those segments make when choosing between meat and meat alternatives?'

The research approach deployed to answer the main question consists of roughly two phases: preparing the Discrete Choice Experiment (DCE) and analysing the choices of the respondents. Preparing the DCE constitutes identifying influential product-related attributes and person-related attributes through literature. A validation step was performed by means of a focus group. The final product-related attributes included are the Nutri-score, eco-score, price, taste, texture, appearance and animal welfare label. Subsequently, the product-related attributes had to be varied in such a way that allows for the identification of the influence of independent attributes on the utility derived from a product. This was done by using an orthogonal experimental design that ensured that there was no correlation between the attributes. The resulting choice tasks were examined to detect dominant alternatives, which resulted in the deletion of 1 of the 16 choice tasks. This led to 15 choice tasks, divided into two choice experiments, where respondents were asked to choose between one conventional mince product and two vegetarian mince alternatives. The same survey included questions defined to measure the selected person-related characteristics using 5-point Likert-scales. This survey led to the data needed for this research.

The second phase of the research consisted of analysing the data and transforming it into relevant information for the manufacturers of meat alternatives. The data was first cleaned and studied using Python. Principal Axis Factoring was applied to aggregate the separate person-related measurement scales into a set of factors that measure the same latent factor. The factors derived are pro-meat attitude, food neophilia, sustainable behaviour, pro-meat alternatives attitude, environmental concern, food neophobia, health consciousness, pro-animal attitude and preparation skills. After an idea was formed about what the sample population looked like, the data was used to estimate a Multinomial Logit (MNL) Model and a Latent Class Choice Model (LCCM). Those choice models allow researchers to study the trade-offs that individuals make and determine the impact of product-related attributes on utility derived from an alternative. Where the MNL model ignores respondent heterogeneity, the LCCM assumes that the population can be segmented into a certain number of classes that differ in their motivations, choice behaviour and preferences. The LCCM enables researchers to capture and explain this heterogeneity based on differences in attribute preferences and person-related characteristics. The results of the LCCM were used to determine the preferences of segments, the profiles and the willingness to pay for the improvement of a product. Based on this information, strategies for manufacturers could be proposed accompanied by the expected increase in market share and revenues, and the expected decrease in environmental impact as a result.

9.1 Conclusions

Based on the results there can be concluded that there are three segments within the Dutch potential meat alternative adopters population that have different preferences when it comes to vegetarian mince alternatives. Besides different product-related attribute preferences, these three segments also have other sociodemographic and psychographic profiles. The first segment is named the *Price Sensitive Consumers* segment and has a size of 39.8% of the sample population. As the name implies, the individuals from this segment are the most sensitive to the price of a product.

Meat alternatives that mimic the taste and appearance of meat are preferred and the individuals in this segment are willing to pay €0.46 for a similar taste and €0.92 for a similar appearance. Another remarkable finding for this segment is that there is a non-linear relationship between utility derived from a product and the Nutri-score. Results suggest that the utility derived from a product with Nutri-score B is not significantly worse than one with Nutri-score A, but when the Nutri-score worsens further to C or D, the utility does rapidly decrease. A discount of -€0.07 is needed to weigh up against a Nutri-score of C and -€0.51 for a Nutri-score of D. The same kind of conclusion can be made about the relationship between utility and Eco-score, but for this attribute, it goes that only an Eco-score of D negatively impacts the utility as compared to an Eco-score of A. A discount worth -€0.38 is needed to weigh up against an Eco-score of D. The individuals from this class tend to identify as omnivores and have a low affinity with the animal friendliness of their daily consumption. The majority of this segment is believed to still be a student.

The second segment is the biggest segment which constitutes 47.5% of the sample population and is labelled *Health and Environment Lovers*. As the name suggests, the individuals from this class attach much value to the Nutri-score and the Eco-score of a product. As was observed for the first segment, the price of a product is of relatively high importance for the individuals from this segment. However, both the Nutri-score and Eco-score are of the same relative importance. Results suggest that both an improvement of the Nutri-score and the Eco-score has a significant positive influence on the utility derived from a product. In addition, the difference between an Eco-score and Nutri-score of A and B does matter for individuals from this segment, as opposed to what was observed for individuals from the previous segment. Results suggest that a discount of -€0.82 is needed for a product with Eco-score B as compared to A to make up for the utility loss. For a Nutri-score of B, this discount has to be -€1.04. Those required discounts become rapidly higher when the scores worsen, to a maximum of €-1.70 for an Eco-score of D and -€1.12 for a Nutri-score of D. A meat-like taste, on the other hand, is of less importance. This segment has a very high concentration of both meat reducers and meat avoiders, a finding that was not observed for the other classes. Furthermore, this segment has a high frequency of individuals that (strongly) disagree with the foodneophobia statements. The individuals from this segment also have remarkably high objective knowledge.

The third segment is the smallest segment of the 3 with a 12.7% share of the sample population, labelled the *Taste Driven Consumers* segment. The preferences of the individuals from this segment are unique considering only the taste and appearance of a product influence the utility derived from the product. This suggests that the individuals from this segment are insensitive to improvements of other attributes such as the price, Eco-score or Nutri-score. As for the taste and appearance, this segment strongly prefers alternatives that mimic the taste and appearance of conventional mince. This results in a relatively high willingness to pay for meat alternatives that mimic the taste and appearance of meat. The results suggest that the individuals are willing to pay €14.22 and €13.33 for an improvement in taste and appearance respectively. Those estimates are expected to be upwardly biased estimates due to hypothetical, as wil be further discussed in Section 9.4. The individuals from this segment generally have a lower educational background than the other two segments. Furthermore, the segment consists predominantly of omnivores who tend to be slightly foodneophobic.

In this research, the expected impact of threefold foreseeable futures is also examined. The impact is expressed in terms of expected market shares of vegetarian mince compared to conventional mince, revenues and environmental impact. The first future scenario describes the impact of a general improvement of the Eco-score. Assuming that the utility derived from a product with Eco-scores A, B and C stays 0 and does not improve between A and C in the *Price Sensitive Consumers* segment, this future scenario leads to a small market share increase of vegetarian mince. The increase in market share equals 0.3% which equals a €0.86 Million increase in revenues. The relatively small increase in market share indicates that not many consumers switch from consuming meat to meat alternatives. As a result, the expected environmental benefits also remain relatively low.

The second future scenario is the wide availability of meat-like vegetarian alternatives. This future scenario is expected due to the rise of new technologies and for example cultured meat. When comparing the market share of vegetarian mince in this future scenario with the base scenario, there is an increase in the size of 21.3%. This is a much bigger increase than was observed for the previous future scenario. This increase in market share goes along with a large increase in annual revenues. Because of the big increase in the market share of vegetarian mince, the consumption of meat is expected to go down. This future scenario has the greatest environmental benefit of the three scenarios that were examined. This finding could serve as a motivation to continue developing realistic meat alternatives such as for example cultured meat.

The last future scenario describes the impact of the price reduction of meat alternatives. This could be the result of cheaper production processes, economies of scale or a subsidy. It was observed that the higher the price reduction, the higher the market share but the lower the revenues. This does not mean that the manufacturers of vegetarian mince are making losses in this future scenario because the production costs also went down. The market share increases that are estimated for the price reductions vary from +3.95 for a 10% price reduction to +12.01% for a 30% price reduction. The environmental benefits also depend on the magnitude of the price reduction, but they are estimated to be bigger than for the increased Eco-score future scenario.

9.2 Comparison of results with the existing literature

The findings of this research will be compared with the existing literature. Explanations for conflicting findings will be discussed as well as new findings. First of all, three segments were identified during this research, the *Price Sensitive Consumers*, the *Health and Environment Lovers* segment and the *Taste Driven Consumers* segment. As described in Section 1.1, the head of product development from one of the biggest meat alternative producers suggested that the Dutch market of meat alternatives is divided into two groups: 'creative alternatives' and 'meat imitation products'. The results of this research suggest that these two product groups do not fit in well with the existing segments. All three identified segments prefer alternatives that taste similar to meat more than alternatives that do not mimic the taste of conventional meat. Furthermore, based on the preferences of the different segments, other product groups may be more suitable. For the *Price Sensitive Consumers* segment, a budget line would be suitable for example. Furthermore, for the *Health and Environment Lovers* a healthy and environment-friendly product group should be developed. The 'meat imitation products' already existing fits the *Taste Driven Consumers* segment. The more the products mimic the taste and appearance of meat, the more the products are expected to be liked by the *Taste Driven Consumers* segment.

Furthermore, Verain et al. (2022) executed a segmentation study of Dutch society and found five distinct consumer segments. The segments found by them are *compulsive meat consumers*, *meat lovers*, *unconscious flexitarians*, *potential flexitarians* and *conscious flexitarians*. This segmentation study was solely based on answers to seven-point Likert scales measuring psychographics, so choice behaviour was not taken into account. The segments in the current study are formed based on their preferences derived from their choices. The preferences within the segment are homogeneous but differ strongly from other segments. Subsequently, there is determined which psychographics function as predictors of class membership. Based on this segmentation protocol, the chances are high that the *compulsive meat consumers* segment and the *meat lovers* would not be two separate segments for example. The same questions arise for the three flexitarian segments. Therefore, the segmentation protocol could be a good explanation for the differences in segments.

Another segmentation study that does include both product-related attributes and person-related characteristics is the study by Apostolidis and McLeay (2016). In this study, the same segmentation protocol was maintained. Six segments were defined by Apostolidis and McLeay (2016), namely *Price Conscious*, *Green*, *Taste driven*, *Healthy*, *Organic* and *Vegetarian*. Some of the attributes that they included have similarities with the attributes used for this research. First of all, the price has a negative impact on the utility derived from a product, which was also validated through other research (Loo et al., 2020; Profeta et al., 2020). Price was found to be of significant negative impact in two of the segments defined in this research and the importance of price differed per segment. This difference in relative importance is in line with the findings of Apostolidis and McLeay (2016). Price not being of any importance for the *Taste Driven Consumers* segment in this research could be the result of the hypothetical bias of a stated choice experiment. It can be reasonably expected that price does play a role when respondents are actually asked to pay. More about hypothetical bias will be discussed in Section 9.4.

Another similarity was found with fat content, this is partially related to the Nutri-score. However, the Nutri-score considers a lot more nutritional values than only fat, so they are not the same. The same goes for the carbon footprint and the eco-score used in this research. In addition, they included the method of production, brand and region of origin that was not included in this research. The use of different attributes is one possible explanation for the different segments. Furthermore, the survey of the research by Apostolidis and McLeay (2016) was distributed in such a way that the sample represents the UK population's consumption patterns regarding meat products. This research only included the potential adopters of meat alternatives instead of the whole population and convenience sampling was applied. This could also have led to the differences in results. Furthermore, three of the 6 segments defined by Apostolidis and McLeay (2016) have a share of fewer than 30 individuals. In this research, a minimum of 30 respondents per segment was maintained to ensure theoretically meaningful results.

When comparing the labels and interpretations of the segments there are some similarities and some differences. There is a price-conscious segment who are strongly influenced by price, the same can be seen back in the *Price Sensitive Consumers*. Apostolidis and McLeay (2016) also found that the price-sensitive segment constitutes predominantly meat eaters. This is in line with the findings of the *Price Sensitive Consumers* segment. Furthermore, they have the green and healthy segments, which seem to be separate segments that together have similarities with the *Environment and Health Lovers* segment. The green segment attaches value to the carbon footprint, similar to the value that individuals from the *Health and Environment Lovers* attach to the Eco-score. In the healthy segment, the fat content attribute is the attribute with the highest relative importance. This is in line with the importance of the Nutri-score in the *Health and Environment Lovers* segment. According to Apostolidis and McLeay (2016), the individuals of these segments are mainly meat-reducing individuals. They suggest that there are 0 vegetarians in this segment, but this can be traced back to them having a 'Vegetarian' segment that includes all vegetarians in their study. The green and healthy segment including relatively many meat reducers is in line with the findings for the *Health and Environment Lovers* segment identified in the current research. Lastly, Apostolidis and McLeay (2016) also identified a taste-driven segment. They labelled this segment the taste-driven segment because of their preference for beef mince bought from the butcher. The label taste driven therefore has been assigned based on other preferences. However, there are some

similarities such as the relatively low importance of the health-related attribute and the environment-related attribute.

Elzerman et al. (2011) performed a real-life experiment from which they concluded that products being similar or not similar to meat does not impact product liking in a meal. This is in contrast with the findings of this research that suggest that a meat-like taste increases the utility derived from a vegetarian mince product in all three segments. Also, an appearance similar to conventional mince positively impacts the utility derived from a product for individuals from the *Price Sensitive Consumers* segment and the *Taste Driven Consumers* segment. Furthermore, Weinrich (2018) concluded that for most consumers the main reason not to substitute meat is the taste of meat. However, according to the results of this research, the taste of meat is only the most important for the *Taste Driven Consumer* segment. For the *Price Sensitive Consumers* segment, the taste of meat comes in fourth place in terms of importance and the taste of vegetarian mince only plays a very minor role for individuals from the *Health and Environment Lovers* segment.

The reason for the findings of this research conflicting with the findings of Elzerman et al. (2011) is highly likely to be the result of this research being hypothetical and theirs being a real-world experience. During the experiment of Elzerman et al. (2011), respondents were asked to rate the meat alternative that they tasted in a meal. Even though respondents were asked to rate the meat alternative separately from the meal, the context still differs greatly from the stated choice experiment from this research. It may well be possible that the utility difference between a meat alternative that mimics the taste and looks of meat is less great than estimated in this research when the products are both incorporated in the exact same dish and tasted in real life. Furthermore, the estimates for taste are negative in all segments, indicating that meat-like alternatives are preferred, as concluded by Weinrich (2018). The average educational background of the focus group attendees of Weinrich (2018) is either 'middle pro' or 'higher pro', but lower numbers of individuals with a university degree. In this research, the segment consisting predominantly of individuals with a university degree attached the least value to a similar taste to meat. The lower number of individuals with a university degree in the focus groups could also be an explanation for the conflicting results with the research of (Weinrich, 2018).

Even though the fat content is related to the Nutri-score, and the carbon footprint is related to the Eco-score, the attributes are not exactly the same. Furthermore, the impact of taste, texture and appearance similar to meat was tested on the acceptance of meat substitutes by Elzerman et al. (2011) and Weinrich (2018), but they did not allow for consumer heterogeneity. They also did not study choice behaviour by means of a DCE but performed tasting experiments and focus groups. Therefore, the information resulting from the parameter estimates for Eco-score, Nutri-score, taste, texture and appearance adds to the existing literature. First of all, the Eco-score impacts the utility derived from a product for the individuals from the *Price Sensitive Consumers* segment and the *Health and Environment Lovers* segment. For the *Price Sensitive Consumers* segment goes that the utility derived from a product only starts to decrease if a product has an Eco-score of D. The difference between A, B and C does not impact the utility negatively. For the *Health and Environment Lovers* segment this was not observed. In this segment, the difference between Eco-score A and B significantly impacts the utility derived. Once the Eco-score worsens further the utility derived decreases more rapidly due to a non-linear relation between utility and Eco-score.

The Nutri-score significantly impacts the utility derived from a product in the same two segments. As was observed for the Eco-score, the Nutri-score in the *Price Sensitive Consumers* segment is also not linearly related to the utility derived of a product. Results suggest that utility starts decreasing from a Nutri-score of C or worse. Due to a quadratic relationship, the utility decreases rapidly when the Nutri-score worsens than B. In the *Health and Environment Lovers* segment, the utility does have a near-linear relation with the Nutri-score. Therefore, a decrease from Nutri-score A to B is associated with a utility decrease of the same magnitude as when the Nutri-score decreases from B to C. The results observed for the taste and appearance show an unequivocal preference for meat-like vegetarian mince. However, the importance of these attributes differs between the segments.

Not only does this research contribute to more knowledge about the meat alternative preferences of the identified consumer segments, but it also included person-related characteristics to sketch the profiles of these segments. This differs from the studies that only elicited product-related preferences of segments or only sketched profiles based on person-related characteristics and not on choice behaviour. Already, very limited research could be found that included both product-related attributes and person-related characteristics to offer such a comprehensive overview. What makes this research especially unique is that this is the first Choice Behaviour study regarding meat and meat alternatives that includes psychographic characteristics. The psychographic characteristics of the respondents were measured to test their significance as class membership predictors. Basing targeted design development on influential psychographic characteristics instead of solely sociodemographic characteristics is deemed more effective. This research provides evidence that psychographic characteristics can be significant predictors of class membership of the three identified segments. The covariates that are significant predictors for the class membership of the *Price Sensitive Consumers* segment are not having a pro-animal attitude and not being foodneophobic. Predictors for the membership of the *Health and Environment Lovers* are not being neophobic, increased affinity with animal friendliness and very high objective knowledge. The individuals from the *Taste Driven Consumers* segment are most likely to be lower-educated omnivores who tend to be foodneophobic and have low objective knowledge.

9.3 Recommendations and implications

In this Section, the implications of this research will be discussed and advice will be given both from a business perspective and a societal perspective. The goal of this research was to identify consumer segments within the potential meat alternative adopter segment and study the trade-offs and profiles of those segments. With this knowledge, advice can be given on how manufacturers of meat alternatives can target specific consumer segments with tailored products and marketing. This knowledge can efficiently raise the success adoption rate of meat alternatives, resulting in less meat consumption. This decrease in meat consumption is desirable from a societal perspective because of the positive environmental and health effects that come along with this decrease. First and foremost, it is advised to focus on one of the three identified segments. Recommendations per target segment will be given below. The advice will consist of product alteration advice and high-level marketing strategy advice that should function as a starting point for experts in marketing.

If the selected target segment is the *Price Sensitive Consumers* segment, the first strategy proposed is reducing the price. The reason is that individuals from this segment are far most sensitive to the price of a product. This strategy is sensitive to the costs of producing meat alternatives because the cost per product should not transcend the price, because this would mean making a loss. In addition, it is advised to focus on creating mince products that mimic the appearance and taste of meat, where priority should be given to appearance. Optimizing the Nutri-score and Eco-score is not worth the effort, but it is advised to maintain Nutri-scores above C and Eco-scores above D. Animal-welfare labels do impact the utility derived from a vegetarian mince product for this segment, so therefore receiving such a label when it is introduced to the market is also recommended. As for marketing strategies, it is recommended to tailor your marketing campaigns in such ways that it is expected to reach students. This can be related to the location of the campaign, the used channels or the content of the campaign. Furthermore, it is advised to aim at increasing the objective knowledge of individuals from this by means of marketing. There already is a certain interest in the environment and health as reflected in the impact of the Eco-score and Nutri-score. This interest may be reinforced by increasing objective knowledge.

The main product alteration strategies that are advised when targeting the *Health en Environment Lovers* segment are increasing the Eco-score, increasing the Nutri-score or reducing the price. It is advised to strive for the best achievable Eco-score and Nutri-scores, considering each improvement brings about a significant utility increase. The price of a product is also of significant negative influence, which means that a price increase will lead to a utility decrease. Efforts to mimic the taste of meat should take place after the aforementioned product alterations. Considering marketing strategies, it is advised for marketing experts to focus on highlighting what makes a certain meat alternative more environmentally friendly or more healthy than other meat alternatives. Comparisons should not be made with conventional meat, but with vegetarian alternatives as those are the competing products for individuals from this segment. Furthermore, it is recommended to highlight the animal friendliness of a product in other manners than the animal-welfare label. Lastly, the individuals from this segment show disagreement with the foodneophobia statements. Therefore, creating new, exciting and exotic vegetarian alternatives may be well received.

The last option is to focus on *Taste Driven Consumers* as the target segment. A taste and appearance similar to meat are very important for the individuals from this segment. Therefore, the strategy proposed is to produce meat alternatives that mimic the taste and appearance of meat as closely as possible. The price of products is not important for the individuals from this segment, therefore price increases are not problematic and can lead to more profits for manufacturers. In terms of marketing strategies, there are two recommendations. First of all, the objective knowledge of this segment is very low. It is expected that this is also one of the causes of the low concentrations of meat reducers and -avoiders in this segment. One option is to try and increase the objective knowledge of the individuals from this segment. A better understanding of the downside of meat consumption could drive individuals to reduce their meat intake and substitute it with vegetarian alternatives. However, it is expected that attempts to increase the objective knowledge of the individuals from this segment may not be very successful. A strategy that may be more effective is familiarizing the individuals from this segment with the product. The foodneophobic tendencies of this segment may form a barrier for individuals to try new meat alternatives. Familiarization techniques may guide the transition from meat to meat alternatives.

Two final implications can be inferred from the future scenario explorations. First of all, the time and effort put into innovating food technology such as cultured meat are expected to have promising results. In the predicted future where meat-like vegetarian alternatives are widely available, the vegetarian mince industry gains a lot of market share and revenues. Furthermore, the reduced price future scenario results can serve as an argument in favour of the meat tax. Results suggest that once vegetarian alternatives get cheaper, the vegetarian mince industry will gain market share. The same effect is expected when meat gets more expensive, which equals vegetarian alternatives being relatively cheaper. The gain of market share of desirable from a societal perspective.

9.4 Limitations

This study has several limitations that will be mentioned and explained in this Section. First of all, a disadvantage of online surveys is that it is difficult or even impossible to identify, understand and describe the population that could have accessed and responded to the survey, and to what population the results can be generalized (Andrade, 2020). In order to generalize the findings of this research to the potential adopter of meat alternatives population, this population has to be known. Because there is no information about this population available, the sample is the best guess and it still gives much more insight into Dutch choice behaviour regarding meat and meat alternatives than knowing nothing. Furthermore, due to convenient sampling, the results are also not generalizable. The survey was spread among personal contacts of the author, and therefore constitutes many students who are likely to have the same mindset to some extent. In addition, because the survey is spread via online channels, only persons with access to the internet will respond. This leads to a part of the population not being represented. In the Netherlands, they will mainly be the elderly (CBS, 2020), as can also be seen back in the lack of elderly respondents to the survey.

The second limitation is the so-called "hypothetical bias" due to the stated preferences data collection paradigm (Lizin et al., 2022). This shortcoming arises because individuals might not actually behave the way they state in their survey choices. In other words, respondents do not feel the consequences of their choices. This could lead to an overestimation of the WtP values or invalid estimations (Lizin et al., 2022). As already explained, this probably has caused the WtP estimates of the *Taste Driven Segment* to be very high. An attempt was made to reduce the hypothetical bias in this research by recreating a choice situation as close to the real-world context as possible. In addition, attitudinal questions regarding health and the environment were asked after the choice experiment to influence the respondents' choices as little as possible.

Furthermore, the texture attribute was of insignificant influence in all three segments. It is however expected that texture may have influence in real life and the insignificance is again the result of the hypothetical choice situation. The impact of texture on utility could be further investigated by executing a real life choice situation where respondents can feel the product.

In addition, as already explained, the segment with the least pro-animal attitude is the only segment where the animal welfare label was of significant positive influence. One would expect that a animal welfare label is only of significant influence when individuals from that segment attach value to the welfare of animals. No good explanation could be found for this observation.

Another method-related limitation is the lack of focus group iterations due to the limited time and resources available for this research. The goal of the focus group was to validate the attributes and attribute levels that were to be included in the survey. Due to the small size of the focus group and the lack of iterations, there is a chance that there are still important attributes missing or ill-defined attribute levels. However, there is expected that the chances of very important attributes missing are small due to them being grounded in literature and because there are no comments on the survey suggesting that important attributes needed for making decisions were missing. Still, in further research, iterative focus groups to validate attributes and attribute levels are recommended.

This research does not provide any information about how preferences may vary as a result of person-related characteristics that were not included. It may be possible that other characteristics also play a big role as predictors for class membership. Another possibility may be that the choice of measurement scales could be improved to better measure latent structures underlying choices. Therefore more systematic research into the latent structures underlying choices between meat and meat alternatives has to be performed. This will be further discussed in Section 9.5.

Lastly, in this research there is focused on mince only. It is unknown to what extent these findings are generalizable to other meat alternatives. Additional research that studies choice behaviour regarding other forms of meat alternatives has to be performed to determine the generalizability. This will be further discussed in the next Section.

9.5 Future research commendations

The first recommendation for future research is the further investigation of which psychographic characteristics are determinants of class membership. More knowledge of which psychographic characteristics are significant class membership predictors leads to more useful information to base marketing strategies on. A systematic review of the literature should be performed to get a comprehensive overview of what person-related characteristics could explain or predict class membership. After identifying these characteristics, there must be determined how to best measure these characteristics. What measurement scales are most suitable to measure the set of characteristics selected. Another interesting research direction is to investigate whether different measurement scales aimed at measuring the same latent structure lead to the same results. However, the priority should be to identify a set of characteristics that are significant and relevant predictors for class membership. By relevant predictors, there is meant that the characteristics should not only be predictors of class membership, but the manufacturers of meat alternatives should be able to alter

their marketing strategies based on the characteristic.

A recommendation that fits in well with the above mentioned recommendation is measuring the pro-animal attitude more extensively and operationalizing the animal welfare of another attribute differently. As explained in Section 9.4, it was unexpected that the segment with the least pro-animal attitude gained the most utility from the animal-welfare label. To better understand this relation, it is recommended to either measure the pro-animal attitude with more statements because it is currently measured with one statement. Otherwise, the animal-welfare label could have led to confusion because it is not currently existing. Another label such as the existing better life label could be used instead.

Another recommendation is to investigate what the potential adopters of meat alternatives segment in the Netherlands look like. As explained in the limitations Section, this population has to be known in order to generalize the findings of the research. Once the population of potential meat adopters is known, the experiment can be executed again to see whether new segments arise and whether other covariates function as significant predictors of the new segments. As a result, a broader, more reliable and more inclusive segmentation of the population can be derived.

As already explained in the limitations Section, this research focused on trade-offs made between conventional mince and vegetarian mince. Therefore, it is unclear whether the results can be generalized to all other meat alternatives or not. It is recommended to execute similar experiments that focus on other meat alternative products to compare the results.

Lastly, it is recommended that experts in marketing use the findings of this research to develop tailored marketing strategies. As already mentioned before, the interpretations of classes and the observed class profiles should function as starting points for experts in marketing. No detailed marketing strategies were provided in this research due to the lack of knowledge and expertise in the field of marketing. The class profiles will be of greater value when translated into suitable and appropriate marketing strategies.

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A Appendix A

A.1 Literature review attribute development

For the small literature review aimed at identifying relevant articles published after the research of Onwezen et al. (2021), the same keywords will be used as they have been using in their research. These are the following:

> ALL (consumption*) AND TITLE-ABS-KEY (food* AND consumer* AND (accept* OR preference* OR willing* OR buy* OR purchas* OR choice* OR behavio* OR adopt* OR perception*) AND ("cultured meat*" OR "in vitro meat*" OR "synthetic meat*" OR seaweed* OR alga* OR insect* OR lupin* OR pulse* OR legume* OR *bean* OR "dry pea*" OR chickpea* OR "cow pea*" OR "pigeon pea*" OR lentil* OR "meat alternative*" OR "meat substitute*" OR "plant-based meat*" OR "meat analogue*")).

The inclusion and exclusion criteria used to determine which articles to select are also adopted from the research of Onwezen et al. (2021). Those criteria are:

Table 23: Inclusion and exclusion criteria

Inclusion criteria
Concerns consumer behaviour or acceptance of alternative protein sources
Contains empirical data (e.g., focus groups, surveys, experiments)
Focusses on understanding, explaining, or influencing consumer acceptance or purchase behaviour regarding alternative proteins
Concerns protein sources (product level) instead of proteins (nutrient level)
Full-text paper written in English or Dutch and published in a peer-reviewed journal
Concerns studies conducted in Western countries
Exclusion criteria
Only concerns technical or ethical aspects of alternative protein sources
Reviews, opinion papers, conference papers and abstracts, concept articles
Is unrelated to consumer behaviour
Concerns trends in food or meat consumption patterns
Concerns animal welfare or hunting and eating wild animals
Concerns studies conducted in non-Western countries

By using the search query as stated above, 185 new articles could be found. After applying the inclusion and exclusion criteria, 15 articles were selected and deemed relevant for this research. The articles that were added are:

- Spendrup and Hovmalm (2022)
- Rombach et al. (2022)
- Quevedo-Silva and Pereira (2022)
- Dean et al. (2022)
- Pointke et al. (2022)
- Grasso et al. (2021)
- Sijtsema et al. (2021)
- Escribano et al. (2021)
- Götze and Brunner (2021)
- Knaapila et al. (2022)
- Elzerman et al. (2022)
- Paffarini et al. (2021)
- Antoniak et al. (2022)
- Godschalk-Broers et al. (2022)
- Young et al. (2022)

A.2 List of allowed health-claims

- Low energy
- Energy-reduced
- Energy-free
- Low fat
- Fat-free
- Low saturated fat
- Saturated fat-free
- Low sugars
- Sugars-free
- With no added sugars
- Low sodium/salt
- Very low sodium/salt
- Sodium-free or salt-free
- No added sodium/salt
- Source of fiber
- High fiber
- Source of protein
- High protein
- Source of [name of vitamin/s] and/or [name of mineral/s]
- High [name of vitamin/s] and/or [name of mineral/s]
- Contains [name of the nutrient or other substance]
- Increased [name of the nutrient]
- Reduced [name of the nutrient]
- Light/lite
- Naturally/natural
- Source of Omega-3 fatty acids
- High Omega-3 fatty acids
- High monounsaturated fat
- High polyunsaturated fat
- High unsaturated fat

A.3 Attribute and attribute level development

First, the environment-related aspects will be discussed. The environment-related attributes mentioned in the literature are 'a mix of health and environmental claims associated with the product', 'country of origin', 'the degree to which meat substitute was less environmentally impactful compared to meat', 'sustainability certification', 'animal welfare' and 'packaging'. The goal of this research is to understand the trade-offs that consumers make when choosing between meat and meat alternatives to gain knowledge on how to reduce meat intake. Therefore, the attribute 'the degree to which meat substitute was less environmentally impactful than meat' is of great relevancy. It will be explained shortly that all the other mentioned attributes will also be taken into account. Weinrich and Elshiewy (2019) operationalized 'the degree to which meat substitute was less environmentally impactful than meat' using the following levels: 10%, 20%, 30% and 40%. However, according to Mudgal et al. (2012), it is easier to understand comparative scales such as colour coding systems for consumers when they are comparing two products. They also argue that physical values such as percentages are to technical for consumers. Therefore, there is decided to use an easy-to-understand rating system within the survey of this research. Erdem and Campbell (2022) also concluded that colour-coded labels make it easier for consumers to process information when making a decision as compared to no-colour-coded numeric labels.

Weber (2021) conducted research on the effect of colour-coded eco-scores on sustainable food choices. More specifically, she researched whether providing more information about the meaning of each eco-score would lead to more sustainable food choices. The colour-coded eco-scores refer to the overall environmental impact as opposed to different scores for water usage, transportation distance, certification, GHG emissions etc. She concluded that simple colour-coded eco-ranking as compared to a comprehensive overview of key metrics leads to consumers being more consistent in and more confident about their sustainable food choices. Therefore the plant-based mince alternatives will be assigned a colour code score. One promising colour-coded eco-score in Europe is the French sustainability label Eco-Score (van Zinderen Bakker, 2021). Products are scored red (E), orange (D), yellow (C), light green (B) and dark green (A) based on a Life Cycle Analysis (LCA). This Eco-Score includes all environment-related aspects mentioned before. More information about this Eco-Score can be read in section 3.2. Four of the five Eco-Scores from the scale are selected to include in this research: A, B, C and D. The current existing pant-based mince alternatives were analyzed and non of them scored E. All mince currently available on the other hand scores E.

Not surprisingly, the environmental-related aspects are usually positively correlated with the utility gained from choosing meat alternatives. However, meat alternatives still own a small market share compared to conventional meat. This is due to the trade-offs that have to be made when choosing between meat and meat alternatives (Hoek, Luning, et al., 2011). The product that maximizes the consumer's utility is chosen, and this does not only depend on environmental aspects.

Other aspects that play a role according to the literature are health-related aspects. The attributes that are mentioned that are health-related are 'product nutritional claim (presence of Omega 3)', 'information about e-numbers', 'information about health effects', 'fat content', 'sodium contents', 'calorie contents' and 'safety to eat'. The attributes can be divided into three categories, health claims, nutritional claims and food safety. Health claims refer to a relationship between a food and its health benefits instead of the factual composition of a food (Talati et al., 2016). Nutritional claims refer to the nutrients of a product and are a statement of content (Talati et al., 2016). Because of missing background knowledge on the relationship between food and health aspects such as diseases and the limited time available, there is decided to focus on nutritional claims in this research. The safety aspect is also not included in this research because food safety is generally not an issue in the Netherlands and is more applicable in research focused on other countries (Kreijl et al., 2006).

The nutritional claims chosen to include are fibre-related, fat-related and energy-related because those are mentioned as possible aspects that can make plant-based meats a better choice (Good Food Institute, 2022). Because of this, it is interesting to see which of those nutritional claims influences consumer choices the most. Based on this, advice can be given on which nutritional claims to include on the packaging of meat alternatives. There is a list of nutritional claims that are permitted on packaging based on European law (The European Parliament and the Council, 2006). This document also explains what conditions a product must meet in order to express a certain nutritional claim. For the complete list of allowed nutritional claims, see Appendix A.2. From this list, a selection was made of the nutritional claims that apply to meat alternatives the most.

To determine nutritional claims that will be included, the conditions applying to the different claims were studied. Based on this, what nutritional claims are feasible and realistic for meat alternatives can be determined. The existing fibre-, fat- and energy-related nutritional claims are:

- Low energy
- Energy-reduced
- Energy-free
- Low fat
- Fat-free
- Low saturated fat
- Saturated fat-free
- Source of fibre
- High fibre

The conditions for the low energy claim ask for the product to contain no more than 40 kcal/100 g for solids. Considering the energy content of current plant-based mince alternatives ranges from 100 kcal/100 grams to 238 kcal/100 grams, it is not feasible or realistic to meet the conditions of this nutritional claim (Albert Heijn, 2022; Aldi, 2022; Coop, 2022; Ekoplaza, 2022; Jumbo, 2022; SPAR, 2022). The energy-reduced claim refers to a product from which the energy value is reduced by at least 30%. One could say that a 30% reduction of calories in meat alternatives is possible, considering the current plant-based meat alternative with the lowest amount of calories (100 kcal/100 g) has more than 30% less calories than the highest energy plant-based mince alternative. Comparing the calories of two different alternatives is not the same as reducing the calories of one product by 30%, however, it indicates that it is a realistic option. Therefore, it is interesting to see whether altering a product to meet those conditions is worth it for marketers and manufacturers. This can be done by investigating the impact of an energy-reduced nutritional claim. The last energy-related claim is the energy-free claim, meaning that a product may not contain more than 4 kcal/100 ml. This is, as the low energy statement, not feasible nor realistic. Therefore, there is decided to include the energy-reduced nutritional claim in this research.

The low-fat claim is allowed when a product contains no more than 3 grams of fat per 100 grams for solid products. By comparing existing plant-based meat alternatives there was investigated whether the low-fat claim was feasible and realistic. There are several plant-based mince options that comply with the conditions of the low-fat claim, examples are the Albert Heijn vegan house brand mince and the mince of the vegetarian butcher (Albert Heijn, 2022). Therefore, there can be concluded that a low-fat mince alternative product is feasible and realistic. The fat-free claim may be used when the product contains no more than 0.5 grams of fat per 100 gram of the product. Only the mince of the Vegetarian Butcher is eligible for this claim (Coop, 2022). The remainder of the plant-based mince alternatives have far more than 0.5 grams per 100 grams of the product. For the majority of the producers of plant-based mince, the low-fat claim is already a challenge and the fat-free claim is not very realistic. To advise a wider selection of producers, there is decided that the low-fat claim is preferred to include in this research as compared to the fat-free claim. However, besides the total fat claims, there are also saturated fat claims.

The low saturated fat claim applies to products from which the sum of saturated fatty acids and trans-fatty acids do not exceed 1.5 grams per 100 grams for solid products. Plant-based alternatives that meet those conditions already exist, so, therefore, this nutritional claim is feasible and realistic. In order to comply with the conditions for the saturated fat-free claim, a product should contain less than 0.1 grams of saturated fat per 100 grams of product. No

plant-based mince alternatives with less than 0.1 grams of saturated fat per 100 grams could be found. Therefore, it is way less realistic and feasible to obtain the saturated fat-free claim and it is a good first step to focus on the low saturated fat claim as more producers may be able to comply with those conditions. According to Moll (2022), it is desirable to limit the number of saturated fats in your diet. The majority of someone's fat intake should be unsaturated fats. Therefore the health claim included in this research will be focused on saturated fats, considering limiting those is more desirable than limiting total fats. The health claim that will be included is the low saturated fat claim.

The source of fibre claim can be made when the product contains 3 or more grams of fibre per 100 grams of solid product. Plant-based mince alternatives with more than 3 grams of fibre per 100 grams of the product are already sold in Dutch supermarkets, so, therefore, this claim is feasible. A stronger claim is the high-fibre nutritional claim. This claim requires that a product contains at least 6 grams of fibre per 100 grams. After analyzing the product range of the 6 biggest Dutch supermarkets, there can be concluded that there are plant-based meat alternatives that achieved the high-fibre nutritional claim. Examples are the Albert Heijn House brand Bean Mince and the vegan mince of the Vegetarian Butcher. The high-fibre claim may be a bit more difficult to achieve but it is feasible and realistic. The high fibre claim will be used in this research because it may create a stronger image of the influence of fibre on the food choices of consumers. It also leads to advice on whether food producers should target adding more fibres to their meat alternatives or not.

To summarize, the three nutritional claims that will be included in this research are the energy-reduced claim, the high fibre claim and the low saturated fat claim. The claims have two attribute levels. Either the product has the claim, or the product does not have the claim. Based on the attribute weights assigned to the different claims, there can be determined whether certain consumer segments gain more utility from specific claims. This is useful information for producers or marketers because they can alter their products and campaigns to fit the needs of their consumer segment.

Another category of aspects that are deemed important by consumers are the economic aspects. All researchers agree that price has, to some extent, a significant influence on food choices. How to operationalize the attribute price is straightforward, namely the product's price. When choosing the exact price levels to include, two important requirements have to be kept in mind according to Molin (2022c): 1) Choosing wide ranges and 2) Checking whether the attribute values and the combination of them make sense. To determine suitable price levels, existing product prices were compared and a range was chosen from below the cheapest alternatives to above the most expensive option. This makes sure that the existing alternatives fall within the range and that there is room for cheaper or more expensive future alternatives. Based on this information, advice can be given on the impact of making plant-based mince alternatives cheaper than the existing ones or more expensive. 6 of the biggest supermarkets, including a supermarket dedicated to environmental friendliness, were scanned to determine the price range. Value packs containing roughly double the amount of product were excluded from the comparison. There is chosen not to correct for other differences in grams because the real market prices are a good reference for the price range. The comparison of the lowest and highest prices of meat alternatives can be seen in Table 24

As can be seen the cheapest product sold currently is €1.48 at the Aldi, and the most expensive product sold costs €4.89 at Ekoplaza. The price range used in the DCE has to be wider than €1.48 to €4.89. Whenever it is possible, it is beneficial to preserve equidistance between the levels (Molin, 2022c). This means that the distance between the levels is equal. Based on the varying prices of meat alternatives it has been decided to include 4 price levels in this research. The price levels are: €1.30, €2.60, €3.90 and €5.20.

Table 24: Price comparison meat alternatives

Supermarket	**Lowest price**	**Highest price**
Albert Heijn	€1.69	€4.09
Jumbo	€1.69	€3.99
Aldi	€1.48	€1.48
Coop	€2.82	€3.25
SPAR	€3.35	€3.49
Ekoplaza	€2.89	€4.89

Lastly, there are intrinsic properties of plant-based meat alternatives. The intrinsic properties mentioned in the literature are the preparation time of plant foods, taste, sensory quality, smell and meaty flavour. According to Lamas (2021), the appearance, texture and flavour are the three main challenges of food scientists that are developing plant-based meat alternatives. An obvious sensory-related aspect of plant-based mince alternatives is whether it actually tastes, looks and feels like an alternative to meat. Multiple researchers mention that there is no consensus on whether

meat alternatives should resemble conventional meat or not (Elzerman et al., 2013; Hoek, Luning, et al., 2011). On the one hand, consumers who do not use meat alternatives a lot tend to like products with meat-like sensory properties (Elzerman et al., 2013; Hoek, Luning, et al., 2011). On the other hand, people who use meat alternatives are more drawn to products that are dissimilar to meat (Elzerman et al., 2013; Hoek, Luning, et al., 2011).

Insights into the sensory property preferences of consumer segments are valuable for the producers and marketers of meat alternatives. Using this knowledge, advice can be given on whether products should be developed to look, taste and feel like meat. Furthermore, there can be advised whether marketing campaigns should focus on persuading people that it tastes just like meat, or the contrary. Because taste, texture and someone's liking of a taste, appearance or texture is difficult to measure, it is decided to choose simple levels that are understandable for all consumers. The two levels used to find out what consumers are looking for in terms of the sensory properties of meat alternatives are mimics of the looks, texture and flavour of meat and dissimilar to the looks, texture and flavour of meat. The texture is defined as the properties of food that are sensed by touch in the mouth (Dahl, 2020).

Besides including sensory properties, shedding light on the preparation aspect of meat alternatives may also lead to interesting findings for producers and marketers. One preparation aspect that has been proven to play a role is the preparation time due to people's time scarcity. A very short reparation time is not necessarily positive for all consumers (Elzerman et al., 2022). The satisfaction derived from time spent on cooking and certain slow-cook recipes may lead to a negative association with easy-to-prepare products or short preparation times. To investigate whether consumer segments in the Netherlands value product convenience differently it is valuable to include preparation time in the DCE. Based on this, insights can be given to producers and marketers on whether they should focus on food that is quick and ready to go or food that has a longer preparation time. Again, the preparation times of different mince alternatives that currently exist are analyzed to determine the current range. Subsequently, a preparation time range consisting of 4 levels is determined where equidistance is kept between the levels. The current range of preparation time varies from 3 minutes to 15 minutes. A range wider than the current existing range will be chosen to make sure all possible preparation time levels are included. Therefore, the four levels chosen to include in the DCE are: 2 minutes, 7 minutes, 12 minutes and 17 minutes.

A.4 Attributes and attribute levels translated

Table 25: Attributen en attribuut niveau's

Attribuut definitie	Attribuut niveau's
Milieu-impact: dit attribuut verwijst naar de algehele milieu-impact van een product. Deze algehele milieu-impact wordt berekend aan de hand van een levenscyclusanalyse aangevuld met andere kwaliteitscriteria. Voorbeelden van elementen die mee worden genomen zijn productiemethode, verpakking, herkomst, vervoer, verwerking en water gebruik.	
Verlaagde energetische waarde claim: deze claim is van toepassing op producten waarvan de energetische waarde met minimaal 30% verlaagd is.	Product heeft de verlaagde energetische waarde claim Product heeft de verlaagde energetische waarde claim niet
Vezelrijk claim: deze claim is van toepassing op producten met een vezelgehalte van minimaal 6 gram per 100 gram product.	Product heeft de vezelrijk claim Product heeft de vezelrijk claim niet
Arm aan verzadigde vetten claim: deze claim is van toepassing op producten waarvan de som aan verzadigde vetzuren en transvetzuren niet groter is dan 1.5 gram per 100 gram product.	Product heeft de arm aan verzadigde vetten claim Product heeft de arm aan verzadigde vetten claim niet
Prijs: dit attribuut verwijst naar de prijs van een product.	€1.30 €2.60 €3.90 €5.20
Smaak: dit attribuut verwijst naar of een vleesvervanger de smaak van vlees nabootst of niet.	Bootst de smaak van vlees na Bootst de smaak van vlees niet na
Textuur: dit attribuut verwijst naar of een vleesvervangers de textuur van vlees nabootst of niet. Textuur is gedefinieerd als de eigenschappen van vlees die kunnen worden waargenomen door aanraking in de mond.	Bootst de textuur van vlees na Bootst de textuur van vlees niet na
Uiterlijk: dit attribuut verwijst naar of een vleesvervanger het uiterlijk van vlees nabootst of niet.	Bootst het uiterlijk van vlees na Bootst het uiterlijk van vlees niet na
Bereidingstijd: dit attribuut verwijst naar de bereidingstijd die aan staat gegeven op de verpakking van een vleesvervanger.	2 minuten 7 minuten 12 minuten 17 minuten

A.5 Focus group

A focus group is a method used to gain more knowledge and understanding of participants' beliefs, perceptions and attitudes related to a specific topic (O.Nyumba et al., 2018). This is done by moderating the discussion between a small group of participants, usually between six and eight individuals. O.Nyumba et al. (2018) explain that the focus group process exists of four consecutive steps: 1) research design, 2) data collection, 3) analysis and 4) reporting of the results. They stress the importance of providing a clear rationale for choosing a focus group. Furthermore, they mention the need for identifying the main aim and research objectives, creating a question list and elaborate on the participant identification. First, the main aim and the research objective of the focus group will be explained, followed by the rationale for choosing a focus group, a question list and the participant identification process.

The goal of the focus group is to validate whether: 1) the most important attributes for respondents are included and 2) all attributes and attribute levels are well defined and understood. To do so the participants will be presented with the list of the attributes that are selected and they will be asked to share their opinion on the list. The other participants are allowed to respond to the participant speaking or to complete what someone says. Besides asking for their opinions about the list, the focus group will be recorded to analyse the use of wording related to meat and meat alternatives of the participants. Based on the words used to describe attributes and attribute levels, there can be determined whether some attributes or levels need rephrasing.

There is chosen to perform a single online focus group. Hosting a focus group is of added value to validate the attributes that will be included in the survey. As a result of the focus group, there is more certainty that no attributes of great importance are forgotten and that people will be able to understand the attributes and attribute levels. Focus groups are more often used for developing questionnaires (O.Nyumba et al., 2018). A focus group saves time because the input of several individuals can be requested at once. Furthermore, a focus group can lead to more valuable insides as compared to interviews due to discussion. People can react to each other and agree or disagree, which will lead to more knowledge about the complexity of the topic. A single online focus group implies that one focus group will be hosted online where all participants join one group discussion. First of all, a single online focus group makes it accessible for individuals to participate. People do not need to travel to a focus group location and can join the discussion at home. Other researchers that hosted a focus group online were contacted to find out whether there were any difficulties related to hosting a focus group online. They stated that there were no difficulties and that the opportunity to record images and sound leads to better analysing options. Furthermore, due to the time and resources available for this research, one online focus group was the most feasible option as compared to a multitude of consecutive focus groups. The focus group will have a duration of approximately 60 minutes.

As mentioned in the main text, the topic schedule of the focus group is the following:

1. Introduction of MSc Thesis subject and goal of the focus group
2. Introduction of selected attributes and their description
3. Discussion about missing or redundant attributes
4. Introduction of selected attribute levels
5. Discussion about selected attribute levels and whether they are understandable

Purposive sampling is applied as recommended by O.Nyumba et al. (2018). This means that participants are selected based on certain characteristics that are desired for the research. The participants that are needed are individuals who buy meat alternatives sometimes or regularly. There is chosen to select a wide range of individuals to check whether the important attributes for different ages, educational backgrounds, employments and genders are included. There is chosen to use those characteristics to stratify respondents because they are proven to have a significant influence on attribute importance and because those characteristics are insensitive in nature. The latter has the benefit of people not being hesitant to share the information. The survey will also be spread among all people who buy meat alternatives, so, therefore, it has to be made sure that the important attributes for a wide range of individuals in included in order for them to fill in the questionnaire.

One of the main disadvantages of focus groups is that the method is susceptible to all biases that are commonly encountered in group settings (O.Nyumba et al., 2018). Examples of such biases are when a dominant participants shapes the discussion, when the status of one participant influences the discussion and when all the participant agree to think the same due to group cohesion. There is expected that those biases will not be a big issue during this research. The moderator will give someone the opportunity to speak, which reduces the chance that one person will be very dominant during the discussion. Also, the fact that people have different motivations to buy meat alternatives will be highlighted so respondents will not feel ashamed or strange for having another opinion. Furthermore, the participants do not know each other and non of them is an expert in the field so this decreases the chance that someones status will influence the discussion.

A.5.1 Analyses and reporting of focus group results

In line with Informed Consent guidelines, the moderator started the focus group by explaining the aim of the research is, and what the respondents were asked to do. The respondents were informed about the potential risks and the mitigation strategy. Everyone agreed to participate in the focus group and gave permission to record the focus group for personal use.

The focus group was designed and executed for the purpose of validating and judging the selected attributes and attribute levels, as well as introducing new ones and suggesting the deletion of existing ones. The first item of discussion was focused on identifying missing or redundant attributes. 3 main discussions of relevance will be explained and illustrated with translated citations elicited from the recording of the focus group.

Suggestion 1: include the nutri-score
Suggestion 1 derived from the focus group is the aggregation of the multiple nutritional claims into the nutri-score. The nutri-score was a known score for all respondents but one. A selection of citations in favor of this suggestion are:

> 'On many of the products currently sold, there is a nutri-score. The current attributes are very specific, high fibre, low in fat and reduced energy. This may be too much information for an average consumer in the supermarket to determine whether a product is healthy or not.'
>
> 'I agree. In no choice about my food do I base my decision on whether or not it has a reduced energy claim or reduced saturated fat claim. High fibre at most with bread. When choosing between meat and meat alternatives, the three claims are not relevant.'
>
> 'Estimating the overall health of a product is difficult based on those claims. Personally, I would rather look at protein content together with the nutri-score. I can imagine that someone who is on a diet is more likely to look at saturated fats.'
>
> 'Just because something is low in saturated fat doesn't mean it doesn't contain added sugars to mimic a certain taste.'
>
> 'The back of a package always states how many fibres and proteins are in a product. Someone who finds that important will look there, and then for most people, a simple nutri-score is enough indication whether something is fine or not.'
>
> 'Yes, I agree, I would tend to use that nutri-score myself because it is a bit more comprehensive. When you see these claims I wonder what those claims mean, people won't know that. You summarize it more comprehensibly with the nutri-score and it is easier to read.'
>
> 'I think there are many possibilities to make your dish more nutritious outside of meat substitutes. You can get the things you want in your dish without really considering meat substitutes, for example with vegetables or beans. So for me, it is not very important what exactly is included in meat substitutes, I would personally solve this with other products.'

What can be concluded from those citations and the focus group as a whole is that separate nutritional claims do not play a role in the decision for a product. Preference is given to a nutri-score, which provides a better overview of the overall nutritional value of a product. People with a specific interest in certain nutritions always have the possibility of obtaining this information on the back of the packing or may add those nutritions to their meals through other ingredients than meat alternatives.

To include the nutri-score in the DCE, the attribute levels have to be determined. The nutri-score exists of 5 possibles scores: A, B, C, D and E. Cutroneo et al. (2022) compared the nutri-scores of multiple meat analogues and their counterparts. They concluded that there were no plant-burgers or plant-meatballs with the nutri-score E. Because plant-burgers and plant-meatballs both fall within the processed meat category, and plant-based mince does as well, there is assumed that there is also no plant-based mince with a nutri-score E. Therefore, the nutri-scores that will be included in this research are the scores A to D.

Figure 21: Nutri-score A

Figure 22: Nutri-score B

Figure 23: Nutri-score C

Figure 24: Nutri-score D

Suggestion 2: adding animal welfare

One respondent suggested that the most important attribute was missing, that is animal welfare. The respondent said:

> 'When I look at the list, animal rights are the most important to me. You talk about environmental impact, but I think it's most important for vegetarians that animal welfare is included.'

Even though only one respondent mentioned the missing animal welfare attribute, and no other respondents verbally or with body language expressed agreement with this statement, there is still decided to look into it. The reason is that the respondent in question has been a vegetarian for a long time, as opposed to other respondents who are not vegetarian or have been vegetarian for a short time. The insights of the long-time vegetarian respondent could lead to a broader view of reasons to buy meat alternatives. To determine whether animal welfare should be included, the existing literature on the main reasons for Dutch consumers to refrain from meat consumption was consulted.

According to the 'voedingscentrum', an independent organisation consisting of dietitians and scientists, 34% of Dutch meat reducers give animal welfare as the reason to reduce meat consumption (Voedingscentrum, 2021). The other main reasons are environmental impact (37%) and health (27%). Considering such a significant part of Dutch society reduces their meat intake due to animal welfare, it is estimated that including this attribute can have a significant impact on consumer choices. Multiple research articles that studied the impact of animal welfare on consumer preferences were found. According to by Chen Chen et al. (2017), consumer preferences for eggs from enhanced animal welfare production systems are heterogeneous. In other words, consumers from different segments value animal welfare products differently. Liang et al. (2022) studied the consumer preferences for pork produced using animal-welfare-enhancing farming strategies. They conclude that Chinese consumers were willing to pay more for animal welfare pork. Furthermore, they also agree that there was significant heterogeneity in consumer preferences regarding age, educational level, and income. Therefore, they suggest that producers and should develop differentiated marketing strategies for animal welfare products. Lastly, Schulze et al. (2021) also performed a DCE to determine the consumer preferences for animal welfare-friendly meat products and concluded that consumers have a clear preference for products linked to animal welfare. To conclude, animal welfare is the main reason for meat reduction in the Netherlands and has been proven to have an impact on consumer preferences by other researchers. Therefore there is decided to include animal welfare as an attribute.

The European Commission indicated on 20 May 2020 that it would investigate the possibilities of an EU-wide animal welfare label (Het secretariaat-generaal van de Raad, 2020). The Council believes that an EU-wide animal welfare label could be an effective response to the consumer demand for easier identification of products with higher animal welfare standards (Het secretariaat-generaal van de Raad, 2020). The EU-wide animal welfare label is not yet developed and implemented yet. However, the European Commission asked ICF international together with a team of experts to gather evidence that supports potential initiatives concerning animal welfare labelling in the EU (ICF, 2022). They concluded that consumers would respond positively to any labelling initiative that covers general animal welfare. Furthermore, they concluded that consumers prefer labelling schemes owned by NGOs and EU public authorities. As for the labelling scheme itself, they argue that EU consumers prefer text or logo formatting of animal welfare labels.

Because the label does not yet exist, a choice of logo or text has to be made. There is chosen to use the EU Ecolabel as a source of inspiration. The EU ecolabel is an official European Union label that guarantees independently-verified low environmental impact of non-food products (Ecolabel, n.d.). The EU Ecolabel incorporates the whole lifecycle of a product in the assessment of the environmental impact of a product, including raw material extraction, manufacturing production, packaging, distribution, utilization and disposal or recycling (Ecolabel, n.d.). Therefore, the EU animal welfare label referred to in this research will also include the full duration of life of animals. There are existing labelling schemes focusing on the full duration of life of animals that include standards for welfare on the farm, during transport, and slaughter (ICF, 2022). As a result, a logo in the style of the EU Ecolabel will be used that refers to animal welfare throughout the lifespan. As for the attribute levels, products can either have the logo or not.

The logo is inspired by the existing EU Ecolabel and therefore includes the same components as the Ecolabel. These components are the signature European Flag stars, the abbreviation 'EU' and a website link to the animal welfare label website. Lastly, there is decided to include an icon of multiple animals as a substitute for the plant on the EU Ecolabel. There is decided to pick an icon with more than one animal to clarify that the label includes the welfare of all animals as compared to one specie. For a comparison of the EU Ecolabel and the self-designed EU Animal Welfare label see 25 below.

Suggestion 3: deleting preparation time

Suggestion 3 derived from the focus group is the deletion of preparation time. One of the respondents said:

> 'For me, when I buy something I never look at the preparation time. I don't know if other people do but I tend to look at all the other features but never how long it takes to prepare. It could matter if it takes an hour, but I wouldn't expect that with a meat substitute.'

Figure 25: EU label comparison

2 respondents verbally agreed with this statement, 2 other respondents agreed with this statement by nodding. The last respondent added:

> 'Meat substitutes usually have a shorter preparation time.'

To determine whether preparation time should indeed be deleted, the article where the attribute was derived from was revisited. This was the research executed by Elzerman et al. (2022) that aimed to explore the appropriateness of the use of meat substitutes in different usage situations. After re-analysing the article, the following statement was found: 'Vegetarian stir-fry pieces, vegetarian mince and vegetarian hamburgers were often associated with a quick meal...'. They also indicate that the possible positive association with a longer preparation time applied to other types of meat substitutes such as vegetarian steaks. This research focuses on processed meat such as mince and hamburgers. Therefore, there can be concluded that including preparation time when respondents will be asked to choose between mince options is not very relevant. However, more importantly, it is not of great relevance for consumers and producers. Mince is associated with a quick meal, and therefore there is no need to investigate the influence of long preparation times. To conclude, preparation time is a relevant attribute of other meat alternative products, but not for processed meats. Therefore, preparation time will be deleted.

Those were the suggestions concerning missing attributes or redundant attributes derived from the focus group. Besides missing or redundant attributes, the attribute levels and whether they were understandable. One last suggestion was derived from this discussion, this will be elaborated on in the section below.

Suggestion 4: make environmental impact more tangible

One aspect that all participants seemed to agree about is that the eco-scores do not give enough information about the differences in environmental impact yet. A few citations that indicate this view will be presented below.

> 'The environmental impact currently is from A to E. But I especially want to see a comparison with meat because for me the environment is basically the only reason why I buy meat substitutes. I would like to be able to compare emissions or something like that to determine how much better a meat alternative is compared to meat. I know that soy is not necessarily very good for the environment either, but I don't know to what degree. I would like to see a comparison such as: eating meat once is just as bad as eating soy products for 10 days, for example. It helps because then I know a little bit about how much I am contributing to the environment. Because it is A to E now, but does this mean 5 or 10 times as bad? This knowledge would make a big difference in my choice between products.'

> 'Yes, I very much agree with this. The comparison would give me a very clear overview for me, especially from an environmental perspective. Because currently, I feel like I am contributing to improving the world by eating many meat alternatives, however, I am not exactly sure to what extent.'

> 'The environmental-impact label should be as easy as possible, however, I believe that the first group that will switch to meat substitutes will be people that are interested in the numerical values regarding environmental impact. Maybe not for all people in the society, but for me, numerical values would work.'

> 'Personally, I do eat meat. This is also due to my unfamiliarity with the positive impact of eating meat alternatives instead. If this becomes more visible and tangible you can see that you are doing a good job, it could really make a difference.'

During the discussion, the remainder of the respondents all showed signals of agreeing by nodding. What can be concluded is that there is a need for a more tangible comparison of the environmental impact related to eating meat or meat alternatives. It is not clear to what degree eating meat alternatives is better than eating conventional meat. Some more research was executed on the calculation of the eco-score. One interesting finding is that products do not

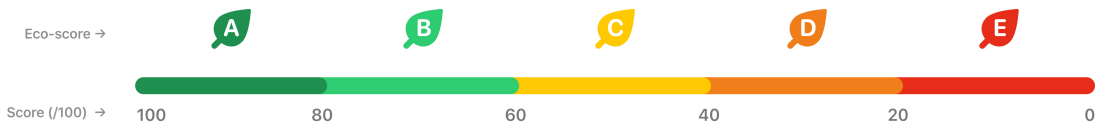

Figure 26: Eco-Score with bandwidths
Source: https://www.foodnavigator.com

only get assigned an eco-score from A to E, but they also get assigned a numeric score within the bandwidth of their corresponding eco-score (A to E). For a visualisation of the bandwidths of the different eco-scores see Figure 26 below. Instead, or in addition to the A to E score, the numeric eco-score could be added to allow for better comparison between multiple products. There will be explained that the eco-score can vary from 0 to 100, 100 being the least environmental impact and 0 being the most environmental impact. In this way, comparison of the environmental impact of 2 products will be easier from consumers. In this research, the numeric eco-score will be added to the logo. The labels that will be used to indicate the environmental impact of a food product are:

Figure 27: Final Eco-Scores

The suggestions of the focus group were processed and resulted into a new selection of attributes and attribute levels. For a overview of the complete translated final list of attributes and attribute levels that will be included in the DCE, see Table 4 below.

Table 26: Definitieve attributen and attribuut levels

Attribute definition	Attribute levels	Level coding
Milieu-impact: dit attribuut verwijst naar de algehele milieu-impact van een product. Deze algehele milieu-impact wordt berekend aan de hand van een levenscyclusanalyse aangevuld met andere kwaliteitscriteria. Voorbeelden van elementen die mee worden genomen zijn productiemethode, verpakking, herkomst, vervoer, verwerking en water gebruik. Producten krijgen een score toegewezen van 0 tot 100. Hier geldt dat 0 de slechtste score is van een milieuvriendelijk aspect, en 100 de beste score.		0
		1
		2
		3
Nutri-score: dit attribuut verwijst naar de algehele voedingswaarde van een product. Producten met een Nutri-Score A hebben de hoogste voedingswaarde en producten met een Nutri-Score D de laagste voedingswaarde.		0
		1
		2
		3
Prijs: dit attribuut verwijst naar de prijs van een product.	€1.30	0
	€2.60	1
	€3.90	2
	€5.20	3
Smaak: dit attribuut verwijst naar of een vleesvervanger de smaak van vlees nabootst of niet.	Bootst de smaak van vlees na	0
	Bootst de smaak van vlees niet na	1
Textuur: dit attribuut verwijst naar of een vleesvervangers de textuur van vlees nabootst of niet. Textuur is gedefinieerd als de eigenschappen van vlees die kunnen worden waargenomen door aanraking in de mond.	Bootst de textuur van vlees na	0
	Bootst de textuur van vlees niet na	1
Uiterlijk: dit attribuut verwijst naar of een vleesvervanger het uiterlijk van vlees nabootst of niet.	Bootst het uiterlijk van vlees na	0
	Bootst het uiterlijk van vlees niet na	1
Animal-welfare: het officiële Europese dierenwelzijnskeurmerk wordt toegewezen aan producten die gegarandeerd goedgekeurd zijn vanuit dierenwelzijn perspectief gedurende de gehele levensduur van de dieren.	No label	0
		1

Validation of the relevancy of other attributes
Another contribution from the focus group is that it validated that different consumers assign different weights to different attributes. This was the case for nutritional value, price, taste, texture and appearance.

B Appendix B

B.1 Complete list of indicator variables

Demographic variables

- Age
- Gender
- Educational level
- Ethnicity
- Cultural background
- Political conservatism
- Household income
- Political views
- Monthly income

Behavioral variables

- Consumption of legumes
- Consumption of plant-based foods
- Skills concerning preparation of plant foods
- Diet
- Lentil consumption frequency
- Meat consumption habit
- Meat consumption frequency
- Experience with preparing insect-based food
- Previous experience with insect consumption
- Familiarity with foreign food
- Intention to eat insects
- Prior frequency of meat substitute consumption
- Familiarity with cultured meat
- Meat consumption habits
- Green eating behaviour
- Exercise behavior
- Travel behavior
- Trying new recipes

Psychographic variables

- Motivation for legume consumption
- Environmental concerns
- Food Neophobia
- Health Consciousness
- Attitude towards meat
- Attitude towards meat substitutes
- Disgust sensitivity
- Desire for new food alternatives
- Intention to reduced meat intake
- Perceived social acceptance
- Perceived social norm regarding insect consumption
- Beliefs about insects
- Attitudes about insects
- Perceived behavioural control
- Belief that eating insects benefits health and environment
- Disgust towards insects
- Concern for health-related and environmental effects of food
- Food technophobia
- Motives for eating insects
- Trait disgust propensity
- Convenience orientation
- Need for familiarity
- Perceived health benefits of meat
- Curiosity about eating insects
- Perceived environmental benefits of eating insects
- Opinions of family and friends
- Perceived food appropriateness
- Perceived appropriateness of food preparation
- Awareness of and concern about environmental impact of animal production and meat consumption
- Enjoyment of meat consumption
- Implicit negative attitudes towards insect-eating
- Perception of health-related risks of insect consumption.
- Perceived naturalness of traditional or in-vitro meat
- Degree of distrust in science
- Degree of conspiratorial ideation

- Internalised food-related motivation
- Intrinsic enjoyment of eating and cooking
- Meat attachment
- Food fussiness
- Food choice motives
- Attitude towards the environment
- Attitude towards agriculture
- Ecological reasons for considering alternative protein sources
- Meat Commitment
- Animal welfare as motivation

Knowledge

- Knowledge concerning preparation of plant food
- Knowledge/awareness of environmental and nutritional advantages of entomophagy
- Knowledge concerning preparation of plant food
- Subjective and objective knowledge of product
- Awareness of the link between food and climate

B.2 Overview of possible interventions

Table 27: Suggested interventions (1/3)

Article	Intervention suggestions
Onwezen et al., 2021	Health claims
	Environmental claims
	Societal benefits as compared to individual benefits
	Introducing alternative proteins in existing and recognizable dishes
	Developing products that fit with known products and recipes
Szejda and Parry, 2020	Develop products that mimic the sensory properties of meat
	Reduce price to reach a larger consumer segment
	Develop products that are easy
	Develop products that fit with consumers' habits and social norms
	Develop plant-based meat that can directly replace the conventional meat component in familiar dishes
	Frame plant-based meat as a new, excisting variation of a familiar meal component
	Promote plant-base meat's perceived health benefits and adress consumers' health concerns in product development
	Don't put altruistic benefits at the forefront
	On-product health labels should focus on health gains, particularely high protein or high fiber
	Develop positive messaging around the taste and sensory properties of plant-based meat.
	Highlight the properties of plant-based meat that are similar to those of conventional meat.
	Highlight plant-based meat's ease and quickness of preparation.
	Design message content and framing with a specific subsegment of consumers in mind
	Increase general awareness of or familiarity with plant-based meat to increase purchasing.
	Design messages that appeal to target consumers' attitudes.
	Use messaging that provides encouragement and instructions regarding the preparation of plant-based meat.
Hoek, Luning, et al., 2011	Providing certain verbal information about product use with respect to food neophobia
	Enabling resemblance to more familiar foods with respect to food neophobia.
	Bringing about exposure with respect to food neophobia.
	Focus on ethical aspects for vegetarians and heavy-users.
	Develop products that have desirable meat like properties.
Apostolidis and McLeay, 2016	Information capmaigns to increase consumer awareness
	Product labelling (nutritional labels, carbon footrpint labels and country of origin labels)
	Campaings highlighting the hedonic value and pleasure from eating meat alternatives.

Table 28: Suggested interventions (2/3)

Article	Intervention suggestions
van den Berg et al., 2022	Education in order to improve knowledge about plant-based alternatives of meat
	Distributing recipes in order to improve knowledge about plant-based alternatives of meat
	Lower meat alternative prices
Peschel et al., 2016	Align subjective and objective knowledge
Verain et al., 2022	Developing tasty meat alternatives
	Providing tasty recipes with meat alternatives
	Providing tasty meals with meat alternatives
	Better informing consumers on the potential health benefits of meat reduction
	Taking away consumers feeling that they need meat
	Use health, safety, affordability and sensory appeal as arguments for all segments
	Use animal welfare and environmental friendliness for flexitarian segments
Jahn et al., 2021	Make novel foods resemble familiar foods
	Organize activities that include trying out plant-based meat alternatives
	Food fortification
	Focus on both health and environmental benefits
Beacom et al., 2022	Replicate the functional and nutritional properties of animal proteins (as compared to taste)
	Develop less processed products
	Pay more attention to motivations such as sustainability and health
He et al., 2020	Improve consumers' familiarity with Plant Based Meat Alternatives
	Improve consumers' awareness toward personal health and environment benefits
	Take into account convenience-related issues
Grasso et al., 2019	Informing health and/or environmental benefits of the protein source.
	Increase the familiarity of alternative more sustainable protein sources
Lacroix and Gifford, 2019	Develop interventions that include a social component
	Apply group-specific tailoring.
	Increase understanding of nutritional guidelines.
	Increase perceived self-efficacy for preparing healthier less meat-centric meals.
Götze and Brunner, 2021	Product development should be more target group-oriented.
	Marketing should be more target group-oriented.
	Emphasise the advantages in terms of health and the environment.
	Emphasise the advantages in terms of ethical aspects.
	Emphasise the advantages in terms of the naturalness of the product.
	Emphasise the advantages in terms of the origin of the product.
Grasso et al., 2021	Emphasize the healthiness and sustainability of meat alternatives for targeting medium consumers.
	Address sensory appeal and familiarity in communication strategies and product development for heavy meat consumers.

Table 29: Suggested interventions (3/3)

Article	Intervention suggestions
Dupont et al., 2022	Communications and marketing should provide a more natural and positive image of meat alternatives.
	Use less technological terminology and product labelling.
	Be transparent about the production of meat alternatives.
Henn et al., 2022	Education about preparation through recipes on food packages
	Inspiration for utilizing alternative protein including recipes via social media platforms.
Dean et al., 2022	Advertise nutritional and sensory similarity to consumers who enjoy eating traditional meat products.
	Emphasize on the safety and sustainability aspect and make comparisons with other plant-based products for vegetarians or vegans.

B.3 Themes derived from interventions

Theme	Interventions
Health	Health claims
	Promote plant-base meat's perceived health benefits and adress consumers' health concerns in product development
	On-product health labels should focus on health gain, particularely high protein or high fiber
	Better informing consumers on the potential health benefits of meat reduction
	Use health as argument for all segments
	Don't put altruistic benefits at the forefront
	Food fortification
	Focus on both health and environmental benefits
	Replicate the functional and nutritional properties of animal proteins (as compared to taste)
	Pay more attention to motivations such as sustainability and health
	Improve consumers' awareness toward personal health and environment benefits
	Informing health and/or environmental benefits of the protein source
	Emphasise the advantages in terms of health and the environment
	Emphasize the healthiness and sustainability of meat alternatives for targeting medium consumers
	Advertise nutritional and sensory similarity to consumers who enjoy eating traditional meat products
	Product labelling (nutritional labels, carbon footrpint labels and country of origin labels)
Environment	Environmental claims
	Information campaigns to increase consumer awareness
	Product labelling (nutritional labels, carbon footrpint labels and country of origin labels)
	Use animal welfare and environmental friendliness for flexitarian segments
	Societal benefits as compared to individual benefits
	Focus on ethical aspects for vegetarians and heavy-users
	Focus on both health and environmental benefits
	Pay more attention to motivations such as sustainability and health
	Improve consumers' awareness toward personal health and environment benefits
	Informing health and/or environmental benefits of the protein source
	Emphasise the advantages in terms of health and the environment
	Emphasise the advantages in terms of ethical aspects
	Emphasize the healthiness and sustainability of meat alternatives for targeting medium consumers
	Emphasize on the safety and sustainability aspect and make comparisons with other plant-based products for vegetarians or vegans

Theme	Interventions
Ease of preparation	Highlight plant-based meat's ease and quickness of preparation
	Use messaging that provides encouragement and instructions regarding the preparation of plant-based meat
	Distributing recipes in order to improve knowledge about plant-based alternatives of meat
	Providing tasty recipes with meat alternatives
	Take into account convenience-related issues
	Increase perceived self-efficacy for preparing healthier less meat-centric meals
	Education about preparation through recipes on food packages
	Inspiration for utilizing alternative protein including recipes via social media platforms
Animal welfare	Societal benefits as compared to individual benefits
	Focus on ethical aspects for vegetarians and heavy-users
	Emphasise the advantages in terms of ethical aspects
Sensory properties	Develop products that mimic the sensory properties of meat
	Develop positive messaging around the taste and sensory properties of plant-based meat
	Develop products that have desirable meat like properties
	Campaings highlighting the hedonic value and pleasure from eating meat alternatives
	Developing tasty meat alternatives
	Providing tasty meals with meat alternatives
	Don't put altruistic benefits at the forefront
	Address sensory appeal and familiarity in communication strategies and product development for heavy meat consumers
	Advertise nutritional and sensory similarity to consumers who enjoy eating traditional meat products
Familiarity	Introducing alternative proteins in existing and recognizable dishes
	Developing products that fit with known products and recipes
	Develop plant-based meat that can directly replace the conventional meat component in familiar dishes
	Frame plant-based meat as a new, excisting variation of a familiar meal component
	Highlight the properties of plant-based meat that are similar to those of conventional meat
	Increase general awareness of or familiarity with plant-based meat to increase purchasing
	Providing certain verbal information about product use with respect to food neophobia
	Enabling resemblance to more familiar foods with respect to food neophobia
	Bringing about exposure with respect to food neophobia
	Make novel foods resemble familiar foods
	Organize activities that include trying out plant-based meat alternatives
	Improve consumers' familiarity with Plant Based Meat Alternatives
	Increase the familiarity of alternative more sustainable protein sources

Theme	**Interventions**
Knowledge	Education in order to improve knowledge about plant-based alternatives of meat
	Align subjective and objective knowledge
	Increase understanding of nutritional guidelines
Habits and social norms	Develop products that fit with consumers' habits and social norms
	Taking away consumers feeling that they need meat

B.4 Selection of characteristics and scales

The characteristics will be selected based on the identified intervention themes. The identified themes are health, environment, ease of preparation, animal welfare, sensory properties, familiarity, knowledge and habits and social norms. It is suggested by Jenkins et al. (2021) that different kinds of segmentation variables should be combined to provide meaningful segment profiles. Therefore, there will be aimed to include both behavioural and psychographic variables. The characteristics will be selected from a list of person-related characteristics derived from literature. To measure the characteristics, measuring scales have to be included. For this research, there is decided to use scales derived from other studies or literature. The starting point of the scale selection per theme will be the single items scales as proposed by Onwezen et al. (2019). Using single scales to measure a characteristic instead of multiple items will keep the questionnaire shorter and therefore will reduce respondent fatigue and dropouts. After including the appropriate single-item scales there will be determined whether other scales should be included to provide more relevant information for producers and marketers of meat alternatives.

Focus on health
There was a great number of interventions aimed at the health aspect of meat alternatives. To determine whether the health-focused interventions are suitable for a segment, the following characteristics are relevant:

- Exercise behaviour
- Health Consciousness
- Belief that eating meat alternatives benefits health
- Concern for health-related effects of food
- Perceived health benefits of meat

The two single items that are related to health that are proposed by Onwezen et al. (2019) are: "It is important to me that the food I eat on a typical day is healthy" and "It is important to me that the food I eat on a typical day helps me control my weight". As with all the items proposed by Onwezen et al. (2019), the original scales range from 1 = not at all important to 7 = very important. For this research all scales will be the same, namely from 1 = Strongly disagree to 5 = Strongly agree. This scale still matches the items proposed by Onwezen et al. (2019), so no alterations have to be done. By including those two items, Health Consciousness and the concern for health-related effects are covered. These characteristics both focus on health-related to food in general as compared to health related to meat and meat alternatives.

The exercise behaviour characteristic is the only behavioural variable in the list. This characteristic differed significantly between the multiple consumer segments found by Escribano et al. (2021). Because the aim is to include a combination of behavioural and psychographic characteristics, there is decided to include this characteristic. The scale used for exercise behaviour is adopted from the research by Escribano et al. (2021) and looks the following: I exercise regularly (0 = not at all frequent, 4 = very frequent). As mentioned in the main text, all scales will be transformed to a 5-point scale. The scale that will be used to rate exercise behaviour is 1 = Strongly disagree and 5 = Strongly agree.

In addition to the two items proposed by Onwezen et al. (2019), there is determined to go a bit deeper into detail. The proposed items cover the health related to food in general aspect, but the perceived health related to meat and meat substitutes is also of interest to producers and marketers of meat alternatives. The relationship between health and meat and meat alternatives gives insights into whether choices depend more on beliefs about meat or beliefs about meat substitutes. With this knowledge, producers and marketers know if they need to focus on persuading consumers about the benefits of meat alternatives, or whether they need to spread the negative health effects of eating too much meat.

The scale used for perceived health benefits of meat is adopted from Götze and Brunner (2021). It exists of 4 statements, and the respondents were asked to respond based on a scale from 1 to 6. 1 meaning do not agree at all, and 6 meaning strongly agree. The statements are the following:

1. Eating meat is healthy
2. Eating meat is necessary for obtaining beneficial nutrients
3. Meat contains important nutrients
4. Meat is good for general health
5. Meat is an important part of a healthy diet

The items used in this scale have a lot of overlap, and this level of detail does not lead to much more useful information. As explained, it is desirable to limit the number of questions and therefore not all items of this scale will be used. The items can be divided into two main aspects, namely the healthiness of meat and the nutrients of meat. Therefore two items of this scale will be used: meat is an important part of a healthy diet and eating meat is necessary for obtaining beneficial nutrients. This scale will also be transformed into a 5-point scale, ranging from 1 = Strongly disagree and 5 = Strongly agree.

The scale for the belief that eating meat alternatives benefits health is adopted from Jang and Cho (2022). The survey items had to be rated by the use of a 5-point Likert scale. The survey items were:

1. Meat substitutes are beneficial to health
2. Meat substitutes consist of nutrients that are beneficial to health
3. Meat substitutes help our health in many ways
4. Meat substitutes have various benefits for health

As with the scale used for the health benefits of meat, not all items of this scale have to be included to give valuable advice to producers and marketers. Therefore, this scale will also be divided into items that focus on the benefits of meat substitutes to health and the nutrients of meat substitutes. The items that will be included are: meat substitutes have various benefits for health and meat substitutes consist of nutrients that are beneficial to health.

Focus on environment
A lot of the proposed interventions by multiple researchers were focused on highlighting the environmentally friendly aspect of meat alternatives. To determine the impact of highlighting this aspect of meat alternatives, the following characteristics could be of good use to producers and marketers:

- Green eating behaviour
- Travel behaviour
- Environmental concerns
- Belief that eating meat alternatives benefits the environment
- Concern for environmental effects of food
- Perceived environmental benefits of eating meat alternatives
- Awareness of and concern about the environmental impact of animal production and meat consumption
- Attitude towards the environment
- Attitude towards agriculture
- Ecological reasons for considering alternative protein sources

The environment-related item proposed by Onwezen et al. (2019) reads the following: "It is important to me that the food I eat on a typical day is environmentally friendly". Including this statement is deemed sufficient to measure the concern about the relationship between food and the environment.

There are two behavioural variables in the list above, green eating behaviour and travel behaviour. Those two behaviours both refer to environmentally friendly behaviour besides meat consumption reduction. They were both found to be of significant influence on the acceptance of plant-based food. Travel behaviour was included in the research of Escribano et al. (2021). The following statement was used: I travel frequently for pleasure (0 = not at all frequent; 4 = very frequent). There are some difficulties with the interpretation of this statement. The statement is probably meant to measure environmentally friendly travel behaviour, however, this is not explained or indicated somewhere in the research. The statement also does not make clear what kind of travelling it refers to, so therefore the respondents have space to fill in their own interpretations. It could be that people do not travel for pleasure due to environmental concerns, however, it could also be that people do not travel because of financial limitations or because they do not derive any joy from travelling. Because the statement is not clear it won't lead to any useful conclusions and advice. Therefore, this behavioural characteristic will be discarded.

Green eating behaviour was measured by adopting items from the scale developed by Żakowska-Biemans et al. (2019). Directly asking respondents to score their green eating behaviour leads to a very broad range of possible interpretations. Using a scale to measure green eating behaviour will result in more clarity in what kind of behaviour is meant and better interpretative results. Żakowska-Biemans et al. (2019) developed a scale that measures self-reported Sustainable and Healthy eating behaviour. The items that will be selected for this research will be the items that focus on sustainable

eating behaviour. Also, some of the items that focused on sustainability are part of another theme. Those will not be included in this section but in the section of the corresponding theme. There is one item that overlaps greatly with the item already included by Onwezen et al. (2019), and this is "I choose food that is produced in an environmentally friendly way". To limit the number of questions, there is decided to leave this item out. The items that will be included are:

1. I buy locally produced foods
2. I try not to throw away food
3. I eat seasonal fruit and vegetables

Besides characteristics that refer to the concern about the relationship between food and the environment, there are characteristics pointing to the general concern about the environment. Investigating this aspect will lead to an understanding of which segments are concerned about the environment, but may not be aware of the link between consumption and the environment. These segments may be easier to persuade by highlighting the connection between consumption and the environment instead of changing their whole mindset. For this set of characteristics, the 4-item scale can be adopted from Moons et al. (2018).

- When humans interfere with nature it often produces disastrous consequences
- The Earth is like a spaceship with very limited room and resources
- The so-called "ecological crisis" facing humankind has been greatly exaggerated
- Humans are seriously abusing the environment

Focus on ease of preparation
Another important aspect of choices in food is the ease of preparation. How easy it is to prepare meat alternatives depends on skills, experience, knowledge and convenience. Besides, ease of preparation is valued differently by different consumers. The characteristics that could be connected to this theme are:

- Skills concerning the preparation of plant-based meat alternatives
- Experience with preparing plant-based meat alternatives
- Trying new recipes
- Knowledge concerning the preparation of plant-based meat alternatives
- Convenience orientation

Convenience orientation can be included in the DCE by adopting the single item as proposed by Onwezen et al. (2019). The item that they propose is 'It is important to me that the food I eat on a typical day is convenient (in buying and preparing)'. However, producers and marketers have more options to meet the demand for easy preparation, considering the supermarkets decide what gets sold. Furthermore, by including this item, it is unclear whether respondents prefer easy preparation or easy access. For clarity, there is decided to alter the item to the following: 'It is important to me that the food I eat on a typical day is convenient in preparing'.

Skills concerning the preparation of plant-based meat alternatives, experience with preparing plant-based meat alternatives and knowledge concerning the preparation of plant-based meat alternatives can all be included by adopting 1 item of the capability scale used by Sijtsema et al. (2021), namely: "I know how to prepare meals with meat substitutes".

Lastly, the desire to try new recipes can be included through the scale used by Escribano et al. (2021): 'I like to try new recipes' (0 = not at all frequent; 4 = very frequent).

focus on animal welfare
The importance of animal welfare can be included by adopting the single item scale defined by Onwezen et al. (2019). The item is defined as the following: 'It is important to me that the food I eat on a typical day is animal friendly'. Including this scale is deemed sufficient for covering this theme.

Focus on sensory properties
What respondents wish for regarding taste, texture and appearance can be elicited from the choice they make during filling in the DCE. Those choices will lead to more information about whether respondents want the products to mimic meat or not. To determine the influence of sensory properties in general the single item as proposed by Onwezen et al. (2019) can be used. This item is defined the following: 'It is important to me that the food I eat on a typical day

provides me with pleasurable sensations (e.g., texture, appearance, smell and taste)'.

Focus on familiarity
There is a broad selection of interventions that focuses on the familiarity or the newness of products. The characteristics that can be assigned to this theme can be separated into three categories: Food Neophobia, Food Neophilia and familiarity.

- Previous experience with plant-based meat alternative consumption
- Familiarity with foreign food
- Familiarity with plant-based meat alternatives
- Food Neophobia
- Desire for new food alternatives
- Need for familiarity
- Perceived appropriateness of food preparation
- Food fussiness
- Curiosity about eating meat alternatives

To include the influence of familiarity, the item as proposed by Onwezen et al. (2019) can be used. This item reads the following: 'It is important to me that the food I eat on a typical day is familiar'. Behavioural components to measure previous experience with meat alternative consumption or curiosity about eating meat alternatives will be included at the start of the survey to determine whether the respondent falls within the target population of this research. This will be further explained in section 4.3.

Where Food Neophobia refers to the fear of novel foods, Food Neophilia refers to the willingness to try novel foods (Dória et al., 2015). The degree of Food Neophobia or Food Neophilia can be measured using one scale: the Food Neophobia Scale (FNS). The original scale exists of 10 items that all need to be measured using a 7-point Likert scale. Kock et al. (2022) developed an alternative FNS to avoid weaknesses of the original FNS. In addition, the FNS developed by them consists of 8 items instead of 10. Due to the aim to keep the number of survey questions as low as possible without losing important aspects, it is decided to include the alternative FNS. The items of the scale are:

1. New food eating experiences are important for me.
2. I am afraid to eat things I have never had before.
3. I don't trust new foods.
4. New foods mean an adventure for me.
5. I like to challenge myself by trying new foods.
6. It is exciting to try new foods when travelling.
7. Foods from other cultures look too weird to eat.
8. Foods that look strange scare me.

Focus on knowledge
Another big influence on the choice between meat and meat alternatives is knowledge. A distinction has to be made between subjective and objective knowledge. Subjective knowledge is what individuals think they know, and objective knowledge is what is actually memorized.

- Knowledge/awareness of environmental advantages of plant-based meat alternatives
- Subjective and objective knowledge of product
- Awareness of the link between food and climate

Peschel et al. (2016) executed research with the goal of assessing the impact of subjective and objective knowledge on environmentally sustainable food choices. To measure subjective knowledge, respondents were asked to indicate how well-informed they consider themselves to be about various sustainability-related issues such as ways to reduce greenhouse gas. Objective knowledge was measured based on the agreement of respondents with four statements about environmental issues. To include subjective and objective knowledge, questions need to be developed that focus on respondents' knowledge about plant-based meat and its relation to the environment.

To measure subjective knowledge about plant-based meat alternatives, 3 statements were adopted from the research by Piha et al. (2018). Respondents were asked to rate those statements based on a 5-point scale ranging from 1 = Strongly disagree to 5 = Strongly agree. The items that will be included are:

- I know pretty much about plant-based meat alternatives
- Compared to most other people, I know less about plant-based meat alternatives
- When it comes to plant-based meat alternatives, I really don't know a lot

To measure objective knowledge about plant-based meat alternatives a set of statements will be defined. The statement is either true or false, but respondents will be asked to indicate how much they agree with the statement. The statements will focus on the health-related and environment-related aspects of meat alternatives and meat because those statements can be defined as purely factual. Statements about sensory properties or ease of preparation are very person-dependent and are therefore not useful to measure objective knowledge. The statements were verified by the use of literature. The statements are derived from The Good Food Institute (2019) and Good Food Institute (2022), and look the following:

- Plant-based meats generally have fewer calories and less saturated fat than animal-based meat.
- Swapping conventional animal meat for plant-based meat can lower cardiovascular disease risk factors and be more conducive to a healthy weight
- Replacing conventional meat with plant-based meat substantially reduces every environmental impact measured, even after the processing required to turn plants into plant-based meat.
- Using all cropland to grow food for humans instead of animals would allow farmers to feed more than twice as many people.

Focus on habits and social norms
The last category of characteristics are habits and social norms. As already mentioned before, meat consumption is proven to be strongly habitual. Therefore, it is expected that habitual strength is a strong predictor variable that should be included to see if different consumer segments show different habitual strengths concerning meat consumption. Based on this information, advice can be given on whether consumer segments act based on habits or goal-directed behaviour. When a highly habitual consumer segment is the target segment, strategies must be implemented that turn buying meat alternatives into a new habit. If the consumer segment shows goal-directed behaviour, producers and marketers should identify their goal and alter their product and campaign based on that.

- Consumption of plant-based meat alternatives
- Diet
- Meat consumption habit
- Meat consumption frequency
- Meat Commitment

Habit strength can be measured using the same scale that Götze and Brunner (2021) used in her research. They used the scale items as proposed by (Verplanken & Orbell, 2003). This habit strength scale aims to directly measure habit strength without relying on estimates of behavioural frequency. It measures habit based on multiple features of habit such as the history of repetition, automaticity and expression of one's identity. In the research of Götze and Brunner (2021), this scale was focused on the strength of the meat consumption habit. The scale consists of 4 items that have to be rated from 1 = Strongly disagree to 7 = strongly agree. The scale is the following:
Eating meat is something...

- ... I do without thinking
- ... that would cost me effort not to do
- ... that is part of my daily/weekly routine
- ... I would find hard not to do

The diet of the respondents will be asked alongside some other demographic variables. Meat consumption frequency and the consumption of plant-based meat alternatives are both focused on the current consumption pattern of consumers. Some questions to pinpoint the current consumption patterns of respondents will be asked in a separate section at the start of the survey. This will be further explained in section 4.3.

B.5 Dutch translations of scales

The two 5-point scale that is used looks the following in full:

1. Volledig oneens
2. Oneens
3. Niet mee eens of oneens
4. Mee eens
5. Volledig mee eens

Gezondheid

Ik sport regelmatig	1 = Volledig oneens; 5 = Volledig mee eens
Het is voor mij belangrijk dat het voedsel dat ik op een normale dag eet gezond is	1 = Volledig oneens; 5 = Volledig mee eens
Het is voor mij belangrijk dat het voedsel dat ik op een normale dag eet mij helpt mijn gewicht onder controle te houden	1 = Volledig oneens; 5 = Volledig mee eens
Vlees eten is nodig voor het binnenkrijgen van voordelige voedingsstoffen	1 = Volledig oneens; 5 = Volledig mee eens
Vlees is een belangrijk onderdeel van een gezond dieet	1 = Volledig oneens ; 5 = Volledig mee eens
Vleesvervangers hebben meerdere voordelen voor je gezondheid	1 = Volledig oneens; 5 = Volledig mee eens
Vleesvervangers bevatting voedingsstoffen die voordelig zijn voor je gezondheid	1 = Volledig oneens; 5 = Volledig mee eens

Milieu

Ik vind het belangrijk dat het voedsel dat ik op een normale dag eet milieuvriendelijk geproduceerd is	1 = Volledig oneens; 5 = Volledig mee eens
Ik koop lokaal geproduceerde voedsel producten	1 = Volledig oneens; 5 = Volledig mee eens
Ik probeer geen voedsel weg te gooien	1 = Volledig oneens; 5 = Volledig mee eens
Ik eet seizoensfruit en -groenten	1 = Volledig oneens; 5 = Volledig mee eens
Wanneer de mens zich met de natuur bemoeit, heeft dit vaak desastreuze gevolgen	1 = Volledig oneens; 5 = Volledig mee eens
De aarde is net al een ruimteschip met heel gelimiteerde ruimte en middelen	1 = Volledig oneens; 5 = Volledig mee eens
De zogenaamde "ecologische crisis" waarmee de mensheid wordt geconfronteerd is sterk overdreven	1 = Volledig oneens; 5 = Volledig mee eens
De mens maakt ernstig misbruik van het leefmilieu	1 = Volledig oneens; 5 = Volledig mee eens

Gemak van bereiding

Ik weet hoe ik maaltijden met vleesvervangers moet bereiden	1 = Volledig oneens; 5 = Volledig mee eens
Ik probeer graag nieuwe recepten uit	1 = Volledig oneens; 5 = Volledig mee eens
Ik vind het belangrijk dat het voedsel dat ik op een normale dag eet gemakkelijk te bereiden is	1 = Volledig oneens; 5 = Volledig mee eens

Dierenwelzijn

Ik vind het belangrijk dat het voedsel dat ik op een normale dag eet diervriendelijk geproduceerd is	1 = Volledig oneens; 5 = Volledig mee eens

Sensorische eigenschappen

Ik vind het belangrijk dat het voedsel dat ik op een normale dag eet me aangename sensaties geeft (bijv., textuur, uiterlijk, geur en smaak)	1 = Volledig oneens; 5 = Volledig mee eens

Vertrouwdheid

Ik vind nieuwe eetervaringen belangrijk	1 = Volledig oneens; 5 = Volledig mee eens
Ik ben bang om dingen te eten die ik nog nooit eerder heb gegeten	1 = Volledig oneens; 5 = Volledig mee eens
Ik vertrouw nieuwe voedselproducten niet	1 = Volledig oneens; 5 = Volledig mee eens
Voor mij betekent nieuwe voedselproducten avontuur	1 = Volledig oneens; 5 = Volledig mee eens
Ik daag mijzelf graag uit door nieuwe voedselproducten te proberen	1 = Volledig oneens; 5 = Volledig mee eens
Ik vind het opwindend op nieuwe voedselproducten te proberen tijdens het reizen	1 = Volledig oneens; 5 = Volledig mee eens
Voedsel uit andere culturen ziet er te raar uit om op te eten	1 = Volledig oneens; 5 = Volledig mee eens
Ik vind voedsel wat er vreemd uit ziet eng	1 = Volledig oneens; 5 = Volledig mee eens
Ik vind het belangrijk dat het voedsel dat ik op een normale dag eet vertrouwd is	1 = Volledig oneens; 5 = Volledig mee eens

Kennis

Ik weet vrij veel over plantaardige vleesvervangers	1 = Volledig oneens; 5 = Volledig mee eens
In vergelijking met de meeste andere mensen weet ik minder van plantaardige vleesvervangers	1 = Volledig oneens; 5 = Volledig mee eens
Als het gaat om plantaardige vleesvervangers, weet ik echt niet veel	1 = Volledig oneens; 5 = Volledig mee eens
Plantaardige vleesvervangers bevatten over het algemeen minder calorieën en minder verzadigde vetten dan dierlijk vlees	1 = Volledig oneens; 5 = Volledig mee eens
Het ruilen van dierlijk vlees voor plantaardig vlees kan het risico van hart- en vaatziekten verlagen en bijdragen aan een gezond gewicht	1 = Volledig oneens; 5 = Volledig mee eens
Door dierlijk vlees te vervangen door plantaardig vlees wordt elk gemeten milieu-effect substantieel verminderd, zelfs na de verwerking die nodig is om van planten plantaardig vlees te maken	1 = Volledig oneens; 5 = Volledig mee eens
Door al het akkerland te gebruiken om voedsel voor mensen te verbouwen in plaats van voor dieren zouden boeren meer dan twee keer zoveel mensen kunnen voeden	1 = Volledig oneens; 5 = Volledig mee eens

Gewoontes en sociale normen

Vlees eten is iets wat ik doe zonder er over na te denken	1 = Volledig oneens; 5 = Volledig mee eens
Het zou mij moeite kosten om geen vlees te eten	1 = Volledig oneens; 5 = Volledig mee eens
Vlees eten is onderdeel van mijn dagelijkse/wekelijkste routine	1 = Volledig oneens; 5 = Volledig mee eens
Ik zou het moeilijk vinden om geen vlees meer te eten	1 = Volledig oneens; 5 = Volledig mee eens

C Appendix C

C.1 Orthogonal array

A orthogonal array for the attributes and number of attribute levels in this research was found. The Orthogonal array was designed by Dr. Genichi Taguchi. According to the orthogonal design array, 16 choice tasks are needed.

Table 30: Taguchi Orthogonal Array L16 (2^6 4^3)

Run	**Columns**								
	1	2	3	4	5	6	7	8	9
1	1	1	1	1	1	1	1	1	1
2	1	1	2	2	2	2	1	2	2
3	2	2	1	1	2	2	1	3	3
4	2	2	2	2	1	1	1	4	4
5	2	2	1	2	1	2	2	1	2
6	2	2	2	1	2	1	2	2	1
7	1	1	2	2	2	1	2	3	4
8	1	1	1	1	1	2	2	4	3
9	1	2	2	2	2	1	3	1	3
10	1	2	1	1	1	2	3	2	4
11	2	1	2	2	1	2	3	3	1
12	2	1	1	2	2	1	3	4	2
13	2	1	2	2	2	2	4	1	4
14	2	1	1	1	1	1	4	2	3
15	1	2	2	1	1	1	4	3	2
16	1	2	1	2	2	2	4	4	1

C.2 Ngene syntax

The abbreviations used in the Ngene to refer to the attribute weights and attributes can be seen in Table 31 below.

Table 31: Attribute abbreviations

Attribute	**Attribute abbreviation**	**Attribute weigth**
Environmental impact	env	beta_env
Nutri-score	nutri	beta_nutri
Price	price	beta_price
Taste	taste	beta_taste
Texture	tex	beta_tex
Appearance	app	beta_app
Animal welfare	AW	beta_AW

The Ngene Syntax used to determine the experimental design for the SCE can be seen below.

design:
;alts = meatalt1, meatalt2
;rows = 16
;block = 2
;orth = seq
;model:

U(meatalt1) =
beta_env * env[0,1,2,3] + beta_nutri * nutri[0,1,2,3] + beta_price * price[1.30, 2.60, 3.90, 5.20] + beta_taste * taste[0,1] + beta_tex * tex[0,1] + beta_app * app[0,1] + beta_AW * AW[0,1]/

U(meatalt2) =
beta_env * env + beta_nutri * nutri + beta_price * price + beta_taste * taste + beta_tex * tex + beta_app * app + beta_AW * AW $

C.3 Generated Design

After the design is generated it is important to check for dominant alternatives. When an alternative is dominant, one alternative outperforms another alternative on all attributes (Molin, 2022b). Dominant alternatives should be avoided because they reveal no information about the trade-offs that respondents make. To determine whether there are dominant alternatives, the desired attribute levels of meat alternatives have to be estimated. For the eco-score and the nutri-score there can be assumed that higher scores are desired, meaning it is healthier and more environmentally friendly. For the price, there is assumed that a low price is desired. Furthermore, it is assumed that an animal-welfare label is better than no animal-welfare label. For the taste, texture and appearance it is difficult to determine which level is preferred by respondents. Therefore there was chosen to leave those attributes out of consideration while checking for dominance. After checking for dominance, one row was removed from the design. The removed row is coloured grey. For the experimental design see Table 32 below.

Table 32: Generated Experimental Design

#	**Env1**	**Nutri1**	**Price1**	**Taste1**	**Tex1**	**App1**	**AW1**	**Env2**	**Nutri2**	**Price2**	**Taste2**	**Tex2**	**App2**	**AW2**	**Block**
1	0	2	1.3	1	1	1	1	1	2	2.5	0	1	1	0	2
2	3	0	3.7	1	1	1	0	2	2	4.9	1	0	0	0	2
3	0	3	3.7	1	1	0	0	2	1	2.5	0	1	0	0	1
4	2	2	4.9	1	0	0	0	3	1	1.3	1	1	0	1	2
5	3	2	3.7	0	0	0	1	0	0	1.3	0	0	0	0	2
6	3	3	1.3	0	0	1	0	3	0	3.7	1	1	1	0	1
7	2	1	2.5	0	1	0	0	0	2	1.3	1	1	1	1	2
8	1	0	2.5	1	0	0	1	0	1	3.7	0	0	1	1	1
9	0	1	3.7	0	0	1	1	2	0	4.9	0	1	1	1	2
10	1	2	2.5	0	1	1	0	1	1	4.9	1	0	1	0	2
11	3	1	1.3	1	1	0	1	1	3	4.9	0	1	0	1	1
12	1	1	4.9	1	0	1	0	0	3	3.7	1	1	0	0	1
13	1	3	4.9	0	1	0	1	3	3	1.3	0	0	1	0	1
14	2	3	2.5	1	0	1	1	3	2	3.7	0	0	0	1	2
15	2	0	4.9	0	1	1	1	2	3	2.5	1	0	1	1	1
16	0	0	1.3	0	0	0	0	1	0	2.5	1	0	0	1	1

Before the removal of the row, the correlations among attributes within alternative 1 were 0. This is expected due to the use of an orthogonal design. The attributes between alternative 1 and alternative are correlated, but this is not very problematic because the parameters can still be estimated (Molin, 2022a). For the correlation matrix of the Experimental Design before removing the dominant alternative, see Table 33 below.

Table 33: Correlation matrix of complete experimental design including dominant alternatives

	Env1	**Nutri1**	**Price1**	**Taste1**	**Tex1**	**App1**	**AW1**	**Env2**	**Nutri2**	**Price2**	**Taste2**	**Tex2**	**App2**	**AW2**
Env1	1.00													
Nutri1	0.00	1.00												
Price1	0.00	0.00	1.00											
Taste1	0.00	0.00	0.00	1.00										
Tex1	0.00	0.00	0.00	0.00	1.00									
App1	0.00	0.00	0.00	0.00	0.00	1.00								
AW1	0.00	0.00	0.00	0.00	0.00	0.00	1.00							
Env2	0.10	0.50	0.20	0.00	0.00	0.22	0.00	1.00						
Nutri2	0.15	-0.10	0.30	0.34	0.56	0.11	0.22	0.00	1.00					
Price2	0.05	-0.25	-0.30	0.22	0.00	0.56	0.00	0.00	0.00	1.00				
Taste2	0.22	-0.34	0.11	-0.25	0.00	0.25	-0.75	0.00	0.00	0.00	1.00			
Tex2	-0.11	0.22	-0.11	0.25	0.00	0.00	-0.25	0.00	0.00	0.00	0.00	1.00		
App2	-0.22	0.00	-0.11	-0.50	0.25	0.25	0.25	0.00	0.00	0.00	0.00	0.00	1.00	
AW2	0.00	-0.45	-0.11	0.00	-0.25	-0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	1.00

It is essential to check the correlations after removing the dominant alternative. If high-within alternatives arise after removing the dominant alternative, valuable trade-off information is lost (Molin, 2022a). The reason is the following: if one attribute has a strong correlation with another attribute, the researcher cannot determine which of those two attributes determines the preference or dislike of an alternative. For example, if the environmental impact is highly correlated with the nutri-score, one can not determine whether a respondent chose an alternative because of environmental considerations or because of health considerations. A new correlation matrix was constructed after the removal of the dominant alternative, for this matrix see Table 34 below. The maximum within-alternative correlation is -0.14. Correlation coefficients with a magnitude lower than 0.3 have little if any correlation (Calkins, 2005). Therefore, there can be concluded that the choice sets constructed are ready to use in the SCE.

Table 34: Correlation matrix of experimental design without dominant alternatives

	Env1	**Nutri1**	**Price1**	**Taste1**	**Tex1**	**App1**	**AW1**	**Env2**	**Nutri2**	**Price2**	**Taste2**	**Tex2**	**App2**	**AW2**
Env1	1.00													
Nutri1	0.04	1.00												
Price1	-0.14	0.04	1.00											
Taste1	0.10	-0.03	0.10	1.00										
Tex1	0.10	-0.03	0.10	-0.07	1.00									
App1	0.10	-0.03	0.10	-0.07	-0.07	1.00								
AW1	0.10	-0.03	0.10	-0.07	-0.07	-0.07	1.00							
Env2	0.06	0.52	0.17	0.03	0.03	0.26	0.03	1.00						
Nutri2	0.20	-0.11	0.36	0.32	0.55	0.09	0.20	0.01	1.00					
Price2	0.01	-0.24	-0.36	0.26	0.03	0.61	0.03	-0.01	0.01	1.00				
Taste2	0.15	-0.32	0.02	-0.20	0.07	0.34	-0.73	-0.03	0.03	-0.03	1.00			
Tex2	-0.02	0.20	-0.02	0.20	-0.07	-0.07	-0.34	0.03	-0.03	0.03	0.07	1.00		
App2	-0.15	-0.03	-0.02	-0.61	0.20	0.20	0.20	0.03	-0.03	0.03	0.07	-0.07	1.00	
AW2	-0.10	-0.43	-0.22	0.07	-0.20	-0.20	0.34	-0.03	0.03	-0.03	-0.07	0.07	0.07	1.00

D Appendix D

D.1 Removing duration outliers

To identify outliers in duration time, the duration was plotted by means of a box plot. The box plot indicated that there were indeed outliers in the data set. The box plot before removing the outliers looked the following:

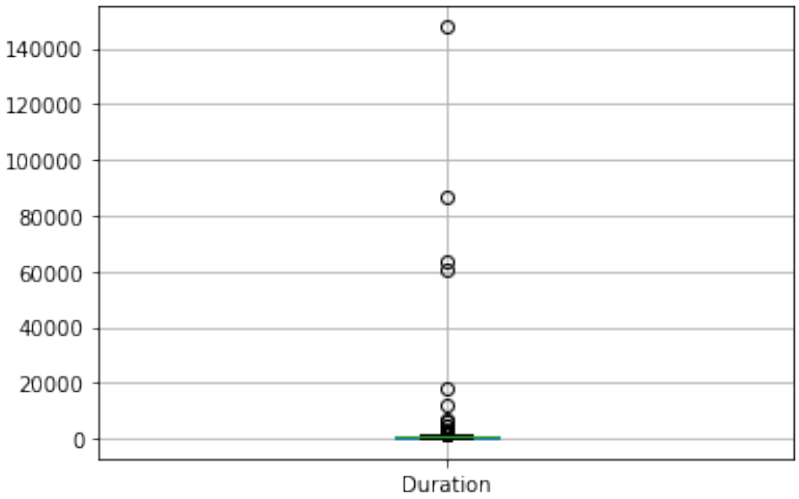

Figure 28: Box plot of duration before removal of outliers

The method used to identify the outliers is the Interquartile Range (IQR) approach. When using the IQR approach, the dataset is divided into 4 equal parts Q1, Q2, Q3, and Q4. Q1 is the 25th percentile of the data, Q2 the 50th percentile and Q3 the 75th percentile. The IQR is calculated by Q3 - Q1. The outliers are the data points that fall below Q1 - 1.5 * IQR (lower limit) or fall above Q3 + 1.5 * IQR (upper limit). In the case of this research, the IQR is 423, the lower limit is -169.5 and the upper limit is 1522.5. A negative value for the lower limit is impossible, so therefore the lower limit is 0. There are 28 data points identified as outliers. These will be removed from the data set in order to calculate the mean duration. After the removal of the outliers, a new box plot is plotted. The new box plot looks the following:

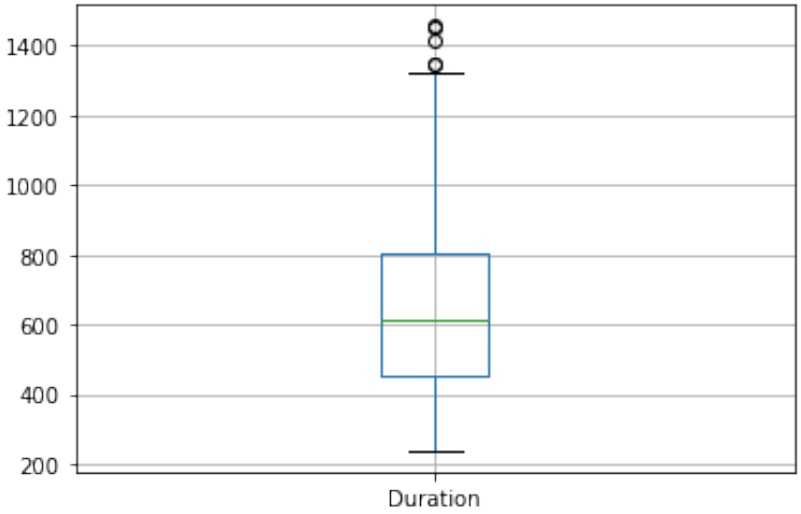

Figure 29: Box plot of duration after removal of outliers

As can be seen from the box plot, the outliers are successfully removed from the data set. The mean duration time needed to complete the survey is now 652 seconds, or 11 minutes.

D.2 Exploratory Factor Analysis

The survey consisted of 33 questions aimed at measuring respondents' person-related characteristics, those are all the questions excluding the discrete choice experiment and the knowledge-related questions. Those person-related characteristics can also be explained as latent factors, latent factors being factors that cannot be observed directly but can be measured with a set of variables. To identify the latent variables underlying the responses to the 33 questions

a Principal Axis Factoring method with oblique rotation was applied. The other rotation option is orthogonal rotation but this is not applicable because, with this rotation method, no correlation between underlying factors is assumed.

To execute the Principal Axis Factoring method, an Exploratory Factor Analysis process as proposed by E. Molin (2017) was followed. The goal of the analysis is to derive a set of latent factors that can be used as covariates in the LCCM. When conducting the analysis there should be aimed to derive a simple structure and interpretable useful factors. The analysis will be executed using SPSS.

The factor loadings lower than 0.30 will be suppressed considering those values are negligible. Factor loadings are the correlations between the items and the factors. There should be a minimum of two variables with a high factor loading for each factor. The first resulting patterns matrix when including all 33 variables looks the following:

Pattern Matrix[a]

	Factor								
	1	2	3	4	5	6	7	8	9
habit4	,886								
habit2	,846								
habit3	,735								
habit1	,468								-,398
Qenv9									
prep1									
fam5		,793							
fam4		,656							
prep2		,646							
fam6		,620							
fam1		,502							
fam2		,352							
Qenv2			,723						
Qenv4			,664						
Qenv3			,404						
Qenv1									
health6				,857					
health7				,650					
Qenv8					,606				
Qenv6					,509				
Qenv5					,435				
fam8						,784			
fam7						,645			
fam3									
health2							,629		
health3							,528		
health1							,428		
prep4								,569	
prep3								,348	
health5	,447								-,602
health4	,392								-,546
Qenv7					-,421				-,457
fam9									

Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 35 iterations.

Figure 30: Exploratory Factor Analysis iteration 1

The goal is to derive a simple structure, this means that each indicator loads high (>0.50) on one factor and low (<0.30) on all other factors. As can be seen in Figure 30, this is not the case yet. There are a few violations of the simple structure that can be identified. First of all, there are indicators that do not load above 0.30 on any of the factors. According to E. Molin (2017), these can be removed. Removing those indicators will be done step-by-step, as removing one indicator changes the complete results. Removing indicators with a factor loading below 0.30 will be done iteratively until there are no indicators left that score low on all factors. The indicators removed step by step are: fam9, Qenv9, Qenv1 and lastly fam3. The resulting pattern matrix looks the following:

Pattern Matrix[a]

	Factor							
	1	2	3	4	5	6	7	8
health5	,826							
habit3	,818							
habit4	,772							
health4	,739							
habit2	,726							
habit1	,719							
prep1	-,441							
fam5		,774						
fam4		,672						
prep2		,650						
fam6		,624						
fam1		,511						
fam2		,377						
Qenv4			,748					
Qenv2			,653					
Qenv3			,389					
health6				,930				
health7				,584				
Qenv8					,672			
Qenv6					,466			
Qenv7	,338				-,452			
Qenv5					,409			
fam8						,801		
fam7						,629		
health3							,521	
health2							,518	
health1							,488	
prep4								,551
prep3								,357

Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 8 iterations.

Figure 31: Exploratory Factor Analysis iteration 2

As can be seen from Figure 31, a simple structure is still not reached. There is one indicator, Qenv7, that scores on two factors and both factor loadings are not interpreted as high. This indicator will be removed before continuing with the analysis. The pattern matrix derived after removing Qenv7, looks the following:

Pattern Matrix[a]

	Factor							
	1	2	3	4	5	6	7	8
health5	,841							
habit3	,815							
habit4	,762							
health4	,757							
habit1	,725							
habit2	,714							
prep1	-,446							
fam5		,765						
fam4		,679						
prep2		,652						
fam6		,620						
fam1		,512						
fam2		,385						
Qenv4			,745					
Qenv2			,653					
Qenv3			,388					,309
health6				,888				
health7				,616				
Qenv6					,562			
Qenv5					,511			
Qenv8					,481			
fam8						,808		
fam7						,617		
health2							,620	
health3							,511	
health1							,458	
prep4								,465
prep3								,324

Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 10 iterations.

Figure 32: Exploratory Factor Analysis iteration 3

Again, there can be seen that one of the variables loads below 0.30 on all factors, namely Qenv3. Therefore, this variable will be removed. After the removal of Qenv3, the following pattern matrix arises:

Pattern Matrix[a]

	Factor							
	1	2	3	4	5	6	7	8
health5	,945							
health4	,814							
habit1	,620							
habit3	,563							,440
prep1	-,439							
fam5		,769						
fam4		,671						
prep2		,663						
fam6		,624						
fam1		,511						
fam2		,372						
prep3								
Qenv4			,703					
Qenv2			,678					
health6				,868				
health7				,632				
Qenv6					,562			
Qenv5					,507			
Qenv8					,492			
fam8						,870		
fam7						,575		
health2							,604	
health3							,542	
health1							,445	
habit2	,359							,613
habit4	,429							,585
prep4								

Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 18 iterations.

Figure 33: Exploratory Factor Analysis iteration 4

After the removal of Qenv3, two variables appeared that loaded below 0.30 on all factors, can be seen in Figure 33. Again, those variables will be removed one by one to derive a new pattern matrix. First prep4 was removed, and after that prep3 was removed because it still loaded low on all factors. This new pattern matrix looks the following:

Pattern Matrix[a]

	Factor						
	1	2	3	4	5	6	7
habit3	,835						
health5	,815						
habit4	,782						
health4	,738						
habit2	,734						
habit1	,731						
prep1	-,431						
fam5		,810					
fam4		,675					
prep2		,646					
fam6		,637					
fam1		,524					
fam2		,376					
Qenv4			,711				
Qenv2			,671				
health6				,942			
health7				,578			
fam8					,904		
fam7					,527		
Qenv8						-,533	
Qenv6						-,520	
Qenv5						-,512	
health2							,537
health3							,500
health1							,478

Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 9 iterations.

Figure 34: Exploratory Factor Analysis iteration 5

The last pattern matrix derived almost satisfies the aim of a simple structure. One violation is that there are some variables that do not have a high loading on the factor but a loading between 0.30 and 0.50. For these variables, there will be examined if they fit within the factor, and if not they will be removed. In the end, there is decided to only delete prep1 from factor 1 because it did not seem to fit. The final pattern matrix derived with oblique rotation is shown in Figure 35 below.

Pattern Matrix[a]

	Factor						
	1	2	3	4	5	6	7
habit3	,840						
health5	,822						
habit4	,793						
habit2	,744						
health4	,734						
habit1	,728						
fam5		,811					
fam4		,682					
fam6		,640					
prep2		,632					
fam1		,524					
fam2		,365					
Qenv4			,736				
Qenv2			,641				
health6				,939			
health7				,581			
Qenv8					,530		
Qenv5					,520		
Qenv6					,518		
fam8						,780	
fam7						,661	
health2							,538
health3							,509
health1							,482

Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 8 iterations.

Figure 35: Exploratory Factor Analysis iteration 6

The next step was to decide whether the orthogonal rotation is more suitable than the oblique rotation. The first step was to examine the Factor Correlation Matrix generated along with the simple structure presented in Figure 35. If there are factor correlations bigger than 0.50, this suggests that no simple structure will be found when applying orthogonal rotation. The Factor Correlation Matrix can be seen in Figure 36 below. The highest correlation observed is -0.40 between factors 2 and 6. It will be further examined whether orthogonal rotation leads to a simple structure without removing additional variables. If this is the case, orthogonal rotation is preferred. The reason that orthogonal rotation is preferred is that this method leads to uncorrelated factors due to the preserved orthogonality (StudyCorgi, 2021). The interpretation of uncorrelated factors is less difficult than interpreting correlated factors.

Factor Correlation Matrix

Factor	1	2	3	4	5	6	7
1	1,000	-,189	-,106	-,097	-,193	,217	-,099
2	-,189	1,000	,098	,101	,162	-,400	-,027
3	-,106	,098	1,000	-,020	,089	-,172	,164
4	-,097	,101	-,020	1,000	,061	-,033	-,081
5	-,193	,162	,089	,061	1,000	-,130	,138
6	,217	-,400	-,172	-,033	-,130	1,000	-,088
7	-,099	-,027	,164	-,081	,138	-,088	1,000

Extraction Method: Principal Axis Factoring.
Rotation Method: Oblimin with Kaiser Normalization.

Figure 36: Factor Correlation Matrix Oblique Rotation

The same steps as mentioned above were applied, and there can be concluded that Orthogonal Rotation leads to a simple structure without removing additional variables. The exact same variables get removed as was observed with Oblique Rotation. Furthermore, the exact same factors were derived, only the factor loadings differ slightly. The Rotated Factor Matrix derived from applying Orthogonal Rotation can be seen in Figure 37

Rotated Factor Matrix[a]

	Factor						
	1	2	3	4	5	6	7
habit3	,841						
health5	,798						
habit4	,788						
habit2	,757						
habit1	,738						
health4	,732						
fam5		,793					
fam4		,672					
fam6		,637					
prep2		,623					
fam1		,554					
fam2		,416					
health6			,933				
health7			,582				
Qenv4				,718			
Qenv2				,654			
fam8					,732		
fam7					,629		
health2						,549	
health3						,540	
health1						,463	
Qenv8							,536
Qenv6							,512
Qenv5							,507

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 6 iterations.

Figure 37: Rotated Factor Matrix Orthogonal Rotation

For the resulting factors and the variables within those factors, see Table 35 below.

Table 35: Factors derived from PAF

Factor 1: pro meat attitude		
habit3	Eating meat is something that is part of my daily/weekly routine	+
health5	Meat is an important part of a healthy diet	+
habit4	Eating meat is something I would find hard not to do	+
habit2	Eating meat is something that would cost me effort not to do	+
habit1	Eating meat is something I do without thinking	+
health4	Eating meat is necessary for obtaining beneficial nutrients	+
Factor 2: food neophilia		
fam5	I like to challenge myself by trying new foods	+
fam4	New foods mean an adventure for me	+
fam6	It is exciting to try new foods when travelling	+
prep2	I like to try new recipes	+
fam1	New food eating experiences are important for me	+
fam2	I am afraid to eat things I have never had before	-*
Factor 3: pro meat alternatives attitude		
health6	Meat substitutes have various benefits for health	+
health7	Meat substitutes consist of nutrients that are beneficial to health	+
Factor 4: sustainable behaviour		
env4	I eat seasonal fruit and vegetables	+
env2	I buy locally produced foods	+
Factor 5: food neophobia		
fam8	Foods that look strange scare me	+
fam7	Foods from other cultures look too weird to eat	+
Factor 6: health consciousness		
health2	It is important to me that the food I eat on a typical day is healthy	+
health3	It is important to me that the food I eat on a typical day helps me control my weight	+
health1	I exercise regularly	+*
Factor 7: environmental concern		
env8	Humans are seriously abusing the environment	+
env6	The Earth is like a spaceship with very limited room and resources	+
env5	When humans interfere with nature it often produces disastrous consequences	+

The scores of the new factors will be calculated by taking the average of the numerical responses to the variables within the factors. Lastly, the variables that got removed during the exploratory factor analysis will be examined to determine if some of them will be individually included as a measuring scale because an important aspect is not covered yet. The removed variables are:

Variable	Question
fam9	It is important to me that the food I eat on a typical day is familiar
Qenv9	It is important to me that the food I eat on a typical day is animal friendly
Qenv1	I choose food that is produced in an environmentally friendly way
fam3	I don't trust new foods
Qenv7	The so-called "ecological crisis" facing humankind has been greatly exaggerated
Qenv3	I try not to throw away food
prep3	It is important to me that the food I eat on a typical day is convenient in preparing
prep4	It is important to me that the food I eat on a typical day provides me with pleasurable sensations (e.g., texture, appearance, smell and taste)
prep1	I know how to prepare meals with meat substitutes

The derived factors were compared with the earlier defined solution themes. There are two themes that are not covered by the factors resulting from the PAF. These are animal welfare and ease of preparation. To still include those themes in this research, individual measurement scales will be kept to examine if they play a role when estimating the LCCM. The two individual scales that will be included are Qenv9 to cover the animal welfare theme, and prep1 to cover the ease of preparation theme.

D.3 One-way ANOVA test

By means of a one-way ANOVA test, there will be examined whether the mean value of the constructed factors differs between different sociodemographic groups. Considering the sample size is above 30, there can be assumed that the sample mean is normally distributed. A p-value of 0.05 is maintained as the level of significance.

D.3.1 Difference between age categories

Because the number of respondents within the elderly category is very low, there is decided to add these respondents to the middle-aged adults' category. Therefore, there are three independent age categories. The three age categories score significantly different on the animal welfare factor, sustainable behaviour factor, the food neophobia factor, the health consciousness factor and the subjective knowledge factor. There is examined whether a pattern could be seen back in the differences between the age groups. The first pattern identified is that older respondents tend to score higher on the animal welfare factor. The youth respondents score 3.60 on average with a minimum of 1 and a maximum of 5. The young adults score an average of 3.84, with a minimum of 2 and a maximum of 5. Middle-aged adults score an average of 4.19, with a minimum of 3 and a maximum of 5. Another finding is that younger respondents score the lowest on the sustainable behaviour factor and the health consciousness factor, followed by young adults and middle-aged adults respectively scoring the highest on those two factors. The results also show that the youth category generally scores higher on the foodneophobia factor, indicating that young people tend to be more foodneophobic. There is a negligible difference between young adults and middle-aged adults when it comes to foodneophobia. As for subjective knowledge, it can clearly be seen that middle-aged adults score lower on the subjective knowledge factor.

D.3.2 Difference between gender categories

To examine whether different genders answer significantly differently, only men and women are taken into consideration. Therefore, 2 anonymous respondents who indicate that they rather not tell their gender will be excluded. Men and women also score significantly differently on the animal welfare factor, pro-meat factor and food neophilia factor. Women tend to score higher on the animal welfare factor, indicating that women attach more value to animal-friendly production. Furthermore, men generally score higher on the pro-meat factor. Lastly, women generally score higher on the foodneophilia factor, indicating that women are more inclined to enjoy new food experiences and recipes.

D.3.3 Difference between educational levels

The respondents can be divided into 5 different educational levels, high school, intermediate vocational education, higher vocational education, university Bachelor's degree, University Master's degree and University PhD degree. Some of these categories include very few respondents, such as high school, intermediate vocational education and university PhD degree. When the number of respondents within a category is very small, there is less confidence that the results can be extrapolated to the overall population (Faber & Fonseca, 2014). Therefore, only the higher vocational category, university Bachelor's degree category and university Master's degree category will be taken into consideration when looking for patterns. The different educational level categories score significantly differently on the ease of preparation factor, the animal welfare factor, the pro-meat factor, the sustainable behaviour factor, the food neophobia factor and the health consciousness factor.

One pattern that can be observed is that the higher the education, the higher respondents generally score on the ease of preparation factor. This indicates that higher education respondents have greater knowledge of how to prepare meals with meat substitutes. Furthermore, the results show that lower-educated respondents (higher vocational education category) tend to score higher on the animal welfare factor. Regarding the pro-meat attitude factor, results indicate that the higher the education the smaller the pro-meat attitude. Furthermore, the results do not show a clear pattern for the sustainable behaviour factor, only that respondents with a Bachelor's degree tend to score lower on the sustainable behaviour factor. Both the lower educational level and the higher educational level generally score higher. The results for the food neophobia factor show that respondents with a university Master's degree tend to score lower on the food neophobia factor. Lastly, the results of the health consciousness factor also do not follow a clear pattern. It can only be concluded that respondents with a bachelor's degree tend to score lower than the other two categories.

D.3.4 Difference between income categories

Respondents from different income categories score significantly differently on the animal welfare factor, the sustainable behaviour factor and the health consciousness factor. The results show that the higher the income category, the higher respondents generally score on the animal welfare factor. The difference between the middle-income and high-income category is negligible. Therefore, there can be concluded that animal welfare is generally deemed less important by lower-income groups. Another clear pattern that can be observed is that respondents within the high-income category generally score higher on the sustainable behaviour factor than respondents from the middle-income category, and people from the low-income category generally score the lowest on this factor. Lastly, the results show that lower-income respondents generally score lower on the health-conscious factor. Indicating that respondents with a lower income attach less value to healthy and weight controlling food.

D.3.5 Difference between diets

As could be reasonably expected, the respondents from different diet categories score significantly differently on the ease of preparation factor, the animal welfare factor, pro-meat attitude factors, the sustainable behaviour factor, the pro-meat alternative factor and the environmental concern factor. The meat avoiders score highest on the ease of preparation factor, animal welfare factor, the pro-meat alternative factor, the sustainable behaviour factor and the environmental concern factor. They score lowest on the pro-meat attitude, as could also be expected.

There were also significant differences for other factors that were not as straightforward as the above mentioned. Respondents from different diet categories also score significantly different on the food neophilia factor and the objective- and subjective knowledge factor. Meat avoiders generally score highest on the food neophilia scale, followed by meat reducers and omnivores generally score lowest. For both objective and subjective knowledge applies that meat avoiders score highest, followed by meat reducers and lastly omnivores.

E Appendix E

E.1 MNL Apollo Syntax

```
rm(list = ls())

### Load Apollo library
library(apollo)

### Initialise code
apollo_initialise()

### Set core controls
apollo_control = list(
  modelName = "MNL",
  modelDescr = "MNL",
  indivID = "ID"
)

### Load data
database = read.delim("LCCMallrespondents.dat",sep=',',header=TRUE)
### Define model parameters
apollo_beta = c(BETA_env = 0,
                BETA_nutri = 0,
                BETA_price = 0,
                BETA_taste = 0,
                BETA_tex = 0,
                BETA_app = 0,
                BETA_AW = 0,
                delta_alternative = 0
                )

apollo_fixed = c()

### Validate inputs
apollo_inputs = apollo_validateInputs()

### Define model and likelihood functions

apollo_probabilities=function(apollo_beta, apollo_inputs, functionality="estimate"){

  ### Attach inputs and detach after function exit
  apollo_attach(apollo_beta, apollo_inputs)
  on.exit(apollo_detach(apollo_beta, apollo_inputs))

  ### Create list of probabilities P
  P = list()

  ### List utilities
  V = list()
  V[['alt1']] = 0
  V[['alt2']] = delta_alternative + env2 * BETA_env +  nutri2 * BETA_nutri +
    price2 * BETA_price + (taste2 == 1) * BETA_taste + (tex2 == 1) * BETA_tex +
    (app2==1) * BETA_app + (AW2==1) * BETA_AW


  V[['alt3']] = delta_alternative + env3 * BETA_env + nutri3 * BETA_nutri +
    price3 * BETA_price + (taste3 == 1) * BETA_taste + (tex3 ==1) * BETA_tex +
    (app3 ==1) * BETA_app + (AW3 == 1) * BETA_AW

  ## Define settings for MNL model component
  mnl_settings= list(
    alternatives = c(alt1=1, alt2=2, alt3=3),
```

```
    avail = list(alt1=1, alt2=1, alt3=1),
    choiceVar = value,
    V = V
  )

  ### Compute probabilities using MNL model
  P[['model']] = apollo_mnl(mnl_settings, functionality)

  ### Take product across observation for same individual
  P = apollo_panelProd(P, apollo_inputs, functionality)

  ### Prepare and return outputs of function
  P = apollo_prepareProb(P, apollo_inputs, functionality)
  return(P)
}


#### MODEL ESTIMATION
model = apollo_estimate(apollo_beta, apollo_fixed, apollo_probabilities, apollo_inputs)


### MODEL VALIDATION

apollo_sink()
apollo_outOfSample(apollo_beta,
                   apollo_fixed,
                   apollo_probabilities,
                   apollo_inputs,
                   outOfSample_settings = list(validationSize = 0.33)
)

apollo_sink()

#### MODEL OUTPUTS
apollo_modelOutput(model,modelOutput_settings=list(printPVal=TRUE))

apollo_saveOutput(model)
```

E.2 LCCM Apollo Syntax

```
rm(list = ls())

### Load Apollo library

library(apollo)

### Initialise code

apollo_initialise()


### Set core controls
apollo_control = list(
  modelName = "LCCM_covariates",
  modelDescr = "LCCM_covariates",
  indivID = "ID"
)


### Load data
database = read.delim("finalthesis.dat",sep=',',header=TRUE)

###
apollo_beta = c(BETA_env_a = 0,
                BETA_env_b = 0,
                BETA_env_c = 0,
                BETA_qenv_a = 0,
                BETA_qenv_b = 0,
                BETA_qenv_c = 0,
                BETA_nutri_a = 0,
                BETA_nutri_b = 0,
                BETA_nutri_c = 0,
                BETA_qnutri_a = 0,
                BETA_qnutri_b = 0,
                BETA_qnutri_c = 0,
                BETA_price_a = 0,
                BETA_price_b = 0,
                BETA_price_c = 0,
                BETA_taste_a = 0,
                BETA_taste_b = 0,
                BETA_taste_c = 0,
                BETA_app_a = 0,
                BETA_app_b = 0,
                BETA_app_c = 0,
                BETA_AW_a = 0,
                BETA_AW_b = 0,
                BETA_AW_c = 0,
                delta_alternative_a = 0,
                delta_alternative_b = 0,
                delta_alternative_c = 0,
                delta_a = 0,
                delta_b = 0,
                delta_c = 0,
                gamma_omnivore_a = 0,
                gamma_omnivore_b = 0,
                gamma_omnivore_c = 0,
                gamma_reducers_a = 0,
                gamma_reducers_b = 0,
                gamma_reducers_c = 0,
                gamma_age_a = 0,
                gamma_age_b = 0,
```

```
                gamma_age_c = 0,
                gamma_education_a = 0,
                gamma_education_b = 0,
                gamma_education_c = 0,
                gamma_female_a = 0,
                gamma_female_b = 0,
                gamma_female_c = 0,
                gamma_income_a = 0,
                gamma_income_b = 0,
                gamma_income_c = 0,
                gamma_prep_a = 0,
                gamma_prep_b = 0,
                gamma_prep_c = 0,
                gamma_animal_a = 0,
                gamma_animal_b = 0,
                gamma_animal_c = 0,
                gamma_promeat_a = 0,
                gamma_promeat_b = 0,
                gamma_promeat_c = 0,
                gamma_foodneophilia_a = 0,
                gamma_foodneophilia_b = 0,
                gamma_foodneophilia_c = 0,
                gamma_promeatalt_a = 0,
                gamma_promeatalt_b = 0,
                gamma_promeatalt_c = 0,
                gamma_sustainablebehaviour_a = 0,
                gamma_sustainablebehaviour_b = 0,
                gamma_sustainablebehaviour_c = 0,
                gamma_foodneophobia_a = 0,
                gamma_foodneophobia_b = 0,
                gamma_foodneophobia_c = 0,
                gamma_EnvConcern_a = 0,
                gamma_EnvConcern_b = 0,
                gamma_EnvConcern_c = 0,
                gamma_HealthConscious_a = 0,
                gamma_HealthConscious_b = 0,
                gamma_HealthConscious_c = 0,
                gamma_objknow_a = 0,
                gamma_objknow_b = 0,
                gamma_objknow_c = 0,
                gamma_subjknow_a = 0,
                gamma_subjknow_b = 0,
                gamma_subjknow_c = 0)

apollo_fixed = c("gamma_reducers_c","gamma_education_c","gamma_age_c","gamma_female_c",
                 "gamma_income_c","gamma_prep_c", "gamma_animal_c",
                 "gamma_foodneophilia_c","gamma_promeat_c",
                 "gamma_promeatalt_c","gamma_sustainablebehaviour_c",
                 "gamma_EnvConcern_c","gamma_foodneophobia_c",
                 "gamma_HealthConscious_c","gamma_objknow_c","gamma_subjknow_c",
                 "gamma_omnivore_c","delta_c")



### Defining Latent Class Parameters
apollo_lcPars=function(apollo_beta, apollo_inputs){
  lcpars = list()
  lcpars[["BETA_env"]] = list(BETA_env_a, BETA_env_b, BETA_env_c)
  lcpars[["BETA_nutri"]] = list(BETA_nutri_a, BETA_nutri_b, BETA_nutri_c)
  lcpars[["BETA_price"]] = list(BETA_price_a, BETA_price_b, BETA_price_c)
  lcpars[["BETA_taste"]] = list(BETA_taste_a, BETA_taste_b, BETA_taste_c)
  lcpars[["BETA_app"]] = list(BETA_app_a, BETA_app_b, BETA_app_c)
  lcpars[["BETA_AW"]] = list(BETA_AW_a, BETA_AW_b, BETA_AW_c)
```

```
  lcpars[["BETA_env2"]] = list(BETA_qenv_a, BETA_qenv_b, BETA_qenv_c)
  lcpars[["BETA_nutri2"]] = list(BETA_qnutri_a, BETA_qnutri_b, BETA_qnutri_c)
  lcpars[["delta_alternative"]] = list(delta_alternative_a,
                                       delta_alternative_b,
                                       delta_alternative_c)


  V=list()
  V[["class_a"]] = delta_a  + gamma_reducers_a * (diet1 == 1) +
    gamma_omnivore_a * (diet1 == 2) + gamma_age_a * AgeCategory +
    gamma_education_a * education + gamma_female_a * (gender == 1) +
    gamma_income_a * IncomeCategory +  gamma_prep_a * prep1 +
    gamma_animal_a * Qenv9 + gamma_promeat_a * promeat +
    gamma_foodneophilia_a * foodneophilia       + gamma_promeatalt_a * promeatalt +
    gamma_sustainablebehaviour_a * sustainablebehaviour +
    gamma_EnvConcern_a * EnvConcern + gamma_foodneophobia_a * foodneophobia     +
    gamma_HealthConscious_a * HealthConscious + gamma_objknow_a * objknow +
    gamma_subjknow_a * subjknow

  V[["class_b"]] = delta_b  + gamma_reducers_b * (diet1 == 1) +
    gamma_omnivore_b * (diet1 == 2) + gamma_age_b * AgeCategory +
    gamma_education_b * education + gamma_female_b * (gender == 1) +
    gamma_income_b * IncomeCategory + gamma_prep_b * prep1 +
    gamma_animal_b * Qenv9 + gamma_promeat_b * promeat +
    gamma_foodneophilia_b * foodneophilia       + gamma_promeatalt_b * promeatalt +
    gamma_sustainablebehaviour_b * sustainablebehaviour +
    gamma_EnvConcern_b * EnvConcern + gamma_foodneophobia_b * foodneophobia     +
    gamma_HealthConscious_b * HealthConscious + gamma_objknow_b * objknow +
    gamma_subjknow_b * subjknow

  V[["class_c"]] = delta_c  + gamma_reducers_c * (diet1 == 1) +
    gamma_omnivore_c * (diet1 == 2) + gamma_age_c * AgeCategory +
    gamma_education_c * education + gamma_female_c * (gender == 1) +
    gamma_income_c * IncomeCategory + gamma_prep_c * prep1 +
    gamma_animal_c * Qenv9 + gamma_promeat_c * promeat +
    gamma_foodneophilia_c * foodneophilia       + gamma_promeatalt_c * promeatalt +
    gamma_sustainablebehaviour_c * sustainablebehaviour +
    gamma_EnvConcern_c * EnvConcern + gamma_foodneophobia_c * foodneophobia     +
    gamma_HealthConscious_c * HealthConscious + gamma_objknow_c * objknow +
    gamma_subjknow_c * subjknow



  mnl_settings = list(
    alternatives = c(class_a=1, class_b=2, class_c=3),
    avail        = 1,
    choiceVar    = NA,
    V            = V
  )


  lcpars[["pi_values"]] = apollo_mnl(mnl_settings, functionality = "raw")
  lcpars[["pi_values"]] = apollo_firstRow(lcpars[["pi_values"]], apollo_inputs)
  return(lcpars)
}



### VALIDATING AND PREPARING INPUTS
apollo_inputs = apollo_validateInputs()
```

```
### Model definition
apollo_probabilities = function(apollo_beta, apollo_inputs, functionality="estimate"){

  ### Attach inputs and detach after function exit
  apollo_attach(apollo_beta, apollo_inputs)
  on.exit(apollo_detach(apollo_beta, apollo_inputs))

  ### Create list of probabilities P
  P = list()

  ## Define settings for MNL model component that are generic across classes
  mnl_settings= list(
    alternatives = c(alt1=1, alt2=2, alt3=3),
    avail = list(alt1=1, alt2=1, alt3=1),
    choiceVar = value
  )


  ### Loop over classes
  for(s in 1:3){

    ### Compute class-specific utilities
    V = list()
    V[['alt1']] = 0
    V[['alt2']] = delta_alternative[[s]] + env2 * BETA_env[[s]] + qenv2 * BETA_env2[[s]] +
      nutri2 * BETA_nutri[[s]] + qnutri2 * BETA_nutri2[[s]] + price2 * BETA_price[[s]] +
      taste2 * BETA_taste[[s]] + app2 * BETA_app[[s]] + AW3 * BETA_AW[[s]]

    V[['alt3']] = delta_alternative[[s]] + env3 * BETA_env[[s]]  + qenv3 * BETA_env2[[s]] +
      nutri3 * BETA_nutri[[s]] + qnutri3 * BETA_nutri2[[s]] + price3 * BETA_price[[s]] +
      taste3 * BETA_taste[[s]] + app3 * BETA_app[[s]] + AW3 * BETA_AW[[s]]

    mnl_settings$V = V
    mnl_settings$componentName = paste0("Class_",s)

    ### Compute within-class choice probabilities using MNL model
    P[[paste0("Class_",s)]] = apollo_mnl(mnl_settings, functionality)

    ### Take product across observation for same individual
    P[[paste0("Class_",s)]] = apollo_panelProd(P[[paste0("Class_",s)]],
                                               apollo_inputs, functionality)

  }

  ### Compute latent class model probabilities
  lc_settings = list(inClassProb = P, classProb=pi_values)
  P[["model"]] = apollo_lc(lc_settings,
                           apollo_inputs,
                           functionality)

  ### Prepare and return outputs of function
  P = apollo_prepareProb(P, apollo_inputs, functionality)
  return(P)
}

#### MODEL ESTIMATION
model = apollo_estimate(apollo_beta,
                        apollo_fixed,
                        apollo_probabilities,
                        apollo_inputs)
```

```
#### MODEL OUTPUTS
apollo_modelOutput(model,modelOutput_settings=list(printPVal=TRUE))


apollo_saveOutput(model)

### POSTERIOR ANALYSIS

apollo_sink()

apollo_lcConditionals(model, apollo_probabilities, apollo_inputs)

apollo_sink()



### MODEL VALIDATION

apollo_sink()
apollo_outOfSample(apollo_beta,
                   apollo_fixed,
                   apollo_probabilities,
                   apollo_inputs,
                   outOfSample_settings = list(validationSize = 0.33)
)

apollo_sink()
```