

# Dissertation/Project Coversheet

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## **Abstract**

This paper is a collaboration between The University of Leeds and ProVeg International (the client). ProVeg International is a leading international food awareness organisation, with the mission of reducing the global consumption of animal-based foods by 50% by 2040. The growth of Europe's plant-based industry grew an overall 49% in the 2-year period between 2018 and 2020, equivalent to a total sales value of EUR 3.6 billion (CORDIS, 2021). To provide greater clarity in terms of the priorities for future development in the market, ProVeg engaged in a pan European consumer survey in 2019. The findings were disseminated to stakeholders in the industry through a series of seminars, however given budget and time constraints, ProVeg did not engage in analytics beyond descriptive statistics. This paper builds upon existing capabilities, with the objective of establishing differences between plant-based food consumption and the levels of satisfaction with the attributes of plant-based dairy and meat/fish, across the 9 countries in the sample. Although the existing literature is extensive, a simultaneous comparison of more than one plant-based food category in more than three countries is missing. Hence, in addition to providing actionable insight to the client, this paper also seeks to fill the research gap. The data was provided by the client (n=6,260). The findings suggest a statistically significant difference between the levels of plant-based food consumption across the countries in the sample, confirming findings in the literature, implying a difference in levels of dietary consumption between countries. Furthermore, with respect to the levels of satisfaction with the attributes of the plant-based food categories in the survey, it can be concluded that respondents were more satisfied with the attributes of plant-based dairy. The findings are explored at a more granular level, looking at the difference between categories within countries. The managerial implications of the findings are discussed focusing on Germany (given the client's location in Germany) and the price attribute as a starting point for comparison. Finally, future research directions expanding upon the findings are considered.

## **Acknowledgements**

I would like to extend my gratitude to my supervisor Alessandro Biraglia and ProVeg International for their unwavering support.

So long as you have food in your mouth, you have solved all  
questions for the time being.

-Franz Kafka

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## 1.0 Introduction

1985 saw the first commercially available vegetarian burger by Quorn. This product was developed from a combination of rice, vegetables, and cheese, and tasted distinctively unlike meat (Beldrock, 2021). Up until this point most vegetarian/vegan alternatives consisted of products not resembling meat, such as tofu, tempeh and falafel. Fast forward to 2009, when Beyond Meat was founded, this marks the turn towards “meat-mimicking”, whereby recipes are experimented with to make meat substitutes more meat like. Since then, there have been two more landmark dates for the alternative protein space. The first is 2013, when a cultured meat burger was developed in the Netherlands, made from cow cells. The second is 2020, when the first cultured chicken was approved for consumption in Singapore. According to a report by Bloomberg Intelligence, the plant-based foods market could contribute to 7.7% of the global protein market by 2030, a value of \$162 billion, up from \$29.4 billion in 2020 (Bloomberg Intelligence , 2021). On the supply side, this growth is being driven by established incumbents such as Oatly, Impossible Foods, and Oatly, as they partner with restaurants and major chains. On the demand side, this growth is fuelled by the dietary changes, most notably the “flexitarian” segment, which refers to an individual eating predominantly vegetarian/vegan dishes but have not fully eliminated animal-based products from their diet. In fact, to a certain extent the fight for market share in the plant-based market is concerned with making headway in this segment (Steson and Buttriss, 2021). Amongst incumbents marketing these products to consumers, are activist organisations working across markets to encourage more sustainable dietary lifestyles, one such organisation is ProVeg International.

ProVeg International is a leading international food awareness organisation founded by Sebastian Joy (ProVeg International, 2021). ProVeg International’s mission is to reduce global consumption of animals by 50% by 2040 (ProVeg International , 2021), by working to transform the food system through the replacement of conventional animal-based food products with plant-based and cultured alternatives. This paper is a collaboration between The University of Leeds and ProVeg International.

To gain a deeper understanding of the plant-based market, ProVeg launched a consumer survey in 2019 in 9 European countries. Findings were disseminated to stakeholders through a series of seminars. The objective of this paper is to explore how the levels of plant-based

consumption and satisfaction of two plant-based categories (plant-based dairy and meat/fish) varies across countries. The aim is to establish which of the two plant-based categories consumers are most satisfied with. In addition to providing the client (ProVeg International) with valuable insights, this paper makes two key contributions to the existing literature. First, it attempts to quantify the differences in the overall plant-based consumption levels of the 9 countries in the sample. Second, it establishes which of the two plant-based categories has the highest level of satisfaction and thus is more positively perceived. Although these notions have been alluded to in the literature, they have not been explicitly explored, therefore this paper attempts to fill this gap. The rest of this research paper is structured in the following manner. In chapter two, the literature on consumer behaviour pertaining to plant-based foods will be reviewed. In chapter three, the data provided by the client will be explored and the data pre-processing steps will be presented. Chapter four will present the findings. In chapter five, the findings will be discussed relative to the client and the literature, along with managerial implications, limitations, and future research directions. Chapter six will conclude, by summarising the main outcomes of the paper.



## 2.0 Literature Review

Onwezen et al. (2021), present a systematic review on consumer acceptance of alternative proteins, encompassing pulses, algae, insects, plant-based meat alternatives and cultured meat. The authors demonstrate that according to existing literature, relative to acceptance of meat, alternative protein acceptance remains low. Amongst the alternative protein categories, pulses and plant-based alternative proteins have the highest acceptance. The literature has identified a range of domains pertaining to the consumer acceptance of alternative proteins and plant-based foods more generally, these include but are not limited to innovative food acceptance (Siegrist, 2008), naturalness of food (Roman et al., 2017) and consumption of animal based-foods (Sanchez-Sabate and Sabaté, 2019). Although research in the field is expanding and significant contributions have been made, there is a lack of research exploring consumer acceptance including multiple plant-based categories, let alone between plant-based alternative categories, for instance, comparing naturalness perception of plant-based dairy and plant-based meat. Expanding upon this notion, this research attempts to compare perceptions of satisfaction regarding different attributes of plant-based milk and plant-based meat/fish, across countries.

With regards to plant-based meat the research has demonstrated how product-related attributes and psychological factors influence consumer adoption. Product-related attributes may include factors such as perceived appeal (Bryant and Dillard, 2019), environmental and health concerns (Siegrist and Hartmann, 2019), country of origin and price (Apostolidis and McLeay, 2016), nutritional concerns (Weinrich, 2018), and familiarity (Hoek et al., 2013). In contrast, psychological concerns, refer to attitudes and beliefs, including measures of food neophobia and intention to adopt/purchase plant-based meat alternatives (Hoek et al., 2011). Similar findings are evident in literature pertaining to plant-based dairy alternatives. Wolf et al (2020) finds a relatively high usage of plant-based dairy amongst consumers, suggesting that these products are consumed at a higher rate than other plant-based alternatives.

### 2.1 Satisfaction with plant-based alternatives

Relevant marketing literature refers to satisfaction as the extent to which consumers/customers are pleased with a product or service (Korkofingas, 2019). Satisfaction is postulated to be a key driver of customer loyalty and post-purchase behaviours, such as

repeat purchasing (Korkofingas, 2019). The extent to which customers are satisfied with attributes of a product, has long been a subject of interest, this also applies to food products, and perhaps more importantly, to plant-based alternatives. A study Quelch and Ash (1980) sought to establish the level of satisfaction across categories of food products, to stimulate cooperation between marketers and policy makers to address consumer dissatisfaction. The results demonstrate that there is a significant variation between the levels of satisfaction across the food products.

Kim and Yim (2014) expand upon this notion, by investigating the extent to which consumers are satisfied with specific product attributes of a food product, such as price and quality. The authors demonstrate that the effect of product attributes on satisfaction, particularly satisfaction with the specific attribute, is significant. Bryant (2019) points out, that in practice, the main determinants of food choices are convenience, price, and taste.

## 2.2 Satisfaction with Price

Price of plant-based alternatives has been a topic of interest in the literature, mostly in the form of attitudinal studies, exploring price perception and willingness to purchase (Onwezen et al., 2021). The consensus seems to be that for plant-based meat alternatives to be on par with conventional meat, they need to be offered at competitive prices (Michel et al., 2021). This is in line with the findings by Bryant (2019) who identifies price as one of the drivers of plant-based alternatives. However, relative to drivers such as environmental concerns, price of plant-based alternatives is consistently rated negatively. (Bryant, 2019). Michel et al. (2021) found that meat alternatives are still lacking in terms of price perception, and that this varies according to dietary lifestyle, where consumers who consume plant-based meat alternatives more frequently tend to rate the price higher. As with the plant-based meat category, price has also been identified as inhibiting the adoption of plant-based dairy alternatives (Boaitey and Minegishi, 2020; Haas et al., 2019). Cumulatively, the literature implies that plant-based alternatives, particularly plant-based meat and dairy is currently perceived as too high. The literature suggests that the price of plant-based meat is rated more negatively than plant-based dairy, however, this has not been explicitly outlined, let alone explored across 9 countries. Hence it is expected:

*H1: There is a significant difference between the satisfaction with price of plant-based meat and dairy alternatives across countries.*

## 2.3 Satisfaction with Taste

As Bryant (2019) pointed out, taste is one of the key drivers of food choices. In line with this finding, Onwezen et al. (2021) confirm that taste plays a key role in the case of plant-based meat alternatives. In fact, Weinrich (2018) states that the main reason inhibiting adoption of plant-based meat alternatives is the taste of meat or rather, the lack of taste of plant-based-meat alternatives. In addition, the author argue that the taste of plant-based meat generates negative connotations of artificiality, health outcomes, and naturalness. Despite advancements in the taste of plant-based meat alternatives, satisfaction with their taste is still relatively negative. In contrast, with regards to taste of plant-based dairy alternatives, taste has also been identified as affecting adoption (Boaitey and Minegishi, 2020; Bryant and Dillard, 2019; Haas et al., 2019). Even if taste is also identified as an inhibiting factor, it seems that it is mentioned less so, relative to price and at a lower rate than for plant-based meat alternatives (Bryant, 2019; Haas, et al., 2019). Therefore, it is proposed:

*H2: There is a significant difference between the satisfaction with taste of plant-based meat and dairy alternatives across countries.*

## 2.4 Satisfaction with Convenience

The third main driver of food choices is convenience, and as Boukid (2021) established, is also the case for plant-based meat. Boukid (2021) highlights the role of convenience in driving adoption of plant-based meat alternatives, nevertheless there is room for improvement, both in terms of production and usage in recipe preparations. Schenk et al. (2018) identify convenience as a major barrier to plant-based meat adoption. These results have been replicated elsewhere, bringing to light difficulty of preparation, lack of options when eating out, time and knowledge, as making them more inconvenient (Bryant, 2019; Vanhonacker et al., 2013 ). With regards to the convenience of plant-based dairy alternatives, convenience was also identified as inhibiting adoption, particularly due to the lack of versatility of plant-based dairy alternatives as a food ingredient (Boaitey and Minegishi,

2020; Haas et al., 2019). Nevertheless, Bryant (2019) suggests that relative convenience perception of plant-based dairy alternatives may be higher than plant-based meat. There for it is stipulated that:

*H3: There is a significant difference between the satisfaction with the convenience of plant-based meat and dairy alternatives across countries.*

## 2.5 Satisfaction with Naturalness

Given the nature of plant-based alternatives as food products, the extent to which they are *natural* has always been a topic of interest (Onwezen et al., 2021). Román et al. (2017) discuss that there may be a lack of perceived naturalness when it comes to food innovations such as plant-based and cultured meat. The authors argue that the importance of naturalness when making food choices applies across countries and at different stages of the food value chain. In line with these findings, Michel et al. (2021) find that the positive associations with the *naturalness* of meat inhibited the adoption of meat alternatives, this varied between gender and dietary lifestyle. Conversely, Piazza et al. (2015) identify that consumer justify meat consumption due to its naturalness and therefore abstain from consuming plant-based meat alternatives because of perceived artificiality (Boukid, 2021). As such, developments in the market and findings in the literature call for increased mimicking of the natural aspects of meat. Similarly, Haas et al. (2019) confirm existing findings establishing that plant-based dairy alternatives are perceived as less natural than conventional milk, which is exacerbated by the practice of fortification of plant-based dairy (McCarthy et al., 2017; Palacios et al., 2010). Oduro et al. (2021) demonstrate that there are fluctuations between consumer acceptance of plant-based dairy alternatives due to their colour. Thus, whilst research on both plant-based meat and dairy alternatives has been developed in parallel, the extent to which satisfaction with naturalness differs between alternatives and across countries in Europe, has not been documented. Therefore, it is suggested that:

*H4: There is a significant difference between the satisfaction with the naturalness of plant-based meat and dairy alternatives across countries.*

## 2.6 Satisfaction with Nutrition

Relevant literature on the perceived nutrition of plant-based alternatives show that nutrition is key component when considering the healthiness of these food products (Myers and Pettigrew, 2018; Onwezen et al., 2021). Lea et al. (2006) highlight that consumers express concerns with regards to the nutrition of plant-based meat alternatives. Graça et al. (2015), expands upon these findings demonstrating that the perceived nutritional benefit of meat as increasing attachment to meat and thus inhibiting adoption of plant-based alternatives. Van Loo et al. (2017) show that there is an increasing trend of consumers perceiving the nutritional component of plant-based alternatives positively, particularly when perception of sustainability is also positive. Nevertheless, the authors acknowledge that there is conflict amongst consumers when considering the nutritional robustness of plant-based diets solely in terms of nutrition. Despite this, the trend seems to be towards more positive perceptions of the nutrition of plant-based meat alternatives. With regards to plant-based dairy alternatives, the effect of perceived nutrition is perhaps less stark than for plant-based milk. This might be due to a lesser emphasis on the negative health outcomes of milk consumption in the literature and in the media, although these have not been undocumented (Haas et al., 2019). Haas et al. (2019) show that nutritional and health benefits of milk consumption as drivers of continued consumption of milk, and thus an aversion to adopt plant-based dairy alternatives. Concerns have been raised in the literature with regards to the nutritional *inferiority* of plant-based dairy alternatives (Jeske et al., 2018; Sethi and Rahul, 2016). Perception of lack of nutrition has also been further cemented by the practice of fortification of plant-based alternatives, such as calcium fortification (McCarthy et al., 2017; Palacios et al., 2010). Paradoxically consumers have also expressed nutrition as a driver of adoption of plant-based alternatives, both meat and dairy, with flexitarians being more positive towards conventional alternatives but increasingly adopting plant-based alternatives (Bryant, 2019; Haas, et al., 2019; Onwezen et al., 2021). To this end it remains to be seen whether consumers are more satisfied with the nutrition of plant-based meat or plant-based dairy alternatives. Therefore, it is stipulated that:

*H5: There is a significant difference between the satisfaction with the nutrition of plant-based meat and dairy alternatives across countries.*

## 2.7 Satisfaction with Appearance and Consistency

Plant-based meat appearance has been studied in the literature and has been influenced by findings in the previous aspects (i.e. taste, naturalness, etc.). Hoek et al. (2011) demonstrate this by suggesting that preference for appearance of meat fluctuates according to meat usage. That is, consumers who prefer meat also prefer meat alternatives that more closely resemble meat in terms of appearance, whilst the inverse is true of consumers favouring meat alternatives. A similar effect was also observed for consistency and the previously discussed attributes (Hoek et al., 2011). According to Haas et al. (2019) it seems that when it comes to consumer perception of appearance and consistency of plant-based dairy alternatives, consumers are more satisfied with the former than the latter, although overall satisfaction with these two attributes seems higher than compared to meat alternatives (Bryant, 2019). This can be partially explained by the ability in the production methods of plant-based dairy and the extent to which this enables the resemblance of plant-based dairy with milk in terms of appearance and consistency. In addition, the differences in molecular complexity between meat and dairy, i.e. between liquid and solid foods, facilitate the feasibility of the resemblance of plant-based dairy to milk (Haas, et al., 2019; Oduro, et al., 2021). Despite this, Paul et al. (2020) note that the consistency and appearance of plant-based dairy may vary considerably, given the origin of ingredients, thereby affecting consumer satisfaction with sensory attributes of these products (Grossman et al., 2021). Hence to establish the extent to which consumers are more or less satisfied with the appearance and consistency of the respective plant-based alternative categories across countries, it is expected that:

*H6: There is a significant difference between the satisfaction with the appearance of plant-based meat and dairy alternatives across countries.*

*H7: There is a significant difference between the satisfaction with the consistency of plant-based meat and dairy alternatives across countries.*

## 2.8 Plant-based Consumption Across Countries

There have been several studies comparing plant-based eating across countries. For instance, Van Loo et al. (2017) compare plant-based eating habits across four European

countries. The authors find that the perceptions of healthy, sustainable, and plant-based diets, seem to be consistent across all countries in the study, allowing for broad categorisations of consumers. Ilona et al. (2020) compare the attitudes and knowledge of plant-based diets across, Belgium, Denmark, Netherlands and Spain. The authors identify some differences between the countries, particularly, Belgian and Dutch respondents holding more positive views towards plant-based, whilst Danish and Spanish respondents were indifferent. This suggests that there may be clusters of countries with similar dietary perceptions. The dietary distinction between countries is epitomised by the term, “Mediterranean Diet”, used to denote dietary preferences in southern regions of Europe, such as Spain and Italy (Martínez-González et al., 2017). Moreover, health and sustainability aspects of diets have been emphasised in different countries, in the UK, Netherlands, and Sweden (Garnett and Strong, 2015; Health Council of the Netherlands, 2011; National Food Agency; Livsmerdelsverket, 2015). To this end, Ilona et al. (2020) and Van Loo et al. (2017) argue that consumption of plant-based foods will vary across countries. Chiles and Fitzgerald (2018), points to the centrality of meat in western food culture, noting that meat consumption has in fact increased in some European countries, with Spain being the largest meat consumer in Europe. In contrast, other European countries have large concentrations of self-classified meat reducers, such as Netherlands (Chiles and Fitzgerald, 2018). To the extent that there exist differences in dietary preferences across countries, it is postulated:

*H8: There is a significant difference between the plant-based index across countries.*

The contributions of this report to the literature are two-fold, it compares satisfaction with product attributes for the plant-based meat and dairy categories and across 9 European countries, establishing the extent to which there is a difference between countries. In terms of the client, this report seeks to provide a more nuanced analysis, given the client was not able to engage with the data beyond descriptive statistics, it will provide actionable cross-country results which can be distributed to stakeholders.

### 3.0 Data Exploration and Pre-processing

The data used in this report was provided by ProVeg International. In 2019, ProVeg International conducted a survey to gain a greater understanding of the product landscape, identifying product priorities for product improvement and development, in the plant-based market (ProVeg International, 2020). The instruments for the survey were developed by ProVeg International and data collection was facilitated by partner organisations<sup>1</sup>. The survey was conducted across nine European countries and contains a total of 6,260 responses. The survey was conducted in The United Kingdom, Germany, Austria, Belgium, France, Netherlands, Switzerland, Denmark, and Czech Republic.

#### 3.1 Data Pre-processing and Standardisation

The raw data was provided by ProVeg International was noisy containing more than 100 features, some of which referred to the response duration or the device type that the survey was answered on. Therefore, to reduce the amount of noise in the dataset, this information was removed. This reduced the number of variables in the data significantly, although inconsistencies between the countries remained, as some had more variables than others. Given the data was collected across different countries, the survey items and corresponding answers were in different languages. To overcome this the data across all countries was translated to English using the built-in interpreter in Microsoft Excel. Minor discrepancies in the translation of the respective languages to English were corrected, using the items and responses of the UK sample as a reference.

The next main step in the data pre-processing sought to identify items of further inconsistencies, specifically in terms of measurements being present across countries. For instance, whereas in some countries such as UK and Germany the items measuring satisfaction, were done at the overall category level, whilst for some (Belgium) satisfaction was also measured at the individual product level. Therefore, to attain a standardised dataset only the category level satisfaction items were retained. In addition, inconsistencies between items measuring the satisfaction with supermarkets and the discrepancies in the response

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<sup>1</sup> These include: the Association Végétarienne de France, the Czech Vegan Society, Eva, Swissveg, Veganuary, the Vegan Society of Denmark, and the Vegnae Gessellschaft Österreich.



options for different countries were present, hence omitted from the dataset. The final pre-processed dataset then contained 47 features and 6,260 examples. A brief description of the variables is demonstrated in tables 1, 2 and 3.

<i><b>Variable</b></i>	<i><b>Detail</b></i>
<b>Country</b>	Country of respondent. A categorical variable.
<b>Gender</b>	Gender of respondent. A categorical variable.
<b>Diet</b>	Description of respondent's dietary behaviour. A categorical variable.
<b>Purchase maker</b>	Whether the respondent makes food related purchases for self or anyone in household. A binary variable (yes/no).
<b>Previous_3</b>	Whether the respondent has purchased a plant-based food in the previous 3 months. A binary variable (yes/no).
<b>Recent_(PBm,PBy,PBic, PBc,PBb, PBo, PBn)</b>	Whether the respondent recently purchased the respective plant based dairy alternatives. Recent_PBm refers to plant-based milk, Recent_PBy to plant-based yoghurt, Recent_PBic to plant-based ice cream, Recent_PBc to plant-based cheese, Recent PBb to plant-based butter, Recent_PBo to other plant-based dairy product, Recent_PBn to none. Binary variable (yes/no).
<b>PBD_(Price, Nut,Con,Taste, Conv, App, Nat)</b>	Attitudinal items measuring the satisfaction with attributes of plant-based dairy products, where 0 is not satisfied at all and 5 is very satisfied. PBD_Price refers to satisfaction with price, PBD_Nut to satisfaction with nutrition, PBD_Con to satisfaction with convenience, PBD_Taste to satisfaction with taste, PBD_Conv to satisfaction with convenience, PBD_App to satisfaction with appearance, and PBD_Nat to satisfaction with naturalness.

*Table 1: Variable Overview*

<i>Variable</i>	<i>Detail</i>
<b>Recent_(PBmeat,PBom, PBf,Pbmfn)</b>	Whether the respondent recently purchased the respective plant-based meat alternative or fish alternative. Recent_PBmeat refers to plant-based meat, Recent_PBom to other plant-based meat alternatives, Recent_PBf to plant-based fish alternatives, and Recent_PBmfn to no purchase of plant-based meat/fish alternatives. Binary variable (yes/no).
<b>PBMF_(Price,Nut, Con, Taste, Conv, App, Nat)</b>	Attitudinal items measuring the satisfaction with the attributes of plant-based meat/fish products, where 0 is not satisfied at all and 5 is very satisfied. PMF_Price refers to satisfaction with price, PBMF_Nut to satisfaction with nutrition, PBMF_Con to satisfaction with convenience, PMF_Taste to satisfaction with taste, PMF_Conv to satisfaction with convenience, PMF_App to satisfaction with appearance, and PMF_Nat to satisfaction with naturalness.
<b>Recent_(PBe, PBvs, PBrm, PBcp, PBsn, PBno)</b>	Whether the respondent recently purchased the respective “other” plant based food product Recent_PBe refers to plant-based eggs, Recent_PBvs to plant-based sauces and dressings, Recent_Prnc to plant-based ready meals, Recent_PBsn to plant-based sports nutrition drinks and bars, Recent_PBcp to plant-based cakes and pastries, Recent_PBno to no purchase of miscellaneous plant-based food products.t, Recent_PBn to none. Binary variable (yes/no).

*Table 2: Variable Overview*

<i>Variable</i>	<i>Detail</i>
<b>PBO_(Price, Nut, Con, Taste, Conv, App, Nat)</b>	Attitudinal items measuring the satisfaction with the attributes of “other” plant-based meat/fish products, where 0 is not satisfied at all and 5 is very satisfied. PMF_Price refers to satisfaction with price, PBMF_Nut to satisfaction with nutrition, PBMF_Con to satisfaction with convenience, PMF_Taste to satisfaction with taste, PMF_Conv to satisfaction with convenience, PMF_App to satisfaction with appearance, and PMF_Nat to satisfaction with naturalness.
<b>Age</b>	Age of the respondent A categorical variable.
<b>Location</b>	Living location. A categorical variable.
<b>Household</b>	Respondent’s household situations. A categorical variable.
<b>Expenditure</b>	Variable denoting grocery expenditure per week, in respective country currency. A categorical variable.

*Table 3: Variable Overview*

The following step involved creating a *plant-based index* variable, that summarises the repetition of the *Recent\_* variables, indicating previous plant-based food purchase. In doing so, the plant-based index would represent the respondent’s cumulative plant-based purchases. For this to work the missing values were imputed as “no”, the implications of which will be discussed in subsequent chapters. The values for this variable are string characters, “yes” and “no”, to achieve the index measure the values were converted to numeric values, 1 for yes and 0 for no. Once this was done the plant-based index was calculated using row wise addition<sup>2</sup>. The differences at the country level are shown in figure 1.

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<sup>2</sup> Variables indicating that the respondent purchased *none* were excluded in the calculation of the plant-based index as the other variables would capture if the respondent had not purchased any of the products by providing no for all the respective categories.

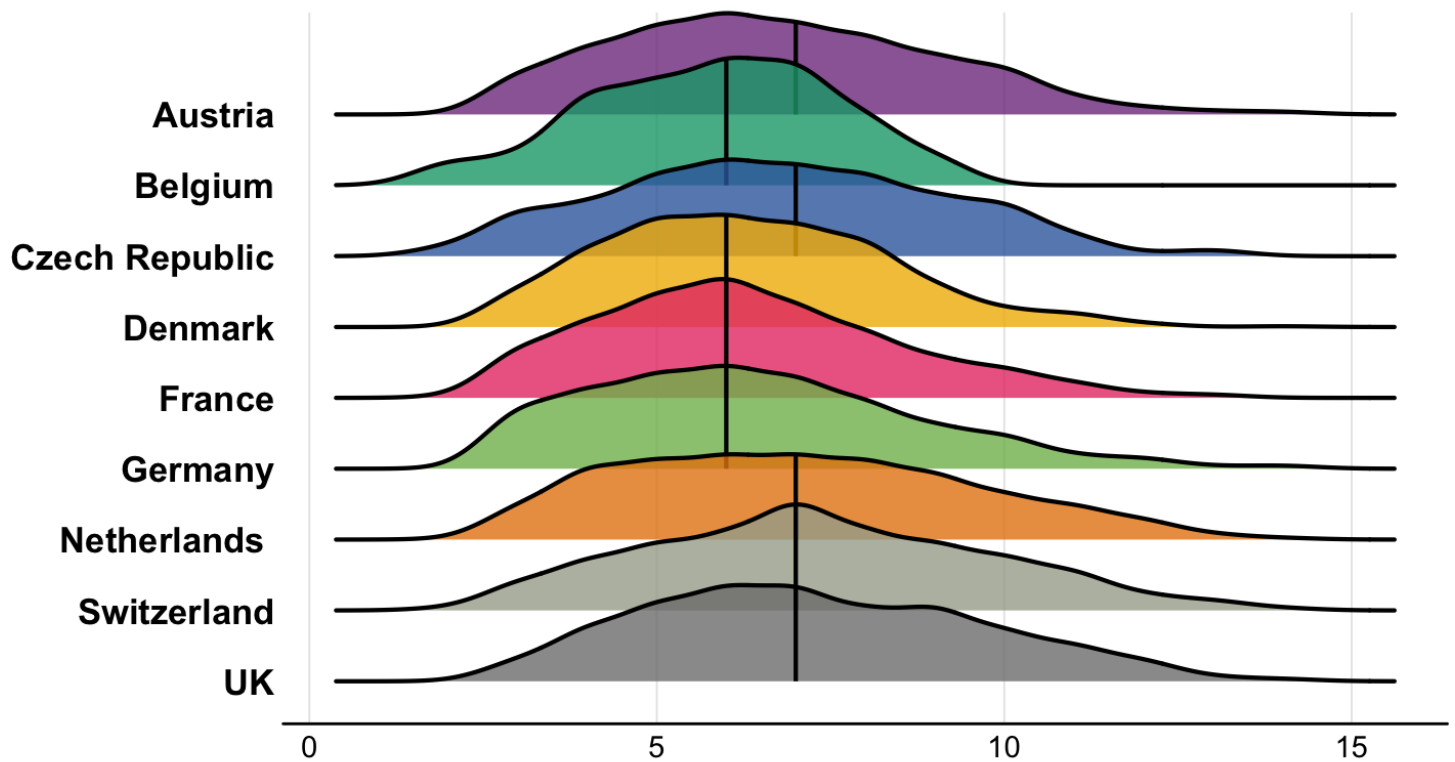


Figure 1: Plant-based index consumption by country

Considering the recent purchases of plant-based alternative products into the plant-based index reduced the total number of variables of the dataset to 31. For the most part, the distribution of the plant-based index scores seem to follow a normal distribution curve, with a slight left skew being present in some. Most cases across countries are in the 0-10 range. This doesn't indicate that overall plant-based consumption is necessarily low, rather, it tells us that the variety of consumption of plant-based products is not very high. This is the case since, higher scores tell us that the respondent consumes more of the product mentioned in the survey, in contrast, a lower score denotes consumption of a smaller range of products.

### 3.2 Satisfaction with Attributes of Plant-based Dairy and Meat/Fish

As with the previous section, data inconsistencies were present in the values pertaining to the satisfaction variables. Therefore, in the case of missing values, 0 were imputed for the satisfaction measures. This was necessary for comparisons between countries and for subsequent analysis, however the implications of this will be discussed in later chapters. Nevertheless, the differences in the satisfaction with attributes of plant-based dairy alternatives across are shown in figure 2.

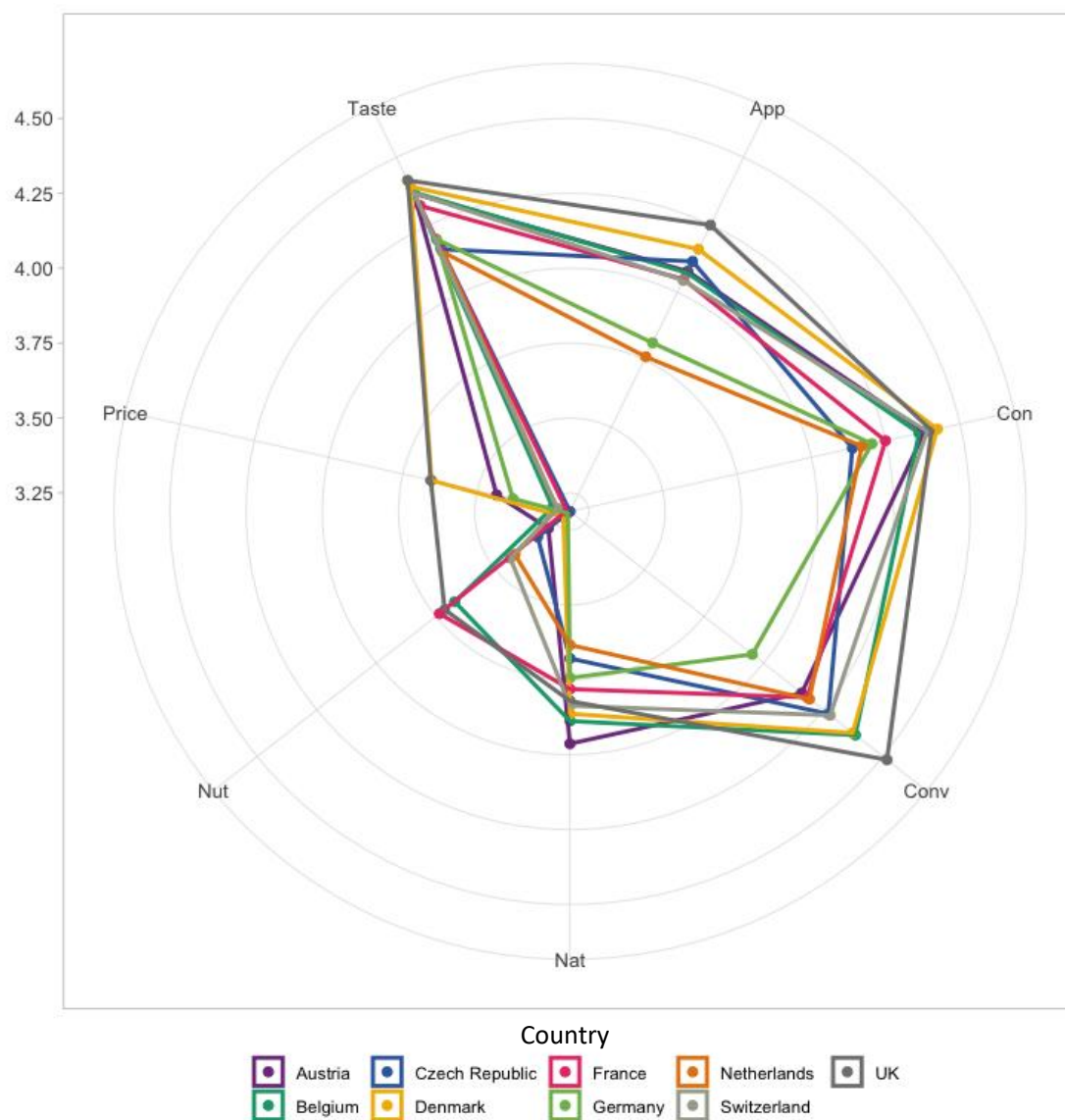


Figure 2: Satisfaction with attributes of plant-based dairy

The previous figure demonstrates that respondents are least satisfied with price and nutrition of plant-based dairy alternatives. In contrast, respondents across countries seem to be more satisfied with taste and convenience. The UK is consistently amongst the most satisfied for all attributes, whereas Germany and Netherlands are consistently less satisfied with the attributes of plant-based dairy alternatives. Respondents in Germany and Netherlands are relatively less satisfied with the appearance of plant-based dairy. In contrast there is a high level of agreement across countries with regards to the taste, a similar case can be made for consistency.

The same comparison is repeated, this time for the differences between satisfaction with plant-based meat/fish attributes across countries, as shown in figure 3.

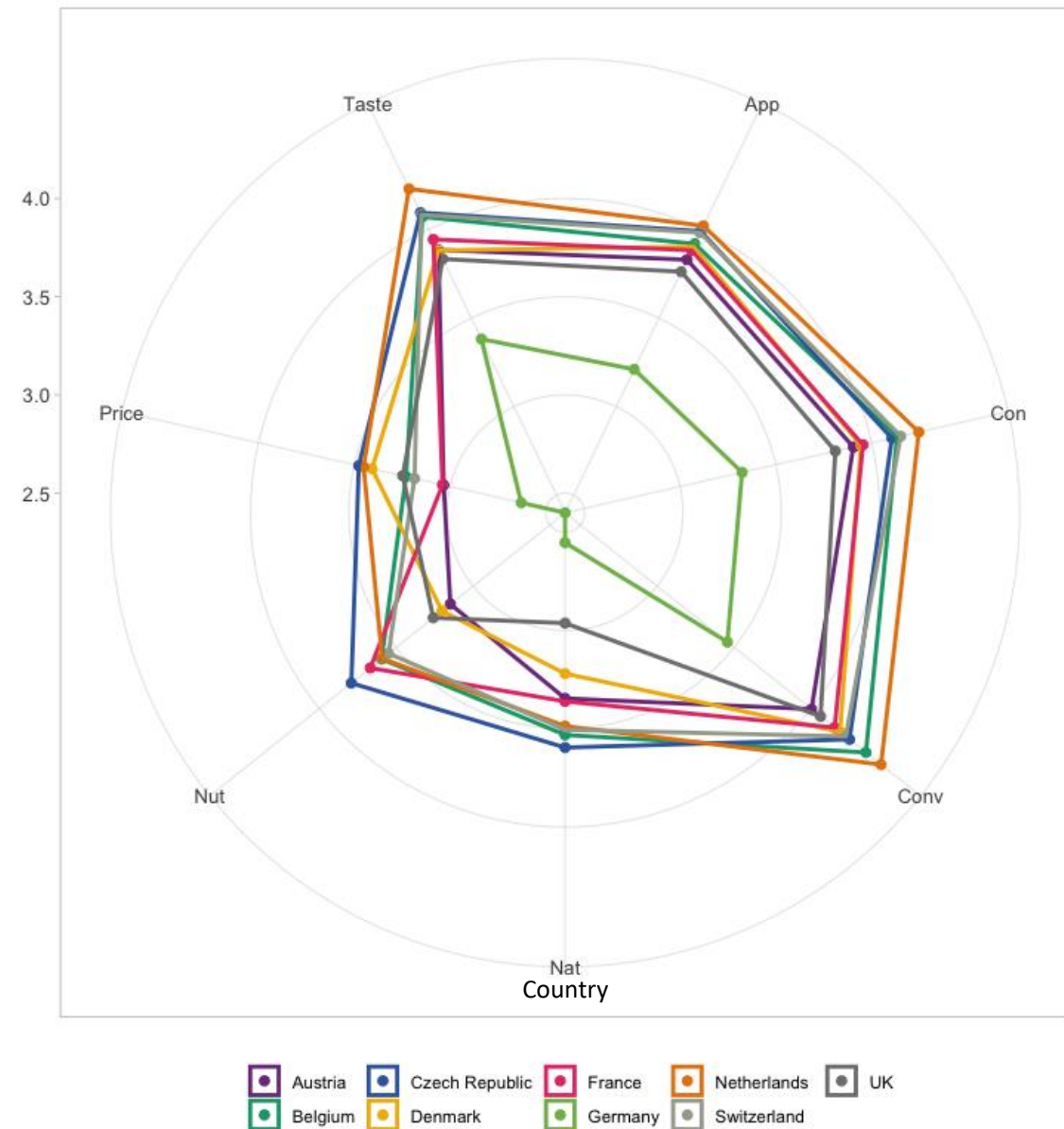


Figure 3: Satisfaction with the attributes of plant-based meat/fish

There are a few key differences between the satisfaction with the plant-based dairy attributes and plant-based meat/fish. Whereas the range for the satisfaction for plant-based dairy is 3.25-4.50, for plant-based meat/fish alternatives it is 2.5-4.0. Another key distinction is Germany's relatively low satisfaction with all attributes of plant-based meat. Particularly when it comes to nutrition and price, Germany distinguishes itself prominently. On the other

hand, there seems to be a greater degree of similarity between the countries with regards to some attributes, such as appearance, with most countries apart from Germany, being indifferent or somewhat satisfied. Netherlands seems to be the most satisfied with the attributes of plant-based meat, particularly taste, convenience, and consistency. This is not too surprising given the number of self-declared meat reducers in Netherlands. As was the case for plant-based dairy alternatives, price stands out as an attribute that respondents are less satisfied with across countries. This is indicative of the findings in the literature, outlining price as one of the main inhibitors of plant-based alternative adoption.

### 3.3 Demographic Variables

#### Age

The sample consisted of six main age groups, 18-24, 25-34, 35-44, 45-54, 55+, and rather not say. Most of the sample was 18-24, followed by 35-44, and the category with the least number of respondents was *rather not say*.

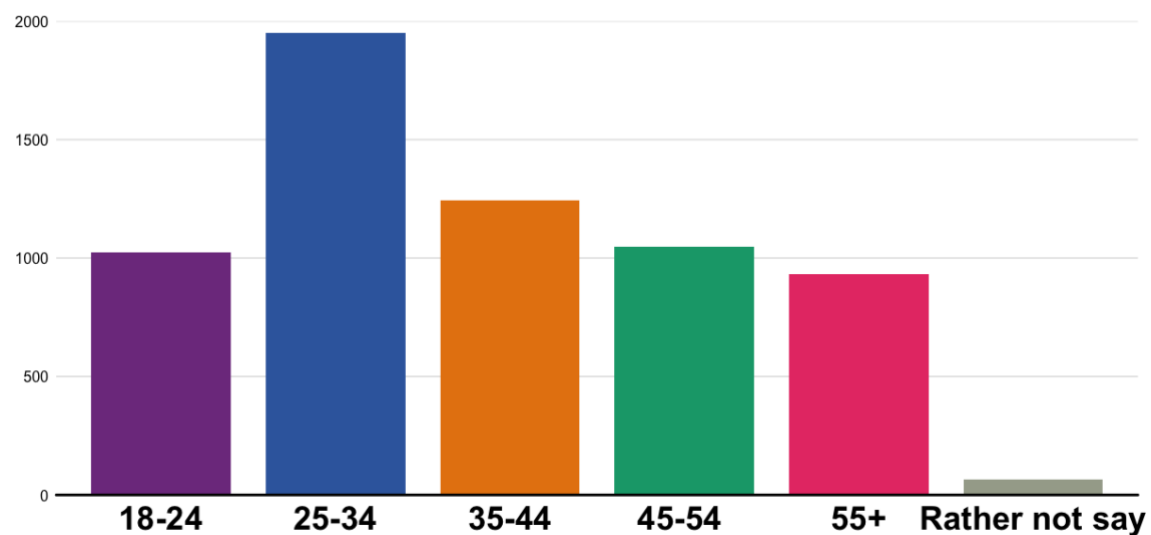


Figure 4: Distribution of age

## Dietary lifestyle

The survey was developed to identify three main types of dietary lifestyles: *I do not try to avoid meat and/or other animal products*, *I reduce or try to reduce my consumption of meat and/or other animal products*, *I eat mainly or only mainly plant-based foods*.

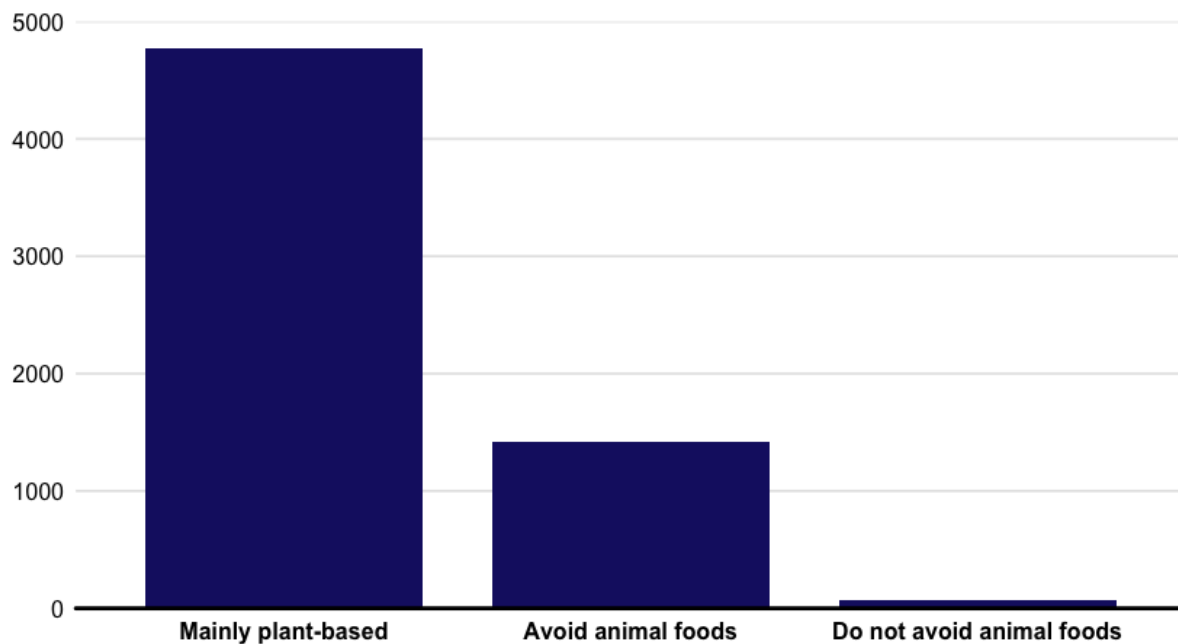


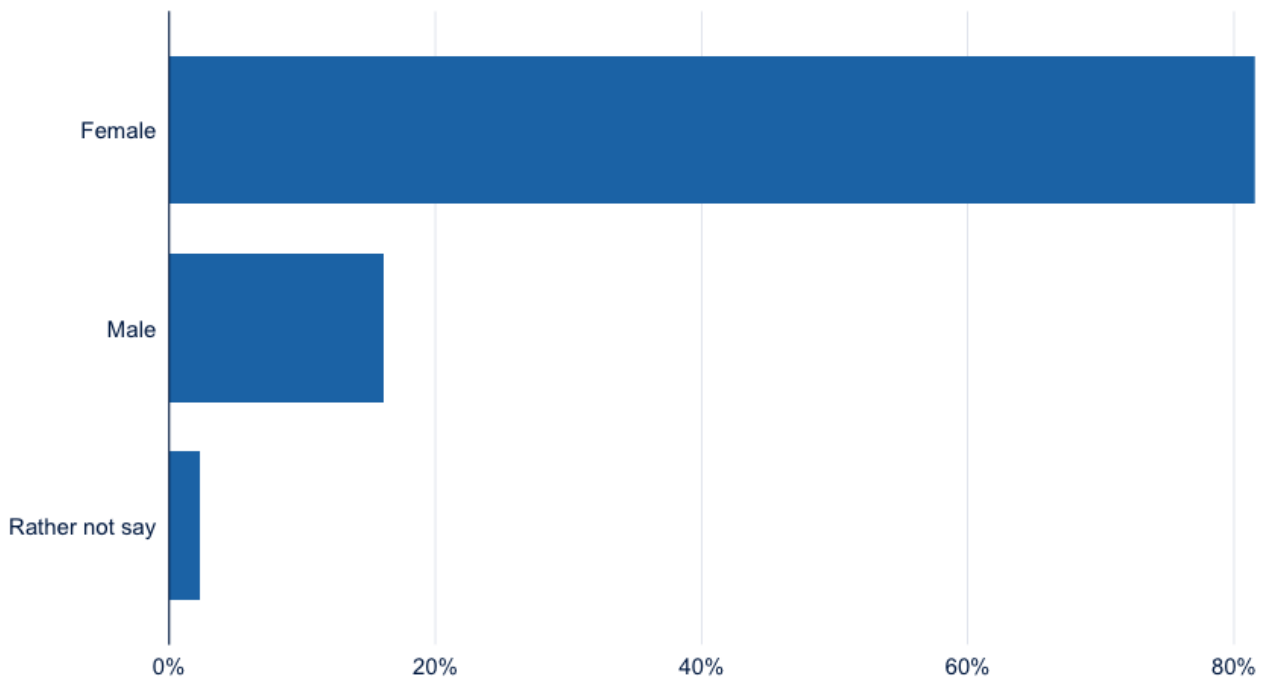
Figure 5: Distribution of dietary lifestyle

There seems to be an overrepresentation of respondents eating mainly plant-based foods, this may be due to the operationalisation of the data collection. As previously mentioned, the data was collected through partner organisations, these include organisations that are advocating for similar outcomes as ProVeg, therefore it is expected that the membership of said organisations is composed of respondent's whose interest align with these organisations, namely reduction of meat/increase consumption of plant-based foods. This will have implications for the robustness of the analysis, this will be further discussed in the section pertaining to limitations.



## Gender

The gender of respondents is categorised into three categories, *Female*, *Male*, *Rather not say*. Similar to the dietary lifestyle variable, there is an overrepresentation in the gender variable. 81.6% of the sample is made up of females. The remaining 18.5% of the sample consists of male respondents and respondents who would rather not say, 16.1% and 2.3% respectively.



*Figure 6: Distribution of gender*

## Location

The living location of respondents is more varied than the previous two variables, and include the following categories: *Capital city*, *Large city not capital*, *Medium Sized city*, *Small city*, and *Town/village*. This variable is more uniformly distributed across the sample, with a relatively large share being from a town/village and the least number of respondents form a small city.

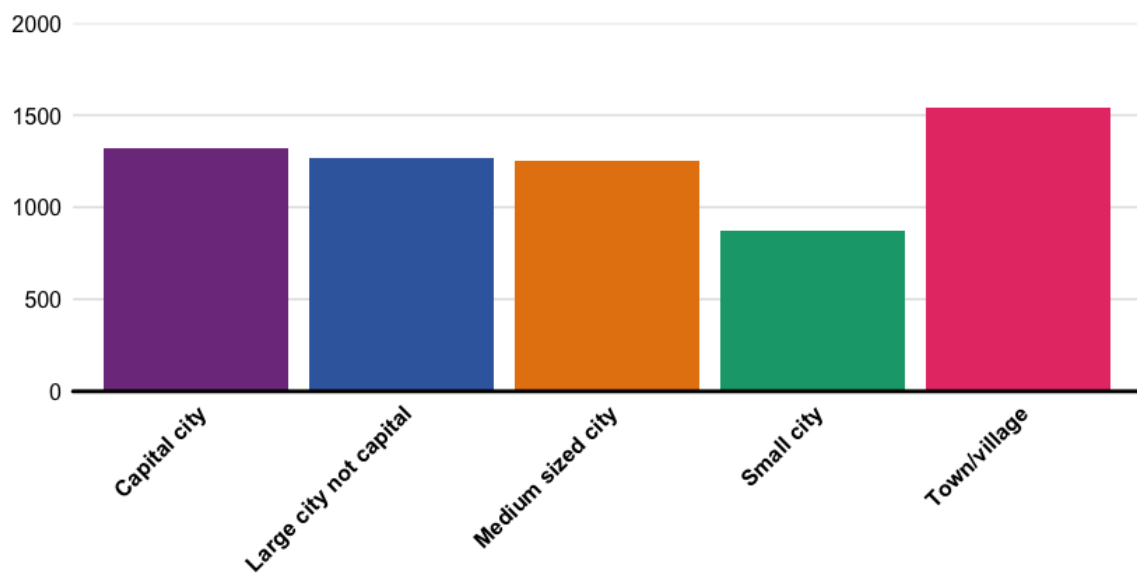


Figure 7: Distribution of location

## Household situation

Another demographic variable of interest is household situation. This variable refers to the household situation the respondent is in, it includes *Alone/Flatshare*, *Child/Children*, *Partner*, *Partner and child/children*. It seems that a relatively large number of respondents live either with a partner or alone/flatshare. Netherlands has the largest proportion of respondents living with a child/child, in contrast, the proportions of respondents across the 4 categories is the lowest for Czech Republic, alluding to the differences in sizes in country samples, this is shown in figure 8.

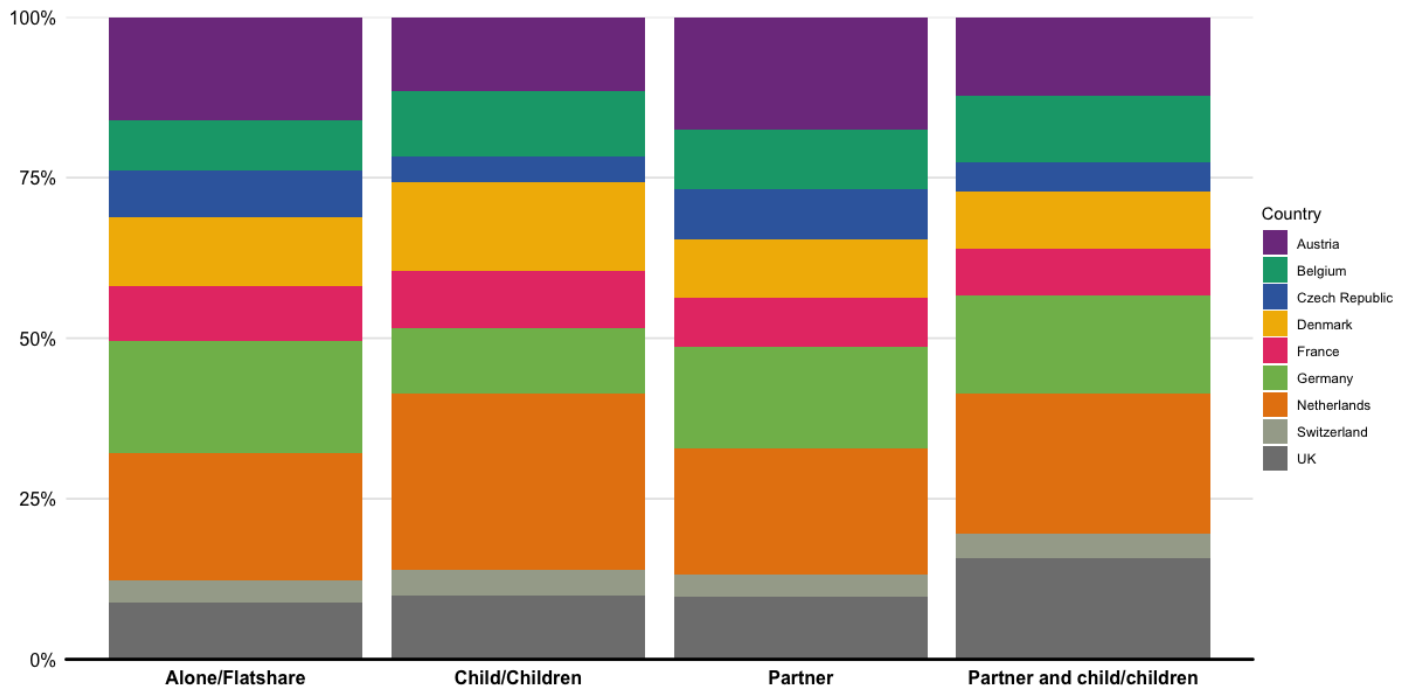


Figure 8: Distribution of living situation by country

## Expenditure

The final demographic variable of interest is the respondent's weekly expenditure on groceries. Given that the data was gathered across countries, the values in this dataset are in the respective currencies of each country. Nevertheless, the categories include 6 categories corresponding to lower and higher values in each currency. It might be useful to compare the weekly expenditure of some countries using the same currency. Figure 9 compares Austria, France, and Germany, suggesting that respondents in these countries have similar expenditure patterns, with the highest number of respondents spending between €40-59, in Austria and Germany, and between €60-79 in France.



Figure 9: Distribution of grocery expenditure, France, Germany and Austria

### 3.5 Relationship Between Variables

It might be interesting to explore the correlations between the variables. All the variables are positively correlated. The correlation between the satisfaction with plant-based dairy consistency and taste stands out, as they are strongly correlated (0.75). With regards to the correlation between the satisfaction variables and the plant-based index score, there doesn't seem to be any strong positive correlations, the strongest correlation is with plant-based dairy taste (0.25), meanwhile the lowest is with nutrition and naturalness (0.08 for both).



Figure 10: Correlation between plant-based index and satisfaction with attributes of plant-based dairy

The figure below demonstrates the differences in this relationship across countries, with a line of best fit. The plot suggests that the relationship is the most pronounced for the UK and Switzerland, i.e., the slope is steeper relative to other countries, in contrast, this is less so the case for Belgium.

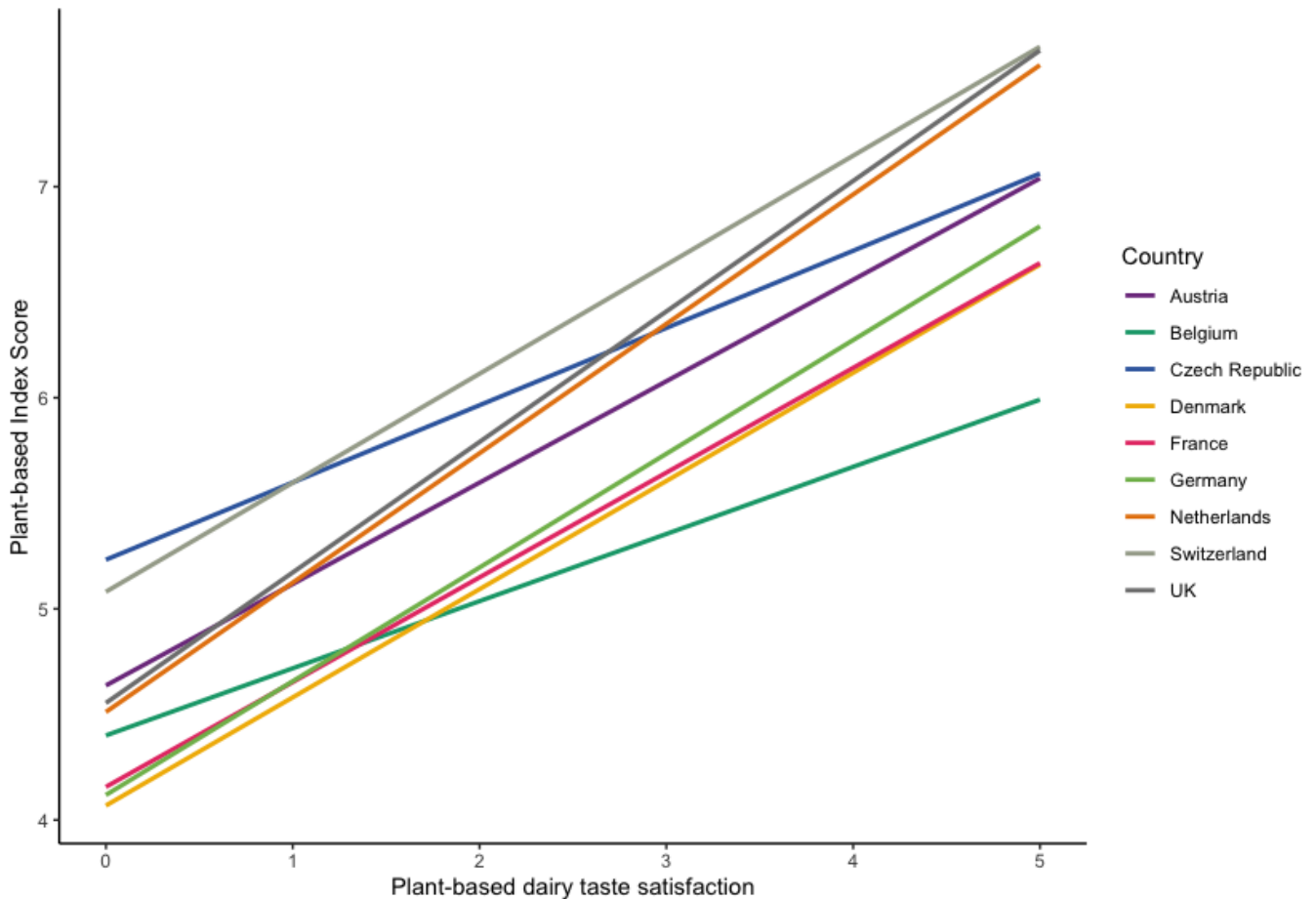


Figure 11: Relationship between plant-based index and satisfaction with taste of plant-based dairy

The correlations between the satisfaction variables for the plant-based meat/fish are stronger than for plant-based dairy. As with the plant-based dairy category, the correlation between taste and consistency is also present, however it is much higher (0.90). The correlations between convenience, consistency, and taste are relatively high (0.81 and 0.82, respectively), this degree of correlation was not seen for plant-based dairy. Moreover, there seems to be a strong positive correlation between appearance, consistency, taste, and convenience (0.76), this was not observed for plant-based dairy. However, the two categories are similar in that the correlation between satisfaction measures and plant-based index score is very low, as was the case for plant-based dairy, the highest correlation with plant-based index score is with taste (0.25).

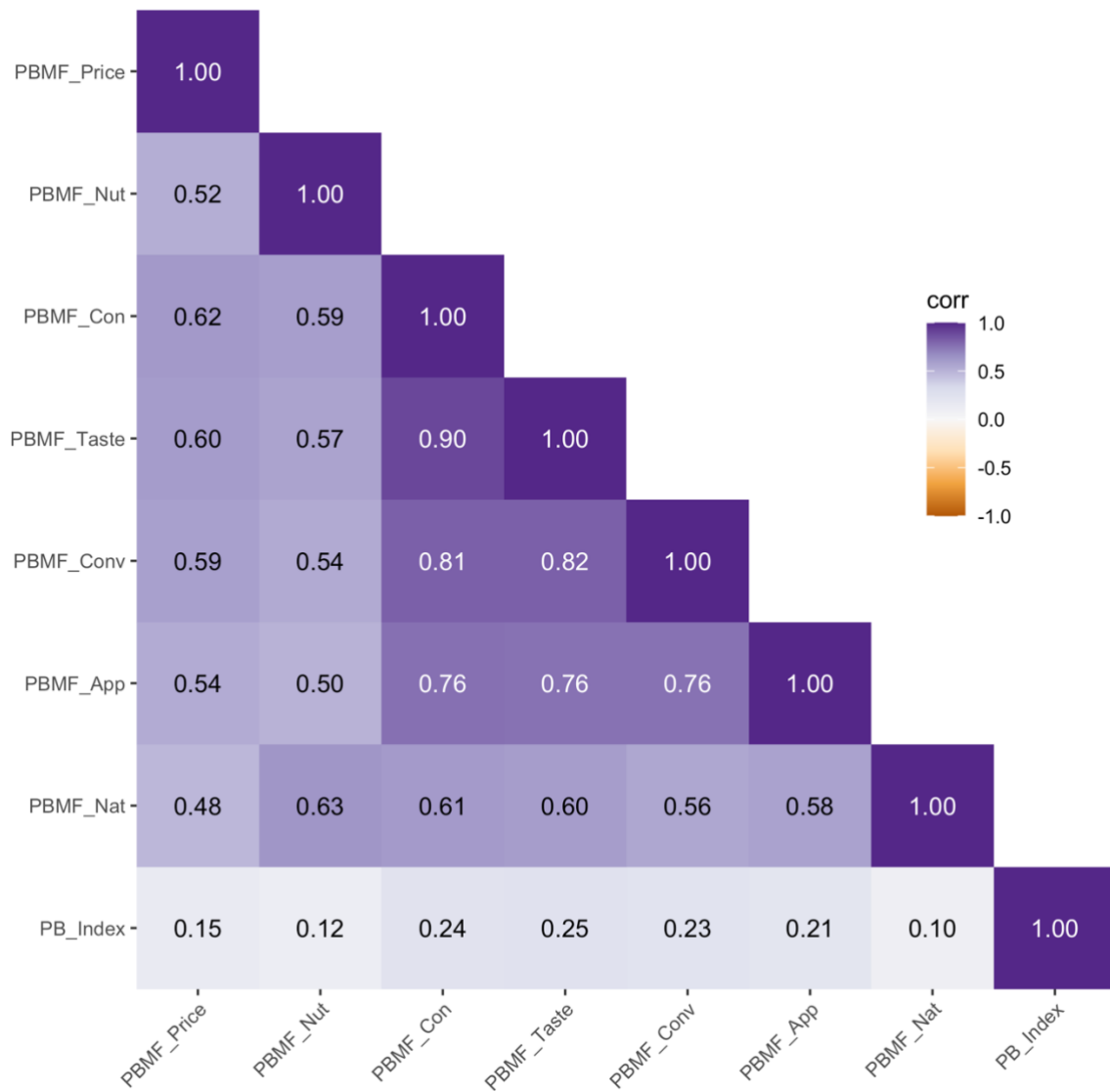


Figure 12: Correlation between plant-based index and satisfaction with attributes of plant-based meat/fish

The relationship between satisfaction with the taste of plant-based meat/fish and plant-based index score, can be further explored. Once again, the relationship is positive for all countries, however, at different rates, indicating that similar relationships are experienced for both categories, across countries.

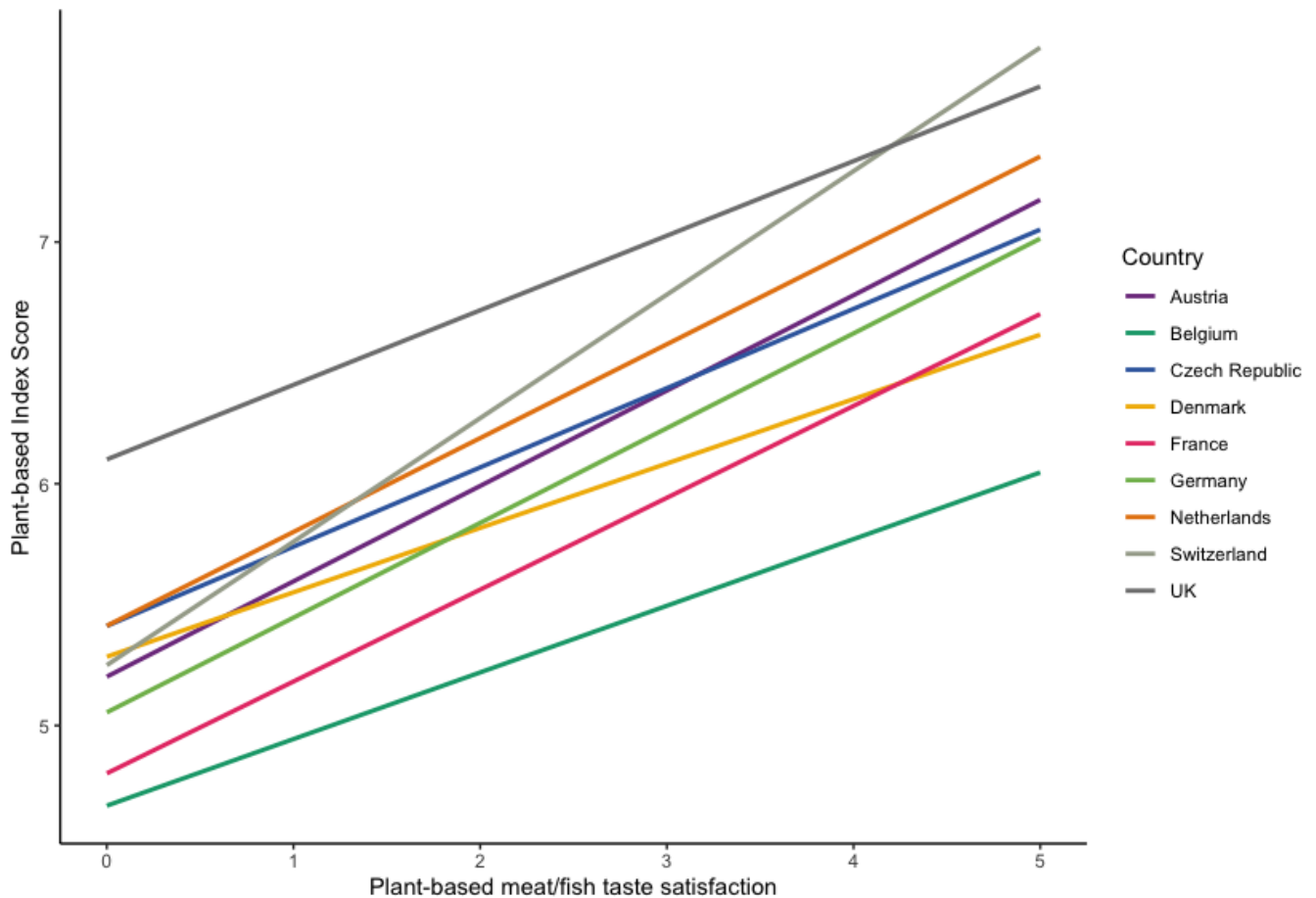


Figure 13: Relationship between plant-based index and satisfaction with taste of plant-based meat/fish

Some of the findings presented in this section will be tested for statistical significance in the following chapter, particularly those pertaining to the hypothesis outlined in the previous section. These include differences between the plant-based index scores of countries and differences in the satisfaction with the attributes of the two plant-based categories across countries.



## 4.0 Analysis and Results

### 4.1 Differences in Satisfaction with Plant-based Dairy Attributes

To determine whether the differences in the satisfaction with attributes of plant-based dairy between the countries is statistically significant and to test *H1-H7*, a one-way ANOVA analysis was used. The findings indicate that the differences in the satisfaction with all the attributes with plant-based dairy between the countries are statistically significant. For the satisfaction with price of plant-based dairy ( $F_{(8,6251)}=9.916, p<0.001$ ), nutrition ( $F_{(8,6251)}=9.956, p<0.001$ ), consistency ( $F_{(8,6251)}=6.348, p<0.001$ ), taste ( $F_{(8,6251)}=6.777, p<0.001$ ), convenience ( $F_{(8,6251)}=8.741, p<0.001$ ), appearance ( $F_{(8,6251)}=8.176, p<0.001$ ), and finally naturalness ( $F_{(8,6251)}=4.043, p<0.001$ ). This supports *H1-H7*, these findings are summarised in figure 14.

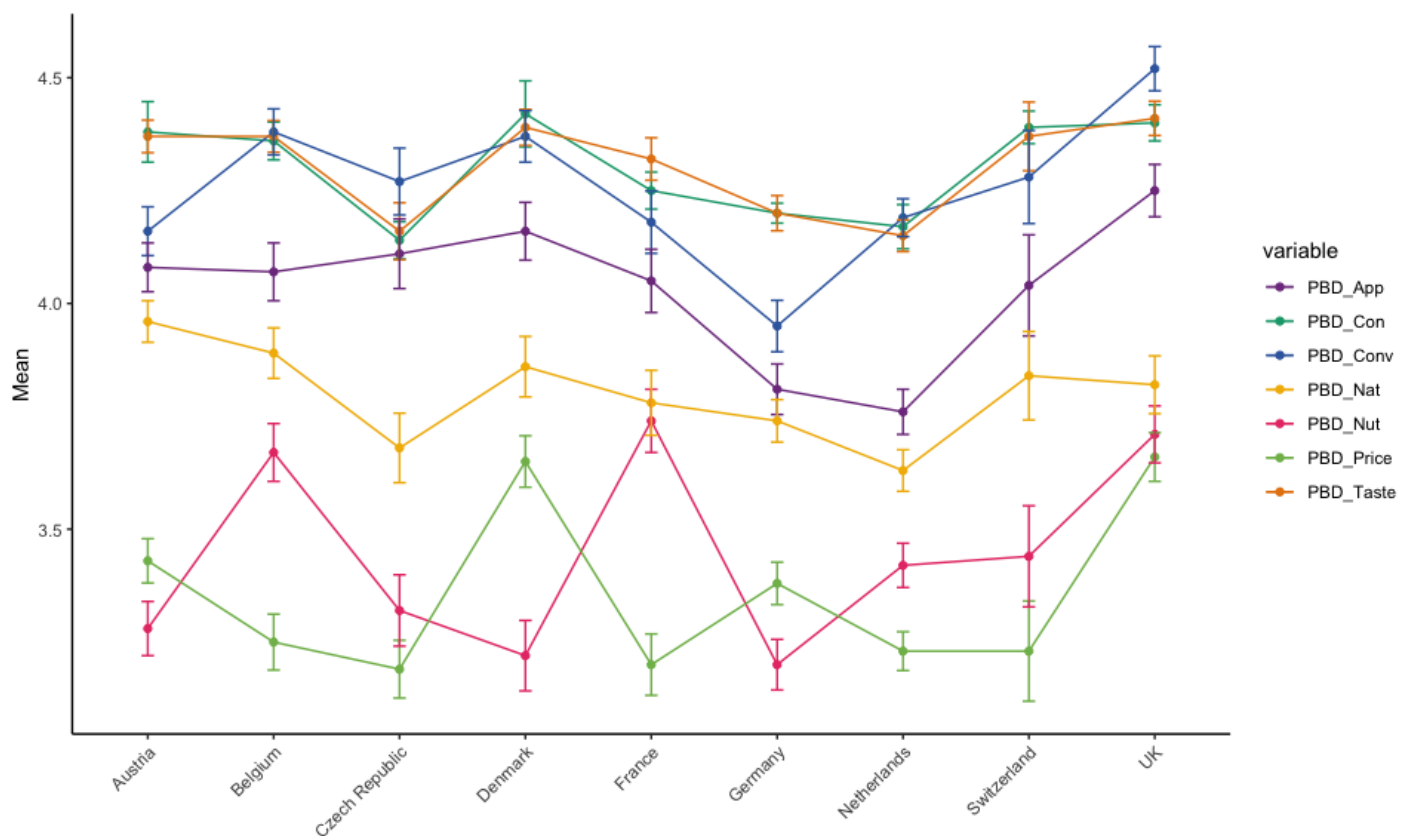


Figure 14: Mean satisfaction values for plant-based dairy attributes by country

## 4.2 Differences in Satisfaction with Plant-based Meat/Fish Attributes

To determine whether the differences in the satisfaction with attributes of plant-based meat/fish between the countries is statistically significant and to test *H1-H7*, a one-way ANOVA analysis was used. The findings indicate that the differences in the satisfaction with all the attributes with plant-based meat/fish between the countries are statistically significant. For the satisfaction with price of plant-based meat/fish ( $F_{(8,6251)}=24.773, p<0.001$ ), nutrition ( $F_{(8,6251)}=46.456, p<0.001$ ), consistency of plant-based meat/fish ( $F_{(8,6251)}=30.090, p<0.001$ ), taste ( $F_{(8,6251)}=24.043, p<0.001$ ), convenience ( $F_{(8,6251)}=31.779, p<0.001$ ), appearance ( $F_{(8,6251)}=19.252, p<0.001$ ), and finally naturalness ( $F_{(8,6251)}=29.040, p<0.001$ ). This supports *H1-H7*, the findings are summarised in the figure 15

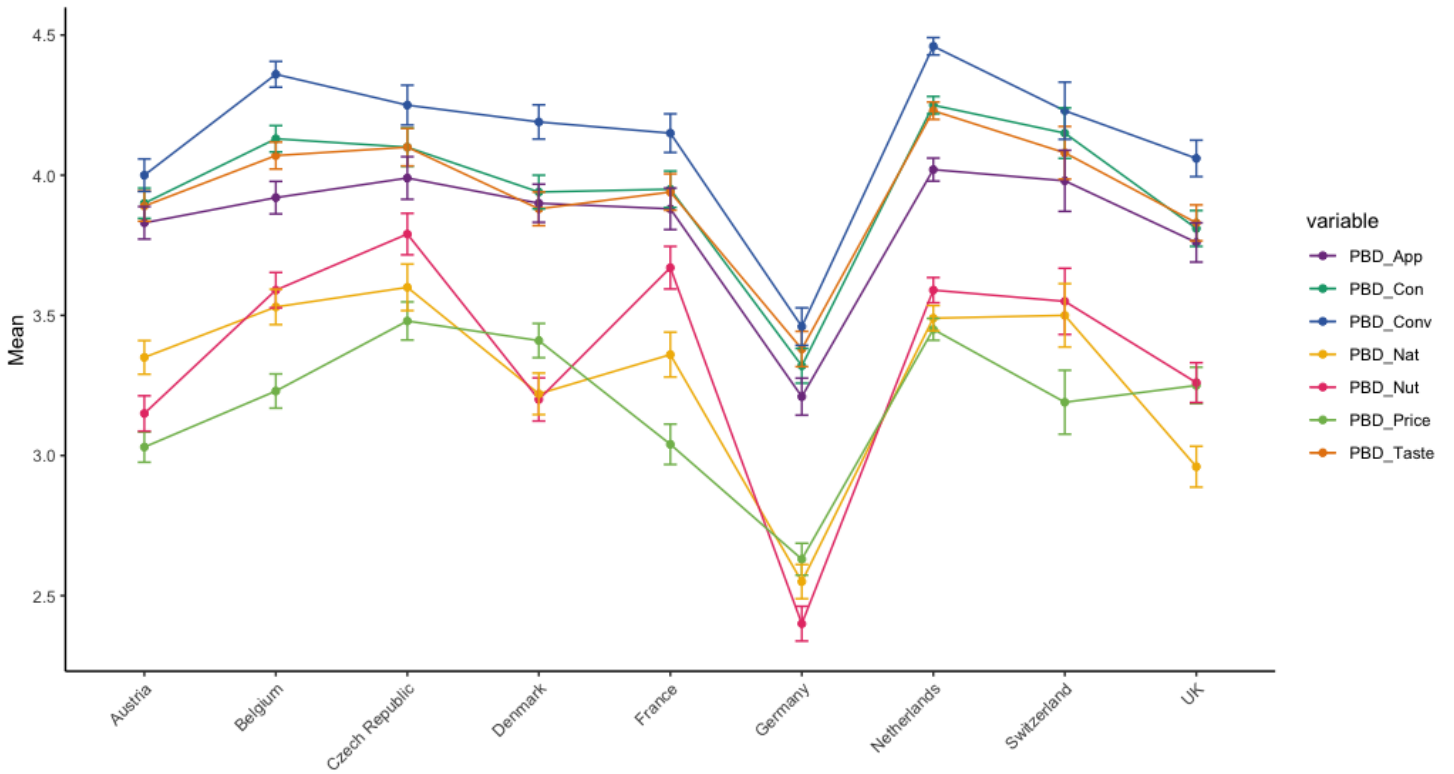


Figure 15: Mean satisfaction values for plant-based meat/fish attributes by country

### 4.3 Differences Between the Satisfaction with Plant-based Dairy and Meat/Fish Within Countries

To identify whether there was a statistically significant difference between the satisfaction with plant-based dairy and plant-based meat/fish within the countries, a mixed ANOVA analysis was used. The results support the hypothesis that there is a significant difference between the satisfaction with the attributes of the plant-based categories, between countries. There was a statistically significant difference in the satisfaction with product categories between product categories ( $F_{(13,81263)}=465.684$ ,  $p=0.000$ ,  $\eta_p^2=0.069$ ). Furthermore there was a statistically significant main effect of country on the satisfaction with the plant-based categories ( $F_{(13,81263)}=25.658$ ,  $p<0.001$ ,  $\eta_p^2=0.032$ ). Finally the results demonstrate that there was a statistically significant difference in satisfaction by country interaction ( $F_{(104,81263)}=16.721$ ,  $p<0.001$ ,  $\eta_p^2=0.021$ )<sup>3</sup>.

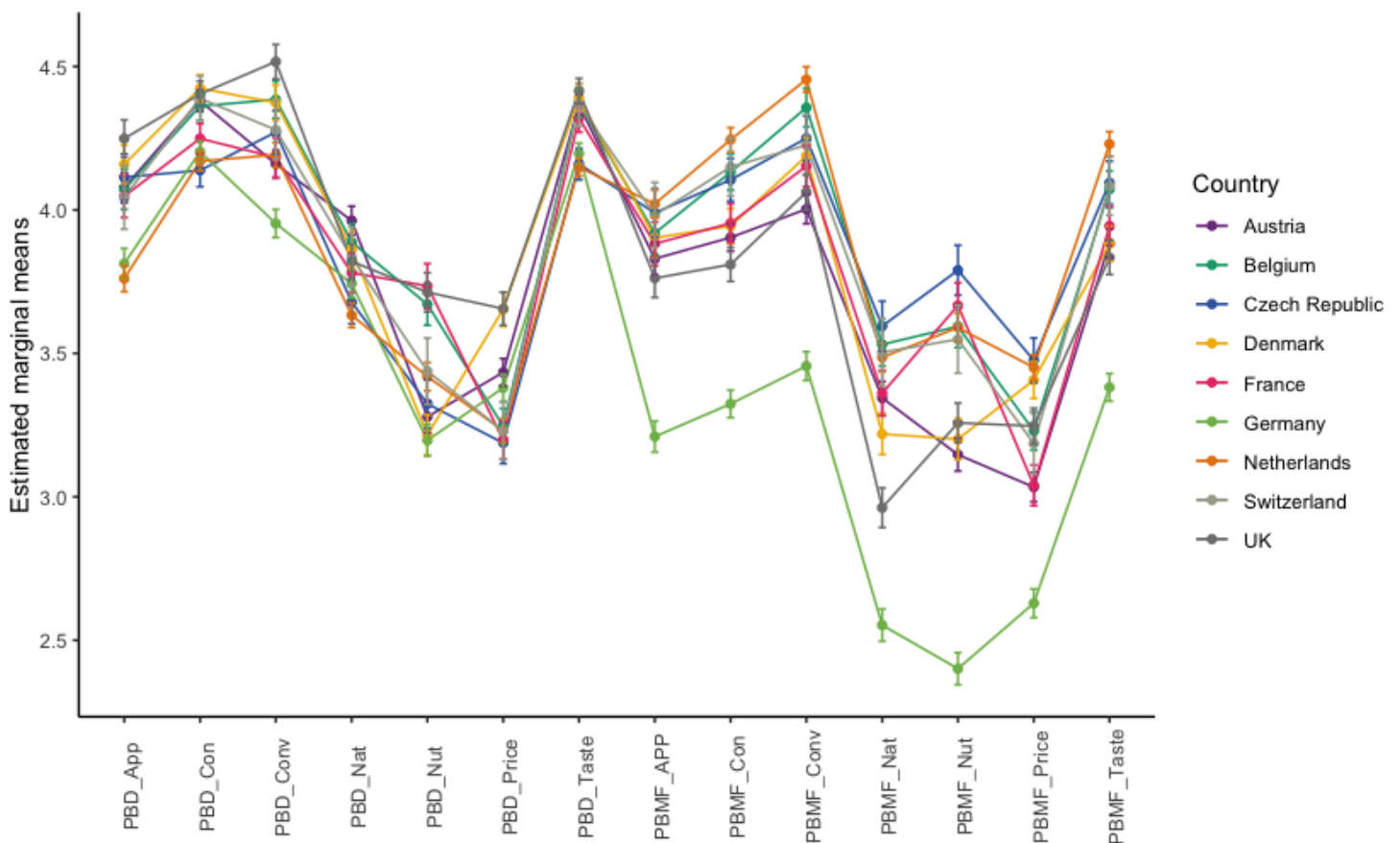


Figure 16: Estimated marginal means for each category attribute by country

<sup>3</sup> See appendix B for full mixed ANOVA results and post-hoc test.

#### 4.4 Differences Between the Plant-based Index of Countries

To determine whether the differences in the plant-based index scores between the countries is statistically significant and to test  $H_8$ , a One-way ANOVA was used. The findings indicate that the differences in plant-based index scores between the countries is statistically significant ( $F_{(8,6251)}=29.282$ ,  $p<0.001$ ).

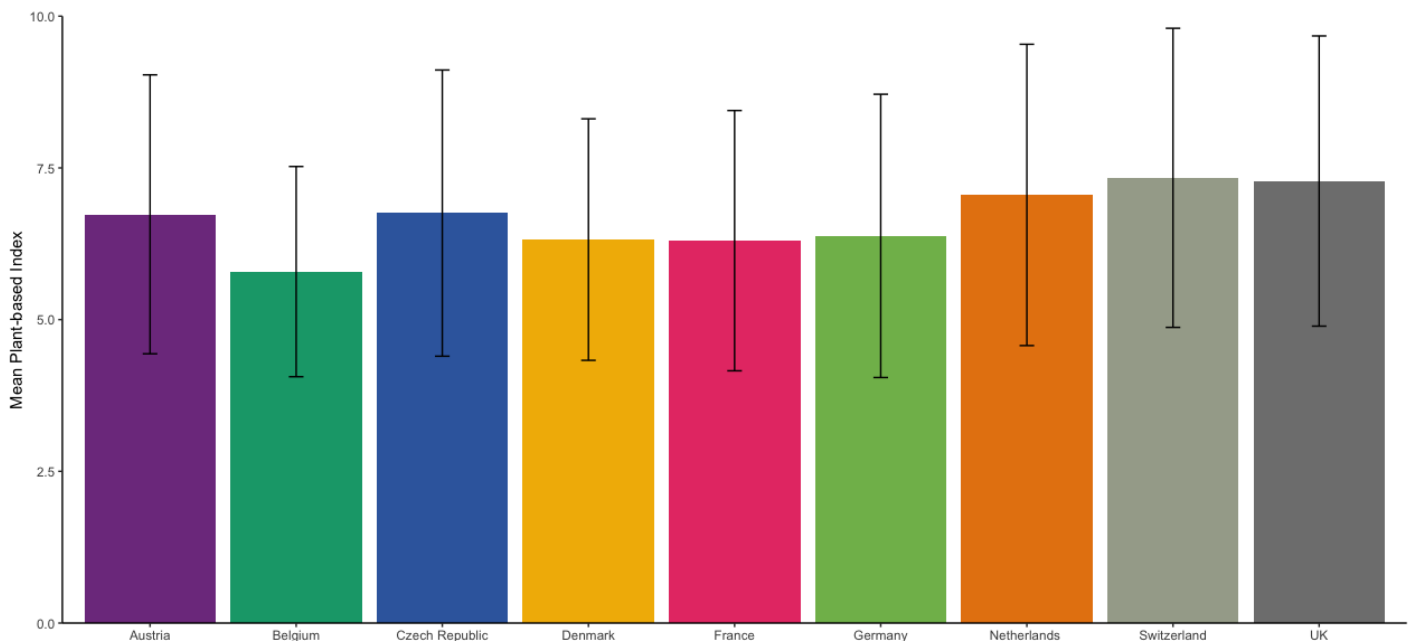


Figure 17: Mean plant-based index score by country

A post-hoc Tukey HSD test was performed to determine between which of the various pairs of means the difference is significant. The post hoc test showed that the differences in the plant-based index between *Germany* and the other countries is statistically significant ( $p<0.05$ ), except between *France* ( $p=0.999$ ), *Denmark* ( $p=1.000$ ), and *Czech Republic* ( $p=0.107$ ). In contrast, the differences in plant-based index between the *UK* and other countries was statistically significant ( $p<0.05$ ), except between *Netherlands* ( $p=0.471$ ) and *Switzerland* ( $p=1.000$ ). The difference in plant-based index between *Belgium* and all other countries was statistically significant ( $p<0.05$ ). For *France*, apart from the relationship with *Germany* described above, the differences were also not statistically significant between *Denmark* ( $p=0.065$ ) and *Czech Republic* ( $p=1.000$ ). For *Netherlands*, apart from the non-significant relationship with the *UK*, there is also a non-significant difference between *Switzerland* ( $p=0.737$ ) and *Czech Republic* ( $p=0.318$ ). For *Switzerland*, apart from the differences already accounted for, the differences between other countries were significant

( $p=0.05$ ,  $p<0.05$ ). Similarly, for *Denmark*, apart from the already considered differences, there is no statistically significant difference between Czech Republic ( $p=0.062$ ). Finally, for *Czech Republic*, considering the non-statistically significant differences already accounted for, there was no statistically significant difference between Austria ( $p=1.000$ )<sup>4</sup>.

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<sup>4</sup> See appendix C, for full post-hoc results.

## 5.0 Discussion

### 5.1 Differences Between the Plant-based Index of Countries

The findings in this study confirm preconceived notions evident in the literature when it comes to discrepancies in plant-based food alternatives consumption across countries. Findings in the existing literature concerning plant-based foods consumption can be conceptualised along two main paradigms. On the one hand, relevant insights demonstrate differences between countries pertaining to consumption of plant-based foods across countries, on the other, the differences between countries concerning the consumption of a specific plant-based alternative between a select few countries. This study expands upon this notion, seeking to merge the two, by providing a more comprehensive measure of plant-based consumption, encompassing the range of plant-based foods identified by ProVeg International (a cumulative 15 products), and expanding the scope to 9 European countries. Thereby confirming the hypothesis that there is a statistically significant difference between the plant-based index between countries. This result is consistent with the literature.

In addition, a post-hoc test confirms that the differences between the pairs of means of countries is statistically significant, albeit at varying levels. This adds to the idea of plant-based food consumption across Europe and establishes the extent to which this difference is evident between countries. Incorporating a plant-based index into future research will increase the robustness of comparisons across countries when comparing consumer behaviour regarding plant-based food alternatives.

### 5.2 Differences in the Attributes of Plant-based Dairy and Meat/Fish

#### 5.2.1 Price

Consumer attitudes towards price of plant-based food alternatives has been identified as one of the main barriers towards plant-based food adoption. In this respect, the findings of this study confirm this insight, comparing two plant-based food categories in 9 countries. In absolute terms, the evidence suggests that satisfaction with plant-based dairy and meat/fish is

still lacking and can be improved. The findings confirm that there is a statistically significant difference between the satisfaction with plant-based dairy prices across country. This implies that different countries have different levels of satisfaction with plant-based dairy alternatives. In reference to the literature the evidence also confirms that the identified perception of satisfaction of price also applies to the countries in the sample.

The difference between the satisfaction with the price of plant-based meat between countries was also significant. This indicates that the countries have different levels of satisfaction with the price of plant-based meat. In addition to establishing the difference between the countries, a mixed ANOVA confirmed that the difference between the satisfaction with the price of plant-based dairy and plant-based meat/fish within each country, is statistically significant. For instance, let's consider Germany and the UK. In Germany the satisfaction with price is higher for plant-based dairy than for plant-based meat/fish. In contrast, the same applies for UK albeit the respective satisfaction levels are much higher. In fact, apart from in two countries (Czech Republic & Netherlands) the satisfaction with price is greater for the plant-based dairy alternative than the plant-based meat/fish. This is shown in figure 18.

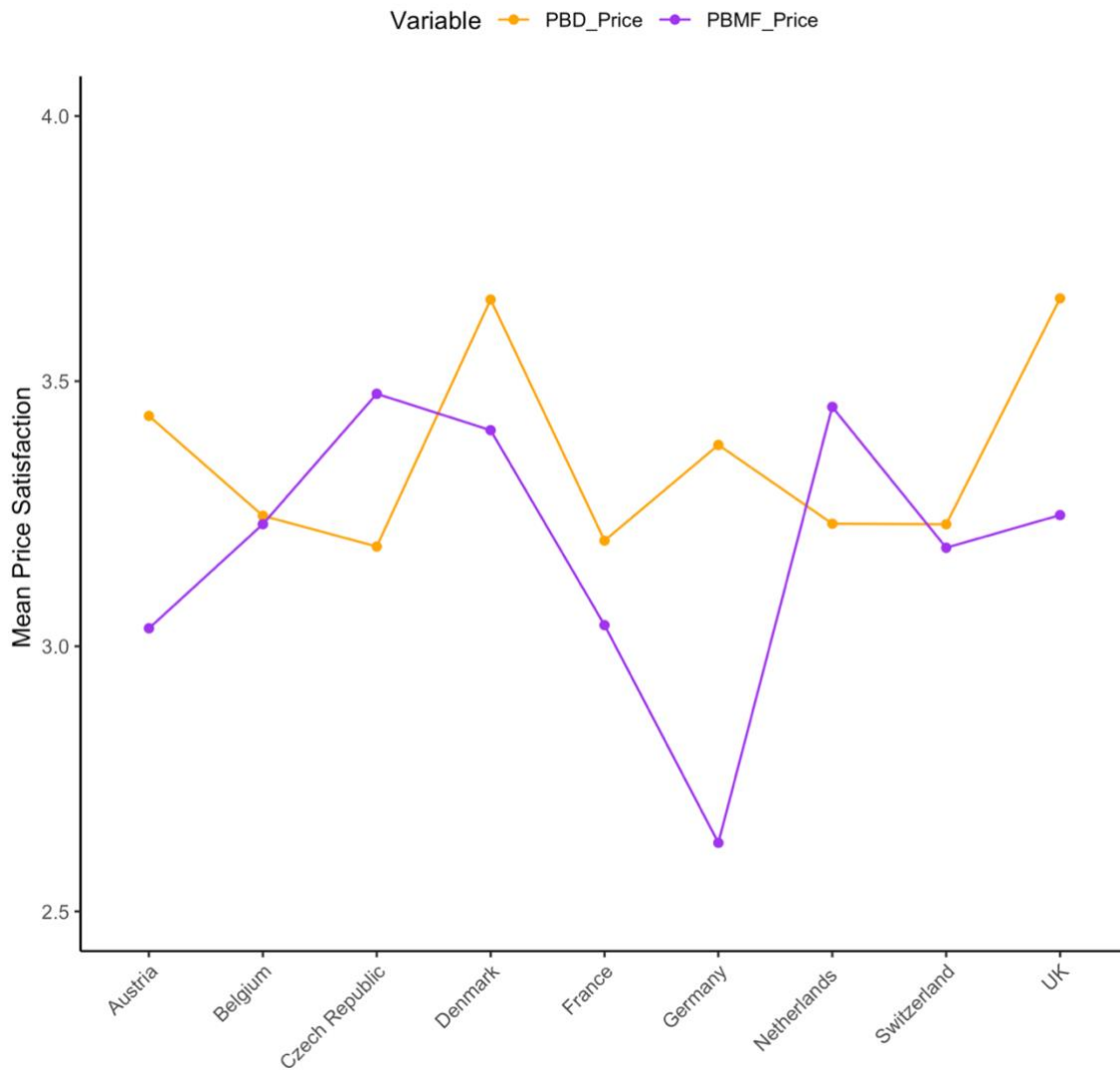


Figure 18: Mean price satisfaction for both categories by country

### 5.2.2 Nutrition

The nutrition of plant-based alternatives has also been a one of the identified barriers to plant-based food adoption. The findings confirm some of the concerns with nutritional aspects of plant-based foods, expressed in the literature. Establishing that there is a statistically significant difference between the satisfaction with the nutrition of both alternatives across countries, therefore supporting the hypothesis. In addition, the results from the mixed ANOVA indicate that the difference within countries is statistically significant.

Figure19 demonstrates the satisfaction with nutrition of the plant- based alternatives can still be improved particularly plant-based meat/fish, as most evident by the dissatisfaction expressed in Germany. Whereas the satisfaction with nutrition of plant-based meat/fish is



higher than plant-based dairy in 3 countries (Czech Republic, Netherlands, and Switzerland), the inverse is true in the remaining 6 countries. This suggests that relative to each other, the category that is considered as most nutritious out of the two, is plant-based dairy. As the literature points out, this might be due to the practice of fortification of plant-based dairy products. Nevertheless, the difference between the two categories and within the countries is confirmed.

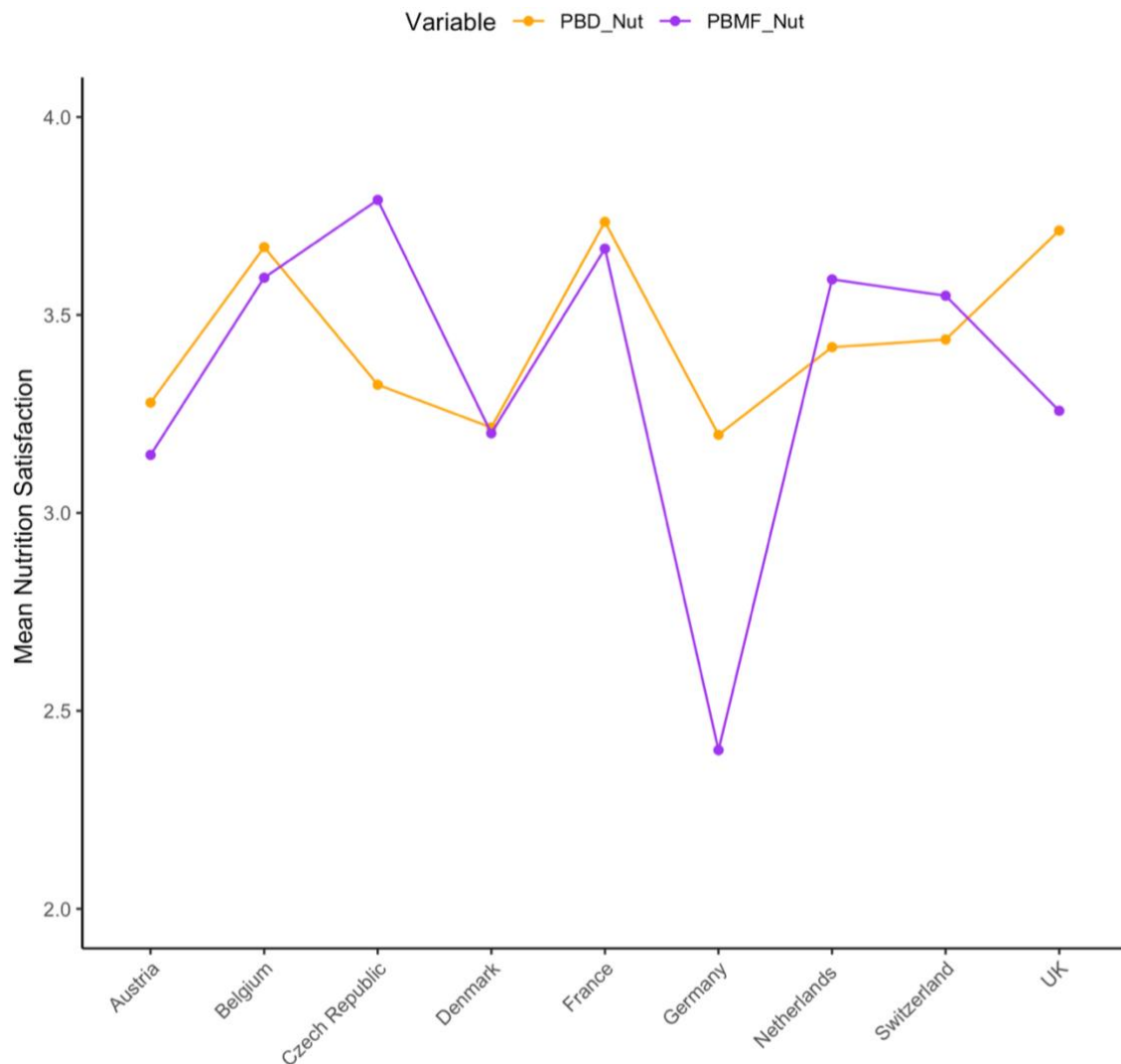


Figure 19: Mean nutrition satisfaction for both categories by country

### 5.2.3 Consistency

The results confirm a statistically significant difference in the satisfaction with the consistency of plant-based between countries. This insight builds upon the existing literature, confirming that the lack of adequacy in the consistency of plant-based dairy is not exclusive

to one market, but rather is evident across markets to varying degrees. This supports the hypothesis that the difference in the satisfaction with plant-based dairy is statistically significant between countries. This can be attributable to certain aspects of plant-based dairy such as appearance, which inevitably also affect satisfaction with other attributes. Thus, the differences between countries in terms of preference for consistency of plant-based dairy alluded to in the literature is present across the 9 countries in the sample.

In contrast a statistically significant difference in the level of satisfaction with the consistency of plant-based meat/food was also found between the countries. This establishes the lack of satisfaction with the consistency of plant-based meat/fish highlighted in the literature. In addition, a statistically significant difference between the plant-based categories within the countries was found. This suggests that the notion of consumer acceptance/satisfaction with the consistency of plant-based dairy being higher than plant-based meat identified in the literature, applies to the countries in the sample. Upon closer inspection, the difference between the categories within the countries is more pronounced for consistency than the previously discussed attributes, the consistency of plant-based dairy alternatives is consistently rated higher than plant-based meat/fish in all but one country, Netherlands. This is perhaps not too surprising, given the anecdotal evidence that Netherlands has the highest level of *self-declared* meat reducers, as such a higher predisposition to consume plant-based meat alternatives may be influencing satisfaction. These findings are shown in figure 20.

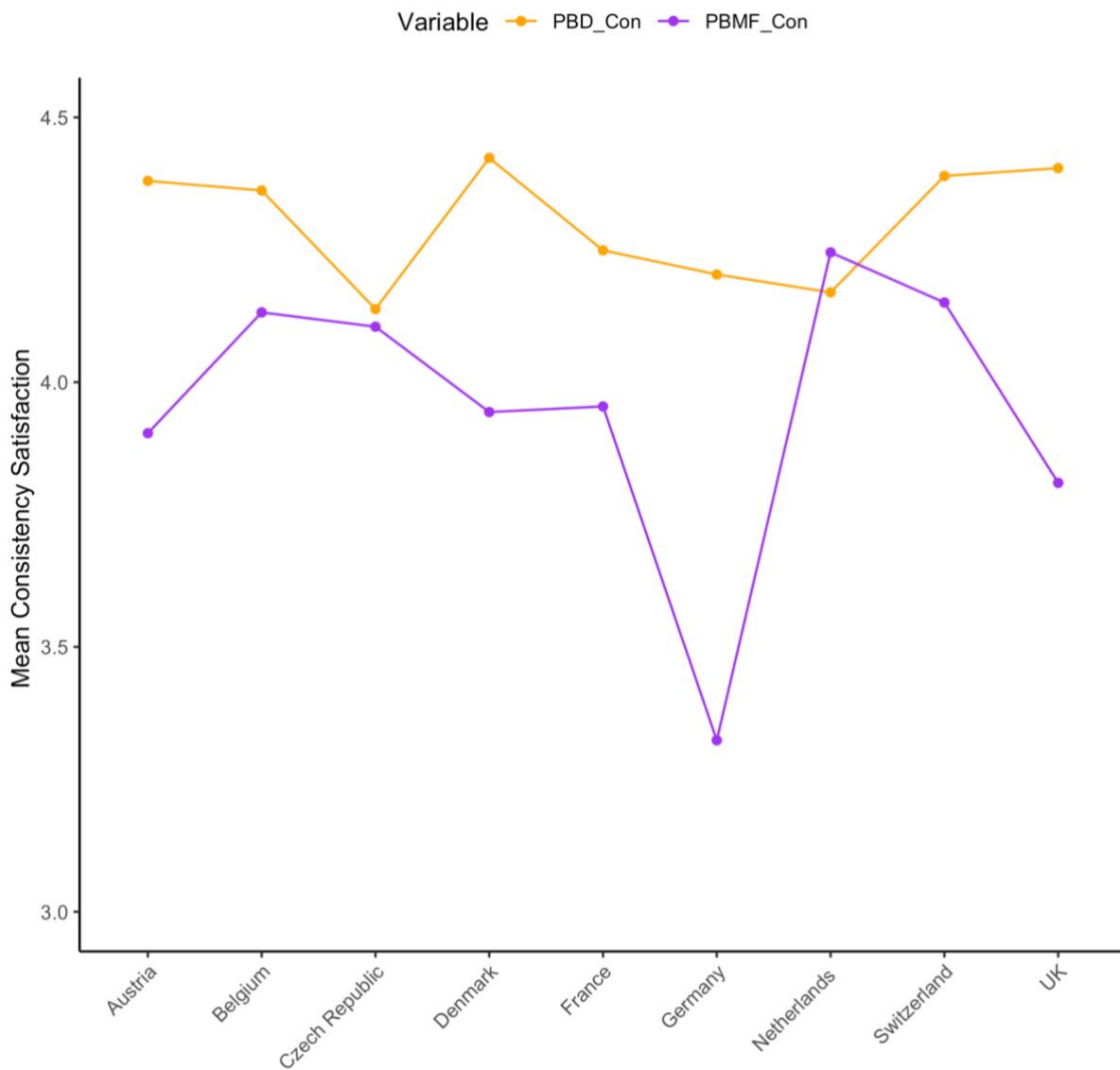


Figure 20: Mean nutrition satisfaction by country

#### 5.2.4 Appearance

On the differences between the level of satisfaction with the appearance across countries, a statistically significant difference was found. The results from a one-way ANOVA demonstrate a statistically significant difference between the satisfaction with the appearance of plant-based dairy alternatives between countries. Similarly, the same findings were evident for the satisfaction with the appearance of plant-based meat/fish. These findings support the hypothesis and suggestions in the literature, that the difference between the levels of satisfaction vary between the countries.

In addition, the difference between the categories within countries was also found to be statistically significant. This is of significance because it presents the extent to which the levels of satisfaction vary between two different plant-based categories within countries. We see that respondents in Netherlands, once again rate plant-based meat/fish appearance higher than that of plant-based dairy. Similarly, the largest discrepancy between the two categories is most stark, in Germany, this was also the case for the satisfaction with the consistency of plant-based alternatives in the country. It is also worth noting that all countries apart from Netherlands, are more satisfied with the appearance of plant-based dairy alternatives than that of plant-based meat/fish.

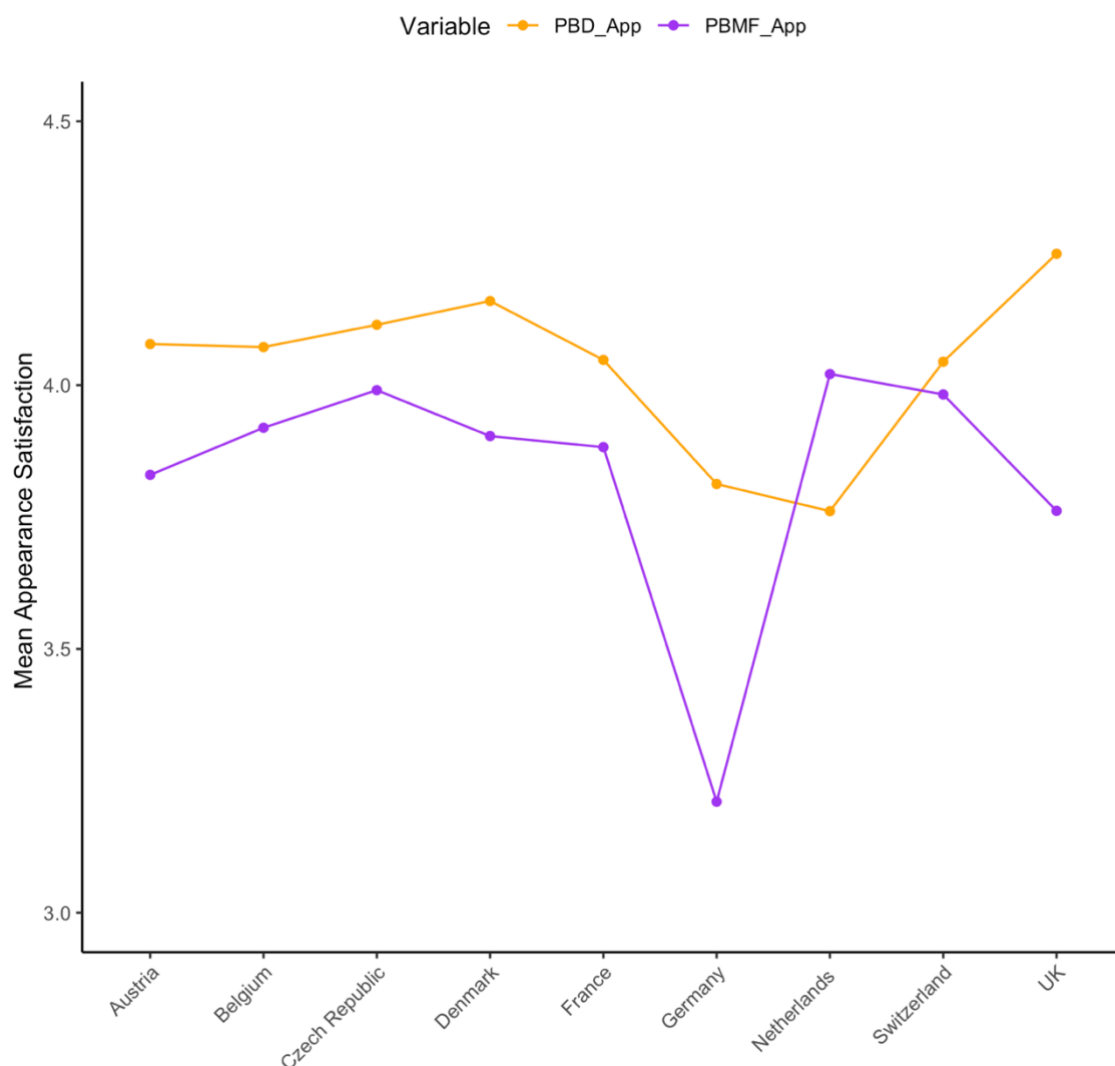


Figure 21: Mean appearance satisfaction by country

### 5.2.5 Taste

Relevant literature has outlined taste as a key driver of food choices, implying that the differences between the satisfaction with taste would be greater for plant-based dairy than plant-based meat/fish. To this end the study sought to establish whether the difference was statistically significant between the countries for each category, and then between the categories within the countries. The findings confirm the notion of taste fluctuations across countries, for the plant-based dairy alternatives, thereby supporting the hypothesis.

For the satisfaction with the taste of plant-based meat/fish, a statistically significant difference was evident across the countries. These findings extend the existing literature in the sense that the extent to which the satisfaction levels vary between the countries for both categories.

Expanding upon these findings, results from a mixed ANOVA confirm that the difference between the levels of satisfaction with the taste between the categories within the countries is statistically significant. This supports the hypothesis and extends the findings in the literature, demonstrating that for all the countries except the Netherlands, the taste of plant-based dairy is rated higher than plant-based meat. Once again, the same pattern as with the previous attributes is evident, that is, the largest difference between the categories being in Germany and Netherlands rating the taste of plant-based meat/fish higher than plant-based dairy. These findings are shown in figure 22.

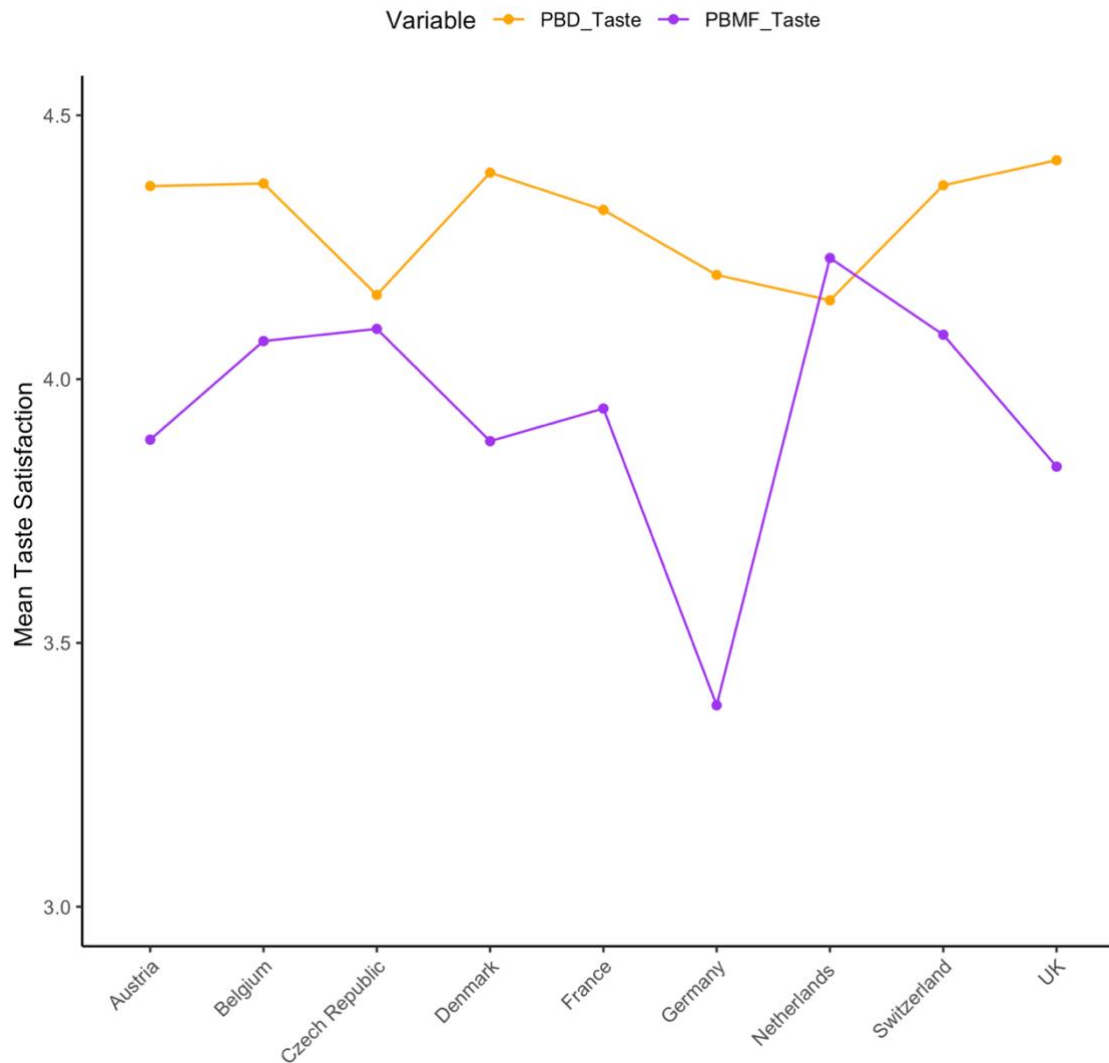


Figure 22: Mean taste satisfaction by country

### 5.2.6 Convenience

Convenience has been dubbed one of the three key drivers of food choices. As such, this study sought to establish whether the differences in satisfaction with convenience between countries were statistically significant. The result from a one-way ANOVA suggests that this is the case. This supports the hypothesis of a statistically significant difference between the countries and builds upon this identified relationship extending it to the countries in the sample. Similarly, the differences in the satisfaction with the convenience of plant-based meat/fish was also statistically significant. Although not explicitly mentioned in the literature, these findings suggest that the variations in the levels of satisfaction with convenience

between the countries is statistically significant, thus it can be concluded that plant-based dairy is considered more convenient than plant-based meat/fish.

Results from a mixed ANOVA demonstrate, the differences in convenience satisfaction between the categories within countries is statistically significant. Although one can conclude that for the most part plant-based dairy is more convenient than plant-based meat/fish, it is not the case for all countries, in fact the previous relationship identified for the other attributes, seems to reproduce itself to some extent, albeit with some significant differences. For instance, the difference between the convenience of the two categories in Germany is still relatively large, however it is smaller than in the previous attributes, once again Netherlands rates plant-based meat/fish higher than plant-based dairy. At an overall level, despite there being a tendency for plant-based dairy to be considered more convenient, the differences are not as large as with previous attributes, suggesting that respondents may perceive both products as in a somewhat similar range of convenience. Nevertheless, the relatively higher convenience of plant-based dairy might be explained by the steps necessary to prepare/cook the categories, the assumption being that it takes more steps or takes longer to prepare plant-based meat/fish. Figure 23 summarises the results.

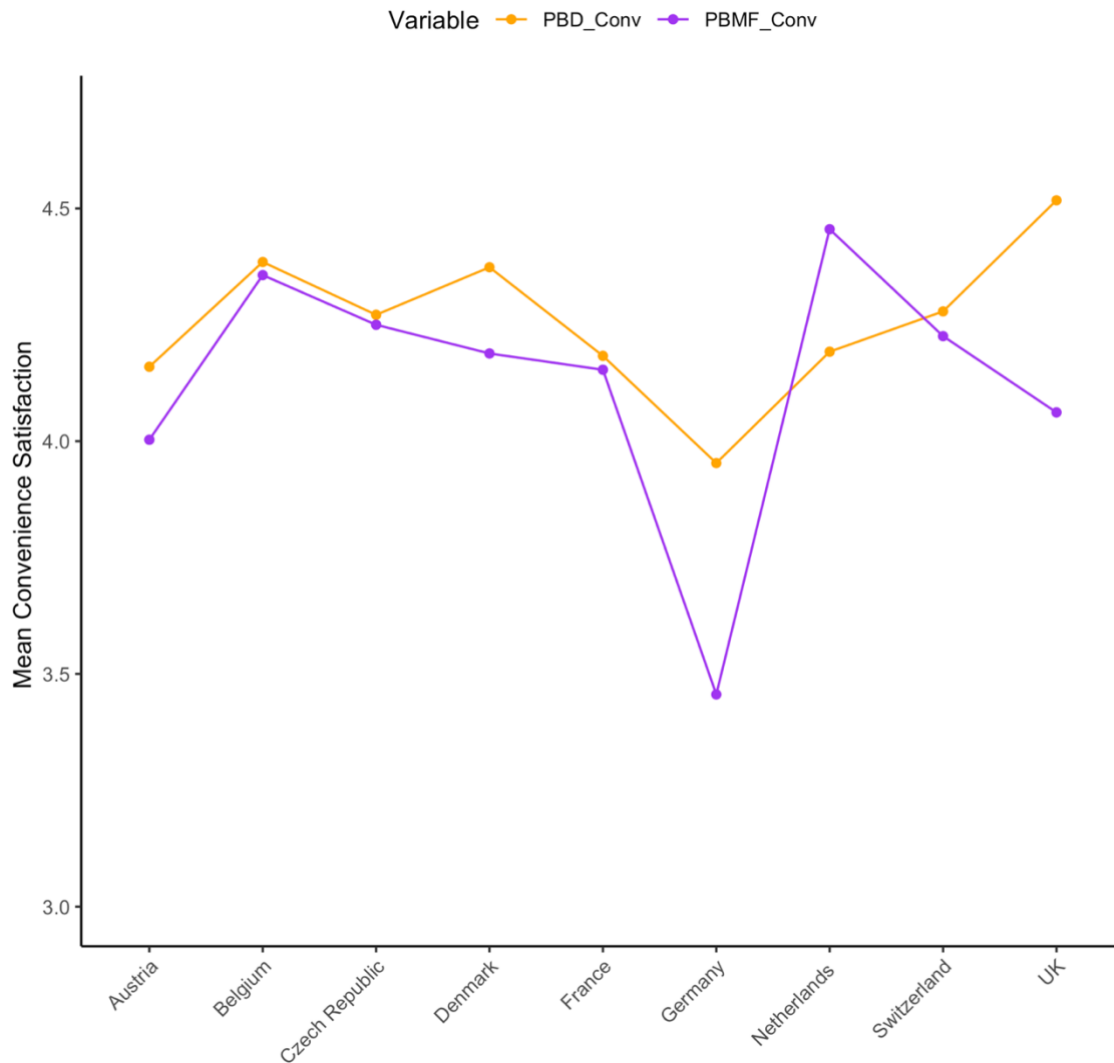


Figure 23: Mean convenience satisfaction by country

### 5.2.7 Naturalness

The naturalness of plant-based alternatives has been a focus in the literature, in specific the extent to which the alternatives are incongruent with the notion of their conventional counterparts. Hence, findings in the literature suggest resolving the incongruity as a means through which adoption or increased perceived naturalness can be stimulated. This has been particularly evident in the case of plant-based meat/fish, where attributes such as texture have negatively contributed towards the perceived naturalness of the product. The results from a one-way ANOVA sought the determine whether the differences in the satisfaction with the naturalness of plant-based dairy is statistically significant between countries. The findings support the hypothesis, establishing the difference as statistically significant, and extends findings in the literature to the countries in the sample. Furthermore, this relationship was



also explored for the plant-based meat/fish category. The difference in the satisfaction with the naturalness of plant-based meat/fish between the countries was found to be statistically significant. This suggests that different countries have different levels of satisfactions with the naturalness of plant-based categories.

A mixed ANOVA determined the extent to which the differences between the categories within the countries was statistically significant. The findings support the hypothesis and confirm the notion that plant-based dairy is considered as more natural than plant-based meat/fish. The satisfaction with naturalness of the two categories stands out relative to the other attributes, this is because plant-based dairy is singlehandedly considered more natural in every country. This is even the case for Netherlands, which previously rated plant-based meat/fish higher than plant-based dairy for all other attributes. Future research may wish to further explore why this may be the case. Nevertheless, for the time being, it can be concluded that plant-based dairy alternatives are considered more natural than plant-based meat. The figure 24 demonstrates these findings.

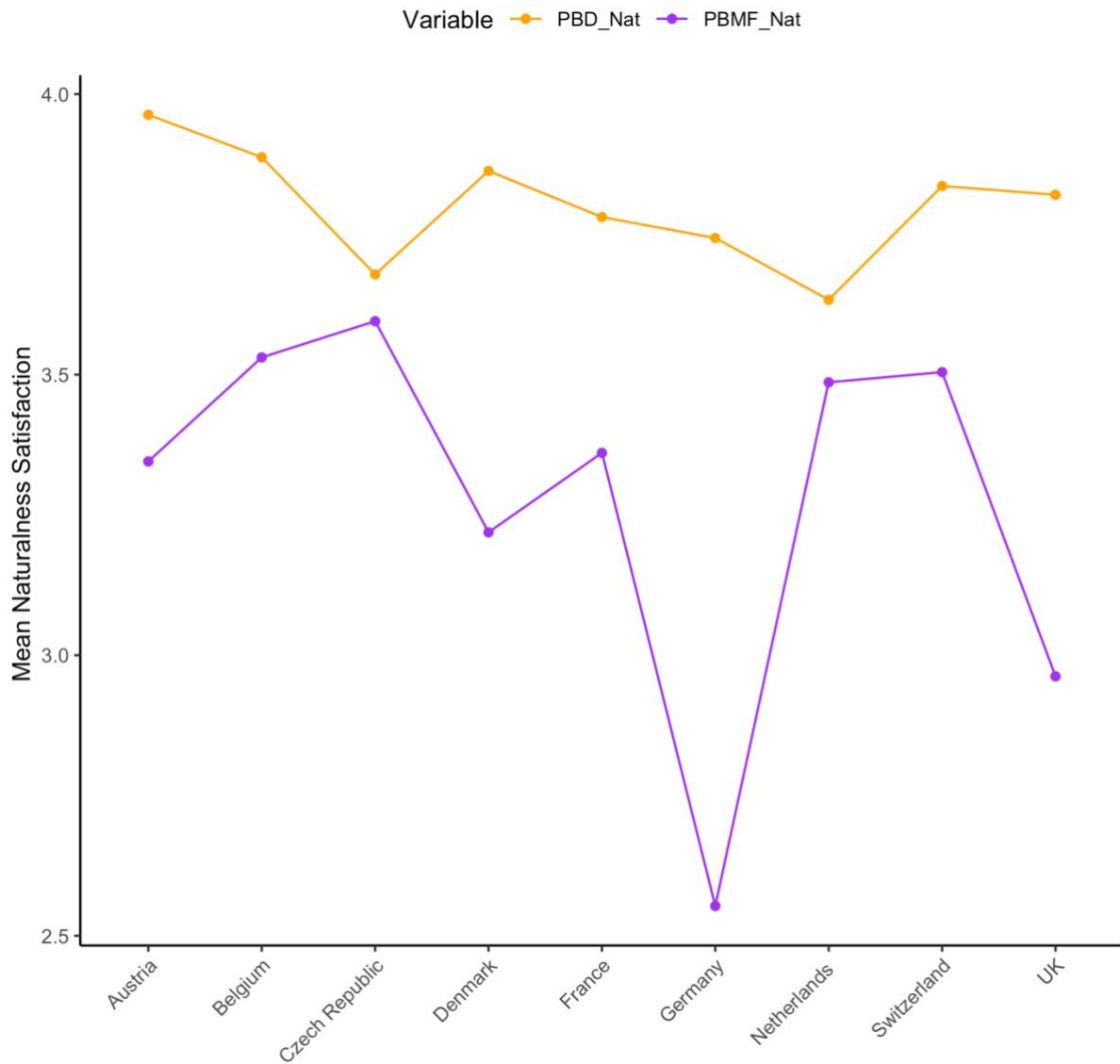


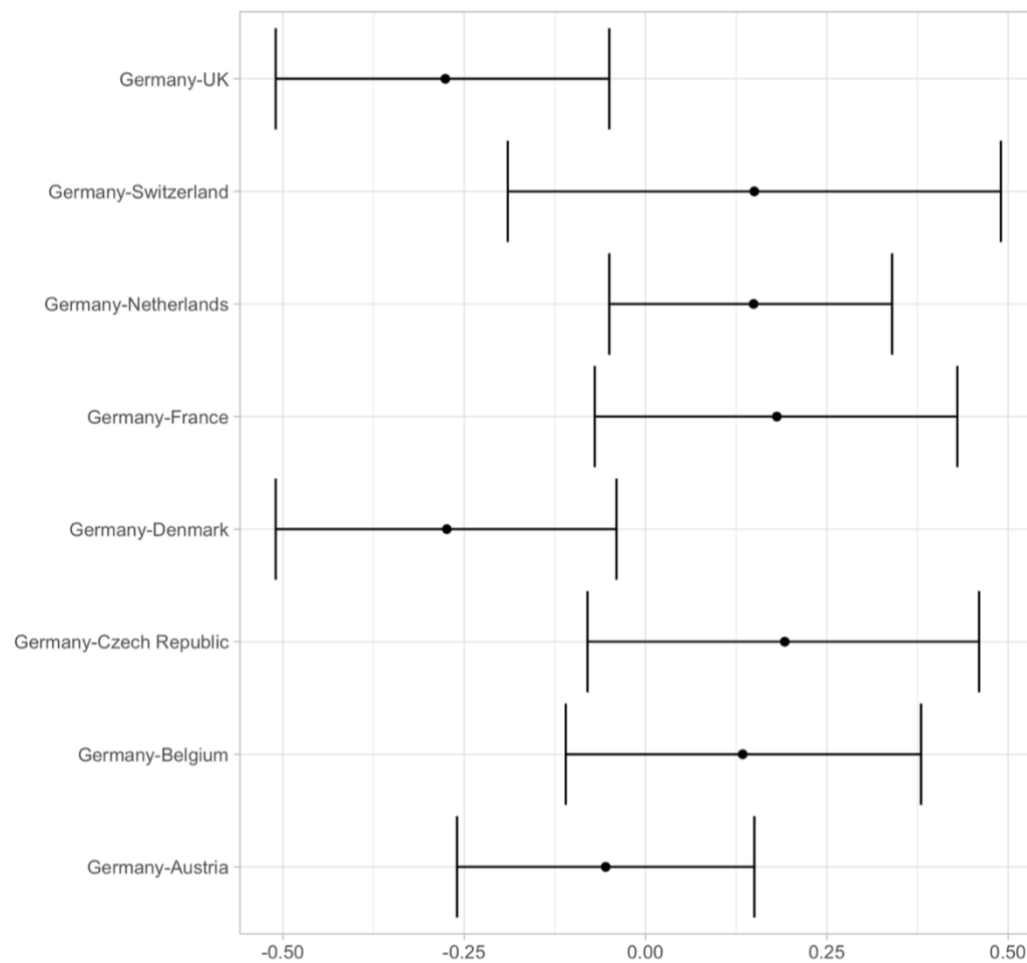
Figure 24: Mean naturalness by country

## 5.2 Managerial Implications

### 5.2.1 Germany in Focus: A Marketing Perspective

Given that the client is based in Germany, it might be interesting to gain a further understanding of the statistical significance between the different pairs of means, thereby determining between which countries the difference is statistically significant. For this the focus will be on the price attribute, as it is a core component of the marketing mix and is arguably the most easily manipulable attribute of the ones being measured. To determine this

a post-hoc Tukey HSD test was done. Figure 25 demonstrates the results for the satisfaction with the price of plant-based dairy, at a 95% confidence interval level.



*Figure 25: Post-hoc Tukey test, comparison of pairs of means at 95% confidence interval*

The differences in the means in the satisfaction with plant-based dairy, the only differences that are statistically significant are Germany-UK and Germany-Denmark. In other words, both Denmark and UK are substantially more satisfied with the price of plant-based dairy. In terms of the differences with Germany and the remaining countries, there is no statistically significant difference, implying that these countries have similar levels of satisfaction with the price of plant-based dairy. The implications of this for ProVeg International are two-fold. First, ProVeg can advocate for the reduction in prices of plant-based dairy in Germany, looking to the UK and Denmark as case studies. Second, these findings lay the foundation for a regionalised approach to strategic marketing decisions. In other words, ProVeg can suggest to companies in the plant-based dairy space that there may merit in adopting a regional

approach whereby based on the differences in levels of satisfaction, a unified strategic effort towards improving price satisfaction in the respective markets. Such an approach may be envisioned by the dichotomy of *price satisfied* and *price dissatisfied* markets, where the former include Denmark and UK and the latter the remaining countries. This might be an oversimplification and thus should be considered in the broader context of strategic decisions relating to the marketing mix, and of course with the assumption that Germany is the starting point for comparison. Nevertheless, a similar analysis can be done at a country specific level, if the client wishes to do so, to benchmark current satisfaction relative to other countries and whether the levels differ significantly.

Similarly, to determine the same but for the satisfaction with the price of plant-based meat/fish a post-hoc Tukey HSD was done. Figure 26 demonstrates the results, at a 95% interval level.

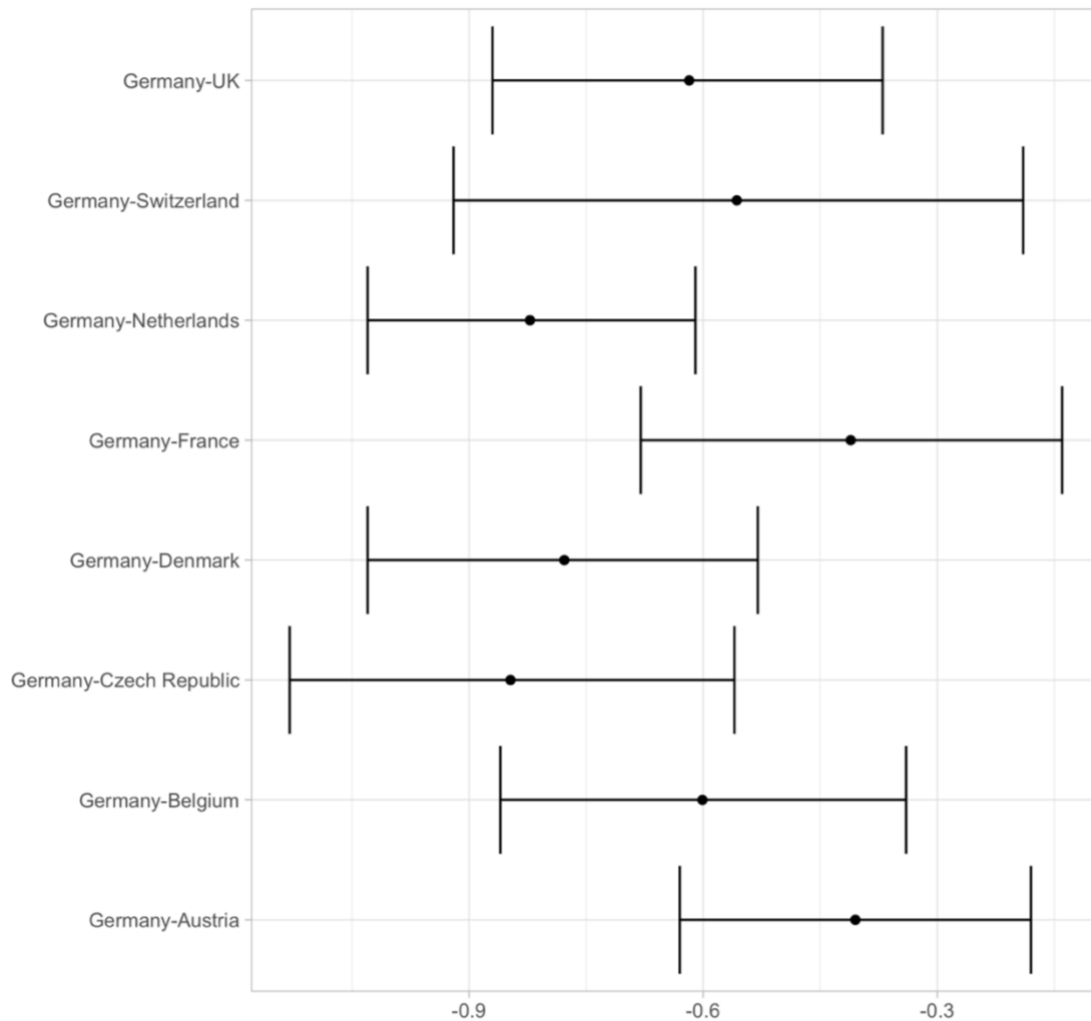
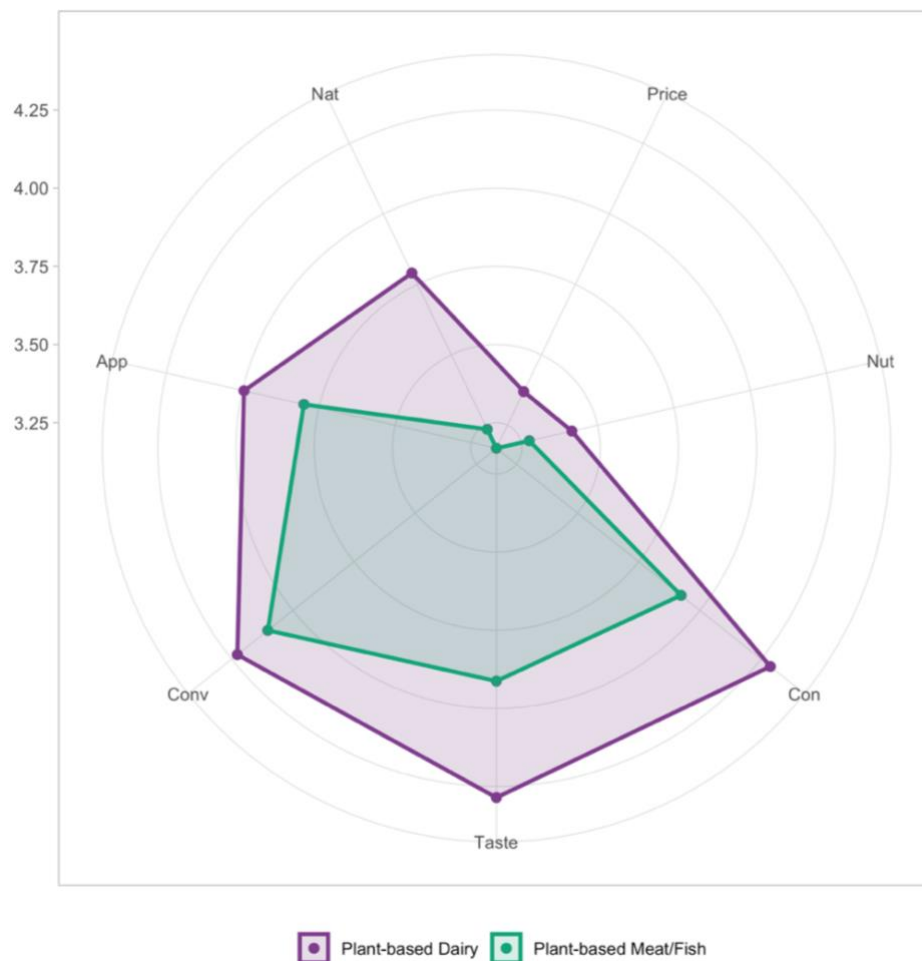


Figure 26: Post-hoc Tukey test, comparison of pairs of means at 95% confidence interval

As the figure above indicates, the differences between Germany and each of the respective countries is statistically significant. This suggests that Germany singles itself out as being the least satisfied with the price of plant-based meat. Therefore, one of the main insights ProVeg may wish to communicate to the incumbents in the plant-based market in Germany, is that price adjustments may be necessary to address the relatively low levels of satisfaction with price of plant-based meat/fish. Once again, these findings assume that the most interesting outcomes are from a Germany-centric perspective, therefore adjustments to the analysis can be made were ProVeg in need of providing a different comparison to incumbents in different markets.

From a more general perspective and considering all the attributes measured ProVeg can communicate to stakeholders that there is a discrepancy between the levels of satisfaction

between the plant-based categories in the study<sup>5</sup>. Hence, an emphasis towards concentrating efforts in the plant-based meat/fish category to improve overall satisfaction with attributes may be a viable strategic focus. As previously pointed out from a marketing perspective and perhaps a more short-term oriented approach, given financial viability, price adjustments can be suggested. It would be difficult to suggest immediate changes to the other attributes of these products given investments necessary to improve them, therefore a long-term strategy would be to partner with organisations in the market to drive innovations, with the goal of improving product attributes and hence levels of satisfaction, particularly of plant-based meat/fish, which lag relative to plant-based dairy in this respect. Figure 27 summarises these concerns.



*Figure 27: Overall category attributes comparisons*

<sup>5</sup> The attributes measured in the survey are by no means extensive.

## 5.3 Future Research Directions and Limitations

### 5.3.1 Future Research Directions

The theoretical implications of this paper are the following. First, the preconceived notion of a difference in the attitudes towards attributes of plant-based foods between countries and within the countries between the alternatives. This lays the foundation for future research looking at comparisons between countries, when exploring different categories of plant-based foods. In addition, the overall conclusion is that consumers are less satisfied with plant-based meat than plant-based dairy. Future research may wish to further explore this discrepancy or look to comparisons with different plant-based food categories. One potential research direction may be to look at the direction of the dissatisfaction, that is, to determine whether consumer satisfaction relative to another category or to the conventional product. In other words, what is the most prominent source of consumer dissatisfaction with the attributes, for instance, when considering of plant-based meat, what are the relative levels of satisfaction, on the one hand, compared to conventional meat and at the same time compared to other plant-based categories. The findings in this paper imply what may be the case relative to other plant-based foods, nevertheless, to gain a greater understanding of consumer behaviour, this needs to be more closely explored. This can be explored through an experimental research design whereby the respondents are randomly allocated questions with comparisons, i.e., plant-based category vs. conventional, or plant-based category vs. another plant-based category.

Secondly, the construct of a plant-based index can be adopted for future research. To measure the plant-based consumption, it may be uniquely suited for future research seeking to explain varying levels of plant-based food consumption across countries. Indeed, a post-hoc test (a linear regression), with plant-based index as the dependent variable and the satisfaction measures as the independent variables, controlling for gender, diet, and age, shows a potential research question. Table 4 shows the results.

	B	SE B	$\beta$	t
<b><i>Constant</i></b>	.435	.208		2.093*
<b><i>Gender</i></b>	.244	.065	.043	3.738*
<b><i>Diet</i></b>	1.314	.060	.3258	21.772*
<b><i>Age</i></b>	-.107	.020	-.062	-5.299*
<b><i>PBD_Price</i></b>	.005	.021	.003	.218
<b><i>PBD_Nut</i></b>	.023	.019	.017	1.205
<b><i>PBD_Con</i></b>	.070	.036	.035	1.909*
<b><i>PBD_Taste</i></b>	.261	.038	.127	6.898*
<b><i>PBD_Conv</i></b>	.038	.022	.026	1.757
<b><i>PBD_App</i></b>	.041	.021	.030	1.996*
<b><i>PBD_Nat</i></b>	-0.31	.023	-.021	-1.351
<b><i>PBMF_Price</i></b>	-.002	.024	-.002	-.093
<b><i>PBMF_Nut</i></b>	-.044	.022	-.035	-1.990*
<b><i>PBMF_Con</i></b>	.047	.044	.031	1.068
<b><i>PBMF_Taste</i></b>	.185	.042	.124	4.347*
<b><i>PBMF_Conv</i></b>	.092	.032	.064	2.844*
<b><i>PBMF_App</i></b>	.025	.027	.018	.891
<b><i>PBMF_Nat</i></b>	-.096	.023	-.075	-4.132*

$R^2 = 0.185$ , \* $p < 0.05$

Table 4: Post-hoc Linear Regression

To the extent that the differences in the levels of satisfaction are statistically significantly different between countries, an analysis such as the one above except exploring the effect satisfaction on consumption of plant-based foods across countries, may yield fruitful cross-country insights. Further research in this direction is required.

### 5.3.2 Limitations

The main aim of the survey done by the client was to gather insights pertaining to the plant-based market across Europe, rather than for explanatory data analysis. In addition, given the time and budget constraints, the client did not engage in analysis other than descriptive



statistics. Inevitably, this has implications for the analyses carried out in this paper, particularly with regards to data robustness, validity, and reliability.

First the representativeness of the data is problematic. As the demographic figures in section 3 show, there is an overrepresentation of certain demographic groups, in specific females and vegans. This has implications for the generalisability of the results as the distribution of these variables across Europe is likely to be far less skewed. This is likely due to the data collection methods the client used, namely, distribution through their network of sister organisations. Thus, future research should seek to achieve a more representative sample to increase the robustness of findings.

Second, the decisions made in the methodology section with regards to missing data are also worth noting. This includes the handling of missing and NA data, by imputing the values with 0 for the respective variables. A total of 29 rows/observations required imputation to varying extents. This may invariably affect the measures in this paper, such as the plant-based index or the satisfaction measures, underestimating the true levels. Therefore, taking transparency into account, the findings in this paper should be taken with a hint of caution. Future research efforts by the client will require more coherent data quality audits, to ensure full completion of the surveys being deployed.

Finally, given the objective of the client being purely descriptive analysis, measurement development was not prioritised. As a result, the validity and reliability of the measures were negatively affected. This is especially important for the attitudinal constructs, measuring the satisfaction with the various attributes of plant-based food. These were measured using a single item each, therefore reliability and validity analyses were not viable. As such the client may wish to increase robustness by developing more than one (ideally 3-5 items) when measuring attitudinal aspects in future research. In addition, scholars seeking to explore similar phenomena, may wish to bear this in mind when developing the items for their research.

## 6.0 Conclusion

This paper sought to explore consumer behaviour regarding plant-based dairy and meat/fish alternatives across 9 European countries. The data in question was provided by the client, ProVeg International, who ran a survey across Europe in 2019. Given time and budget constraints, the client was unable to engage with analysis other than descriptive statistics. Hence, the aim of this paper was to establish the extent to which there exists differences in the consumption of plant-based foods between countries, as well as to determine the differences in the levels of satisfaction with the attributes of plant-based dairy and meat/fish foods respectively.

A literature review is provided to offer a theoretical backdrop for the hypothesis being proposed. The literature uncovered the need to determine preconceived notions, to extend and identify the extent to which plant-based consumption varies across European countries (in this case 9 countries), and to establish the extent of the differences between more than one category of plant-based food categories, namely plant-based dairy and meat/fish, across the countries.

The following section walked the reader through some interesting data exploration exercises, to identify relationships between the variables and visualise key findings. In addition, data pre-processing requirements were also disclosed, most notably the handling of missing and NA data.

Section four engages in statistical analysis to verify the hypothesis from section two and some of the findings from section three. To determine the hypothesis a combination of one-way ANOVAs and mixed ANOVAs were used. The results indicate a statistically significant difference ( $p < 0.05$ ) between the plant-based index of countries, the levels of satisfaction with the attributes of the plant-based categories between the countries, and between the categories within the countries. This confirms the notion in the literature of plant-based foods consumption varying across countries, as well as the suggestion in the literature, that consumers are potentially more satisfied with plant-based dairy relative to plant-based meat/fish.

The discussion section provides an in-depth discussion of the findings, walking through the differences between countries on an attribute-by-attribute level. In addition to focusing on the findings at a granular level, findings from a post-hoc were also presented to determine between which combination of countries the differences were statistically significant, with a focus on Germany, given the clients headquarters. The findings are summarised on a broader level, culminating in the conclusion that consumers across the nine countries are more satisfied with the plant-based dairy alternatives than plant-based meat/fish. Moreover, theoretical implications and future research directions are considered. With regards to the theoretical implications, it is suggested that exploring the direction of comparison of satisfaction, i.e. how the levels of satisfaction differ when comparing plant-based categories with each other from when comparing them to their conventional alternatives, may yield fruitful insights. Similarly, modelling against the plant-based index construct will shed some light on the drivers of plant-based consumption, as a post-hoc linear regression analysis alludes to. Finally, the limitations of the data are discussed. The overrepresentation of certain demographics and methodological decisions made when collecting the data affect the robustness, validity and reliability of the data, this is especially evident in the item development for measuring the attitudinal variables. Future analysis should strive to fill in these gaps in the methodology, to increase generalisability and attempt to replicate the results.

Nevertheless, this paper makes significant contributions to the literature and delivers actionable insight to the client. Cross category findings may be welcome by the industry, mainly by incumbents with diverse portfolios in the plant-based market. These findings may also be useful for new entrants, who might consider the satisfaction levels as a source of competitive advantage when entering the market. The way in which these findings are communicated to the wider industry is up to the discretion of the client. As of November 2021, ProVeg International will hold a series of online seminars in an effort to disseminate results from the SMART Protein work package, part of the EU Horizons Framework. The objective of the SMART Protein project is to gain greater insights into consumer behaviour in the alternative protein market. The project consists of a consortium including ProVeg along with other universities. The series of seminars will involve ProVeg engaging with descriptive analysis. However, given the scale of the project and the consortium members, the survey was developed with robustness in mind, therefore it largely addresses the limitations of this paper. To this end ProVeg and relevant parties can build upon the findings of this paper,

simultaneously addressing its limitations and extending the theoretical constructs to a wider range of alternative proteins (cultured and insect-based protein).

## References

- Apostolidis, C. and McLeay, F. 2016. Should we stop meating like this? Reducing meat consumption through substitution. *Food Policy*. **65**, pp. 74-89.
- Bashi, Z., McCullough, R., Ong, L. and Ramirez, M. 2019. *McKinsey & Company*. [Online]. [Accessed 20 August 2021]. Available from: <https://www.mckinsey.com/industries/agriculture/our-insights/alternative-proteins-the-race-for-market-share-is-on>.
- Beldrock, A. 2021 . *The Rise of Alternative Proteins*. Amsterdam : Roland Berger .
- Bloomberg Intelligence. 2021. *Plant-based Foods Poised for Explosive Growth*. New York: Bloomberg .
- Boaitey, A. and Minegishi, K. 2020. Determinants of Household Choice of Dairy and Plant-based Milk Alternatives: Evidence from a Field Survey. *Journal of Food Products Marketing*. **26**(9).
- Boukid, F. 2021. Plant-based meat analogues: from niche to mainstream. *European Food Research and Technology*. **247**, pp. 297-308.
- Bryant, C. 2019. We Can't Keep Meating Like This: Attitudes Towards Vegetation and Vegan Diets in the United kingdom. *Sustainability*. **11**(23), p. 6844.
- Bryant, C. and Dillard, C. 2019. The impact of framing on acceptance of cultured meat. *Frontiers in Nutrition*. **6**, p. 103.
- Chiles, R. and Fitzgerald, A. 2018. Why is meat so important in western history and culture? A genealogical critique of biophysical and political-economic explanations. *Agriculture and Human Values*. **35**(1), pp. 1-17.
- CORDIS. 2021. *Europe's plant-based food industry shows record-level growth*. [Online]. [Accessed 12 October 2021] Available from: <https://cordis.europa.eu/article/id/429495-europe-s-plant-based-food-industry-shows-record-level-growth>.
- Garnett, T. and Strong, M. 2015. *The principles of healthy and sustainable eating patterns*. London: UK Government Global Food Security Programme .
- Graça, J., Calheiros, M. and Oliveira, A. 2015. Attached to meat? (Un)Willingness and intentions to adopt a more plant-based diet. *Appetite*. **95**, pp. 113-125.
- Grossman, L., Kinchla, A., Nolden, A. and McClements, D. 2021. Standardized methods for testing the quality attributes of plant-based foods: Milk and cream alternatives. *Comprehensive Reviews in Food Science and Food Safety*. **20**(2), pp. 2206-2233.

Haas, R., Schnepps, A., Pichler, A. and Meixner, O. 2019. Cow Milk versus PLant-Based Milk Substitutes: A Comparison of Product Image and Motivational Structure of Consumption. *Sustainability*. **11**(8), p. 5046.

Hartmann, C. and Siegrist, M. 2017. Consumer perception and behaviour regarding sustainable protein consumption: A systematic review. *Trends in Food Sciece & Technology*. **61**, pp. 11-25.

Health Council of the Netherlands, 2011. *Guidelines for a healthy diet: The ecological perspective* , The Hague : Health Council of the Netherlands .

Hoek, A.C., Elzerman, J.E., Hagerman, R., Kok, F.J., Luning, P.A., de Graaf, C. 2013. Are meat substitutes liked better over time?: A repeated in-home use test with meat substitutes or meat in meals. *Food Quality and Preference*. **28**(1), pp. 253-263.

Hoek, A., Luning, P.A., Weijzen, P., Engels, W., Kok, F.J., de Graaf, C. 2011. Replacement of meat by meat substitutes. A survey on person-and product-related factors in consumer acceptance. *Appetite*. **56**(3), pp. 662-673.

Ilona, F., Castellanos-Feijoó, N.A., Van de Sompel, L., Davydova,A., Perez-Cueto, F.J.A. 2020. Attitudes and knowledge towards plant-based diets of young adults across four European countries. Exploratory Survey. *Appetite*. **145**, p. 104498.

Jeske, S., Zannini, E. and Arendt, E. 2018. Past, present and future: The strength of plant-based dary susbstitutes on gluten free raw materials. *Food Research*. **110**, pp. 42-51.

Kim, H. and Yim, H., 2014. Exploratory Study of Korean Traditional Food, Rice Cakes' Product Attributes, and Customers' Satisfaction and Loyalty. *Journal of Culinary Science & Technology*. **12**, pp. 339-353.

Korkofingas, C. 2019. The Influence of Available alternatives and variable expectations on satisfaction. *Journal of Consumer Satisfaction, Dissatisfaction and Complaining Behaviour*. **32**, pp. 16-39.

Lea, E., Crawford, D. and Worsley, A. 2006. Consumers's readiness to eat a plant-based diet. *Nutrition*. **60**, pp. 342-351.

Martínes-González, M., M., H., Zazpe, I. and Trichopoulou, A. 2017. Transferability of the Mediterranean diet to non-Mediterranean countries. What is and what is not the Mediterranean diet. *Nutrients*. **9**(11), p. 1226.

McCarthy, K.S., Parker, M., Ameerally, A., Drake, S.L., Drake, M.A. 2017. Drivers of choice for fluid milk versus plant-based alternatives: What are consumer perceptions of fluid milk?. *Journal of Dairy Science*. **100**, pp. 6125-6138.

Michel, F., Hartmann, C. and Siegrist, M. 2021. Consumers' Associations, Perceptions and Acceptance of Meat and Plant-based Meat Alternatives. *Food Quality and Preference*. **87**, p. 104063.

Myers, G. and Pettigrew, S. 2018. A qualitative exploration of the factors underlying seniors' receptiveness to entomophagy. *Food Research International*. **103**, pp. 163-169.

National Food Agency (Livsmedelsverket). 2015. *Find your way to greenerm not too much and to be active*. Sweden : National Food Agency (Livsmedelsverket).

Oduro, A., Saalia, F. and Adjei, M. 2021. Sensory Acceptability and Proximate Composition of 3-Blend Plant-Based Dairy Alternatives. *Foods*. **10**(3), p. 482.

Onwezen, M., Bouwman, E., Reinder, M. and Dagevos, H. 2021. A systematic review on consumer acceptance of alternative proteins: Pulses, algae, insects, plant-based meat alternatives, and cultured meat. *Appetite*. **159**, p. 105058.

Palacios, O.M., Badran, J., Spence, L., Drake, M.A., Reisner, M., Moskowitz, H.R., 2010. Measuring Acceptance of Milk and Milk Substitutes Among Younger and Older Children. *Food Science*. **75**, pp. 522-526.

Paul, A., Kumar, S., Kumar, V. and Sharma, R. 2020. Milk analog: Plant based alternatives to conventional milk, production, potential and health concerns. *Critical Reviews in Food Science and nutrition*. **60**, pp. 3005-3023.

Piazza, J., Ruby, M. and Loughan, S. 2015. Rationalising meat consumption. The 4Ns. *Appetite*. **91**, pp. 114-128.

ProVeg International. 2021. *ProVeg International*. [Online]. [Accessed 7 October 2021]. Available from: <https://proveg.com/uk/about/>

ProVeg International. 2020. *European Consumer Survey on Plant-based Foods- Describing the product landscape and uncovering priorities for product development and improvement*. Berlin : ProVeg International .

Quelch, J. and Ash, S. 1980. Consumer satisfaction with food products. *Food Policy*. **5**(4), pp. 313-318.

Roman, S., Sanchez-Siles, L. and Siegrist, M., 2017. The importance of food naturalness for consumer results of a systematic review. *Trends in Food Science & Technology*. **67**, pp. 44-57.

Sanchez-Sabate, R. and Sabaté, J. 2019. Consumer attitudes towards environmental concerns of meat consumption: A systematic review. *International Journal of Environmental Research and Public Health*. **16**(7), p. 1220.

Schenk, P., Rössel, J. and Scholz, M. 2018. Motivations and Constraints of Meat Avoidance. *Sustainability*. **10**, p. 3858.

Sethi, S. and Rahul, S. 2016. Plant-based milk alternatives an emerging segment of functional beverages: A review. *Journal of Food Science*. **53**, pp. 3408-3423.

Siegrist, M. 2008. Factors influencing public acceptance of innovative food technologies and products. *Trends in Food Science & Technology*. **19**(11), pp. 603-608.

Siegrist, M. and Hartmann, C. 2019. Impact of sustainability perception on consumption of organic meat and meat substitutes. *Appetite*. **132**, pp. 196-202.

Steson, S. and Buttriss, J. L. 2021 . Healthier and more sustainable diets: What changes are needed in high-income countries?. *Nutrition Bulletin*. **46**(3), pp. 279-309.

Van Loo, E., Hoefkens, C. and Verbeke, W. 2017. Healthy, sustainable and plant-based eating: Perceived (mis)match and involvement-based consumer segments as targets for future policy. *Food Policy*. **69**, pp. 46-57.

Vanhonacker, F., Van Loo, E., Gellynck, X. and Verbeke, W. 2013 . Flemish consumer attitudes towards more sustainable food choices. *Appetite*. **62**, pp. 7-16.

Weinrich, R. 2018. Cross-cultural comparison between German, French and Dutch consumer preferences for meat substitutes. *Sustainability*. **10**(6), p. 1819.

Wolf, C., Malone, T. and McFadden, B. 2020. Beverage milk consumption patterns in the United States: Who is substituting from dairy to plant-based beverages?. *Journal of Dairy Science*. **103**(12 ), pp. 11209-11217.



## Appendices

Where Germany=1, UK=2, Belgium=3, France=4, Netherlands=5, Switzerland=6, Denmark=7, Czech Republic=8, Austria=9.

### Appendix A, One-way ANOVA results

#### Plant-based dairy

		ANOVA				
		Sum of Squares	df	Mean Square	F	Sig.
PBD_Price	Between Groups	174.916	8	21.865	9.916	<.001
	Within Groups	13783.195	6251	2.205		
	Total	13958.111	6259			
PBD_Nut	Between Groups	241.530	8	30.191	9.956	<.001
	Within Groups	18956.598	6251	3.033		
	Total	19198.128	6259			
PBD_Con	Between Groups	69.425	8	8.678	6.348	<.001
	Within Groups	8545.004	6251	1.367		
	Total	8614.428	6259			
PBD_Taste	Between Groups	68.808	8	8.601	6.777	<.001
	Within Groups	7933.640	6251	1.269		
	Total	8002.448	6259			
PBD_Conv	Between Groups	166.748	8	20.844	8.741	<.001
	Within Groups	14906.596	6251	2.385		
	Total	15073.345	6259			
PBD_App	Between Groups	181.025	8	22.628	8.176	<.001
	Within Groups	17299.821	6251	2.768		
	Total	17480.846	6259			
PBD_Nat	Between Groups	77.986	8	9.748	4.043	<.001
	Within Groups	15071.620	6251	2.411		
	Total	15149.606	6259			

## Plant-based meat/fish

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
PBMF_Price	Between Groups	500.595	8	62.574	24.773	<.001
	Within Groups	15789.279	6251	2.526		
	Total	16289.874	6259			
PBMF_Nut	Between Groups	1173.484	8	146.686	46.456	<.001
	Within Groups	19737.521	6251	3.157		
	Total	20911.006	6259			
PBMF_Con	Between Groups	551.816	8	68.977	30.090	<.001
	Within Groups	14329.608	6251	2.292		
	Total	14881.424	6259			
PBMF_Taste	Between Groups	451.335	8	56.417	24.043	<.001
	Within Groups	14668.217	6251	2.347		
	Total	15119.552	6259			
PBMF_Conv	Between Groups	643.117	8	80.390	31.779	<.001
	Within Groups	15812.656	6251	2.530		
	Total	16455.773	6259			
PBMF_App	Between Groups	452.396	8	56.549	19.252	<.001
	Within Groups	18360.799	6251	2.937		
	Total	18813.194	6259			
PBMF_Nat	Between Groups	735.182	8	91.898	29.040	<.001
	Within Groups	19781.745	6251	3.165		
	Total	20516.927	6259			

## Appendix B, mixed ANOVA results and post-hoc

### Mauchly's Test of Sphericity<sup>a</sup>

Measure: MEASURE\_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Greenhouse-Geisser	Epsilon <sup>b</sup>	
						Huynh-Feldt	Lower-bound
satis	.004	34993.296	90	.000	.457	.458	.077

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. Design: Intercept + c

Within Subjects Design: satis

b. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

### Tests of Within-Subjects Effects

Measure: MEASURE\_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
satis	Sphericity Assumed	10230.808	13	786.985	465.684	.000	.069
	Greenhouse-Geisser	10230.808	5.945	1720.845	465.684	.000	.069
	Huynh-Feldt	10230.808	5.959	1716.829	465.684	.000	.069
	Lower-bound	10230.808	1.000	10230.808	465.684	<.001	.069
satis * c	Sphericity Assumed	2938.728	104	28.257	16.721	<.001	.021
	Greenhouse-Geisser	2938.728	47.562	61.788	16.721	<.001	.021
	Huynh-Feldt	2938.728	47.673	61.643	16.721	<.001	.021
	Lower-bound	2938.728	8.000	367.341	16.721	<.001	.021
Error(satis)	Sphericity Assumed	137330.953	81263	1.690			
	Greenhouse-Geisser	137330.953	37163.580	3.695			
	Huynh-Feldt	137330.953	37250.515	3.687			
	Lower-bound	137330.953	6251.000	21.969			

### Tests of Within-Subjects Contrasts

Measure: MEASURE\_1

Source	satis	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
satis	Linear	135.588	1	135.588	22.154	<.001	.004
	Quadratic	824.211	1	824.211	791.165	<.001	.112
	Cubic	866.441	1	866.441	373.005	<.001	.056
	Order 4	4871.764	1	4871.764	2821.053	.000	.311
	Order 5	1294.273	1	1294.273	626.266	<.001	.091
	Order 6	1153.717	1	1153.717	911.808	<.001	.127
	Order 7	3.421	1	3.421	3.123	.077	.000
	Order 8	19.517	1	19.517	19.344	<.001	.003
	Order 9	492.074	1	492.074	445.890	<.001	.067
	Order 10	158.364	1	158.364	197.042	<.001	.031
	Order 11	255.616	1	255.616	321.142	<.001	.049
	Order 12	112.507	1	112.507	107.073	<.001	.017
	Order 13	43.315	1	43.315	27.636	<.001	.004
satis * c	Linear	1610.957	8	201.370	32.903	<.001	.040
	Quadratic	22.981	8	2.873	2.757	.005	.004
	Cubic	202.255	8	25.282	10.884	<.001	.014
	Order 4	53.335	8	6.667	3.861	<.001	.005
	Order 5	334.937	8	41.867	20.258	<.001	.025
	Order 6	26.188	8	3.273	2.587	.008	.003
	Order 7	54.038	8	6.755	6.166	<.001	.008
	Order 8	98.018	8	12.252	12.144	<.001	.015
	Order 9	242.305	8	30.288	27.445	<.001	.034
	Order 10	65.604	8	8.200	10.203	<.001	.013
	Order 11	100.636	8	12.580	15.804	<.001	.020
	Order 12	71.822	8	8.978	8.544	<.001	.011
	Order 13	55.651	8	6.956	4.438	<.001	.006
Error(satis)	Linear	38256.843	6251	6.120			
	Quadratic	6512.093	6251	1.042			
	Cubic	14520.238	6251	2.323			
	Order 4	10795.046	6251	1.727			
	Order 5	12918.646	6251	2.067			
	Order 6	7909.438	6251	1.265			
	Order 7	6848.251	6251	1.096			
	Order 8	6306.804	6251	1.009			
	Order 9	6898.461	6251	1.104			
	Order 10	5023.983	6251	.804			
	Order 11	4975.557	6251	.796			
	Order 12	6568.247	6251	1.051			
	Order 13	9797.345	6251	1.567			

## Post Hoc Tests

### country

#### Multiple Comparisons

Measure: MEASURE\_1

Tukey HSD

(I) country	(J) country	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-.45*	.047	.000	-.59	-.30
	3	-.53*	.049	.000	-.68	-.37
	4	-.43*	.052	.000	-.59	-.27
	5	-.47*	.040	.000	-.59	-.35
	6	-.49*	.069	<.001	-.70	-.27
	7	-.46*	.048	.000	-.61	-.31
	8	-.48*	.055	.000	-.65	-.31
	9	-.38*	.042	.000	-.51	-.25
2	1	.45*	.047	.000	.30	.59
	3	-.08	.054	.863	-.25	.09
	4	.01	.056	1.000	-.16	.19
	5	-.02	.045	1.000	-.16	.12
	6	-.04	.073	1.000	-.26	.19
	7	-.01	.053	1.000	-.17	.15
	8	-.03	.059	1.000	-.22	.15
	9	.06	.047	.912	-.08	.21
3	1	.53*	.049	.000	.37	.68
	2	.08	.054	.863	-.09	.25
	4	.09	.058	.792	-.09	.27
	5	.06	.047	.957	-.09	.20
	6	.04	.074	1.000	-.19	.27
	7	.07	.055	.928	-.10	.24
	8	.05	.061	.998	-.14	.23
	9	.14	.050	.087	-.01	.30
4	1	.43*	.052	.000	.27	.59
	2	-.01	.056	1.000	-.19	.16
	3	-.09	.058	.792	-.27	.09
	5	-.04	.050	.998	-.19	.12
	6	-.05	.075	.999	-.29	.18
	7	-.02	.057	1.000	-.20	.15
	8	-.05	.062	.998	-.24	.15
	9	.05	.052	.988	-.11	.21

5	1	.47*	.040	.000	.35	.59
	2	.02	.045	1.000	-.12	.16
	3	-.06	.047	.957	-.20	.09
	4	.04	.050	.998	-.12	.19
	6	-.02	.068	1.000	-.23	.19
	7	.01	.046	1.000	-.13	.16
	8	-.01	.053	1.000	-.17	.15
	9	.09	.040	.411	-.04	.21
6	1	.49*	.069	<.001	.27	.70
	2	.04	.073	1.000	-.19	.26
	3	-.04	.074	1.000	-.27	.19
	4	.05	.075	.999	-.18	.29
	5	.02	.068	1.000	-.19	.23
	7	.03	.073	1.000	-.20	.26
	8	.01	.078	1.000	-.23	.25
	9	.10	.070	.857	-.11	.32
7	1	.46*	.048	.000	.31	.61
	2	.01	.053	1.000	-.15	.17
	3	-.07	.055	.928	-.24	.10
	4	.02	.057	1.000	-.15	.20
	5	-.01	.046	1.000	-.16	.13
	6	-.03	.073	1.000	-.26	.20
	8	-.03	.060	1.000	-.21	.16
	9	.07	.048	.854	-.08	.22
8	1	.48*	.055	.000	.31	.65
	2	.03	.059	1.000	-.15	.22
	3	-.05	.061	.998	-.23	.14
	4	.05	.062	.998	-.15	.24
	5	.01	.053	1.000	-.15	.17
	6	-.01	.078	1.000	-.25	.23
	7	.03	.060	1.000	-.16	.21
	9	.10	.055	.696	-.07	.27
9	1	.38*	.042	.000	.25	.51
	2	-.06	.047	.912	-.21	.08
	3	-.14	.050	.087	-.30	.01
	4	-.05	.052	.988	-.21	.11
	5	-.09	.040	.411	-.21	.04
	6	-.10	.070	.857	-.32	.11
	7	-.07	.048	.854	-.22	.08
	8	-.10	.055	.696	-.27	.07

Based on observed means.

The error term is Mean Square(Error) = .887.

\*. The mean difference is significant at the .05 level.

## Homogeneous Subsets

### MEASURE\_1

Tukey HSD<sup>a,b,c</sup>

country	N	Subset	
		1	2
1	998	3.39	
9	976		3.77
4	502		3.82
2	663		3.84
7	621		3.84
5	1285		3.86
8	420		3.87
6	226		3.88
3	569		3.92
Sig.		1.000	.216

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square(Error) = .887.

- a. Uses Harmonic Mean Sample Size = 546.162.
- b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.
- c. Alpha = .05.

## Appendix C, One-Way ANOVA plant-based index

### Post Hoc Tests

#### Multiple Comparisons

Dependent Variable: PB\_Index

Tukey HSD

(I) country	(J) country	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-.904 <sup>*</sup>	.114	.000	-1.26	-.55
	3	.589 <sup>*</sup>	.120	<.001	.22	.96
	4	.079	.125	.999	-.31	.47
	5	-.675 <sup>*</sup>	.096	<.001	-.97	-.38
	6	-.957 <sup>*</sup>	.168	<.001	-1.48	-.44
	7	.061	.116	1.000	-.30	.42
	8	-.375	.132	.107	-.79	.04
	9	-.355 <sup>*</sup>	.103	.016	-.67	-.04
2	1	.904 <sup>*</sup>	.114	.000	.55	1.26
	3	1.493 <sup>*</sup>	.130	.000	1.09	1.90
	4	.983 <sup>*</sup>	.135	<.001	.56	1.40
	5	.229	.109	.471	-.11	.57
	6	-.053	.175	1.000	-.60	.49
	7	.965 <sup>*</sup>	.127	.000	.57	1.36
	8	.529 <sup>*</sup>	.142	.006	.09	.97
	9	.549 <sup>*</sup>	.115	<.001	.19	.90
3	1	-.589 <sup>*</sup>	.120	<.001	-.96	-.22
	2	-1.493 <sup>*</sup>	.130	.000	-1.90	-1.09
	4	-.510 <sup>*</sup>	.139	.008	-.94	-.08
	5	-1.264 <sup>*</sup>	.115	.000	-1.62	-.91
	6	-1.545 <sup>*</sup>	.179	.000	-2.10	-.99
	7	-.528 <sup>*</sup>	.132	.002	-.94	-.12
	8	-.964 <sup>*</sup>	.147	<.001	-1.42	-.51
	9	-.944 <sup>*</sup>	.120	.000	-1.32	-.57
4	1	-.079	.125	.999	-.47	.31
	2	-.983 <sup>*</sup>	.135	<.001	-1.40	-.56
	3	.510 <sup>*</sup>	.139	.008	.08	.94
	5	-.754 <sup>*</sup>	.120	<.001	-1.13	-.38
	6	-1.035 <sup>*</sup>	.182	<.001	-1.60	-.47
	7	-.018	.137	1.000	-.44	.41
	8	-.454	.151	.065	-.92	.01
	9	-.434 <sup>*</sup>	.125	.016	-.82	-.05



5	1	.675*	.096	<.001	.38	.97
	2	-.229	.109	.471	-.57	.11
	3	1.264*	.115	.000	.91	1.62
	4	.754*	.120	<.001	.38	1.13
	6	-.282	.164	.737	-.79	.23
	7	.736*	.111	<.001	.39	1.08
	8	.300	.128	.318	-.10	.70
	9	.320*	.097	.027	.02	.62
6	1	.957*	.168	<.001	.44	1.48
	2	.053	.175	1.000	-.49	.60
	3	1.545*	.179	.000	.99	2.10
	4	1.035*	.182	<.001	.47	1.60
	5	.282	.164	.737	-.23	.79
	7	1.017*	.177	<.001	.47	1.57
	8	.582	.188	.051	.00	1.16
	9	.602*	.168	.011	.08	1.12
7	1	-.061	.116	1.000	-.42	.30
	2	-.965*	.127	.000	-1.36	-.57
	3	.528*	.132	.002	.12	.94
	4	.018	.137	1.000	-.41	.44
	5	-.736*	.111	<.001	-1.08	-.39
	6	-1.017*	.177	<.001	-1.57	-.47
	8	-.436	.144	.062	-.88	.01
	9	-.416*	.117	.011	-.78	-.05
8	1	.375	.132	.107	-.04	.79
	2	-.529*	.142	.006	-.97	-.09
	3	.964*	.147	<.001	.51	1.42
	4	.454	.151	.065	-.01	.92
	5	-.300	.128	.318	-.70	.10
	6	-.582	.188	.051	-1.16	.00
	7	.436	.144	.062	-.01	.88
	9	.020	.133	1.000	-.39	.43
9	1	.355*	.103	.016	.04	.67
	2	-.549*	.115	<.001	-.90	-.19
	3	.944*	.120	.000	.57	1.32
	4	.434*	.125	.016	.05	.82
	5	-.320*	.097	.027	-.62	-.02
	6	-.602*	.168	.011	-1.12	-.08
	7	.416*	.117	.011	.05	.78
	8	-.020	.133	1.000	-.43	.39

\*. The mean difference is significant at the 0.05 level.