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Reaction to a low-carbon footprint food logo and other sustainable diet promotions in a UK University's Student Union 'Living Lab'

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Public sector catering outlets have been proposed as ideal places to try new, sustainable food choice interventions. We report on promotions conducted during 2019 as part of a "living lab" at the University of Sheffield Students' Union. Living labs involve staging interventions or experiments in a real-world setting that are carefully monitored and evaluated systematically. Activities included (1) a survey of dietary habits, attitudes and knowledge of staff and students (n=643), (2) a low environmental impact indicator logo created and implemented in different ways across four food outlets in the Students' Union (some outlets also provided information in dining areas), (3) sales data (intervention period and the same period in the previous year) were analysed, and (4) on the day of the global Climate Strikes (20th September 2019), a food outlet introduced additional one-day-only promotions on low impact menu options; sales impact was assessed. An average of 39.4% of respondents recalled the low environmental impact indicator logo. There was a significant increase in oat milk use compared to 2018, but non-significant changes to other low and medium impact food sales. In one outlet, high impact items had the greatest total value of sales in 2018, whereas in 2019 medium impact foods had the greatest value of sales, suggesting a positive trend towards less impactful food choices. The Climate Strike intervention saw a decrease in beef burger sales and an increase in chicken and meat-free burger sales. This paper covers interventions to promote sustainable food choices and their efficacy across a university with ideas for future research avenues. This study applied novel concepts, including the use of a number of geographically close outlets each participating with different types of intervention, the inclusion of sales data for several outlets, and multiple scale temporal interventions (e.g., single-day global Climate Strike, and longer-term interventions).

1. Introduction

It is becoming increasingly apparent that current methods of food production and consumption are unsustainable. Food production systems produce 19-29% of global greenhouse gas emissions (GHGE)

(Camilleri et al., 2019) as a result of significant inputs of water, energy, chemicals and nutrients as well as being a driver of land-use change (Chen et al., 2016). Of GHGE, 18% are accounted for by livestock such as cows, pigs, sheep and chickens (van Hooijdonk & Hettinga, 2015). Ruminant animals, such as cows and sheep, are the main contributors to GHGE due to the methane (CH_4) produced during their digestion of feed, and the nitrogen oxides (NXO) released from their manure. The manufacture and application of fertilisers used on animal feed crops also release nitrogen oxides (Macdiarmid, 2012). Both methane and nitrogen oxides have greater global warming potential than carbon dioxide (CO2). A rapid dietary shift away from animal products, especially beef, lamb and dairy products is necessary to reduce diet-related GHGE and avoid further climate warming (Camilleri et al., 2019, Rust et al., 2020, Reynolds et al., 2014).

Given that only 3% of the UK population are vegetarian and even fewer are vegan (YouGov.co.uk, 2019), it is unrealistic to suggest a population shift to a meat-free diet at least in the short term, despite the significant reductions in GHGE that can be made (Camilleri et al., 2019). Eating meat is deeply ingrained in various cultures and is regarded as a symbol of affluence and success (Bacon & Krpan, 2018). Meat consumption has increased globally over the past 50 years (Bacon & Krpan, 2018), despite growing evidence of its negative impacts on health and the environment. However, not all meat is equal in terms of environmental impact and GHGE; hence, it may not be necessary to avoid meat altogether to reduce meals' environmental impact (Graham et al., 2019). Camilleri et al. (2019) found that replacing ruminant meat with non-ruminant meat and choosing a different species of fish resulted in a 30% reduction in food-related emissions of the weekly diet of an Australian family. Promoting sustainable food choices instead of a shift to vegetarian or veganism may be more effective in reducing GHGE from diets over a large scale and short period. Likewise, Grassian et al. (2020) found participants in UK-based meat reduction and vegan campaigns favour gradual dietary transitions. However, 'planned abstainers' (i.e. vegans and vegetarians) were more likely to report meeting their dietary goals than meat reducers (Grassian et al., 2020). Thus, abstaining from specific meat types (ruminant) in favour of non-ruminant meat may be an strong strategy for effective successful dietary transition.

It is difficult to break pre-established long-term habits (Chen et al., 2016), such as eating meat, especially when consumer awareness of meat production's environmental impacts is low (Camilleri et al., 2019).

However, promoting sustainable food choices can be achieved in various ways, including (but not limited to) changes to the choice architecture (Abrahamse, 2020). Attwood et al. (2020) recently produced 57 behaviour change strategies for the foodservice sector to encourage diners to choose more sustainable, plant-rich options. These strategies include changes to the product, placement, presentation, promotion, and people (staff). Colour-coding dishes listed on menus (e.g., red, yellow, green) to help diners recognise the "better" choice, and publicising the environmental benefits of plant-rich dishes using marketing materials like posters, leaflets, or TV screens, were identified as two possible strategies that could be engaged. Likewise, Bianchi et al. (2018), conducted a systematic review evaluating the effectiveness of interventions that restructured physical micro-environments to reduce the demand for meat. They found that (experimental) interventions offering the most favourable outcomes included reducing portion sizes of meat servings, providing meat alternatives, and changing the sensory properties of meat and meat alternatives at the point of purchase. However, Bianchi et al., (2018) highlights that there was consistently no evidence of purchased reduction effect for interventions that only manipulate the verbal description /label of meat or meat alternatives at point of purchase.

Labels (such as colour-coding or traffic lights) are one of the most straightforward ways to attempt to influence food choice (Camilleri et al., 2019, Brown, et al., 2020), and they have been shown to positively influence sustainable (see Camilleri et al., 2019; Vanclay et al., 2011; Pulkkinen et al., 2015; Bacon & Krpan, 2018), as well as healthy (Oliveria et al., 2018) food choices. Sustainability labelling (such as standards, origin and organic certification) has been shown to affect the sensory attributes of foods (de Andrade Silva et al., 2017), as well as perceptions of food safety/risk, animal welfare, deliciousness, purchase intention, energy density, and carbon footprint (Armstrong & Reynolds, 2020). A carbon label has previously been used at a university restaurant to increase sales of low emission dishes (11.5%) and decrease sales of high emission dishes (4.8%) (Brunner et al., 2018). A dual

traffic light labelling system (for carbon footprint and for healthiness) has been used in two sequential non-hypothetical discrete choice experiments focused on lasagne ready meals (Macdiarmid et al., 2020). It found that although consumers were willing to pay a higher premium for healthier and lower carbon footprint meals, this premium decreased when participants knew these meals contained less meat (Macdiarmid et al., 2020).

The literature suggests that consumers are rarely influenced by sustainability claims alone (Vanclay et al., 2011; Vlaeminck et al., 2014). To ensure price and label incentives of alternative products optimise impact, they must be close in flavour and convenience as the original counterparts (Hoek et al., 2016). Label and price interventions can also be used in tandem with interventions that make sustainable choices easier to see (Campbell-Arvai et al., 2014; Wansink & Love, 2014).

Other (public) catering interventions that can reduce purchases of animal-products include: (1) increasing vegetarian/plant-based meal availability (Garnett et al., 2019; Raghoebar et al., 2020), (2) changing the order of meals at the service counter and distance between vegetarian and meat options (Garnett et al., 2020), (3) providing climate change-health education to students (Jalil et al., 2020, Prusaczyk et al., 2021), (4) rearranging the menu in favour of vegetarian food (Gravert & Kurz, 2019, Sparkman et al., 2020, Wolstenholme et al., 2020), as well as enhancing the visibility of vegetarian dishes (Kurz, 2018), and (5) improving the name of the plant-based dish (Bacon et al., 2019; Gavrieli et al., 2020 Krpan, & Houtsma, 2020).

In the promotion of sustainable diets, public sector catering outlets (such as those in schools and universities) have been proposed as vanguards (Graham et al., 2019). Similarly, many customers expect restaurants to 'lead the way' and use more sustainable and ethically sourced ingredients than they might use at home (Curry et al., 2014). In universities, undergraduate students who have entered a new environment will be most susceptible to habit changes (Chen et al., 2016). Additionally, having a work or study space well suited to learning sustainable behaviours can then be transferred to private consumption (Schrader & Thøgersen, 2011). Still, there are contradictions to using out

of home consumption to change at-home consumption as highlighted by Biermann and Rau (2020). Few people eat sustainably in both settings, as eating out and consuming meat is associated with the terms 'special' and 'treating oneself'. The normative and emotive expectations of eating out and eating at home diverge.

These tensions imply that in certain catering environments and with some clientele some types of intervention may not be as well placed [see Verfuerth et al., (2019); Verfuerth (2019) for an example of how customers of a workplace canteen responded to menu change/dietary choice intervention]. However, university catering outlets can be seen as an intermediary for students and staff between private food consumption (at home or halls of residence), and off-campus public food consumption. For this reason, they are particularly suited as a location to change immediate diets and longer-term dietary habits.

Due to being a prospective space to engage with sustainable behaviour change, universities have become popular candidates as spaces to deploy a 'Living Lab' method (Evans et al., 2015; Lipschutz et al., 2017; Dekker et al., 2019). A living lab method is a form of experimental governance, with co-development and testing of innovations and interventions to address sustainability challenges (Herrera, 2017). Living labs involve staging interventions or experiments in a real-world setting (i.e., a university campus) that are carefully and systematically monitored and evaluated. In some university living labs, students co-create, run and evaluate the experiments with university facility staff and academics as part of dissertations or summer projects. Examples of related previous living labs include Crosby et al. (2018) and Favaloro et al. (2018). They used a living lab to engage a university campus in managing food waste and achieving sustainability benchmarks, respectively. Staisey and Harris (2019) increased food sales at a farmer's market using a living lab approach, and Roggema and Yan (2019) used Urban Living Labs to co-design new food futures for local communities.

This paper seeks to broaden the understanding of diets and views towards sustainable diet interventions in an academic university setting by reporting on research activities conducted under the auspices of a sustainable food living lab at the University of Sheffield. Much of these activities were carried out within the Univer-

sity's Student's Union building over 2019.

This paper provides a further practical example (with quantified sales impacts) of different labelling, information, and menu change interventions carried out within a living lab framework. In doing so, it complements and extends the current evidence base around carbon labels and catering interventions. The main novelty of our study is the use of a number of geographically close outlets each participating in different levels and types of intervention, the inclusion of sales data for a number of outlets, and the use of multiple scale temporal interventions (e.g., the global Climate Strike day, as well as longer-term interventions). Our research questions are 1) what are student and staff attitudes towards sustainable diets? 2) What are the effects of different types of interventions on promoting sustainable food choices across campus?
We are publishing the information in this paper to inform and inspire the wider sustainable food movement and living lab communities who are currently undertaking similar work, and can use these results as a comparison. Also, to impact businesses and sustainability teams that can use our results as a business case to promote change in their organisations.

2. Materials and methods

2.1. Context

The University of Sheffield employs 7,802 staff members and has 29,666 full-time students. It has 18 different university-owned food outlets covering a range of cuisines and dining styles (Graham et al., 2019). A focal point of The University of Sheffield campus is the University of Sheffield's Student's Union (SSU), which features multiple food and beverage outlets. Due to its central nature and multiple outlets, the SSU is a practical environment to explore student perceptions and responses to a living lab intervention to promote sustainable diets. Indeed, sustainability is heralded as one of the SSU's key values (see: https://yoursu.sheffield.ac.uk/get-involved/sustainability).

The SSU's Sustainable Diets Strategy Action Plan (Graham 2018) acted as a springboard for this investigation. The Action Plan outlined key actions SSU catering could take over the next 16 years to deliver their strategy of developing and promoting sustainable diets, including but not limited to veganism. The focus was on promoting sustainable diets from a greenhouse gas emissions (GHGE) perspective, i.e promoting foods with low associated GHGE and hence defined here as having a low environmental impact.

The mix of methodologies discussed below, and co-created interventions is central to the living lab approach. Dekker et al. (2019) outlined that these multiple methods and co-created approaches are needed for methodological robustness, practical implementation, and to mitigate ethical and legal issues and provide value for practitioners and participants.

2.2. Menu interventions

2.2.1. Creation of a low impact food logo

In order to indicate foods that had a low environmental impact, a low impact logo was created. Following the method outlined by Graham (2018), each menu item was categorised as "low impact", "medium impact", or "high impact" (see Table 1). The categorisation exercise used the value of median associated Greenhouse Gas Emissions (GHGE) KgCO2e per kg for each prominent ingredient (Clune et al., 2017). Graham classified the top two protein sources (both outliers of the main dataset) as "high impact", taking the third product as an upper threshold of "medium impact" (9.25 kgCO2e per kg). The lower threshold of the "medium impact" category was half the value of the upper bound (4.44 kgCO2e per kg). Items below this threshold were rated as "low impact". However, since the capture/farming method of fish in dishes in the SSU was unclear, they were included in the medium impact category. Menu items were assigned a low impact rating if they did not contain any medium or high impact ingredients.

The researchers designed the final logo using background research and feedback from restaurant managers and University of Sheffield academics. The logo was designed with the carbon footprint iconography in mind with additional text to signify the items' low GHGE impact. The logo's aim was for it to be easily recognisable, making it usable across different menus and promotional materials (see Figure 1, see Appendix for other prototype logos). Red (high impact) and orange (medium-low) logos were also created, but not

used in the intervention. The choice to not use the red and orange logos was arrived at through iterative discussion with restaurant managers. This choice was due to cost implications of full menu redesign, and some initial nervousness about not wanting to "disincentivise/demonise" medium and high impact foods on campus. The outlet managers instinctively wanted to start lower down the "Nuffield Ladder of Interventions" (Nuffield Council on Bioethics, 2007) by educating and incentivising desirable choices first, rather than negatively educating/disincentivising undesirable choices. The Nuffield Ladder tells us that moving upwards balances greater effectiveness with less acceptability. Like all other outlets, the Students' Union initially wanted to start with less effective but more acceptable interventions. Other versions of the traffic lights can be found in the Appendix 4.

2.2.2. Location and type of interventions

The menus were altered across four SSU food outlets: New Leaf (a build your own salad bar), Bar One (a bar which predominantly serves burgers), Interval (a sit-down restaurant) and Coffee Revolution (a café) (further details can be found at https://yoursu.sheffield.ac.uk/eat-drink-shop). Different methods of altering menus were used in each outlet, as discussed below. All menu alterations were in place in the outlets by 17th May 2019, with the interventions running until the 8th of June 2019. It was hypothesised that the more prominent and visible menu alterations would increase recognition and understanding of the low impact logo and thus be more effective in promoting sustainable food choices.

2.2.3. New Leaf – logo on menu

In the New Leaf salad bar, customers can build their salad choosing from a variety of ingredients grouped into different categories (Base, House Mix-ins, Deli Mix-ins, Dressings and Garnishes). Ingredients in these categories are shown on a magnetic board on the wall. A magnet stating 'low impact foods below' accompanied by the logo (Figure 1) was used in the 'Deli mix-ins' and 'House mix-ins' category. Options in these categories were split into two columns, one

Table 1. Impact categories of different foodstuffs based on their associated greenhouse gas emissions. Reproduced from Graham (2018).

Impact Category	Prominent ingredient
High	Beef, lamb
Medium	Cheese, pork, prawns, fish, butter*, cream*
Low	Poultry, Egg, Vegetables

* Applied to pastries and desserts only.

Figure 1. The low impact logo used throughout the study.

containing low impact ingredients headed by the magnet and the other containing medium impact options with no distinction. 'House mix-ins' consisted of just one column as all options were low impact. Additionally, an A4 informational poster was displayed by the till to help customers recognise and understand the logo. This is provided in the Appendix.

2.2.4. Coffee Revolution – milk guide

Being a café style outlet, the highest selling items in Coffee Revolution are hot drinks. As such, the main focus here was to nudge patrons to try plant milk in their drink rather than cow's milk. An A4 'milk guide' was produced containing information on the environmental benefits of plant milk alongside the low impact logo (Figure 1), as well as information on SSU's local milk supplier 'Our Cow Molly', as outlet managers were keen to avoid a negative slant on cow's milk given the effort put into its local sourcing. This guide was displayed on the end of poles designating the queuing area. Milk guide is provided in Appendix.

2.2.5. Interval – milk guide and logo on menu

Similar to Coffee Revolution, hot drinks are a key seller at Interval, so the milk guide was also implemented and placed alongside coffee stirrers and sugar on a table by the till. Additionally, the low impact logo (Figure 1) was placed alongside low impact food items on the A4 main food menu; however, it was not included on their smaller lunchtime menu. Both milk guides are provided in the Appendix.

2.2.6. Bar One – separate low impact menu

Bar One has an extensive menu, comprised primarily of burgers. The menu is split into daytime, lunch, meat-free and sharer sections housed on a clipboard. Burger sales are roughly evenly split between beef (high impact), chicken (low impact) and vegan burgers (low impact). An additional menu section was produced called the 'Low carbon impact menu' which featured the low impact logo (Figure 1) alongside six existing low impact menu items as chosen by the outlet manager. This menu was of A6 size (notably smaller than the other menu sections) and was placed at the front of the clipboard menu.

2.3. University survey

Baseline data on the diets and other factors surrounding the food choice of patrons of SSU were collected via face-to-face interviews and an online survey. Interviews were conducted on 29th April and 2nd May 2019. Two researchers staffed a stall located outside SSU on 29th April and within SSU on 2nd May. A selection of homemade vegan cakes was used as an incentive to complete the survey. The researchers offered guidance to respondents when and if needed, when completing the survey, for example, if they needed clarification on answering any of the questions.

The same survey was sent out as a Google form via email to all staff and students at the University of Sheffield that had opted to receive 'staff announce' (7th May 2019) or 'student announce' (8th May 2019) emails. In the survey, diet type was split into nine categories using the same question as deployed at the Take a Bite Out of Climate Change events (Kluczkovski et al., 2020), based on questions asked in the ScenoProt sustainable proteins research survey (Makery, 2016). Further detailed information on the survey can be found in Appendix 1. Surveys were analysed in Excel and Google Sheets. In the results this survey data is compared to that collected by YouGov.co.uk (2019).

2.4. Interviews

The reaction to the above menu interventions across outlets was assessed through short, semi-structured face-to-face interviews. These took place on 23rd and 25th May, approximately one week after the menu interventions were in place. An adaptable interview script (Appendix 6) was produced and contained questions regarding whether the interviewee had seen the menu or logo, their thoughts regarding the logo and their thoughts on the SU promoting sustainable diets. Doing so allowed the interviewer to follow the conversation in a content-focused manner (Dunn, 2010).

Interviews lasted approximately five minutes. A researcher would approach outlet customers and ask if they wanted to complete a short interview. Like the survey, homemade vegan cakes were offered as an incentive, but participants could also choose a voucher for £1 off a low impact food or drink item (as adver-

tised by the various menu interventions). Participants were able to choose which incentive they wanted after completing the interview. Some interviews were completed in groups as often several people would be dining together, but responses were recorded separately. Two researchers were present throughout the interview, with one asking the questions and the other taking notes. Additionally, the interviews were recorded with consent and transcribed, with the transcript's content analysed using the software NVIVO.

2.5. Sales and purchasing data

Sales data and supplier-end purchasing data for the intervention period were collected for each outlet and the corresponding period for the year before. These data were used to assess current uptake of low, medium and high impact foods across outlets. Different types of data were collected for each outlet as a result of the data that was available. For Interval and Bar One, sales data were collected, showing the monetary sale values of low, medium and high impact items. At Coffee Revolution, data for the amount of dairy, soya and oat milk used was collected. At New Leaf the amount (kg) of each 'Deli Mix-in' ingredient used was collected, as all the 'House Mix-in' ingredients were low impact. Sales data were grouped and analysed in Excel and Google Sheets.

2.6. Additional intervention- Climate Strike

On the day of the global Climate Strikes (20th September 2019), SSU outlets introduced one-day-only promotions on low impact menu options. Here we assessed the impact of Bar One's additional promotion. Bar One typically provides a 2 -for-1 offer on all burgers at the beginning of each semester, but for the Climate Strike, Bar One excluded all beef burgers from the offer. A total of 31 customers were verbally surveyed and asked nine questions to test whether the promotion impacted beef burgers' sale (please see Appendix 2 for question list; with more detailed analysis in Appendix 7). Their responses were coded using content analysis to allow for categorisation and calculate percentages. The sales data for the Climate Strike day and the day before were also collected, although vegetarian and vegan burgers were categorised into one category (meat-free burgers). Sales data was analysed in Excel and Google Sheets.

3. Results

3.1. Diet survey results

3.1.1. Survey population demographics

A total of 643 people completed the survey. Overall, 57.9% (n = 372) of respondents were classified as staff of either the University of Sheffield or SSU. University of Sheffield students comprised 41.2% (n = 265) of the sample, while the remaining participants classed as 'other' as they did not fall under either category (n = 6). Researchers completed 139 (21.6%) surveys 'face to face' along with the food incentive with the remaining 504 people (78.4%) survey completed the survey online. Study participants were 69.4% female (446) and 25.5% male (164).

3.1.2. Survey age demographics

In the face-to-face surveys, a much greater percentage of participants fell into the 18-25 age-group compared to the online surveys (see Figure 2). There was a broader age range for the online surveys, with approximately 20% of participants falling into each age category apart from 55+ (lower at 9.1%). A significant association was found between the survey method and participant age ($\chi2$ = 215.4, df = 4, p < 0.001). Those in the 18-24 age category were more likely to have completed the survey face to face, whereas those aged 35 and above were more likely to have completed the survey online.

3.1.3. Dietary identification

The majority of respondents (29.2%) identified their diet as 'I often eat both meat and vegetarian food', followed by 'I frequently eat vegetarian food and occasionally eat meat (flexitarian)' at 22.2% of the whole survey population (see Figure 3a). For ease of analysis, 'I frequently eat meat and I am not interested in trying vegetarian food', 'I often eat meat and I occasionally eat vegetarian food' and 'I often eat both meat and vegetarian food' were grouped under the term 'meat-eater'. Similarly, 'I eat dairy and eggs in addition to products derived from plants (ovo-lacto-vegetarian)' and 'I eat dairy in addition to products derived from plants (lacto-vegetarian)' were grouped

under the term 'vegetarian'. Using these groupings, the majority of respondents were labelled meat-eaters (44.9%) followed by flexitarians (22.3%) (see Figure 3b). Detail of all original diet classification categories can be found in Appendix 8. For some analyses 'I frequently eat meat and I am not interested in trying vegetarian food' was left separate and shortened to 'Meat only' to assess the amount of push back that may exist towards more sustainable diets.

Students were more likely to be flexitarians, vegetarians and vegans than staff, with the majority of staff being meat-eaters (see Figure 4). However, more students had no interest in trying vegetarian food (5.28%). The diet types of those who conducted the survey online and face-to-face were similar (see Figure 5). However, those who completed the survey online were more likely to eat meat, whereas those who completed it face to face were more likely to be flexitarian, which may be attributed to the different age demographics of the study populations.

There was a significant association between age and diet type ($\chi2 = 71.96$, df = 44, p = 0.005) (see Figure

6). Meat-eaters predominated in all age groups; however, this was more prominent in those aged 35 and over. The proportion of flexitarians was similar across all age groups but dropped in the 45 – 54 age category. There was a significant difference between the diet proportions found in our study sample and those found by YouGov.co.uk 2019 ($\chi2 = 913.63$, df = 6, p < 0.001). Our study found greater percentages of flexitarians, pescatarians, vegetarians, and vegans than the YouGov study (2019) (see Figure 7).

3.1.4. Reasons for reducing meat intake and likelihood of changing diet

Both staff and students had similar reasons for reducing their meat intake, with environmental concerns, health concerns, and animal welfare concerns being those most frequently cited (see Figure 8). The cost was a greater issue for students than for staff.

This data was assessed in a similar way to the YouGov.co.uk (2019) report 'Is the future of food flexitarian?', focusing on meat-eaters and flexitarians' behaviour. There was a stark difference in the response to the ques-
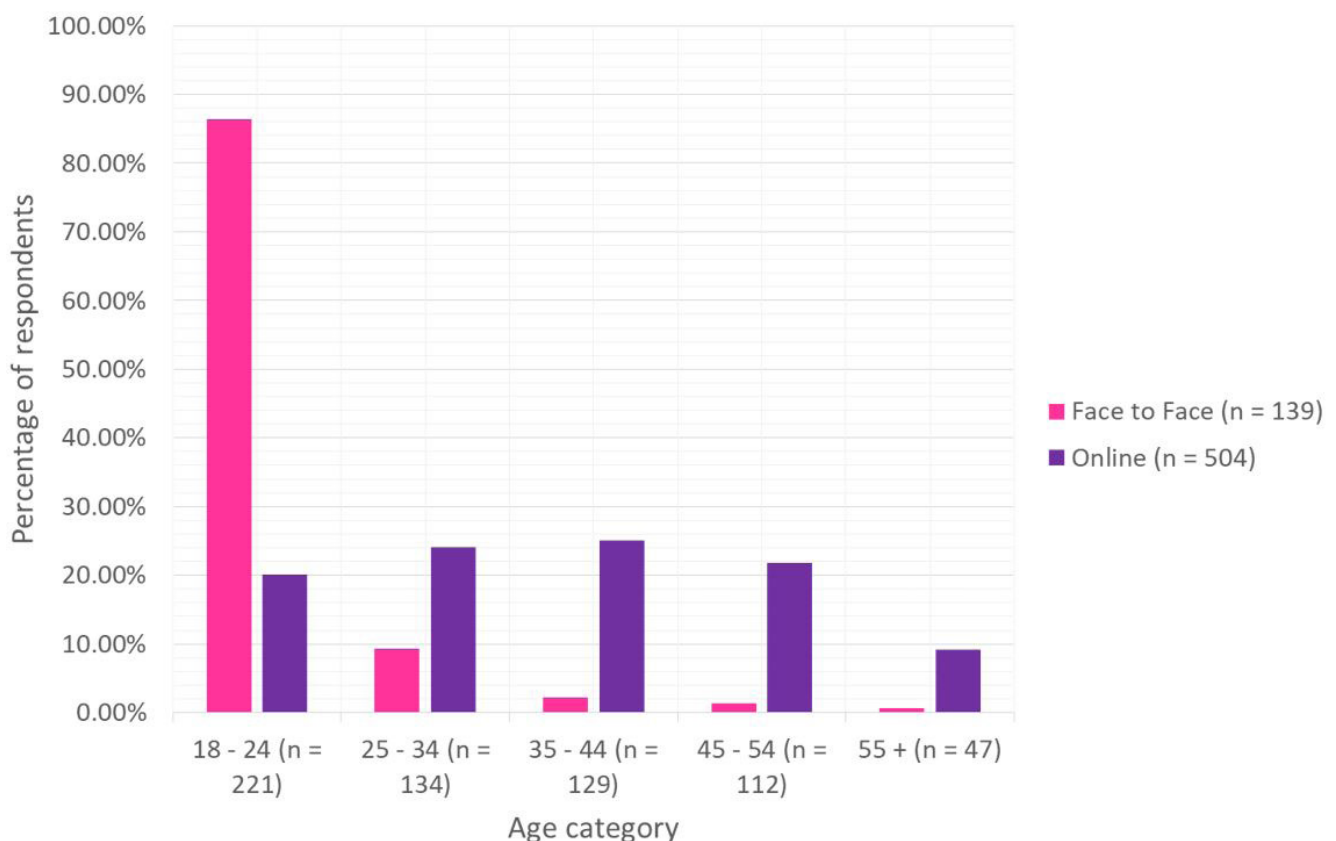
Figure 2. The spread of ages across of survey respondents online and face to face
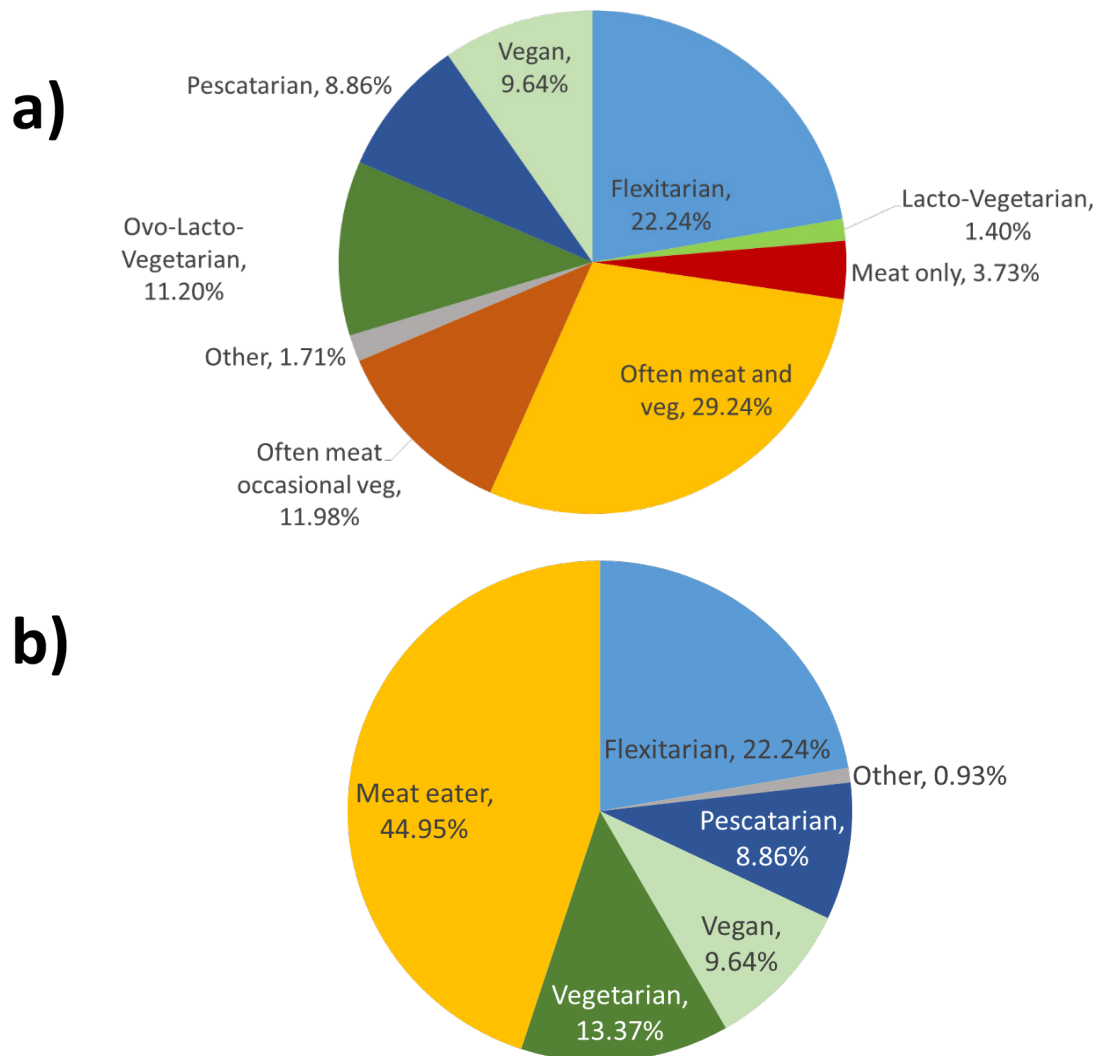
Figure 3. Diet types across all survey respondents using a) separate and b) grouped categories

tion 'To what extent do you agree with the statement 'I am actively trying to reduce my meat consumption'?' between meat-eaters and flexitarians. The majority of flexitarians either tended to agree or definitely agree with the statement (84.6%). In contrast, the majority of those who had no interest in trying vegetarian food ('Meat only') tended to disagree or definitely disagree with the statement (79.2%). Despite this, the majority of those who often ate both meat and vegetarian food and those who ate vegetarian food occasionally ('Meat-eaters') tended to agree with the statement or neither agree nor disagree (63.0%) (see Figure 9).

When asked the likelihood of becoming a vegetarian in the next 12 months, the majority of both meat-eaters and flexitarians answered 'not very likely' (46.0%

and 40.6%, respectively). The majority of those not interested in trying vegetarian food at all unsurprisingly answered 'not likely at all' (83.3%). Nevertheless, Figure 10 shows the answers of flexitarians were slightly more positively skewed. These findings mirror those of the YouGov.co.uk (2019) report, with 79% of meat eaters 'not likely at all' to become vegetarian in the next 12 months. Similarly, the majority of flexitarians (40%) were 'not very likely' to change their diet either.

The majority of both flexitarians and meat-eaters were 'not likely at all' to become vegan in the next 12 months (42.0% and 81.5%, respectively; see Figure 11). This majority was greater for meat-eaters and 'meat only' than for flexitarians. Approximately 5% of flexitarians were 'likely' or 'very likely' to become vegan in the

next 12 months. This is slightly higher than that found by YouGov.co.uk 2019, with only 2% of flexitarians 'likely' or 'very likely' to become vegan. The majority of flexitarians and meat-eaters questioned by YouGov.co.uk (2019) were 'not likely at all' to become vegan in the next 12 months (68% and 93%, respectively).
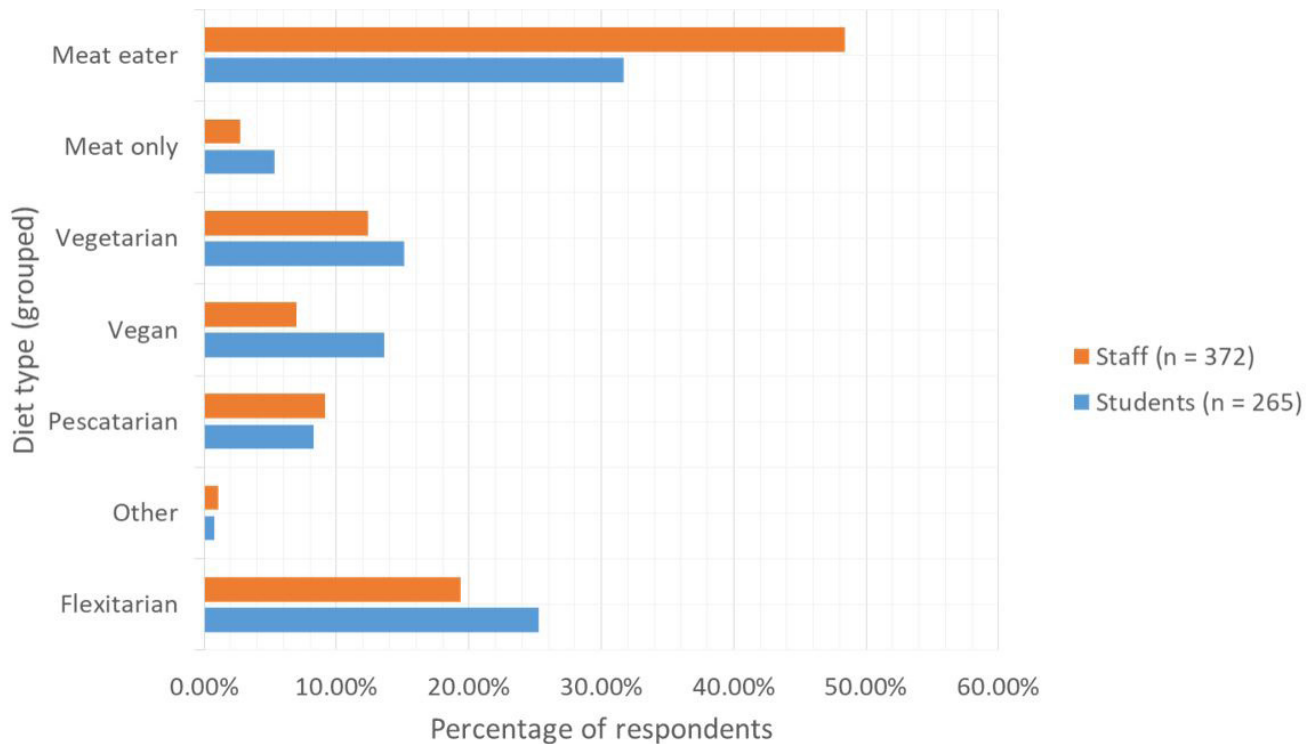
Figure 4. Comparison on the diet types of staff and students using grouped diet definitions
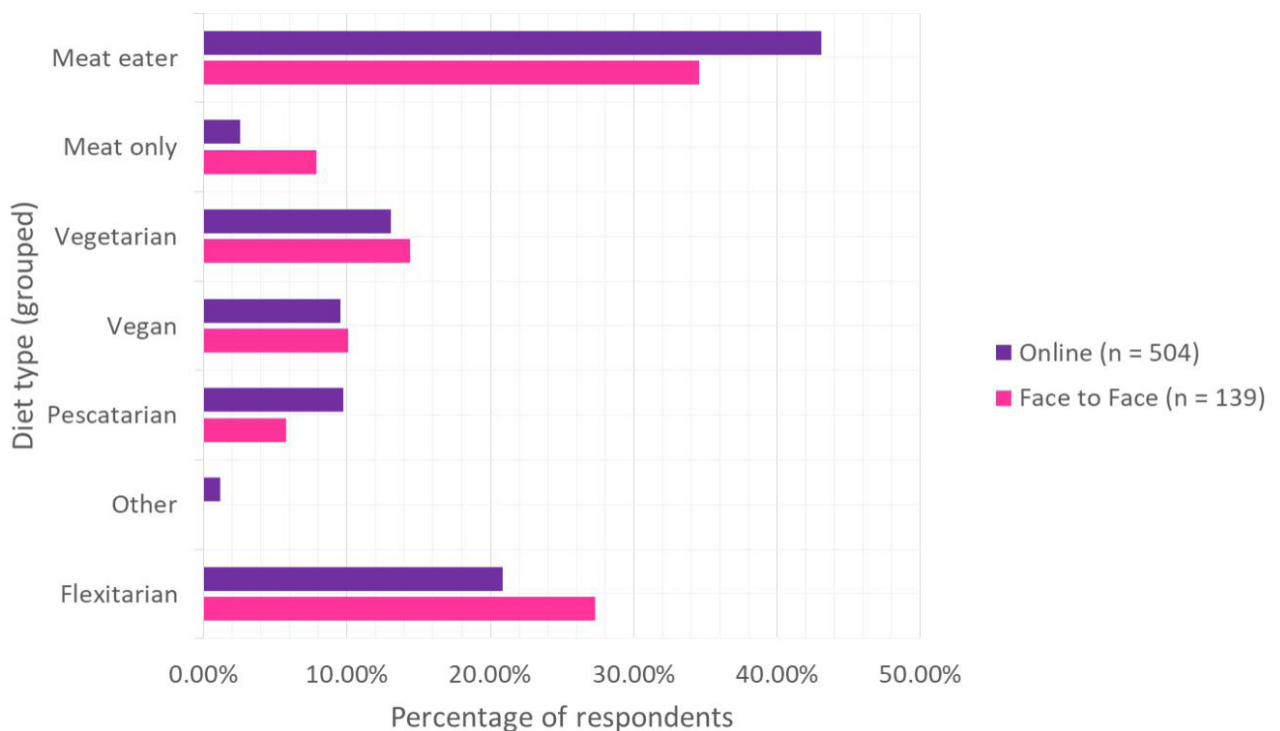
Figure 5. Comparison of diet type between those who completed the survey online and those who completed it face to face
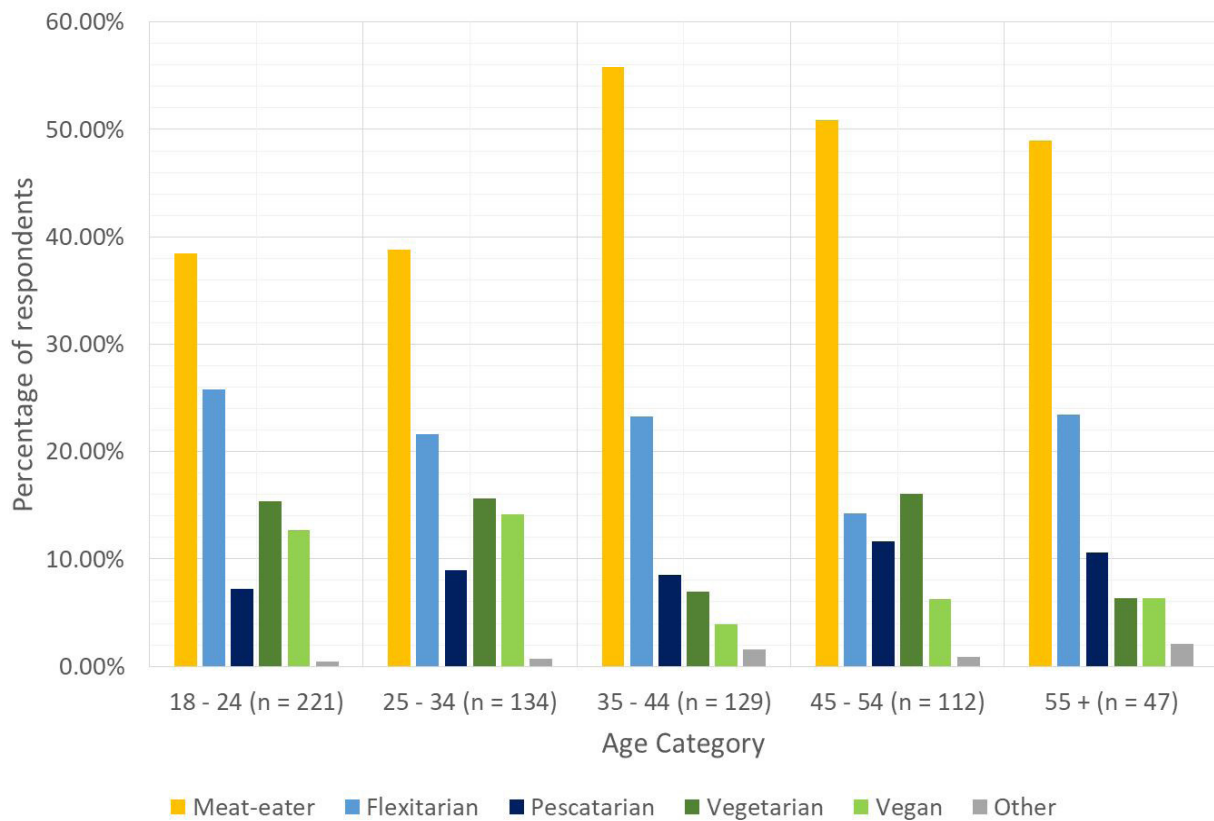
Figure 6. The grouped diet types of each age category
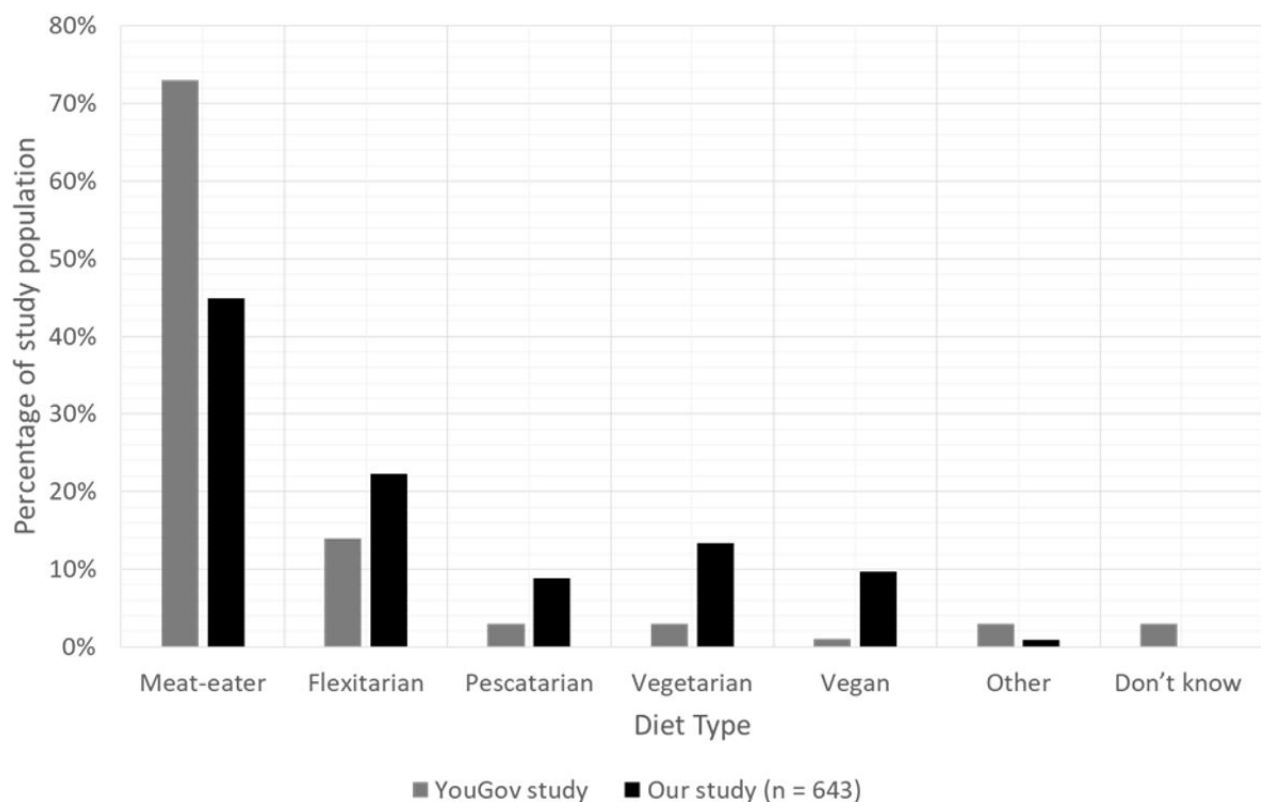
Figure 7. A comparison of the percentage of each diet types found across our study population and that found by YouGov.co.uk 2019
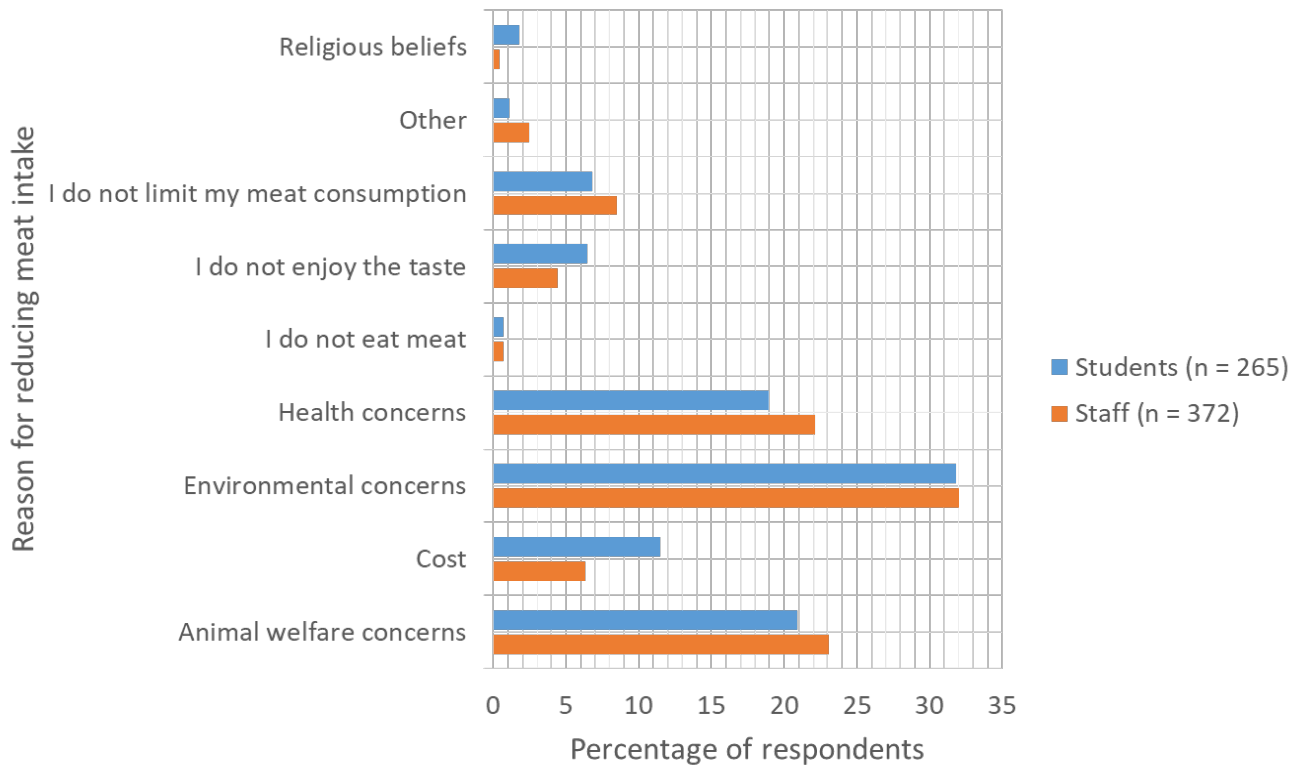
Figure 8. The reasons staff and students cited for reducing their meat intake
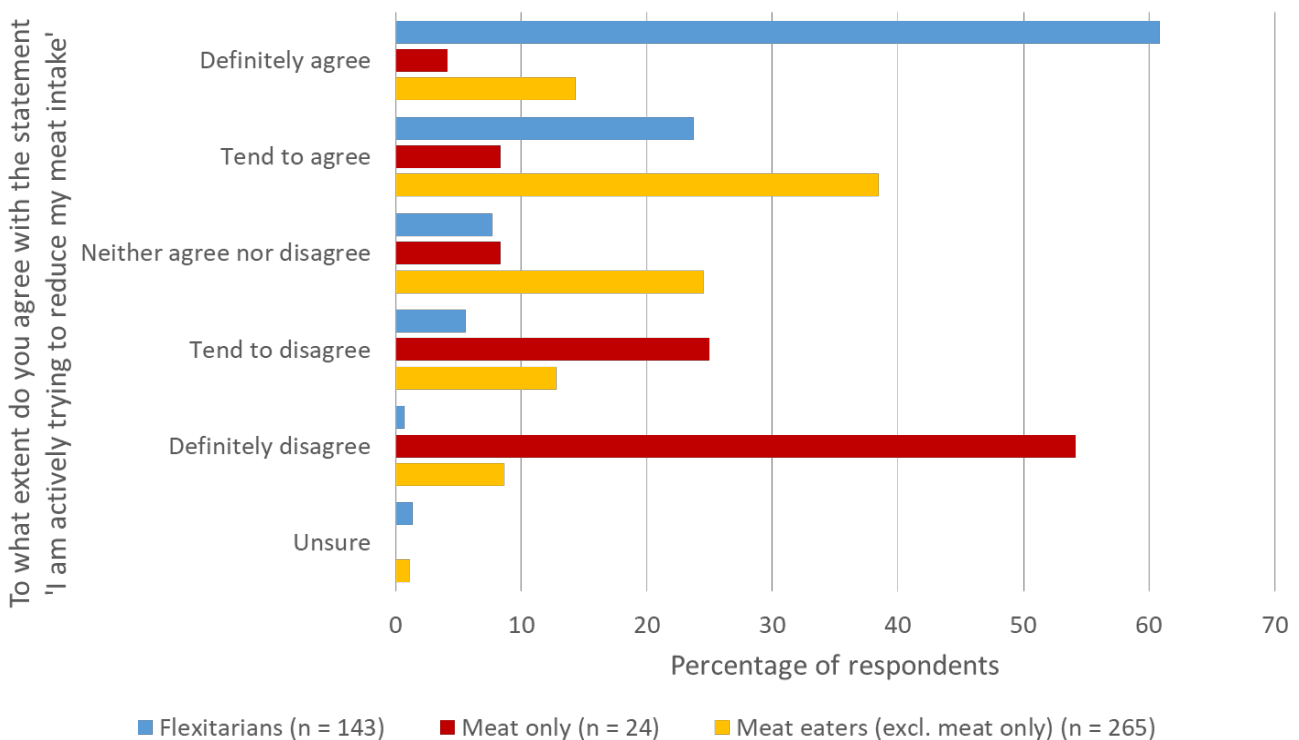
Figure 9. The extent to which flexitarians, those with no interest in trying vegetarian food (meat only) and meat eaters agree with the statement 'I am actively trying to reduce my meat consumption'.
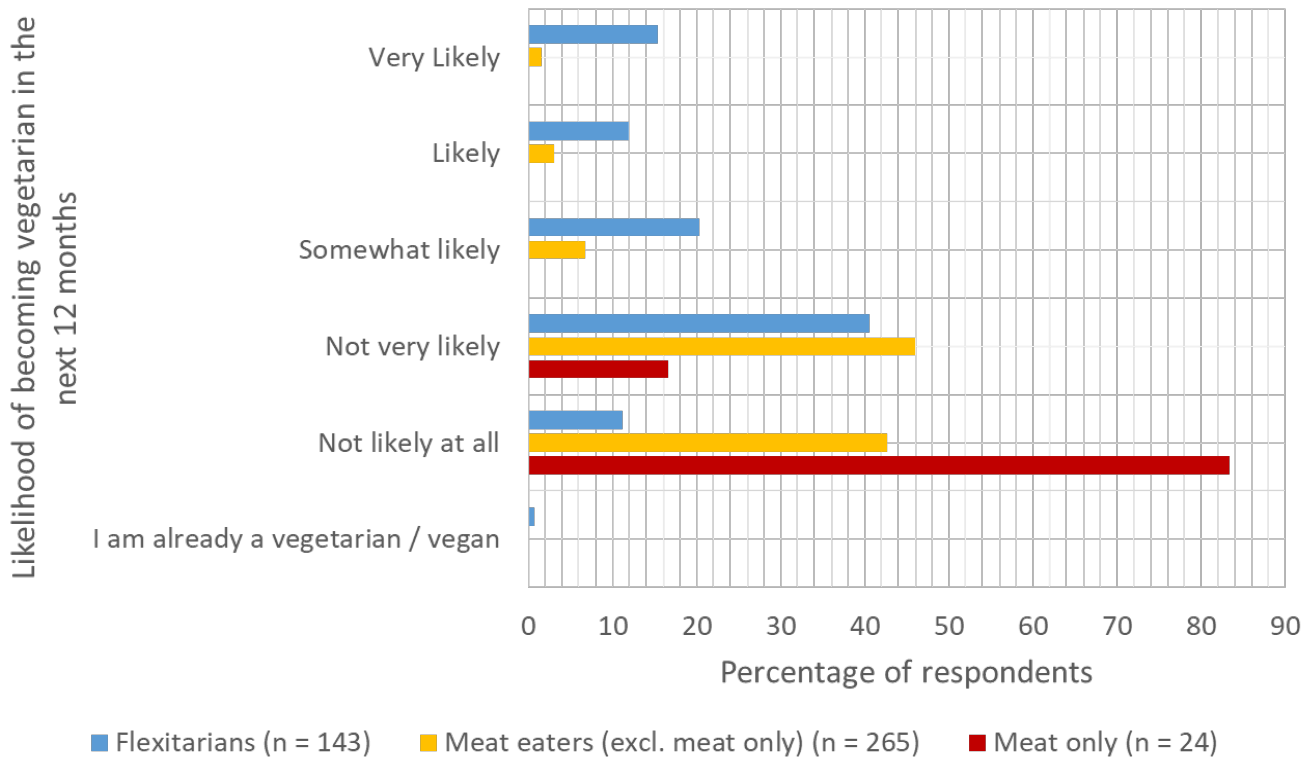
Figure 10. The likelihood of flexitarians, meat eaters and those with no interest in trying vegetarian food ('meat only') in becoming vegetarian in the next 12 months
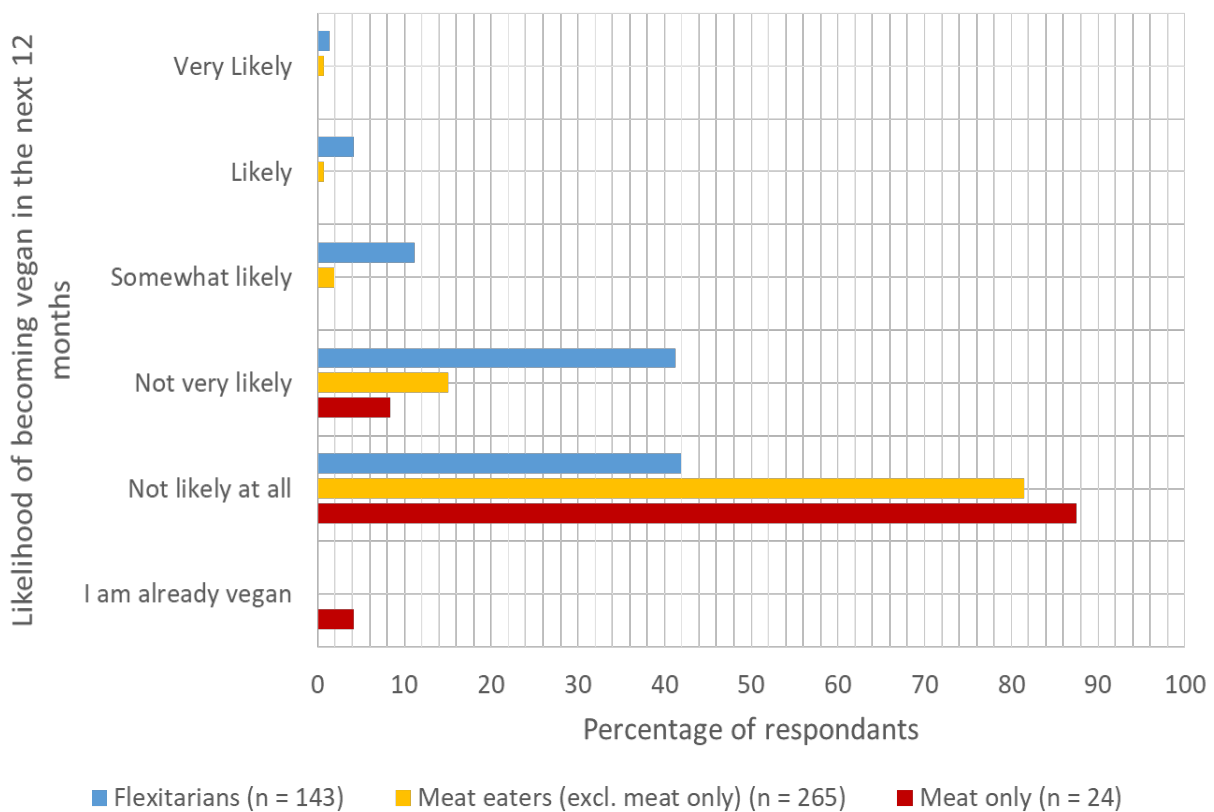
Figure 11. The likelihood of flexitarians, meat eaters and those with no interest in eating vegetarian food ('Meat only') of becoming vegan in the next 12 months

3.2. Menu interventions interview findings

Table 2 details when interviews took place in each outlet and the number of participants and the gender ratios.

Table 3 summarises the main results from the interviews and the interventions used in each outlet. More people had not seen the logo (59.1%) across all restaurants than had seen it (39.4%). The low impact logo's most significant recognition rate was at Interval (47.1%), whereas the lowest recognition rate was at Coffee Revolution (23.5%). In none of the outlets had more people seen the logo than not seen it.

Nevertheless, the majority of respondents (86.4%) said that further rollout of the low impact logo would positively affect their meal choice. Frequently mentioned was the fact that if the person may be choosing between more than one food options and one was low impact, they would be more likely to choose the low impact one as the logo has "[done] the research for you". Many of those who said the logo would not influence their choice were already looking to make more sustainable food choices or already ate a diet that included low impact foods such as vegetarian or vegan.

Reaction to the logo design was similarly positive and it "encompasse[d] a lot of what [we're] trying to say". However, there was some confusion regarding what 'low impact' was referring to, with some thinking it was linked to packaging and recycling rather than the emissions from food production. Also, a few participants thought the logo might be related to health.

Table 2. Dates and times of interviews for each outlet as well as number of participants and gender ratios

Outlet	Day interviews conducted	Time interviews conducted	Total number of participants	Gender ratio m:f
New Leaf	23/05/19	12:30 - 14:00	14	3:4
Coffee Revolution	23/05/19	10:30 - 12:30	17	4:13
Interval	25/05/19	14:45 - 16:45	17	5:12
Bar One	25/05/19	12:45 - 14:00	18	2:5

Table 3. Respondents (%) who had seen the low impact logo and reported it would positively affect their food choice

Restaurant	Intervention Type	Total number interviewed (%)	Percentage (%) who had seen the logo	Percentage (%) (%) who had not seen logo	Percentage (%) who self logo reported would positively affect their food choice
Coffee Revolution	Milk Guide	17	23.5	70.6	82.4
New Leaf	Logo above low impact choices	14	42.9	57.1	85.7
Bar One	Stand alone low impact menu	18	44.4	55.6	88.9
Interval	Logo on main menu and milk guide	17	47.1	52.9	88.2
Overall		66	39.4	59.1	86.4

Table 4. Usage of 'Deli mix in' ingredients across 2018 and 2019

Ingredient	Impact category	Usage in 2018 (kg)	Usage in 2019 (kg)	Increase in usage?
Falafel	**Low**	105.7	91.8	No
Basil Tofu	**Low**	28.5	18.7	No
Hummus	**Low**	73.7	65.1	No
Tuna chunks	**Medium**	33.3	23.0	No
Roasted Mediterranean Vegetables	**Low**	27.9	32.4	Yes
Vegan Sausages	**Low**	374 sausages	723 sausages	Yes
Back Bacon	**Medium**	6.6	-1.5	No
Piri Piri Chicken	**Low**	125	86.6	No
Chicken Breast Slices	**Low**	76.2	58.4	No
Greek Feta	**Medium**	61.6	55.7	No
Mature Cheddar	**Medium**	31.3	53.1	Yes
Stilton	**Medium**	0.07	19.6	Yes
Bacon	**Medium**	891 portions	492.8 portions	No

3.3. Sales and purchasing data

3.3.1. New Leaf

As New Leaf sales data does not record the specific ingredients used in each salad, the quantity of 'Deli mix-in' ingredients used in 2018 and 2019 was compared. The 'Deli mix-in' category was selected as it contained low and medium impact food items. The rest of the categories such as 'House mix-ins' where the logo was also used contained predominantly low impact items. In 2018, ten medium impact items were available across all categories, whereas in 2019 this had fallen to 8. Of the 'Deli mix-in' ingredients that remained across both years, the usage of the majority of medium impact ingredients decreased (4/6). However, the use of the majority of low impact ingredients (5/7) also decreased between 2018 and 2019. Table 4 illustrates this data.

3.3.2. Coffee Revolution

Data on milk usage in 2018 and 2019 were collected and compared. In 2019 there was a significant increase in use of oat milk compared to 2018 ($\chi 2$ = 307.07, df = 2, p < 0.001). The use of soya milk stayed relatively the same across years, and there was a slight decrease in dairy milk usage in 2019 (see Table 5).

3.3.3. Interval

Sales data were collected from the period 29/04/2019 – 08/06/2019 and for the same period in 2018. Given that Interval serves a range of food across the day, the data was split into three categories: 'Afternoon' which includes all hot food served during the lunchtime period such as small pizzas, 'Sandwiches' which includes all hot and cold sandwiches served during the lunchtime period and 'Evening' which includes all hot food served in the evening such as larger pizzas, pasta, salads and nachos. Dessert foods and hot drinks were not included in this data set.

Across all categories, Interval sold more types of me-

dium impact foods than low impact foods. Medium impact foods had a greater value of sales in relation to the number of options available across all categories. On average, each medium impact item generated more money than low or high impact items. Despite this, for the 'Sandwiches' category in 2018, the value of sales in relation to the number of items available was similar for both low and medium impact options. In other words, sales of both low and medium impact sandwich items generated a similar amount of money on average. In 2019 however, medium and high impact items had a greater value of sales than low impact items suggesting they were more profitable as they generated more money. Table 6 illustrates this.

3.3.4. Bar One

Sales data was collected from the period 29/04/2019 – 08/06/2019 and for the same period in 2018. For the purpose of this analysis, the sales of burgers were the main focus. In 2019 the number of low impact options available had increased; however, they had the lowest total value of sales. In 2018, high impact items had the greatest total value of sales. In contrast, in 2019, medium impact foods had the greatest sales value, suggesting a positive trend towards slightly less impactful food choices. This data is illustrated in table 7.

3.3.5. Subsequent action research results – Bar One

Following the feedback of intervention results and co-design of ideas for future interventions to the restaurant outlet managers, Bar One redesigned its menus to promote lower-impact foods. These changes targeted subconscious as well as conscious processes. The date of redesign was September 2019, in use from the first day of trading in 2019 (16/9/2019). Prices of beef and chicken burgers were made more comparable (with beef previously being priced cheaper than chicken). Chicken burgers were placed at the top of the menu above beef burgers along with a textbox ex-

plaining the environmental impact of beef burgers. The low impact logo was not used.

Initial results suggest these interventions have been successful in promoting low impact items. Data collected over the first two weeks of the adjusted menu's circulation show an increase in the proportion of chicken burgers consumed and decreased beef burgers (see Table 8). The proportion of vegetarian and vegan burger sales remained the same.

3.4. Climate Strike intervention

3.4.1. Sales

Table 9 illustrates the changes in sales of beef, chicken and meat-free (vegetarian and vegan) burgers on Climate Strike day from the previous day. There was a considerable reduction in the percentage of beef burgers sold and a subsequent increase in chicken and meat-free burgers sold.

The Climate Strike intervention saw the following changes in sales compared to the previous day: a 35.5% decrease in beef burger sales, a reduction of 6.6% of total burger sales (to 18 burgers), a 20.3% increase in chicken burger sales (161 burgers), and a 15.1% increase in meat-free burger sales (92 burgers). In total, 36 more burgers were sold than on the previous day. (Sales 99 beef, 92 chicken, and 44 meat-free)

3.4.2. Interviews

A total of 31 customers were interviewed. The majority identified as either a 'meat-eater' or a 'flexitarian'. Approximately a quarter was either a 'vegetarian' or a 'pescatarian' and 10% were 'vegan'. When asked why they chose what they had ordered, only five of the respondents mentioned 'environmental reasons', with 'favourite order' and 'it sounded nice' being the most frequently cited reasons. Most respondents were

Table 5. Milk usage and its impact category in Coffee Revolution in 2018 compared to 2019

Milk Type	Impact Category	2018 Usage (Litres)	2019 Usage (Litres)	Increase in Usage?
Dairy	Medium	2460	2206	No
Soya	Low	252	240	No
Oat	Low	282	564	Yes

Table 6. The number of options available in Interval, 29/04/2019 – 08/06/2019 and the same period in 2018. Value (£) of their sales in total, in relation to options available.

Sub-Category	Year	Number of items in each impact category		Value of Sales (£)	Value of sales in relation to number of other options available (£)
Afternoon	2018	Low	4	215.64	53.91
		Medium	13	1283.15	98.80
		High	0		
	2019	Low	7	1088.76	155.54
		Medium	20	10250.97	512.55
		High	0		
Evening	2018	Low	13	4984.85	383.45
		Medium	29	16803.60	597.41
		High	0		
	2019	Low	5	1860.77	372.15
		Medium	10	6615.88	667.59
		High	1	894.20	894.20
Sandwiches	2018	Low	1	430.70	430.70
		Medium	8	3933.85	3933.85
		High	0		
	2019	Low	2	358.55	179.28
		Medium	6	4048.92	674.82
		High	1	596.37	596.37

Table 7. The number of burger options available in Bar One, 29/04/2019 – 08/06/2019 and the same period in 2018. Value (£) of their sales in total, in relation to options available

Year	Number of items in each impact category		Value of Sales (£)	Value of sales in relation to number of other options available (£)
2018	Low	16	14673.49	917.09
	Medium	10	13088.28	1208.83
	High	12	15091.62	1257.64
	Other	9	3843.10	
2019	Low	19	10964.60	577.08
	Medium	13	21848.83	1680.80
	High	13	16795.51	1291.96
	Other	8	2695.41	

Table 8. Comparison of percentage sales of different burger types during the first two weeks of term in 2017-18 and 2019-20. A new menu promoting low impact burgers was introduced in 2019-20.

Year	Burger Type	Percentage of Sales (%)
2017-2018	Beef	39
	Chicken	35
	Vegetarian/Vegan	26
2019-2020	Beef	30
	Chicken	44
	Vegetarian/Vegan	26

Table 9. % Burgers sold on Climate Strike Day, previous day, over the 2019-20 new menu first two weeks (September 2019).

Burger Type	Impact Category	Climate Strike Day (20-9-2019)	Previous Day (19-9-2019)	2019-20 new menu first two weeks (September)
Beef	High	6.6%	42.1%	30%
Chicken	Low	59.4%	39.1%	44%
Meat-free	Low	33.9%	18.8%	26%

aware of the 2-for-1 promotion, but not all were aware that beef burgers were not included in the deal. Two respondents chose chicken burgers as they thought beef was off the menu; a misunderstanding possibly based on another SSU outlet (Our Shop) not to sell beef burgers from their express counter on Climate Strike day. Most said that not including beef burgers in the 2-for-1 promotion did not influence their choice, mainly because they had pre chosen what they would have had. Four respondents said the promotion did influence their choice, with one flexitarian saying it led them to choose chicken instead of beef. Most respondents were aware of the climate strike. However, most said that it did not influence their meal choice. Of the seven respondents who said it did influence their choice, four chose vegan burgers (2 meat-eaters, 1 pescatarian, 1 vegetarian) and 3 chose chicken burgers (all flexitarians).

The response for the suggestion of removing beef from the Bar One menu was very positive from all respondents, regardless of their meal choice or diet. Some said that it would be a "bold move" but would remain supportive of it and recognise its environmental rationale. The two respondents who said that they would have ordered beef had they known it was on the menu were also supportive. They said that they would recognise the rationale behind it despite being 'slightly disappointed' that they would not be able to have it. They also said that as long as chicken remained on the menu, they would not miss beef too much, suggesting a positive response to the promotion of low GHGE foods without a complete shift to a plant-based diet in the short term. No customers who had ordered a beef burger on this day were surveyed. Still, those surveyed' responses indicate they would give positive affirmation to Bar One for supporting the climate crisis in this way. Flexitarians who chose meat options opted for chicken over beef, as many said they do not eat red meat.

4. Discussion

A major dietary shift is needed to reduce the GHGE from food production as altering agricultural practices alone will not be sufficient (Hoek et al., 2016). Despite most staff and students at the University of Sheffield and Sheffield Student's Union being 'meat-eaters', interview findings suggest that reaction to the introduction of a low impact logo to distinguish foods with

low associated GHGE would be overwhelmingly positive in this setting. This finding mirrors a 2008 focus group by the supermarket Tesco, which found that consumers were concerned about climate change and interested in the carbon labelling of products (Vanclay et al., 2011).

This study found that 'clearer signposting of environmental impacts on menus and packaging in SSU outlets' was one of the main things people wanted to see from SSU regarding sustainable diets. Despite this, more research is needed to establish whether such interventions would impact consumption patterns of low impact foods both within SSU and at home. Initial reactions from a menu redesign in Bar One emphasising lower impact chicken items, converging prices of high and low impact items and providing information on environmental impacts has been positive. Over the first two weeks of its introduction, percentage sales of chicken burgers increased, while beef burgers decreased (see Table 8). This effect was replicated in the climate strike intervention (see table 9). One logical next step would be integrating the existing red and orange labels into the new menus - something that was discussed but not actioned in this living lab intervention. This integration of additional colours might have an off-putting effect on consumers to high/medium impact choices, rather than just making low impact choices more appealing (Shewmake et al., 2015; Sonneberg et al., 2013).

Chen et al. (2016) suggest that low impact items may have higher profit margins, given their more efficient means of production. Nevertheless, this may not be the case in this scenario as the value and percentage of sales as investigated by this paper may not represent profit margins of each type of food. Bar One beef burgers are cheaper to buy and thus more profitable than vegan burgers. However, chicken burgers have a high-profit margin and low impact. They would be a good initial point of promotion until vegan burgers become more readily available and cheaper to produce.

This study found that staff and students' diets at the University of Sheffield and patrons of SSU were significantly different from those found by YouGov.co.uk (2019). This contrast is somewhat unsurprising given that the study population can be considered skewed towards those in the 18-24 age bracket. Additionally, during face-to-face surveys, vegan cakes were offered as an incentive. In the online surveys, 'sustainable diets' were mentioned, which may have skewed the population towards those already following or interested in sustainable diets (See Appendix). Given that the proportion of those with 'lower impact' diets (flexitarians, pescatarians, vegetarians and vegans) was greater in this population than the population examined by YouGov.co.uk (2019), interventions to promote sustainable diets may better serve communities and workplaces with a lower awareness of the climate impact of diets.

It should also be noted that people may follow these diets for reasons other than their low climate impacts, such as for health or cultural reasons. Further study into other factors, such as the social connotations of diet, would therefore be relevant.

This study shows which interventions involving a low impact logo had the most significant impact on conscious food choice. Interval had the greatest logo recognition rate of all outlets suggesting that having a low impact logo, directly beside low impact food items on the main menu, is the best-studied method to engage with more environmentally-conscious food choices. Despite this, further study is needed to see whether this impacts food choice long term both within the outlet and if it has a knock-on effect on food choice in the home. Higher rates of logo recognition and understanding may be achieved by using a similar strategy to Interval across all outlets. We are aware that similar interventions using logos and traffic lights are now being trailed in other universities such as London School of Hygiene & Tropical Medicine and Oxford (White, 2019, Brown, et al., 2020, Harris, 2020 and Potter, 2020)

Combining menu interventions with a price incentive would also motivate behaviour change, as shown by Vanclay et al. (2011) and the Bar One menu redesign which included price convergence between beef and chicken burgers. Indeed, this would be beneficial in settings with large student populations given cost is a prominent issue for them than for staff (according to this study). During the interviews, many respondents noted that the 'cup levy' already being applied to all hot drinks bought in take away cups across the SSU,

was successful in reducing take-away cup use: "I always bring my own coffee cup just because it saves money".

The additional global climate strike day intervention highlights that students are receptive to monetary incentives, with the added benefit of raised awareness of the climate impacts of beef products. However, there were multiple limitations to this additional intervention: 1) Many customers on this day had attended the climate strike themselves and were therefore already environmentally conscious - this may have skewed results. 2) Customers who ordered beef burgers were not surveyed, and their responses may have changed the overall responses. 3) There was confusion amongst customers about whether beef was served on this day or not. 4) Most people seemed to think that beef was not being served which may have been why beef sales were low. 5) Customers may have worked out the purpose of the study and subsequently altered the truth with their responses to give a more desirable or socially acceptable answer. For these reasons further research is needed to understand if menu interventions with a price incentive may be viable as a long-term solution.

When initially devising this living lab project, the intention was to investigate both conscious (such as the low impact logos) and subconscious methods of nudging food choice towards more sustainable options. However, it was decided to focus on conscious interventions following feedback from restaurant outlet managers. Since the majority of both meat-eaters and flexitarians were unlikely to change their diet to vegetarian or vegan in the next 12 months, as well as the difficulty in breaking long-term habits (Chen et al., 2016), nudging more sustainable food choices via subconscious methods such as salience building and menu rearrangement (Wansink & Love, 2014) may have a substantial impact across all diet types. Indeed, initial findings from Bar One's menu redesign following this study have proved effective in reducing beef burger consumption.

Results from interviews suggest that social norms may be a useful avenue to assess food choice, especially in students. Many mentioned that their friends and housemate's diet impacted on their own diet, i.e., if their friends were vegan, they would be more likely to choose vegan food themselves. Some studies have found social norms to facilitate behaviour change (Camilleri et al., 2019).

Our findings also lead to specific theoretical and practical implications regarding living labs. This paper shows that the living lab methodology helps co-create and deploy successful sustainable food interventions on a university campus. Our study could be used as a model for further interventions. However, there are many aspects to successfully deploying a living lab methodology (Dekker et al., 2020); care must be taken to carefully co-design the lab/interventions with the location, outlets and community. For this reason, living lab co-creation theory and methods need to be further explored for a broader range of living lab settings (i.e. beyond the campus). Practically, this means that discussions with possible locations, outlets and communities need to occur to understand what is right for each. In this context, we suggest using the interventions suggested by Bianchi et al. (2018), Abrahamse (2020) and Attwood et al. (2020) as starting points for this discussion.

Our study has shown that living labs can assist a university in moving towards its sustainability strategy targets. From a practical policy perspective, we suggest that governments and organisations (such as universities) could use, deploy, (and fund) living labs as part of their toolbox to change diets, improve health, and decrease carbon emissions.

5. Conclusions

This paper suggests that introducing a low GHGE impact logo on main food menus within the university and Student's Union food outlets would be received positively and are something students want to see from their Student's Union. However, it is uncertain if this would be reflected in purchasing and consumption behaviour both within the Student's Union and in people's homes. Information campaigns and cost incentives supporting such interventions may be needed to improve awareness and engagement. Initial findings from a menu redesign where low impact items are given prominence, their cost reduced, and information about environmental impacts provided, has yielded promising positive results. Student diets are atypical to those across the UK, with flexitarian, veg-

etarian and vegan diets being more popular among students. This would, therefore be an interesting and receptive study system to encourage widespread sustainable food choice.

Conflict of interest

The authors declare no conflict of interest, though they do highlight that many of the authors do work for the venues used as study locations.

References

de Andrade Silva, A. R., Bioto, A. S., Efraim, P., & de Castilho Queiroz, G. (2017). Impact of sustainability labeling in the perception of sensory quality and purchase intention of chocolate consumers. Journal of Cleaner Production, 141, 11-21. doi:10.1016/j.jclepro.2016.09.024

Abrahamse, W. (2020). How to Effectively Encourage Sustainable Food Choices: A Mini-Review of Available Evidence. Frontiers in psychology, 11. doi: 10.3389/fpsyg.2020.589674

Attwood, S., Voorheis, P., Mercer, C., Davies, K., & Vennard, D., (2020). Playbook for guiding diners toward plant-rich dishes in food service. World Resources Institute, Washington, DC. Retrieved From https://www.wri.org/publication/playbook-guiding-diners-toward-plant-rich-dishes-food-service

Armstrong, B., & Reynolds, C. (2020). China and the USA, a higher perceived risk for UK consumers in a post COVID-19 food system: the impact of country of origin and ethical information on consumer perceptions of food. Emerald Open Research, 2(35), 35. doi:10.35241/emeraldopenres.13711.1

Bacon, L. & Krpan, D. (2018). (Not) Eating for the environment: The impact of restaurant menu design on vegetarian food choice. Appetite, 125, 190-200. doi: 10.1016/j.appet.2018.02.006

Bacon, L., Wise, J., Attwood, S., & Vennard, D. (2018). The Language of Sustainable Diets: a Field Study Exploring the Impact of Renaming Vegetarian Dishes on UK Café Menus. Retrieved From https://www.wri.org/publication/language-sustainable-diets

Bianchi, F., Garnett, E., Dorsel, C., Aveyard, P., & Jebb, S. A. (2018). Restructuring physical micro-environments to reduce the demand for meat: a systematic review and qualitative comparative analysis. The Lancet Planetary Health, 2(9), e384-e397. doi: 10.1016/S2542-5196(18)30188-8

Biermann, G., & Rau, H. (2020). The meaning of meat:(Un) sustainable eating practices at home and out of home. Appetite, 104730. doi: 10.1016/j.appet.2020.104730

Brown, K. A., Harris, F., Potter, C., & Knai, C. (2020). The future of environmental sustainability labelling on food products. The Lancet. Planetary Health, 4(4), e137–e138. doi: 10.1016/S2542-5196(20)30074-7

Brunner, F., Kurz, V., Bryngelsson, D., & Hedenus, F. (2018). Carbon label at a university restaurant–label implementation and evaluation. Ecological economics, 146, 658-667. doi: 10.1016/j.ecolecon.2017.12.012

Camilleri, A.R., Larrick, R.P., Hossain, S. &Patino-Echeverri, D. (2019). Consumers underestimate

the emissions associated with food but are aided by labels. Nature Climate Change, 9(1), 53. doi: 10.1038/s41558-018-0354-z

Campbell-Arvai, V., Arvai, J. &Kalof, L. (2014). Motivating sustainable food choices: The role of nudges, value orientation, and information provision. Environment and Behavior, 46(4), 453-475. doi: 10.1177/0013916512469099

Chen, D.M., Tucker, B., Badami, M.G., Ramankutty, N. &Rhemtulla, J.M. (2016). A multi-dimensional metric for facilitating sustainable food choices in campus cafeterias. Journal of Cleaner Production, 135, 1351-1362. doi: 10.1016/j.jclepro.2016.06.143

Clune, S.J., Crossin, E., & Verghese, K. (2016). Systematic review of greenhouse gas emissions for different fresh food categories. Journal of Cleaner Production, 140 (Part 2), 766e783. doi: 10.1016/j.jclepro.2016.04.082

Crosby, A., Fam, D., & Lopes, A. M. (2018). Transdisciplinarity and the 'living lab model': Food waste management as a site for collaborative learning. In Transdisciplinary theory, practice and education (pp. 117-131). Springer, Cham. doi: 10.1007/978-3-319-93743-4_9

Curry, R., Crawley, E. & Baird, J. (2014). Values and decisions on sustainable food choices when eating out. In Proceedings of the Institution of Civil Engineers-Waste and Resource Management 168(2), (pp. 87-98). doi: 10.1680/warm.13.00033

Dekker, R., Franco Contreras, J., & Meijer, A. (2019). The living lab as a methodology for public administration research: A systematic literature review of its applications in the social sciences. International Journal of Public Administration, 43(14), 1207-1217. doi: 10.1080/01900692.2019.1668410

Dunn, K. (2010). Interviewing. In: Hay, I. (3rd ed). Qualitative Research Methods in Human Geography. Canada: Oxford University Press, pp. 101-137.

Evans, J., Jones, R., Karvonen, A., Millard, L. & Wendler, J. (2015). Living labs and co-production: university campuses as platforms for sustainability science.

Current Opinion in Environmental Sustainability, 16, 1-6. doi:10.1016/j.cosust.2015.06.005

Favaloro, T., Ball, T., & Lipschutz, R. D. (2019). Mind the Gap! Developing the Campus as a Living Lab for Student Experiential Learning in Sustainability. In Sustainability on University Campuses: Learning, Skills Building and Best Practices (pp. 91-113). Springer, Cham. doi: 10.1007/978-3-030-15864-4_7

Garnett, E. E., Balmford, A., Sandbrook, C., Pilling, M. A., & Marteau, T. M. (2019). Impact of increasing vegetarian availability on meal selection and sales in cafeterias. Proceedings of the National Academy of Sciences, 116(42), 20923-20929. doi: 10.1073/pnas.1907207116

Garnett, E. E., Marteau, T. M., Sandbrook, C., Pilling, M. A., & Balmford, A. (2020). Order of meals at the counter and distance between options affect student cafeteria vegetarian sales. Nature Food, 1(8), 485-488. doi: 10.1038/s43016-020-0132-8

Gavrieli, A., Attwood, S., Stillman, P., Putnam-Farr, E., Wise, J., Upritchard, J., & Bakker, M. (2020). The Impact of Appealing Dish Names on Plant-Based Food Choices in Corporate Cafes: A Field Study. Current Developments in Nutrition, 4(Supplement_2), 1302-1302. doi: 10.1093/cdn/nzaa059_019

Graham, F. (2018). Sheffield Students' Union Sustainable Diets Strategy Action Plan July 2018. Sheffield: Sheffield Students' Union.

Graham, F., Russell, J., Holdsworth, M., Menon, M. & Barker, M. (2019). Exploring the Relationship between Environmental Impact and Nutrient Content of Sandwiches and Beverages Available in Cafés in a UK University. Sustainability, 11(11), 3190. doi: 10.3390/su11113190

Grassian, D. T. (2020). The Dietary Behaviors of Participants in UK-Based Meat Reduction and Vegan Campaigns–A Longitudinal, Mixed-Methods Study. Appetite, 154, 104788. doi: 10.1016/j.appet.2020.104788

Gravert, C., & Kurz, V. (2019). Nudging à la carte: a field experiment on climate-friendly food choice. Behavioural Public Policy, 1-18. doi: 10.1017/

bpp.2019.11

Harris, F. (2020, February 13). Making sustainable food choices | LSHTM. Retrieved from https://www.lshtm.ac.uk/research/centres/centre-climate-change-and-planetary-health/news/100616/making-sustainable-food-choices

Herrera, N.R. (2017). The emergence of living lab methods. In Living Labs (pp. 9-22). Springer, Cham. doi: 10.1007/978-3-319-33527-8_2

Hoek, A.C., Pearson, D., James, S.W., Lawrence, M.A. & Friel, S. (2017). Healthy and environmentally sustainable food choices: Consumer responses to point-of-purchase actions. Food quality and preference, 58, 94-106. doi: 10.1016/j.foodqual.2016.12.008

van Hooijdonk, T. & Hettinga, K. (2015). Dairy in a sustainable diet: a question of balance. Nutrition Review, 73(Suppl), 48-54. DOI: 10.1093/nutrit/nuv040

Jalil, A. J., Tasoff, J., & Bustamante, A. V. (2020). Eating to save the planet: Evidence from a randomised controlled trial using individual-level food purchase data. Food Policy, 95, 101950. doi: 10.1016/j.foodpol.2020.101950

Kluczkovski, A., Cook, J., Downie, H.F., Fletcher, A., McLoughlin, L., Markwick, A., Bridle, S.L., Reynolds, C.J., Schmidt Rivera, X., Martindale, W., Frankowska, A., M. Moraes, M., J. Birkett, A., Summerton, S., Green, R., Fennell, J.T., Smith, P., Ingram, J., Langley, I., Yates, L., & Ajagun-Brauns, J. (2020) Interacting with Members of the Public to Discuss the Impact of Food Choices on Climate Change—Experiences from Two UK Public Engagement Events. Sustainability, 12, (2323). doi: 10.3390/su12062323

Krpan, D., & Houtsma, N. (2020). To veg or not to veg? The impact of framing on vegetarian food choice. Journal of Environmental Psychology, 67, 101391. doi:10.1016/j.jenvp.2020.101391

Kurz, V. (2018). Nudging to reduce meat consumption: Immediate and persistent effects of an intervention at a university restaurant. Journal of Environmental Economics and management, 90, 317-341. doi:10.1016/j.jeem.2018.06.005

Macdiarmid, J.I. (2012). Is a healthy diet an environmentally sustainable diet?. Proceedings of the Nutrition Society, 72(1), 13-20. doi: 10.1017/S0029665112002893.

Macdiarmid, J. I., Cerroni, S., Kalentakis, D., & Reynolds, C. (2020). How important is healthiness, carbon footprint and meat content when purchasing a ready meal? Evidence from a non-hypothetical discrete choice experiment. Journal of Cleaner Production, 124510. doi: 10.1016/j.jclepro.2020.124510

Makery. (2016). Makery ScenoProt overview. Makery, Helsinki, Finland. Retrieved from https://www.luke.fi/scenoprot/wp-content/uploads/sites/5/2017/01/Makery-ScenoProt-WP6-results-2016.pdf

Nuffield Council On Bioethics, (2007). Public Health: Ethical Issues. Nuffield Council On Bioethics, London. Retrieved from https://www.nuffieldbioethics.org/publications/public-health

Lipschutz, R.D., De Wit, D. & Lehmann, M. (2017). Sustainable Cities, Sustainable Universities: Re-engineering the campus of today for the world of tomorrow. In Handbook of Theory and Practice of Sustainable Development in Higher Education pp. 3-16). Springer, Cham. doi: 10.1007/978-3-319-47889-0_1

Oliveira, R.C., Fernandes, A.C., da Costa Proença, R.P., Hartwell, H., Rodrigues, V.M., Colussi, C.F. & Fiates, G.M. (2018). Menu labelling and healthy food choices: a randomised controlled trial. British Food Journal, 120(4), 788-803. doi: 10.1108/BFJ-04-2017-0248

Raghoebar, S., Van Kleef, E., & Vet, E. D. (2020). Increasing the proportion of plant-based foods available to shift social consumption norms and food choice among non-vegetarians. Sustainability, 12(13), 5371. doi:10.3390/su12135371

Reynolds, C.J., Buckley, J.D., Weinstein, P. & Boland, J. (2014). Are the dietary guidelines for meat, fat, fruit and vegetable consumption appropriate for environmental sustainability? A review of the literature. Nutrients, 6(6), 2251-2265. doi: 10.3390/nu6062251.

Roggema, R., & Yan, W. (2019). Developing a de-

sign-led approach for the food-energy-water nexus in cities. Urban planning, 4(1), 123-138. doi: 10.17645/up.v4i1.1739

Rust, N.A., Ridding, L., Ward, C., Clark, B., Kehoe, L., Dora, M., Whittingham, M.J., McGowan, P., Chaudhary, A., Reynolds, C.J. & Trivedy, C. (2020). How to transition to reduced-meat diets that benefit people and the planet. Science of the Total Environment, 718, 137208. doi: 10.1016/j.scitotenv.2020.137208

Potter, C. (2020). Food labelling and online shopping study. (ISRCTN15655434) Springer Science and Business Media LLC. doi: 10.1186/ISRCTN15655434

Prusaczyk, E., Earle, M., & Hodson, G. (2021). A brief nudge or education intervention delivered online can increase willingness to order a beef-mushroom burger. Food Quality and Preference, 87, 104045. doi: 10.1016/j.foodqual.2020.104045

Pulkkinen, H., Roininen, T., Katajajuuri, J.M. & Järvinen, M. (2016). Development of a Climate Choice meal concept for restaurants based on carbon footprinting. The International Journal of Life Cycle Assessment, 21(5), 621-630. doi: 10.1007/s11367-015-0913-8

Schrader, U. & Thøgersen, J. (2011). Putting sustainable consumption into practice. Journal of consumer policy, 34(1), 3-8. doi: 10.1007/s10603-011-9154-9

Shewmake, S., Okrent, A., Thabrew, L. & Vandenbergh, M. (2015). Predicting consumer demand responses to carbon labels. Ecological Economics, 119, 168-180. doi:10.1016/j.ecolecon.2015.08.007

Sonnenberg, L., Gelsomin, E., Levy, D.E., Riis, J., Barraclough, S. & Thorndike, A.N. (2013). A traffic light food labeling intervention increases consumer awareness of health and healthy choices at the point-of-purchase. Preventive medicine, 57(4), 253-257. doi: 10.1016/j.ypmed.2013.07.001.

Sparkman, G., Weitz, E., Robinson, T. N., Malhotra, N., & Walton, G. M. (2020). Developing a scalable dynamic norm menu-based intervention to reduce meat consumption. Sustainability, 12(6), 2453. doi: 10.3390/su12062453

Staisey, N., & Harris, H. (2019). Creating a Farmers' Market Living Lab: Lessons Learned in Growing a Farmers' Market. Journal of Food Distribution Research, 50(856-2019-3206), 145-148. doi: 10.22004/ag.econ.292195

Vanclay, J.K., Shortiss, J., Aulsebrook, S., Gillespie, A.M., Howell, B.C., Johanni, R., Maher, M.J., Mitchell, K.M., Stewart, M.D. & Yates, J. (2011). Customer response to carbon labelling of groceries. Journal of Consumer Policy, 34(1), 153-160. doi:10.1007/s10603-010-9140-7

Verfuerth, C., Jones, C. R., Gregory-Smith, D., & Oates, C. (2019). Understanding contextual spillover: Using identity process theory as a lens for analysing behavioral responses to a workplace dietary choice intervention. Frontiers in psychology, 10, 345. doi:10.3389/fpsyg.2019.00345

Verfuerth, C. (2019). Sustainable behaviour in the workplace: An investigation of contextual spillover effects from work to home through the lens of Identity Process Theory. PhD thesis, University of Sheffield. Retrieved from http://etheses.whiterose.ac.uk/24934/

Vlaeminck, P., Jiang, T., & Vranken, L. (2014). Food labeling and eco-friendly consumption: Experimental evidence from a Belgian supermarket. Ecological Economics, 108, 180-190. doi:10.1016/j.ecolecon.2014.10.019

Wansink, B. & Love, K. (2014). Slim by design: Menu strategies for promoting high-margin, healthy foods. International Journal of Hospitality Management, 42, pp.137-143. doi: 10.1016/j.ijhm.2014.06.006

White, C. (2019). Understanding Consumer Attitudes Towards a Sustainable Labelling Scheme in a University Refectory (MSc Project Report, MSc Nutrition for Global Heal). London: London School of Hygiene & Tropical Medicine.

Wolstenholme, E., Poortinga, W., & Whitmarsh, L. (2020). Two Birds, One Stone: The Effectiveness of Health and Environmental Messages to Reduce Meat Consumption and Encourage Pro-environmental Behavioral Spillover. Frontiers in psychology, 11, 2596. doi: 10.3389/fpsyg.2020.577111

Yougov.co.uk. (2019). Is the future of food flexitarian? | YouGov. [online] Retrieved from https://yougov.co.uk/topics/resources/articles-reports/2019/03/18/future-food-flexitarian [Accessed 25 Sep. 2019].

Appendix 1 – Additional online survey information

The online survey was sent to staff on 7th May 2019 and to students on 8th May 2019.

It was sent with the subject line 'Sustainable diets at Sheffield: Survey participants needed' and was accompanied by an email that follows:

'The Students' Union is looking into ways that we can help promote sustainable diets.

We know the world of sustainability can be confusing at times. This is why we're aiming to make changes to menus to help environmentally conscious students choose low-impact choices. But we need your help!

Please fill in the survey at this address: https://docs.google.com/forms/d/e/1FAIpQLSc-ZwH1C0zF7tQq6C33Vb8EQ_9kMMtn36jIF-wEa-65qwSlYJOw/viewform?usp=sf_link

Filling in this survey will only take 2-3 minutes and provide us the information on how to best help you make sustainable choices.

Together let's make the Students' Union more sustainable!'

The survey comprised of 19 questions including questions regarding the respondent's diet, the importance of different factors on food choice, whether they were trying to reduce their meat intake, the likelihood they would change their diet, how they thought the student's union promoted issues surrounding diet and what other sustainable activities they were involved with. Additionally, demographic questions on age, gender and occupation were asked.

In the survey, diet type was split into 9 categories following the questionnaires designed for the Take a bite out of climate change (Kluczkovski et al., 2020) and ScenoProt projects (Makery 2016).

I frequently eat meat and I am not interested in trying vegetarian food

I often eat meat and I occasionally eat vegetarian food

I often eat both meat and vegetarian food

I frequently eat vegetarian food and occasionally eat meat (flexitarian)

I eat fish, dairy and eggs in addition to products derived from plants (pescatarian)

I eat dairy and eggs in addition to products derived from plants (ovo-lacto-vegetarian)

I eat dairy in addition to products derived from plants (lacto-vegetarian)

I only eat products derived from plants (vegan)

Other

Appendix 2 – Climate Strike Questionnaire.

What have you ordered?

How would you describe your diet?

Why did you choose you chose today?

Are you aware of the promotion today?

Did it influence your choice?

Are you aware of the climate strikes today?

Did the climate strike influence your choice?

What do you think of Bar One supporting sustainable diets with promotions?

What would you think if Bar One took beef off the menu?

Appendix 3 Information flyers

Appendix 4 - Other designs of the traffic light logos

Draft logos

Final traffic light logos

Appendix 5 - Menu information milk guides

MILK GUIDE

Plant Milk

Plant milks are perfect for anyone who might be lactose intolerant, allergic to dairy, following a plant based diet or just wants to try something new!

There are a whole range to try such as almond, hazelnut and coconut milk. All SU outlets stock **soya** and **oat** milk.

Plant milk is good for the environment too! All plant milks produce less greenhouse gas emissions than dairy milk.

Dairy Milk

The Students Union is proud to source its milk from Sheffield's local dairy: **Our Cow Molly.**

Our Cow Molly milk is some of the freshest milk in Sheffield. Their cows are grass fed meaning their milk is more nutritious as well as being a good source of protein.

Sourcing our milk locally reduces the greenhouse gas emissions created by transport, as well as supporting local farmers.

Milk Guide

Plant Milk

Plant milks are perfect for anyone who might be lactose intolerant, following a plant based diet or just wants to try something new!

There are a whole range to try. Coffee Revolution stocks **cashew, coconut, soya** and **oat** milk.

Plant milk is good for the environment too; they all produce less greenhouse gas emissions than dairy milk.

Dairy Milk

The Students Union is proud to source its milk for Sheffield's local dairy: **Our Cow Molly.**

Our Cow Molly milk is some of the freshest milk in Sheffield. Their cows are grass fed meaning their milk is more nutritious and a good source of protein.
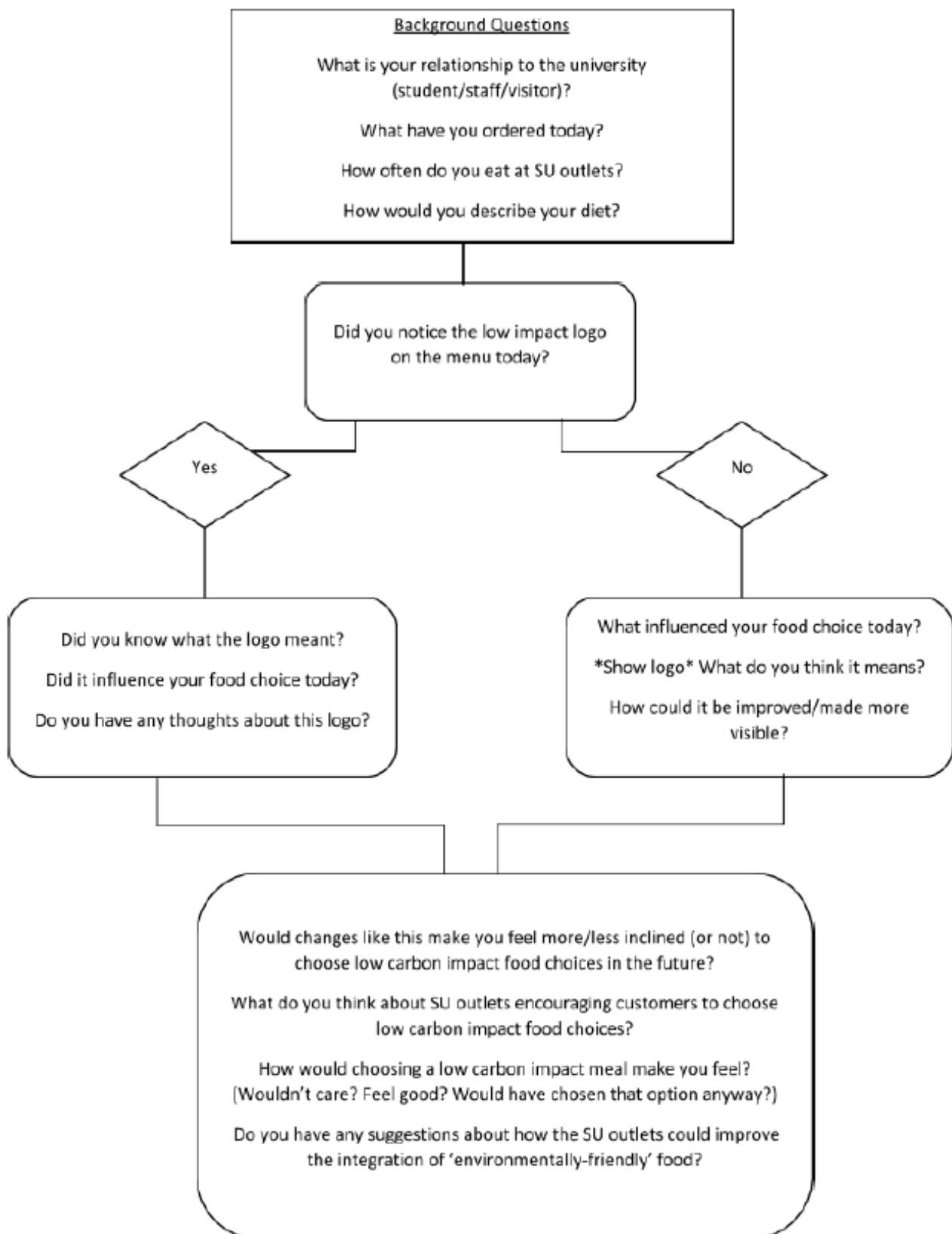
Sourcing our milk locally reduces the greenhouse gas emissions created by transport and supports local farmers.

Appendix 6 - Question script

Background Questions

What is your relationship to the university (student/staff/visitor)?

What have you ordered today?

How often do you eat at SU outlets?

How would you describe your diet?

Did you notice the low impact logo on the menu today?

Yes

No

Did you know what the logo meant?

Did it influence your food choice today?

Do you have any thoughts about this logo?

What influenced your food choice today?

Show logo What do you think it means?

How could it be improved/made more visible?

Would changes like this make you feel more/less inclined (or not) to choose low carbon impact food choices in the future?

What do you think about SU outlets encouraging customers to choose low carbon impact food choices?

How would choosing a low carbon impact meal make you feel? (Wouldn't care? Feel good? Would have chosen that option anyway?)

Do you have any suggestions about how the SU outlets could improve the integration of 'environmentally-friendly' food?

Change 'logo' to 'Low Impact Menu' for Bar One interviews, or 'Milk Menu' in Coffee Revs/Interval

Appendix 7 - Bar One Climate Strike Menu Choice Survey

Key Points

Bar One customers were surveyed to find out what they ordered on the day of the climate strike, and whether the exclusion of beef burgers from the 2 for 1 promotion influenced their choice.

There was a significant decrease in the sale of beef burgers, compared to the previous day's sales, and an increase in chicken and meat-free burgers

Customers supported the idea of Bar One removing beef from the menu completely, including those who eat beef

Introduction

On the day of the global Climate Strikes, Student Union outlets introduced one-day-only promotions on low impact menu options. Bar One hold a 2 for 1 offer on all burgers at the beginning of each semester. For the Climate Strike, Bar One excluded all beef burgers from the offer as the highest impact dishes on the menu. To test whether or not the promotion had an impact on the sale of beef burgers, 31 customers were surveyed.

Methods

Customers who had ordered food were approached and asked 9 questions:

What have you ordered?
How would you describe your diet?
Why did you choose what you chose today?

Are you aware of the promotion today?
Did it influence your choice?
Are you aware of the climate strikes today?
Did the climate strike influence your choice?
What do you think of Bar One supporting sustainable diets with promotions?
What would you think if Bar One took beef off the menu?

Their responses were simplified to allow for categorisation and calculate percentages. The sales data for the Climate Strike day and the day before were also collected, although vegetarian and vegan burgers were categorised into one category (meat-free burgers).

Sales Results

The promotion saw the following changes in sales compared to the previous day:
35.5% decrease in beef burger sales
20.3% increase in chicken burgers
15.1% increase in meat-free burgers
36 more burgers sold

Key Findings

Diets. Two-thirds of customers described themselves as either a meat-eater or flexitarian. Around 25% were either vegetarian or pescatarian, and the remaining 10% were vegan.

Reasons for ordering.

When asked why they chose what the ordered, 5 out of 31 people said 'environmental reasons' after 'favourite order' and 'it sounded nice'. 2 people said they made

Table 9. % Burgers sold on Climate Strike Day, previous day, over the 2019-20 new menu first two weeks (September 2019).

Burger Type	Impact Category	Climate Strike Day (20-9-2019)	Previous Day (19-9-2019)	2019-20 new menu first two weeks (September)
Beef	High	6.6%	42.1%	30%
Chicken	Low	59.4%	39.1%	44%
Meat-free	Low	33.9%	18.8%	26%

their choice because they thought that beef was not on the menu and had to make an alternative choice (both respondents chose chicken burgers)- a misunderstanding possibly based on the Our Shop decision not to sell beef burgers from the express counter on Climate Strike day.

Influence of the promotion.

Most people were aware of the 2 for 1 promotion, but not everyone was aware that beef burgers were not included in the deal. Most people said that this part of the promotion did not influence their choice, often because they chose what they would have had anyway.

4 people said the promotion did influence their choice. 2 meat-eaters said it was because they thought there was no beef on the menu today. 1 vegetarian chose a vegan option because 'not many places sell seitan chicken so it was a treat'. 1 flexitarian said it led them to choose chicken instead of beef.

Influence of the climate strike.

Most people were aware of the climate strike, however most said that it did not influence their meal choice. Of the 7 people who said it did influence their choice, 4 chose vegan burgers (2 meat-eaters, 1 pescatarian, 1 vegetarian) and 3 chose chicken burgers (all flexitarians).

Thoughts on the removal of beef in Bar One.

The response for the suggestion of removing beef off the Bar One menu was very positive from all customers, regardless of their meal choice or diet. Some said that it would be a 'bold move' but would be fully supportive of it and would recognise it as support for the environment and climate change.

The two customers who said that they would have ordered beef had they known it was on the menu were also supportive. They said that they would recognise it as support for the climate despite being 'slightly disappointed' that they would not be able to have it. They also said that as long as chicken remained on the menu, they would not miss beef too much. Unfortunately, no customer who had ordered a beef burger on this day were surveyed, but these responses indicate that praise would be given from customers to Bar One for supporting the climate crisis in this way.

Flexitarians who chose meat options opted for chicken over beef, as many said they do not eat red meat

Limitations and Considerations

Many customers on this day had attended the climate strike themselves and were therefore already environmentally conscious. This may have skewed results. Customers who did order beef burgers were not surveyed and their responses may have changed the overall responses.

There was confusion amongst customers about whether beef was being served on this day or not. Most people seemed to think that beef was not being served which may have meant that beef sales were low for this reason.

Customers may have worked out the purpose of the study (especially likely due to many respondents being students) and subsequently slightly altered the truth with their responses in order to give a more desirable or socially acceptable answer.

Recommendations

Reduce the choice of beef burger options on the bar one menu to limit choice and encourage meat-eaters to choose chicken over meat.

Appendix 8 - Detail of diet categories in Online Survey

Original Diet Category	Grouped Diet Category
I frequently eat meat and I am not interested in trying vegetarian food	Meat eater / Meat Only
I often eat meat and I occasionally eat vegetarian food	Meat eater
I often eat both meat and vegetarian food	Meat eater
I frequently eat vegetarian food and occasionally eat meat (flexitarian)	Flexitarian
I eat fish, dairy and eggs in addition to products derived from plants (pescatarian)	Pescatarian
I eat dairy and eggs in addition to products derived from plants (ovo-lacto-vegetarian)	Vegetarian
I eat dairy in addition to products derived from plants (lacto-vegetarian)	Vegetarian
I only eat products derived from plants (vegan)	Vegan
Other	Other