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Counting contexts that count: An exploration of the contextual correlates of meat consumption in three Western European countries

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Abstract

A reduction in the demand for meat and a shift to more plant-based consumption has the potential to significantly enhance the sustainability and health of many people's diets. In the current work, I examine contextual predictors of meat consumption in nationally representative nutrition surveys from three Western European Counties: Switzerland, France and the Netherlands. More specifically, I examine whether the contextual factors – the meal type, the day of the week and the location of the food consumption occasion – are predictive of whether meat is consumed. The results indicate that all three factors are linked to meat consumption with the patterns varying substantially across the different case study countries and the gender of the consumer. The results emphasise the importance of examining contextual correlates when looking to understand and influence meat consumption, while also highlighting important differences across both cultures and people.

1. Introduction

Over the past decade, increasing emphasis is being placed on meeting the challenge set out by Huddart-Kennedy and colleagues (2015) for research in the behavioural sciences which aims to promote sustainability to 'count what counts'. In other words, many researchers in the area are focusing their efforts on understanding and shaping individual behaviours that have substantive environmental impact and eschewing tokenistic behaviours that have low mitigative potential (Gifford, 2011; Nielsen et al., 2021). Diet, transportation and home heating have been identified as 'behavioural hotspots' – high impact domains in which behaviour change has substantial mitigative potential (Lacroix, 2018; Newell et al., 2021).

Across the behavioural sciences more generally, research has demonstrated that contextual factors, understood here to include both temporal and situational factors, predict behaviour. For example, studies have demonstrated diurnal patterns in physical activity and sedentary behaviour (Reuter et al., 2020; Sartini et al., 2015). Research has also identified differences in pro-social behaviour and risk-seeking on different days of the week (Malhotra, 2008; Sanders & Jenkins, 2016), as well as increased Google searches for diets and increased physical activity at the beginning of weeks, months and years (Dai et al., 2014). Other work has identified location effects on voter behaviour (Berger et al., 2008; Rutchick, 2010).

Researchers have also examined consistency in pro-environmental behaviours across situations, for example, action when on holidays, and/or at work compared to at home (Whitmarsh et al., 2018; Xu et al., 2020). Whitmarsh, Hagger & Thomas (2018) find that pro-environmental action tends to be more prevalent at home than in either of the other two places, for example, despite documenting significant correlations in action across all three. Other work highlights the role of situational features in promoting and inhibiting pro-environmental consumption choices. In an investigation of consumer habits in Switzerland, for example, Tanner and Wölfing Kast (2003) find that shopping in supermarkets compared to small retailers or farmers' markets is negatively associated with green purchases. Further work on the role of temporal and situational predictors of environmentally significant consumption behaviours is warranted. In other words, we need to know more about the contexts that count.

Understanding the contextual predictors of environmentally significant consumption behaviours is of particular relevance to behaviours that people have the opportunity to engage in regularly and across a variety of different situations. For example, if a location is found to be predictive of a given behaviour, then this location may influence people to engage in the behaviour or people may select into this location to engage in the behaviour or both. Regardless of the causal nature of this relationship, designing interventions aimed at encouraging people to reduce the environmental impact of their consumption that target those contexts that matter most would appear to be a fruitful way forward.

Furthermore, examining contextual predictors may highlight external constraints that need to be addressed in order to enhance the plasticity of environmentally significant consumption behaviours (Stern, 2011, 2020). Overall, this approach is aligned with the behaviour mapping that has been called for by Nielsen and colleagues (2021) as part of the case they put forward for impact focused environmental psychology.

In the current work, I explore the contextual correlates of an environmentally significant consumption behaviour that has been identified in existing literature as having substantial mitigative potential: meat consumption (Lacroix, 2018). Meat and other animal-based proteins are typically significantly more resource-intensive and environmentally impactful than plant-based foods (Poore & Nemecek, 2018). Additionally, overconsumption of meat has been linked to ill-health, including cardiovascular disease and some forms of cancer (Godfray et al., 2018). A reduction in the demand for meat and a shift to more plant-based consumption, therefore, has the potential to significantly enhance the sustainability and health of people's diets (Willett et al., 2019).

I examine the contextual correlates of meat consumption in three Western European countries: Switzerland, the Netherlands and France. Diets in all three countries are characterised by high levels of meat consumption with 2017 estimates of 'meat supply', a measure typically used to proxy consumption, of over 67kg per capita annually in all three countries (Switzerland: 67.53kg, the Netherlands: 75.81kg and France: 83.04kg compared to a global average of 43.22kg (Our World in Data, 2021)). Analysis of the consumption of animal-based proteins, which includes meat but also dairy products, in Europe suggests that the Western Europeans consume more animal protein supplies than their Eastern counterparts (de Boer & Aiking, 2018), highlighting Western Europe as an important region within Europe to examine and further motivating the three case study countries. Furthermore, the three case study countries are of interest as France and Switzerland are understood to share overlapping food cultures, whereas the Netherlands does not (Askegaard & Madsen, 1998; Rozin, 2005). As a result, and also given their geographical proximity to one another, it is interesting to explore the extent of any culture differences across this set of countries.

To date, the vast majority of the work examining the predictors of meat consumption has focused on individual characteristics, such as age, gender, place of residence and personality, and examined samples from single countries (Allès et al., 2017; Gossard & York, 2003; Pfeiler & Egloff, 2018, 2020; Sych et al., 2019). In two separate papers, Pfieler & Egloff find that men, young people and those with lower levels of education have higher meat consumption on average in Germany (2018) and that those with high levels of extraversion and low levels of openness and emotional stability have higher meat consumption in an Australian sample (2020). Such work has provided valuable insights into which groups of people have a greater propensity to eat meat within a given country, but do not shed light on the contexts that matter most or whether those contexts tend to be consistent or whether they differ across countries and subpopulations.

Existing research suggests that contextual factors likely play an important role in meat consumption. Work which has looked at diet quality indicators and food consumption more generally, indicates that food consumption follows both diurnal and weekly rhythms, as well as varying depending on who a person is with and their and location (de Castro, 2004b, 2004a; De Castro, 2007; Hetherington et al., 2006; Pachucki et al., 2018). Other work suggests that the healthy eating strategies that individuals adopt (including for example, increasing consumption of healthy foods or avoiding unhealthy foods) vary across contexts (Verain et al., 2022), as does self-regulation around diet (Bouwman et al., 2021)

In an investigation of meat consumption specifically, Horgan et al. (2019), find that among a representative UK sample eating out in restaurants and cafes increases the probability of individuals consuming meat and the amount consumed compared to other situations. This work also highlights other contextual predictors including eating with family and eating on a Sunday. Further work in this area can yield important insights that pertain specifically to meat consumption, as well as to other countries and populations. Additionally, while some research has examined the social and physical correlates of eating patterns of students from different cultures (de Castro et al., 1997), further cross cultural work exploring these the importance actors is needed both in general and in relation to meat consumption specifically.

From the perspective of behavioural interventions, understanding the contexts that count can also help to serve as a foundation for intervention design (Aunger, 2020) and speak to questions of external validity, of which generalisability across situations is a key component (List, 2020). There is a burgeoning research literature in the behavioural sciences that examines the effectiveness of various strategies aimed at reducing people's meat consumption (see Harguess et al., 2020 for a review). These interventions are typically developed and tested in a single situation at a single point in time[1], for example, exploring the effectiveness of changing the availability of vegetarian options in a workplace canteen (Garnett et al., 2019). Little attention tends to be paid to whether the contexts being targeted are those that count the most. By contributing to our understanding of the relative importance of different contexts, the current work provides guidance to those looking to maximise the impact of their behavioural interventions on meat consumption. Additionally, by highlighting the variability of consumption across contexts the work highlights the pressing need for intervention research to examine the generalisability of interventions from one context to another (Abrahamse, 2020).

[1] See Reinders et al., 2020 for an interesting exception that tests the impact of reduced serving sizes across four different contexts and Dai et al., 2014 that documents varying uptake of commitments at different points in time.

Contextual cues consist of both situational and temporal factors can be assessed using the "w" variables: what? where? when? (Saucier et al., 2007). In the current work, I examine the relationships between a range of different contextual cues – objective features of the situation (e.g., the location, the meal occasion and the day of the week) – and the consumption of meat. I also add a fourth "w" variable – who – by examining whether these contextual predictors vary across gender – a key demographic characteristic that has been linked to the consumption of animal-based proteins in previous research in both the three case study countries and elsewhere (Hayley et al., 2015; Marques-Vidal et al., 2015; Prättälä et al., 2007; Rousset et al., 2003)

I carry out multi-level analysis of diary-based nutrition data, examining the individual and episode level predictors of meat consumption in representative adult populations from three countries of interest. The datasets I use are the Third French Individual and National Survey on Food Consumption 2014-15 (INCA3) data, The Swiss National Nutrition Survey (menuCH) 2014-2015, and the Dutch National Food Consumption Survey (DNFCS) 2012-2016[2]. The results indicate that context does count: The contextual variables of when (time and day of the week) and where (place of consumption) are predictive of meat consumption. Importantly, how contextual predictors matter varies across the countries: with notably different patterns in Switzerland and France compared to the Netherlands. Finally, the consumption patterns vary across men and women, with important differences emerging in realtion to the importance of some but not all contextual factors explored.

In what follows, I introduce the data in Section 2, present the analysis and results for each of the three country case studies in Section 3 and discuss the results and future directions in Section 4.

Section 2: Data

I obtained nutrition data for France, Switzerland and the Netherlands for this study. All surveys provide detailed diary-based information on food consumption in a 24-recall format, along with contextual information including the meal type, day of the week and location. The surveys also collected detailed individual-level information on food-related issues.

2.1 French Individual and National Food Consumption 2014-2015

The INCA3 survey is a cross-sectional survey aimed at estimating the food consumption and eating habits of individuals living in France. The study was carried out between February 2014 and September 2015 among a representative sample of individuals living in mainland France. A total of 5855 individuals, divided into 2698 0- to 17- year-old children and 3157 18- to 79-year-old adults,

[2] All three Western European countries have post-2010 nutrition survey data that included 24-hour recall diary-based measures of food consumption that also incorporates contextual information.

participated in the study. The current study makes use of the adult sample (aged 18+) only. Individuals were selected according to a three-stage cluster sampling design (geographical units, households and individuals), based on the 2011 annual national census, with geographical stratification (region, size of urban area).

Data related to various issues connected to food-related, nutritional and health risk/benefit assessment were collected: consumption of foods, drinks and food supplements, eating habits, practices posing a potential health risk, knowledge and habits with regard to food. Data on physical activity and sedentary behaviour, as well as anthropometric and socio-demographic characteristics and standards of living, were also collected. To ensure national representativeness, individual weighting factors were estimated taking account of geographic and socio-economic variables.

The dietary intake of the individuals was collected over three non-consecutive days (two weekdays and one weekend day) spread over around three weeks. The 24h-recall method was used. For the three selected days, individuals had to report their dietary intake by identifying all the foods and beverages consumed during the day or at night. They were asked to describe them in as much detail as possible and to quantify them using a picture book of food portion sizes and household measures. Interviews were conducted by telephone, using the standardised and computerised GloboDiet – a computer directed interview programme for 24-hour recalls, by professional interviewers specifically trained in the methods and the software used. 2121 adults responded to at least two dietary interviews. Full details of the survey and its methodology are available in Dubuisson et al., (2019).

2.2. The Swiss National Nutrition Survey 2014-2015

MenuCH is a cross-sectional survey carried out between January 2014-February 2015 in Switzerland which collected anthropometric characteristics as well as data on food consumption and physical activity. The study was carried out between January 2014 and February 2015. Data were collected on 2085 participants aged 18-75 years. The stratified sampling strategy targeted a sample of individuals representative of the three main linguistic regions of Switzerland (German, French and Italian), balanced with respect to the predefined sex and age strata within each linguistic region.

Data related to socio-demographic characteristics, health-related issues, bodyweight satisfaction, cooking habits as well as on eating and physical activity behaviour were collected. Anthropometric measures including body weight, height and waist circumference were measured using standardized procedures, To ensure the national representativeness, individual weighting factors were estimated taking into account linguistic regions, sex, age groups and educational levels.

Individual food intake was assessed by conducting two non-consecutive 24-Hour Dietary Recalls. The first was collected face-to-face in interviews carried out by German, French or Italian by trained dieticians in 10 study centres. The second by phone two to six weeks later. In both cases, the interviews were carried out using the standardised and computerised GloboDiet software. To start, participants provided general information about their diet; then they were asked and probed by the interviewer to remember and report the kind and amount of all foods and beverages they consumed between waking time on the preceding day and waking time on the interview day. Picture books and household measures were used as aids to help participants accurately report on their consumption. Further details of the survey and its methodology are available in Chatelan et al., (2017).

2.3 Dutch National Food Consumption Survey 2012-2016

The Dutch National Food Consumption Survey (DNFCS) is a cross-sectional survey assessing the food consumption and activity levels of Dutch adults and children. The study was carried out between 2012 and 2016 among a sample of individuals living in the Netherlands. A total of 4,313 individuals, divided into 2163 0- to 17-year-old children and 2,150 18- to 79-year-old adults, participated in the study. The current study makes use of the adult sample (aged 18+) only.

The survey population was intended to be representative within each age category with regard to age and gender, region, degree of urbanisation and educational level (or the educational level of the parents/caretakers for children up to 18 years when living with their parents/caretakers). Therefore, during recruitment, the study population was monitored on these characteristics and, if necessary, the sampling was adjusted on these factors. The survey also includes weights that allow for estimates of the consumption patterns of the population living in the Netherlands.

The adults filled in a questionnaire either on paper or online which covered various background factors, such as educational level, working status, native country, family composition various lifestyle factors, such as patterns of physical activity, smoking, use of alcoholic beverages and various general characteristics of the diet, such as breakfast use, food frequency of fruit, vegetables, fish, and dietary supplements and the use of salt during the preparation of food or at the table.

Participants then recorded food consumption in two non-consecutive 24-hour recalls, with an interval of four weeks. The data were collected by an interviewer using Globodiet. The recalls covered the period from getting up in the morning until getting up on the following day (which was, in fact, the day of the interview). Food consumption on Sunday to Friday was recalled the next day, consumption on a Saturday was recalled the following Monday. Interview days and survey days were not planned on national and/or religious bank holidays, or when the participant was on holiday. Full details of the survey and its methodology are available in Van Rossum et al., (2020).

3. Analysis and results

3.1 Descriptive statistics

The main outcome of interest is whether meat was eaten during a food consumption episode. To assess this, I drop all episodes reported in the diaries that involve drink consumption only, focusing on food consumption episodes and create a dummy variable indicating if meat of any kind was consumed during a given food consumption occasion. The contextual predictors include meal type, day of week and location. I code the variables in each of the three datasets to make them comparable. This involves collapsing categories in some datasets such that I end up with 6 meal occasion categories and 7 food consumption locations that are equivalent across the three datasets. All contextual predictors represent categorical variables with 'Lunch' (Meal type), 'Monday' (Day of the week), 'At home'(Location) acting as the reference categories. I also explore the extent to which these contextual predictors vary across gender with and Female (Gender) being the reference category.

First, I run basic descriptive statistics to compare the frequency of meat consumption across all three countries and across men and women within each country. Overall the Swiss have the lowest percentage of their food consumption occasions involving meat at 23.4% compared to 25.3% in France and 24.6% the Netherlands. These differences are also in line with existing findings that looked at total levels of consumption (Marques-Vidal et al., 2015; Rousset et al., 2003; Van Rossum et al., 2020) See Table A.1 for descriptive statistics.

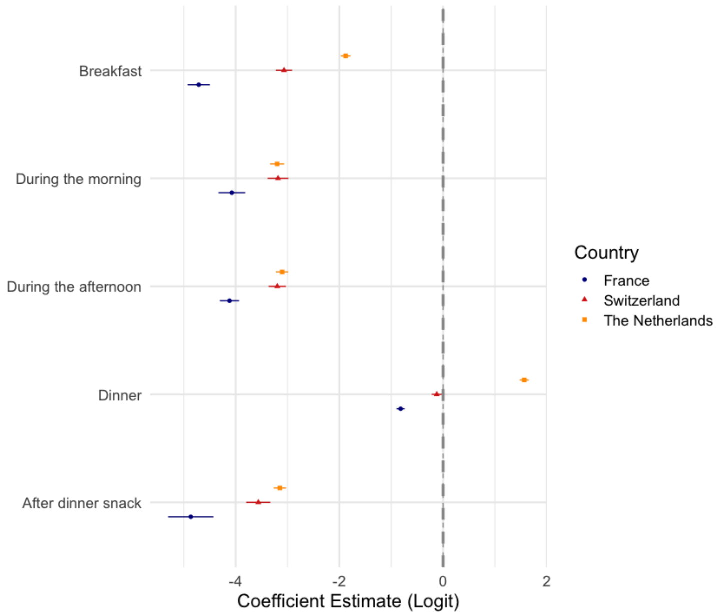
3.2 Modelling the contextual correlates of meat consumption

I then examine the contextual predictors of meat consumption. Following, Horgan et al., (2019), and as the data in all three surveys involves multiple observations per individual respondent with predictors varying both between and within individuals, I first model the probability of meat being consumed during a food consumption episode using generalised linear mixed models (Pinheiro & Bates, 2000), with individuals' unique identifiers being included as a random intercept. I estimate the effects as both logit and odds ratios relative to the reference levels using the lme4 package in R Studio 1.3 (Bates et al., 2007). See Figure 1-3 for coefficient plots of the weighted logit estimates for all three case study countries. See Figures 4-6 for mean predicted probabilities by each contextual factor across each of the three case study countries and Table A.2-5 for the logit and odds ratio estimates for the weighted models. I then go on to estimate a generalised linear mixed model with a cross level interaction between the contextual effects and gender, including a random slope coefficient for gender and random intercept for individuals' unique identifiers (Heisig & Schaeffer, 2019*)*. See Figures A1-3 and Table A5-7.

3.2.1 The association between meat consumption and meal type across the three case study countries

Meal type is associated with meat consumption across all three case study countries with people having much lower odds of eating meat at breakfast, during the morning, during the afternoon and for after dinner snacks compared to at lunch. The magnitude of these differences varies across the three countries, however. For example the odds ratio of eating meat at breakfast compared to lunch is 0.009 and 0.047 in France and Switzerland respectively, compared to 0.153 in the Netherlands. The association between eating meat and dinner also differs altogether across these countries, with meat being significantly less likely to be eaten at dinner relative to lunch in France and Switzerland and more likely in the Netherlands. See Figure 1 for the a coefficient plot of the logit estimates, Figure 4 for mean predicted probabilities for the different locations and Table A2 for the regression results.

Figure 1: Coefficient plot for eating meat at different meal times across the three case study countries.

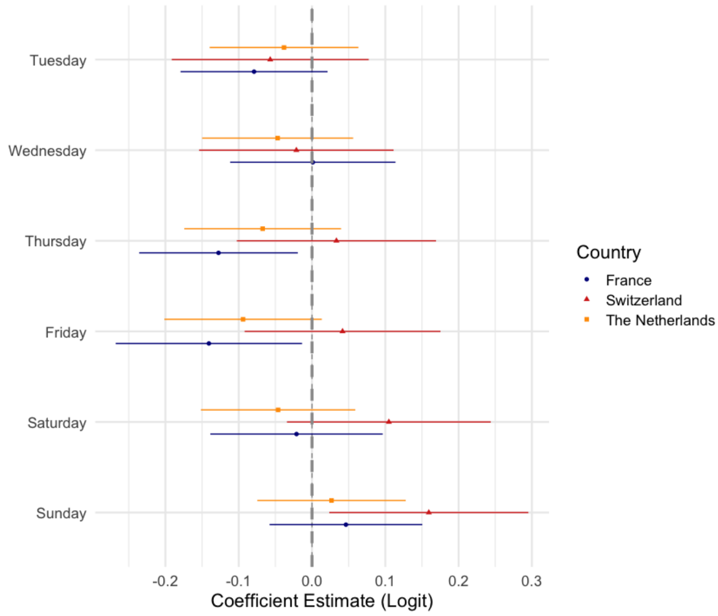


Note. Figure based on weighted samples from France (25, 595), Switzerland (19,544) and the Netherlands (26,683). Lines represent the 95% confidence intervals. Reference category is Lunch.

3.2.2 The association between meat consumption and day of the week across the three case study countries.

The results indicate that meat consumption is associated with the day of the week in both France and Switzerland but not the Netherlands. Meat consumption is less likely on a Thursday and Friday compared to a Monday in France and more likely on a Sunday compared to Monday in Switzerland. See Figure 2 for a coefficient plot of and Figure 5 for the mean predicted probabilities for the days of the week and Table A3 for the logit estimates from the regression analysis.

Figure 2. Coefficient plot for eating meat on different days of the week across the three case study countries.



Note. Figure is based on the weighted samples from France (25, 595), Switzerland (19,544) and the Netherlands (26,683). Lines represent the 95% confidence intervals. Reference category is Monday.

3.2.3 The association between meat consumption and location across the three case study countries.

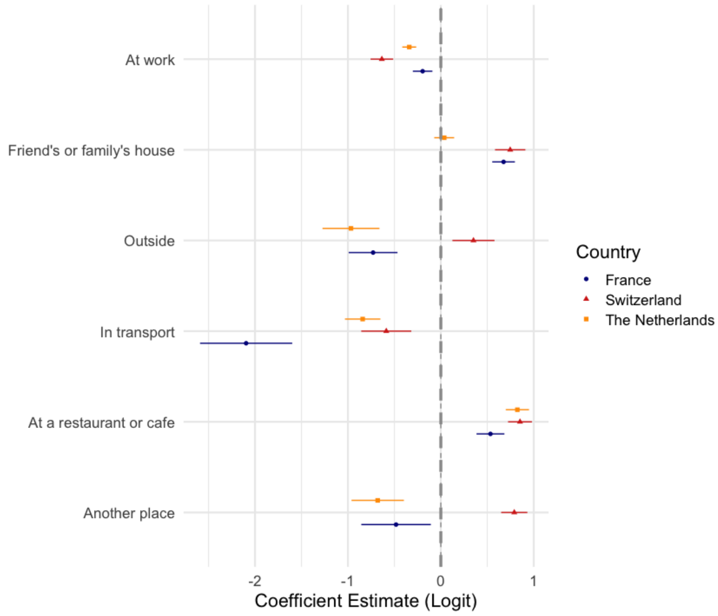
Where the food consumption takes place is predictive of meat consumption in all three case study countries. Compared to when eating at home people are consistently less likely to eat meat at work and in transport, and more likely to eat meat when eating out at a café or a restaurant, across all three countries. The magnitude of the effects vary, however. For example eating at a restaurant or café is associated with an odds ratio of 2.344 and 2.280 of eating meat in Switzerland and the Netherlands respectively but only 1.706 in France.

Differences emerge across the countries in relation to other locations. People are significantly more likely to eat meat when eating at friends' and family members' homes in both France and Switzerland but not in the Netherlands. Eating outside and in other places are both being significantly negatively associated with eating meat in Switzerland but positive in both France and the Netherlands. See Figure 3 for a coefficient plot and Figure 6 for the mean predicted probabilities for the location variables and Table A4 for the logit estimates from the regression analysis.

3.2.4 Differences across gender for meat consumption in the three countries

When I examine interactions between the contextual variables and gender, I find that gender moderates the relationship between context and meat consumption in all three countries. For example, while both men and women have reduced odds of eating meat at breakfast compared to lunch in the Netherlands, the reduction is greater for women than it is men. The same pattern exists in relation to eating meat in the afternoon compared to lunch in France. Also, in relation to eating after dinner compared to lunch in both Switzerland and the Netherlands the reduction in odds is greater for men than it is women. In terms of the days of the week, in the Netherlands women have lower odds of eating meat on a Tuesday and Wednesday compared to a Monday while men have higher odds. The same pattern exists on Fridays in Switzerland. In the Netherlands eating at work compared to at home increases a man's odds of eating meat but decreases a woman's. Despite the differences that emerge in relation to meal type, location and day of the week, it is important to highlight that many of the interactions were not significant and that many contextual features appear to correlate with meat consumption in a similar way for men and women. See Appendix Figures A1-3 and Tables A5-7.

Figure 3. Coefficient plot for eating meat at different locations across the three case study countries.



Note. Figure is based on weighted samples from France (25, 595), Switzerland (19,544) and the Netherlands (26,683). Lines represent the 95% confidence intervals. Reference category is At home.

Figure 4. The mean predicted probabilities of eating meat at different meal times across the three case study countries.

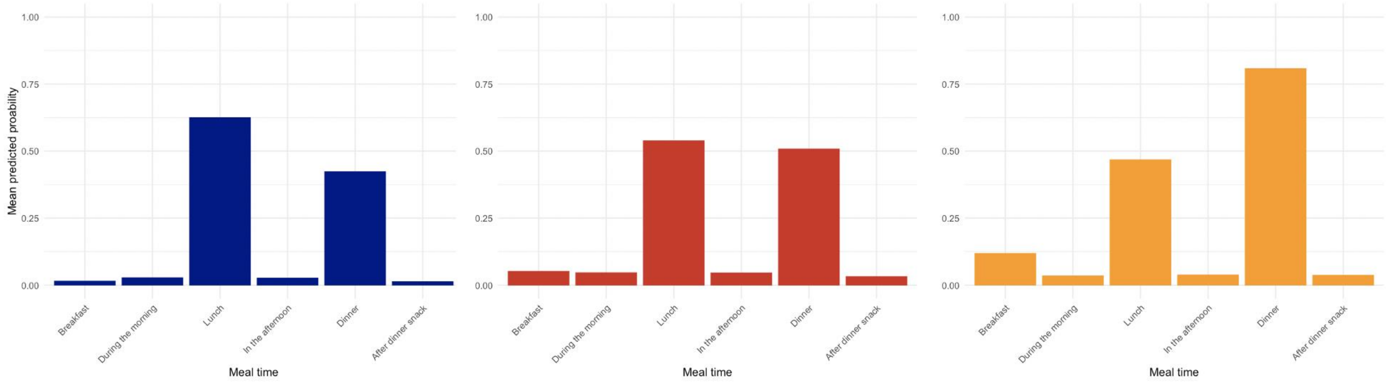


Figure 5: The mean predicted probabilities of eating meat on different days of the week across the three case study countries.

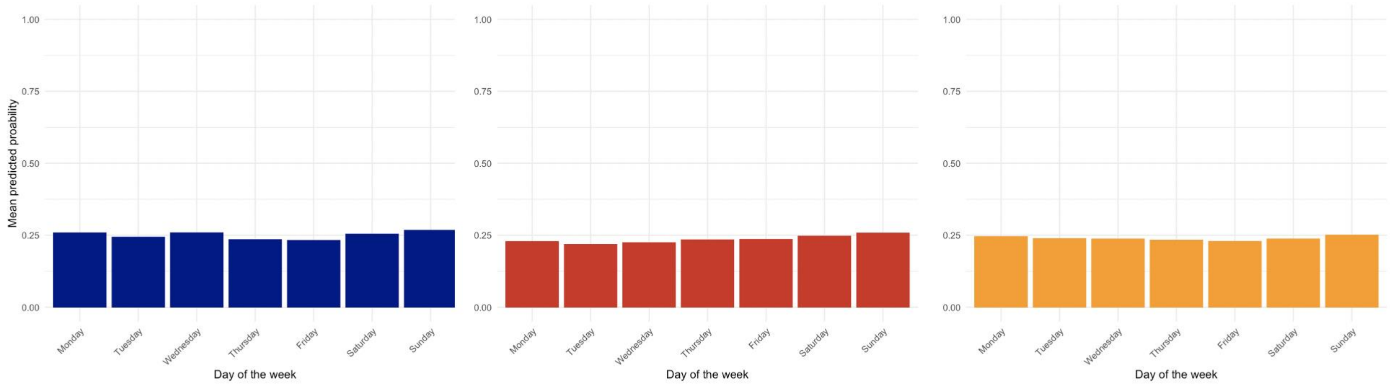
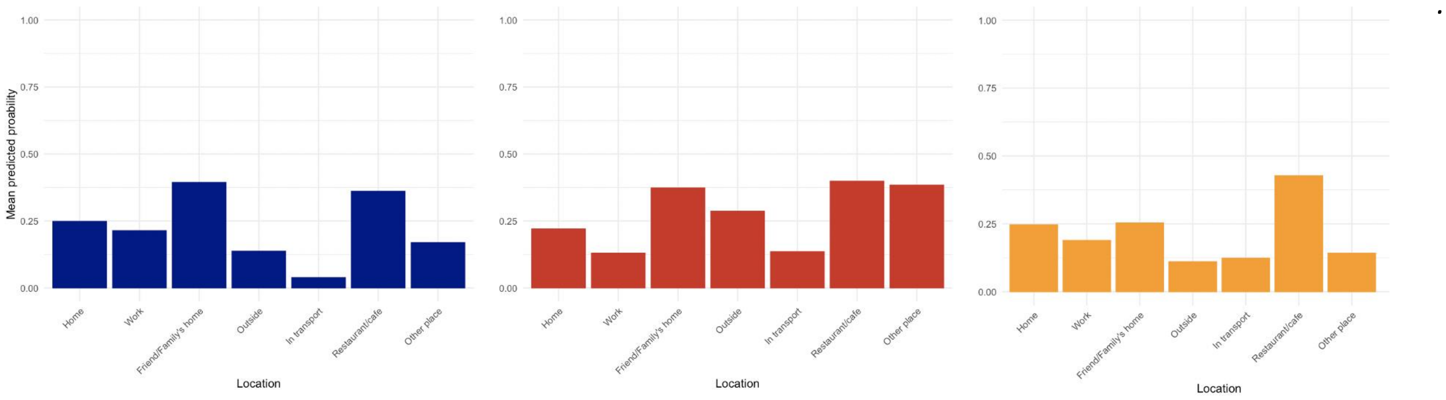


Figure 6: The mean predicted probabilities of eating meat at different locations across the three case study countries



Discussion

Many environmentally significant consumption behaviours involve repeated actions that can take place across a range of contexts. Meat consumption is one such activity which is associated both with high carbon footprint and high mitigative potential from behaviour change. Investigations into meat consumption, therefore, meet the criteria of counting what counts (Huddart Kennedy et al., 2015).

Existing research into the predictors of meat consumption has focused on individual characteristics such as a person's gender, age, personality (Allès et al., 2017; Gossard & York, 2003; Pfeiler & Egloff, 2018, 2020; Sych et al., 2019). In the current work, I build on this literature by examining the contextual correlates of meat consumption using nutrition survey data. By examining when and where people are more likely to eat meat I am able to highlight some key contextual correlates of consumption in this domain. With the exception of Horgan et al., 2018, who explores the contextual correlates of meat consumption in the UK, there is a dearth of literature on this topic.

In the current work, I contribute to the limited knowledge on the contextual correlates of meat consumption and provide a cross-cultural perspective. The results highlight both lunch and dinner as being the meals during the day when meat is most likely to be consumed, particularly lunch in France and Switzerland, where it is customary to have a cooked meal for lunch, and dinner in the Netherlands, where it is not. I also find evidence of a Sunday effect in Switzerland, whereby people are more likely to eat meat on Sunday than any other day of the week, similar to that documented by Horgan et al., (2019) in the UK. Additionally, I find evidence that Thursday and Friday are the days when meat is least likely to be consumed in France, with the Friday result potentially being linked to the catholic practice of abstaining from meat on Fridays.

The results highlight restaurants and cafés as important sites when people tend to eat meat in all three of the case study countries. They also indicate that eating at friends' and family members' homes, is positively associated with eating meat in Switzerland and France but not so in the Netherlands. These results echo findings from qualitative work which examined instances of vegetarians eating meat which report that this typically occurs at family gatherings and on social occasions (Rosenfeld & Tomiyama, 2019). Taken together, the results indicate that meal type, day of the week and location are all important contextual correlates of meat consumption that are worth inquiring into in order to better understand and shape people's choices. Additionally, these results indicate that even within countries that in close geographical proximity to one another, the contextual correlates of meat consumption differ, suggesting cultural influences are at play.

Finally, by examining how contextual factors interact with gender, the work emphasises that the contexts that count may vary substantially across different groups of people. Previous work carried out by Pachuki and colleagues (2018) with a sample of patients with type 2 diabetes found that diet quality in this sample varied depending on meal location patterns, with men eating better at home and women outside the home.

Echoing findings in other samples from the case study countries (Marques-Vidal et al., 2015; Van Rossum et al., 2011; Rousset et al., 2005), men have a higher overall propensity to consume meat compared to women in all three countries. Interestingly, the importance of some of the contextual predictors varies across gender. For example, in the Netherlands men are more likely to eat meat at work than when at home, whereas women are less likely. One potential explanation for this is the greater level of visibility of the consumption choices outside of the home and the associations between meat consumption and masculinity that many in Dutch society report making (Schlöser et al., 2018).

The current work has several of strengths, including its use of large nationally representative samples across three different countries and its exploration of the scientifically and policy-relevant question of the relationship between contextual correlates and meat consumption. It also presents an approach that could be of relevance to other environmentally significant consumption areas, including travel, clothing consumption and waste behaviours. For example, using secondary data including from sources like the National Travel surveys (Ahern et al., 2013), credit card (Agarwal & Qian, 2014) and shopper loyalty data (Felgate & Fearne, 2015), could all help shed light of the contextual correlates of environmentally significant consumption behaviours.

Based on the results, policy makers from each of the three case study countries can better understand the contexts to target when to develop and deliver interventions to reduce meat consumption. For example, across all three countries meat is more likely to be eaten when eating at a restaurant or cafè. This finding highlights this location as a place which interventions and campaigns could address, for example, with interventions such as carbon labelling, for example. Furthermore, the study highlights that policymakers and others are developing behavioural interventions to target repeated environmentally significant consumption behaviours should seek out data which can help them to map the contextual correlates of the behaviours they are looking to change, as well as exploring the generalisability of their interventions across different contexts.

At the same time, the work is not without limitations. First, the available data do not allow me to investigate other features of context that research suggests are linked to meat consumption, including who the person is with at the moment of consumption and more detailed features of their environment such as the food options available to them and whether the person is engaged in other activities (Reed & Castro, 1992; Tanner et al., 2003; Hetherington et al. 2006). Additionally, as the datasets are aimed at understanding population nutrition trends, they do not include individual specific factors, such as self-control, meat attachment or habit strength (Graça et al., 2015; Loy et al., 2016; Nielsen & Hofmann, 2021), which may moderate the relationship between contextual factors and consumption. Future work using other data sources should look to explore these factors.

Second, in focusing on the three Western European countries as case studies, the work cannot speak to the relative importance of the contextual factors explored here in other parts of the world. Although the average diets in all three countries are characterised by high levels of meat consumption, there are other countries with higher per capita meat consumption, as well as in some cases much larger populations such as North America, Australia and Argentina (Our World in Data, 2017) – these places clearly count and should be the focus of future work.

Food is an area of consumption in which the decisions people make throughout their day have a lasting impact on both their personal health and that of the environment. Meat consumption is one area that is particularly important given the threats that overconsumption pose. The current work offers a richer understanding of patterns of meat consumption in daily life in France, Switzerland and the Netherlands than has been available to date, emphasising the links between when and where a food consumption occasion takes place and whether a person eats meat. This information should be taken into account by those looking to encourage reductions in meat consumption, helping them to focus their efforts on those contexts that really count.

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Table A1. Descriptive statistics

	French	French	Swiss	Swiss	Dutch	Dutch
Meat eaten						
False	19122	0.74709904	14962	0.76555465	20225	0.75393275
True	6473	0.25290096	4582	0.23444535	6601	0.24606725
Total	25595	1	19544	1	26826	1
Meal type						
Breakfast	5678	0.2218402	3768	0.19279574	4348	0.16208156
Morning	2109	0.08239891	2217	0.11343635	3785	0.14109446
Lunch	5840	0.22816956	3776	0.19320508	3884	0.14478491
Afternoon	4574	0.17870678	3660	0.18726975	5104	0.19026318
Dinner	5895	0.23031842	3977	0.20348956	4219	0.1572728
After dinner	1499	0.05856613	2146	0.10980352	5486	0.20450309
Total	25595	1	19544	1	26826	1
Day of the week						
Monday	3596	0.14049619	3335	0.17064061	4250	0.15842839
Tuesday	4786	0.18698965	3450	0.17652476	4243	0.15816745
Wednesday	2849	0.1113108	3670	0.18778142	3817	0.14228733
Thursday	3816	0.14909162	3318	0.16977077	3751	0.13982703
Friday	2061	0.08052354	2005	0.10258903	3530	0.13158876
Saturday	3440	0.13440125	1793	0.09174171	3458	0.12890479
Sunday	5047	0.19718695	1973	0.1009517	3777	0.14079624
Total	25595	1	19544	1	26826	1
Location						
Home	19973	0.78034772	12710	0.65032747	19580	0.73380055
Work	2238	0.08743895	2853	0.14597831	3584	0.13431773
Friend/Family's	1385	0.05411213	802	0.04103561	1486	0.05569089
Outside	531	0.02074624	401	0.02051781	291	0.01090582
Transport	417	0.01629224	502	0.02568563	582	0.02181164
Restaurant	838	0.03274077	1257	0.06431641	857	0.03211783
Other	213	0.00832194	1019	0.05213876	303	0.01135554
Total	25595	1	19544	1	26683	1
Gender						
Male	10572	0.41304942	8865	0.4535919	13366	0.49824797
Female	15023	0.58695058	10679	0.5464081	13460	0.50175203
Total	25595	1	19544	1	26826	1

Table A2. Regression results for meat consumption by meal type

	Meat eaten					
	French Logit	French Odds ratio	Swiss Logit	Swiss Odds ratio	Dutch Logit	Dutch Odds ratio
Reference category: Lunch						
Breakfast	-4.712***	0.009***	-3.068***	0.047***	-1.879***	0.153***
	(0.110)		(0.080)		(0.048)	
During the morning	-4.074***	0.017***	-3.183***	0.041***	-3.200***	0.041***
	(0.132)		(0.103)		(0.070)	
In the afternoon	-4.119***	0.016***	-3.198***	0.041***	-3.103***	0.045***
	(0.095)		(0.085)		(0.061)	
Dinner	-0.819***	0.441***	-0.122**	0.885***	1.565***	4.784***
	(0.040)		(0.050)		(0.045)	
After dinner snack	-4.866***	0.008***	-3.564***	0.028***	-3.147***	0.043***
	(0.223)		(0.119)		(0.061)	
Constant	0.510***	1.665***	0.152***	1.165***	-0.131***	0.877***
	(0.031)		(0.040)		(0.039)	
Observations	25,595		19,544		26,826	
Log Likelihood	-9,149.054		-7,511.636		-14,259.770	
Akaike Inf. Crit.	18,312.110		15,037.270		28,533.530	
Bayesian Inf. Crit.	18,369.160		15,092.430		28,590.910	

*Note:** p<0.1**p p<0.05***p<0.01

Table A3. Regression results for meat consumption by day of the week

	Meat eaten					
	French Logit	French Odds ratio	Swiss Logit	Swiss Odds ratio	Dutch Logit	Dutch Odds ratio
Reference category: Monday						
Tuesday	-0.079	0.924	-0.057	0.945	-0.038	0.963
	(0.051)		(0.069)		(0.052)	
Wednesday	0.001	1.001	-0.021	0.979	-0.047	0.954
	(0.058)		(0.068)		(0.053)	
Thursday	-0.128**	0.880**	0.033	1.034	-0.067	0.935
	(0.055)		(0.069)		(0.055)	
Friday	-0.141**	0.868**	0.042	1.043	-0.094*	0.910*
	(0.065)		(0.068)		(0.055)	
Saturday	-0.021	0.979	0.105	1.111	-0.046	0.955
	(0.060)		(0.071)		(0.054)	
Sunday	0.046	1.047	0.159**	1.172**	0.027	1.027
	(0.053)		(0.069)		(0.052)	
Constant	-1.055***	0.348***	-1.220***	0.295***	-1.123***	0.325***
	(0.039)		(0.048)		(0.039)	
Observations	25,595		19,544		26,826	
Log Likelihood	-14,090.190		-10,348.230		-22,242.920	
Akaike Inf. Crit.	28,196.380		20,712.470		44,501.850	
Bayesian Inf. Crit.	28,261.590		20,775.510		44,567.420	

Note: * p<0.1 ** p<0.05 *** p<0.01

Table A4: Regression results for meat consumption by location

	Meat eaten					
	French Logit	French Odds ratio	Swiss Logit	Swiss Odds ratio	Dutch Logit	Dutch Odds ratio
Reference category: At home						
Work	-0.196***	0.822***	-0.635***	0.530***	-0.340***	0.712***
	(0.054)		(0.062)		(0.038)	
Friend/Family's home	0.675***	1.964***	0.747***	2.111***	0.036	1.037
	(0.062)		(0.083)		(0.055)	
Outside	-0.729***	0.482***	0.351***	1.420***	-0.967***	0.380***
	(0.134)		(0.116)		(0.156)	
In transport	-2.096***	0.123***	-0.587***	0.556***	-0.841***	0.431***
	(0.253)		(0.137)		(0.097)	
Restaurant/cafe	0.534***	1.706***	0.852***	2.344***	0.824***	2.280***
	(0.077)		(0.066)		(0.064)	
Other place	-0.482**	0.618**	0.790***	2.203***	-0.680***	0.507***
	(0.191)		(0.072)		(0.144)	
Constant	-1.106***	0.331***	-1.264***	0.283***	-1.116***	0.328***
	(0.018)		(0.025)		(0.021)	
Observations	25,595		19,544		26,683	
Log Likelihood	-13,918.670		-10,083.400		-21,895.420	
Akaike Inf. Crit.	27,853.340		20,182.810		43,806.840	
Bayesian Inf. Crit.	27,918.540		20,245.850		43,872.380	

Note: * p<0.1 ** p<0.05 *** p<0.01

Table A5: Interaction between meal type and gender for the three European countries

	Meat eaten					
	French Logit	French Odds ratio	Swiss Logit	Swiss Odds ratio	Dutch Logit	Dutch Odds ratio
Reference category: Lunch						
Breakfast	-4.827***	0.008***	-3.102***	0.045***	-2.071***	0.126***
	(0.154)		(0.127)		(0.073)	
During the morning	-4.108***	0.016	-3.313***	0.036***	-3.304***	0.037***
	(0.184)		(0.187)		(0.111)	
In the afternoon	-4.317***	0.013***	-3.074***	0.046***	-3.013***	0.049***
	(0.133)		(0.127)		(0.089)	
Dinner	-0.879***	0.415***	-0.123*	0.884*	1.535***	4.641***
	(0.053)		(0.069)		(0.062)	
After dinner snack	-5.304***	0.005***	-3.219***	0.040***	-3.031***	0.048***
	(0.382)		(0.186)		(0.090)	
Male	0.118*	1.125*	0.574***	1.775***	0.538***	1.713***
	(0.063)		(0.079)		(0.078)	
Breakfast: Male	0.250	1.284	0.011	1.011	0.256***	1.292***
	(0.220)		(0.165)		(0.097)	
During the morning: Male	0.074	1.077	0.100	1.105	0.147	1.158
	(0.264)		(0.226)		(0.143)	
In the afternoon: Male	0.459**	1.582**	-0.241	0.786	-0.224*	0.799*
	(0.190)		(0.172)		(0.122)	
Dinner: Male	0.148*	1.160*	-0.001	0.999	0.002	1.002
	(0.081)		(0.099)		(0.090)	
After dinner snack: Male	0.759	2.136	-0.629***	0.533***	-0.271**	0.763**
	(0.472)		(0.242)		(0.122)	
Constant	0.460***	1.584***	-0.118**	0.889**	-0.368***	0.692***
	(0.040)		(0.052)		(0.055)	
Observations	25,595		19,544		26,826	
Log Likelihood	-9,130.943		-7,439.274		-14,204.890	
Akaike Inf. Crit.	18,291.890		14,908.550		28,439.780	

Bayesian Inf. Crit.	18,414.140	15,026.750	28,562.740

Note: * p<0.1**p p<0.05***p<0.01

Table A6: Interaction between location and day of the week for the three European countries

	Meat eaten					
	French Logit	French Odds ratio	Swiss Logit	Swiss Odds ratio	Dutch Logit	Dutch Odds ratio
Reference category: Monday						
Tuesday	-0.127*	0.881*	-0.012	0.988	-0.156**	0.856**
	(0.066)		(0.097)		(0.076)	
Wednesday	-0.006	0.994	-0.015	0.985	-0.154**	0.857**
	(0.074)		(0.099)		(0.074)	
Thursday	-0.201***	0.818***	0.095	1.100	-0.124	0.883
	(0.072)		(0.099)		(0.079)	
Friday	-0.233***	0.792***	-0.220**	0.803**	-0.142*	0.868*
	(0.086)		(0.103)		(0.080)	
Saturday	-0.052	0.949	0.081	1.084	-0.077	0.926
	(0.079)		(0.103)		(0.078)	
Sunday	-0.015	0.985	0.242**	1.274**	-0.016	0.984
	(0.070)		(0.097)		(0.072)	
Male	0.057	1.059	0.326***	1.385***	0.183**	1.201**
	(0.079)		(0.096)		(0.077)	
Tuesday: Male	0.127	1.135	-0.064	0.938	0.223**	1.250**
	(0.104)		(0.136)		(0.104)	
Wednesday: Male	0.019	1.019	-0.009	0.991	0.226**	1.254**
	(0.117)		(0.135)		(0.105)	
Thursday: Male	0.161	1.175	-0.094	0.910	0.109	1.115
	(0.111)		(0.138)		(0.109)	
Friday: Male	0.201	1.223	0.418***	1.519***	0.088	1.092
	(0.131)		(0.138)		(0.109)	
Saturday: Male	0.066	1.068	0.050	1.051	0.065	1.067
	(0.121)		(0.141)		(0.107)	
Sunday: Male	0.151	1.163	-0.135	0.874	0.094	1.099
	(0.108)		(0.138)		(0.103)	

Constant	-1.077***	0.341***	-1.384***	0.251***	-1.213***	0.297***
	(0.051)		(0.070)		(0.055)	
Observations	25,595		19,544		26,826	
Log Likelihood	-14,070.420		-10,289.630		-22,208.580	
Akaike Inf. Crit.	28,174.850		20,613.260		44,451.150	
Bayesian Inf. Crit.	28,313.400		20,747.230		44,590.500	

Note: * p<0.1 ** p p<0.05 *** p<0.01

Table A7: Interaction between location and gender for the three European countries

	Meat eaten					
	French Logit	French Odds ratio	Swiss Logit	Swiss Odds ratio	Dutch Logit	Dutch Odds ratio
Reference category: Home						
Work	-0.223***	0.800***	-0.772***	0.462***	-0.475***	0.622***
	(0.072)		(0.100)		(0.062)	
Friend/Family's home	0.715***	2.044***	0.790***	2.203***	0.104	1.110
	(0.079)		(0.111)		(0.076)	
Outside	-0.749***	0.473***	0.327*	1.387*	-1.086***	0.338***
	(0.185)		(0.167)		(0.229)	
In transport	-2.160***	0.115	-0.839***	0.432***	-1.081***	0.339***
	(0.358)		(0.221)		(0.167)	
Restaurant/cafe	0.480***	1.616***	0.844***	2.326***	0.779***	2.1794***
	(0.110)		(0.102)		(0.093)	
Other place	-0.636**	0.529**	0.720***	2.054***	-0.643***	0.526***
	(0.262)		(0.112)		(0.213)	
Male	0.157***	1.170	0.309***	1.362	0.289***	1.335
	(0.037)		(0.050)		(0.042)	
Male: Work	0.050	1.051	0.212*	1.236*	0.203***	1.225***
	(0.108)		(0.128)		(0.079)	
Male: Friend/Family's home	-0.103	0.903	-0.074	0.929	-0.129	0.879
	(0.127)		(0.167)		(0.109)	
Male: Outside	0.021	1.021	0.038	1.039	0.235	1.265
	(0.268)		(0.231)		(0.314)	
Male: In transport	0.116	1.123	0.444	1.559	0.364*	1.439*
	(0.507)		(0.285)		(0.206)	
Male: Restaurant/cafe	0.071	1.074	-0.032	0.969	0.078	1.081
	(0.154)		(0.133)		(0.128)	
Male: Other place	0.342	1.408	0.090	1.094	-0.067	0.935
	(0.385)		(0.146)		(0.288)	

Constant	-1.168***	0.311***	-1.413***	0.243***	-1.258***	0.284***
	(0.023)		(0.035)		(0.030)	
Observations	25,595		19,544		26,683	
Log Likelihood	-13,900.630		-10,036.470		-21,856.120	
Akaike Inf. Crit.	27,835.260		20,106.930		43,746.230	
Bayesian Inf. Crit.	27,973.810		20,240.900		43,885.490	

Note: * p<0.1 ** p p<0.05 *** p<0.01

Figure A1. The mean predicted probability plots for meal type by gender

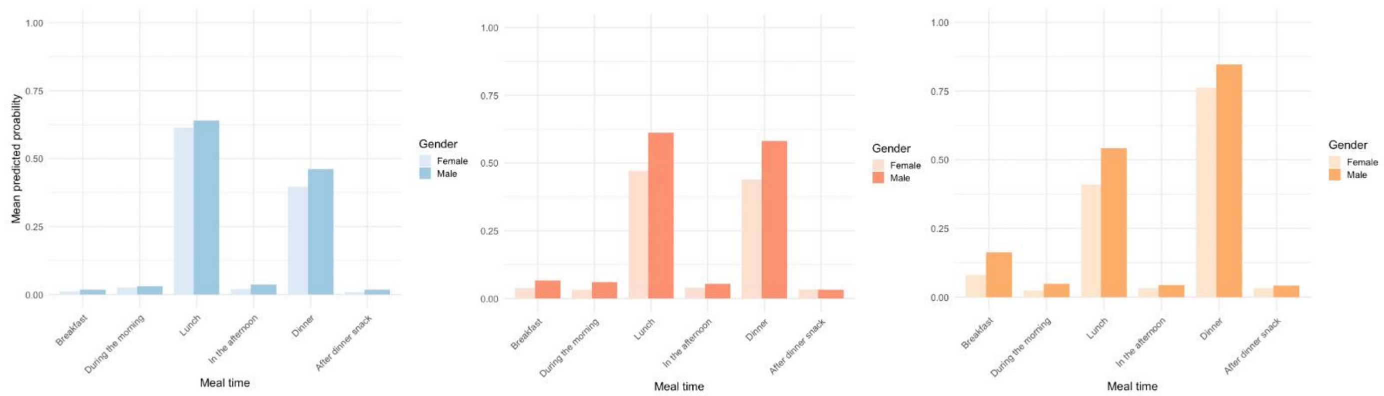

Figure A2. The mean predicted probability plots for day of the week by gender

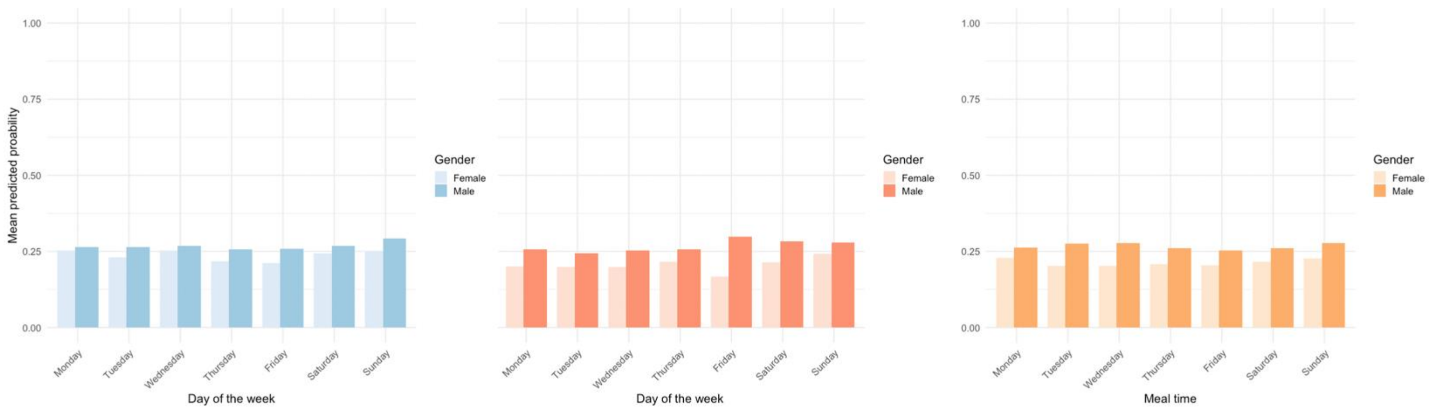

Figure A3. The mean predicted probability plots for location by gender