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Development and evaluation of a point-of-choice intervention to increase healthy and environmentally friendly food consumption: an intervention mapping approach

By

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ABSTRACT

Food production and consumption is having a negative impact on the environment. The adoption of diets comprised of mostly plant-based foods with limited amounts of meat, animal products and processed foods are needed to improve health and reduce environmental burden. Point-of-choice intervention studies have shown promise for increasing the consumption of healthier food. This thesis explores whether a point-of-choice intervention can increase the consumption of healthy and environmentally friendly food choices in a university setting.

The Intervention Mapping Approach was used as a conceptual framework to guide the development and evaluation of the intervention, which was informed by three research studies. The first study quantified the environmental impact of food and beverages sold in university food outlets, using Greenhouse Gas Emission and Water Footprint impact indicator data. It also explored the relationship between environmental impact and nutrient quality of these choices to inform intervention goals. The second study used a qualitative approach to explore the acceptability and feasibility of a university cafe based intervention from the perspectives of customers and caterers. Together this information was used to develop a pilot intervention called 'Points for Our Planet', which was evaluated in the final study of this thesis.

Information provision combined with a financial incentive did not influence cafe customers' food choices. Poor visibility and limited engagement with the materials reduced the success of the intervention. Improvements to the framing of the messages along with additional intervention components are needed.

This thesis highlights the challenges to developing dietary interventions that focus on both health and environmental sustainability. The findings can be used to inform catering establishment food policies to foster healthy and environmentally friendly food consumption. They can also be used to inform UK food policy more broadly, providing insights into development of complex interventions to instil more sustainable patterns of food consumption.

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LIST OF ABBREVIATIONS

AFLOU	Agriculture, Forestry and Other Land Use
DEFRA	Department for the Environment, Fisheries and Rural Affairs
DOIT	Diffusion of Innovations Theory
DOH	Department of Health
DRV	Dietary Reference Value
EF	Environmentally Friendly
EIS	Environmental Impact Score
EU	European Union
EF	Environmentally Friendly
FAO	Food and Agricultural Organisation
GHGE	Greenhouse Gas Emissions
HEF	Health and Environmentally Friendly
IM	Intervention Mapping
IPCC	Intergovernmental Panel on Climate Change
LCA	Life Cycle Analysis
LCI	Life Cycle Inventory
MFM	Meat Free Mondays
MRC	Medical Research Council
MSC	Marine Stewardship Council
NDNS	National Diet and Nutrition Survey
NHS	National Health Service
NMES	Non-Milk Extrinsic Sugars
Non-HEF	Not Healthy and Environmentally Friendly
PFOP	Points For Our Planet
PCA	Principal Components Analysis
RAA	Reasoned Action Approach
SCT	Social Cognitive Theory
SDC	Sustainable Development Commission
TPB	Theory of planned behaviour
TTM	Transtheoretical Model
UOS	University of Sheffield
UN	United Nations

UK	United Kingdom
US	United States
WF	Water Footprint
WFII	Water Footprint Impact Indicator
WHO	World Health Organisation
WRAP	Waste and Resources Action Programme

1 CHAPTER 1: INTRODUCTION

This chapter provides the background and rationale for this thesis. It begins with an overview of the environmental impacts associated with current food production and consumption. It then describes how the environmental impacts of food are currently measured and the results of studies that have explored the environmental impacts associated with different diets. It then highlights the complexities of defining a sustainable diet and the synergies and trade-offs between environmental and nutritional considerations. It discusses various policy strategies to support dietary change in the UK, including the case for embedding sustainability in catering and food provision. The potential that universities have in promoting and supporting the adoption of healthy sustainable diets is discussed drawing on the literature describing point-of-choice interventions in university settings. Approaches to intervention development are discussed along with theories of behaviour and behaviour change. The determinants of food choice behaviours in university settings are examined, along with student attitudes towards dietary change for sustainability. It then presents the aims and objectives of this research and the outline of this thesis.

1.1 Sustainable development and the food system

A major world challenge is to develop a sustainable global food system that produces enough nutritious food to feed the current and future world populations with minimal environmental impact. Food production and consumption is at the heart of the sustainable development goals, which include Zero Hunger, Responsible production and consumption, Climate Action, Life below water and Life on land (Development Initiatives 2017). The United Nation's Food and Agriculture Organization (FAO 2015) asserts:

“Food consumption and production trends and patterns are among the main causes of pressure on the environment. Fundamental changes in the ways food is produced, processed, transported and consumed are indispensable for achieving sustainable development.”

The current global food system is central to environmental sustainability concerns.

1.1.1 Environmental impacts of global food production

Over the past 50 years, modernisation of agricultural practises in the developed world has increased food production and facilitated globalisation of the food system. Selective breeding of high-yield crops and the widespread use of fertilisers and pesticides has improved the efficiency of arable farming (Tilman 1999). At the same time livestock production has escalated, due to an on-going shift away from small holder livestock production to more intensive, larger-scale systems (FAO 2009a). This transformation has helped meet the growing global demand for food, particularly for meat and animal products, but has been at the detriment of the Earth's biodiversity, fish stocks, natural resources (soil, water and fossil fuels), land and atmosphere. These impacts will be discussed separately.

1.1.1.1 Biodiversity

Approximately 35% the ice- and desert- free land area of Earth is now devoted to food production (Poore & Nemecek 2018), thus vast natural ecosystems that used to contain thousands of plant, insect and animal species have been replaced by monocultures resulting in a huge loss of biodiversity (Houghton 2012). The widespread use of nitrogen and phosphorus fertilizers in intensive agriculture is a major cause of fresh water eutrophication which has altered species composition and caused species extinction in some areas (Ramankutty *et al.* 2018). The use of pesticides has also exacerbated biodiversity loss and has led to the accumulation of potentially toxic chemicals in the food chain (Tilman *et al.* 2001).

1.1.1.2 Fish stocks and marine ecosystems

The rise in global capture fish production has been accompanied by an increase in the percentage of overfished stocks (FAO 2014), such that 50-78% of stocks monitored in Europe have recorded stock depletion or evidence of overfishing (Lang *et al.* 2011). Agricultural nutrient pollution of inland reservoirs and coastal waters, is a major threat to marine biodiversity (Tilman *et al.* 2001). Similarly, aquaculture can cause harm to wild species through the release of organic substances or disease treatment chemicals into water bodies (Godfray *et al.* 2010).

1.1.1.3 Water

Agriculture uses 70% of fresh water on earth and accounts for 93% of water consumption (Turner *et al.* 2004). Water is used to irrigate land for crop production, in addition to providing drinking and servicing water for livestock. It is

also used on farms and in food processing plants (Steinfeld 2006). Irrigation can cause leaching and salinization of soils which reduces fertility and ability to support crop growth (Tilman 1999). Water used in agriculture is believed to account for 73% of the total water footprint of the UK, which is just 38% self-sufficient in water, and is the sixth largest net importer of virtual water (the volume of water required to produce a product) (Chapagain & Orr 2008). The UK has a substantial external water footprint, arising from the imports of products originating from oil crops, cotton, livestock products and stimulants including tea, coffee and cocoa (Hoekstra & Mekonnen 2016).

1.1.1.4 Land-use and atmosphere

The majority of land used for agriculture is dedicated to livestock production (either pasture or crop-feed production) (Steinfeld 2006). Land used in agriculture comes from forests, grasslands and other natural habitats (Tilman *et al.* 2001), which has not only led to habitat fragmentation affecting biodiversity, but it has also caused the release of carbon dioxide into the atmosphere through deforestation and land degradation (Asner *et al.* 2004; Stehfest *et al.* 2009). The Intergovernmental Panel on Climate Change (IPCC) has estimated that the Agriculture, Forestry and other Land Use (AFOLU) sector contributes 24% of the anthropogenic global green house gas emissions (GHGE) which is leading to global warming (Edenhofer *et al.* 2014). The majority of this (74%) arises from the production of livestock through the release of methane from manure and enteric fermentation by ruminant animals (cattle, sheep and goats), nitric oxide from the application of fertilisers during cultivation of crop feed and carbon dioxide from farm machinery (Steinfeld 2006). In the UK, agriculture has been estimated to account for 18-20% of GHGE; this figure rises to 30% when land use change is included (Audsley *et al.* 2011).

Environmental impacts occur across the food chain from farming and processing, through to transport, cooking storage and waste yet the largest impacts occur in the agricultural stage (Garnett 2014). Efforts to reduce the environmental impacts of food production have focussed on altering agricultural practises to make them more environmentally sustainable. However, recent models of climate change have indicated that a decrease in overall agriculture-related emissions can only be achieved by employing both supply-side and demand-side reductions, and that changes in the patterns of food consumption are essential to deliver emissions

reduction targets (Bajželj *et al.* 2014; Bryngelsson *et al.* 2016; Stehfest *et al.* 2009; Tilman & Clark 2014).

1.1.2 Changes in global food consumption

The modernisation of food production has been accompanied by a marked growth in food consumption, such that the average food supply globally has risen from 2196 to 2868 kcal/capita/day (1961-2011) in five decades (FAO 2014a). This growth has reduced the number of people that are hungry in the world despite a doubling of the global population (Godfray *et al.* 2010). However, this global increase masks a huge variation between countries. In 2012, food supply per capita was 2120 kcal/capita/day in least developed countries compared to 3430 kcal/capita/day in the most developed countries (Moomaw *et al.* 2012) Moreover, the abundance of food in some developed nations has led to overconsumption of food and high rates of food waste, both of which inevitably drain natural resources and cause avoidable damage to the environment.

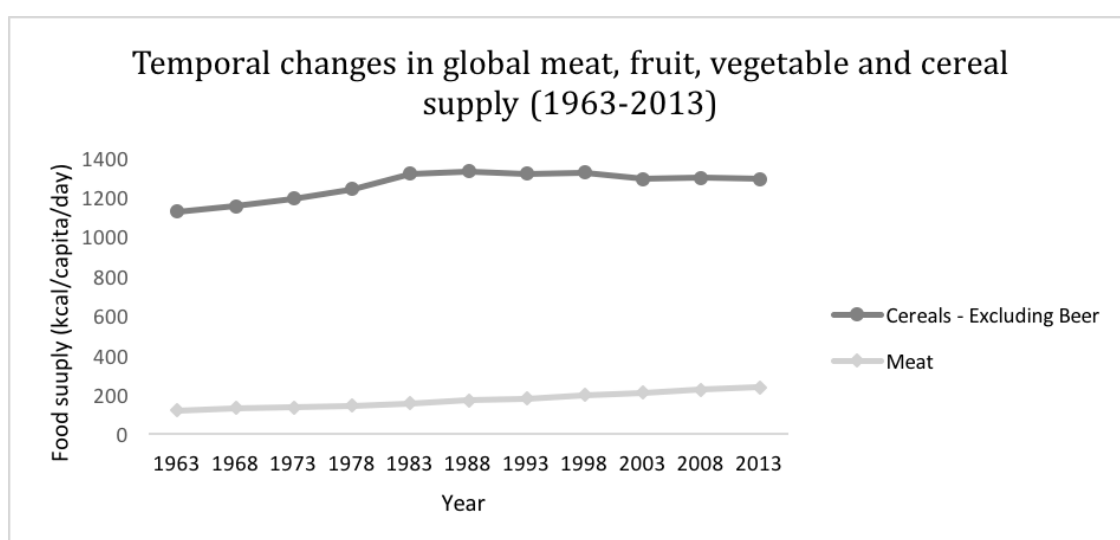
1.1.2.1 Food waste

A study conducted on behalf of the FAO suggests that approximately one third of all food produced for human consumption is lost or wasted, amounting to 1.3 billion tonnes per year (Gustavasson *et al.* 2011). This report noted that most food losses and waste in developing countries occur in the agricultural stage and that this largely due to financial, managerial and technical limitations in harvesting and storage techniques. However, the largest proportion of global food waste occurs in the industrialised world at the consumer level, and is related to consumer behaviour and a lack of coordination between different actors in the supply chain. The FAO estimates that food waste accounts for around 8% of the global anthropogenic GHGE. Furthermore, the carbon footprint of food waste in high income countries is twice that of low income countries as the food that is wasted is further along the supply chain thus has accrued greater carbon emissions (FAO 2011). The Waste and Resources Action Programme (WRAP) estimated that in 2015, household food waste in the UK was around 7.3 million tonnes, which was associated with the release of 19 million tonnes of CO₂e (Quested & Parry 2017). Food waste is a global challenge that ought to be addressed by country-specific efforts. Reducing food waste is important for the development of a sustainable global food system.

1.1.2.2 Global dietary change

In addition to an escalation in calorie intake worldwide, there have also been substantial shifts in dietary patterns, notably a reduction in the consumption of vegetables and cereals and an increase in consumption of meat and energy-dense foods (Guyomard *et al.* 2012). Figure 1-1 shows temporal changes in the supply of fruit, vegetables, cereals and meat at a global level. Whilst cereals continue to provide the largest proportion of calories worldwide, the amount supplied by meat has almost doubled from 120 kcal/capita/day in 1963 to 237 kcal/capita/day in 2013.

Figure 1-1 Temporal changes in world meat and cereal (excluding beer) supply (kcal/capita/day) from 1961-2011 (FAO 2014)



Cereals-excluding beer: Maize and products, Millet, Oats, Rice (milled equivalent), Rye and products, Sorghum and products, Wheat and products. Meat: Bovine meat, Mutton & Goat, Pigeat, Poultry meat.

It is important to note that these figures are derived from food balance sheets and do not accurately reflect the amount of food consumed by individuals in each country. They indicate the average availability of a food item per person and ignore between-person variability in consumption and do not account for food waste (Kearney 2010). Nevertheless, they are useful for monitoring global trends in food consumption.

A range of factors have been reported to underpin the changes in food consumption patterns over the past fifty years including social changes (e.g. urbanisation, increased income, women entering employment) and changes to food supply (increased shelf-life, retail changes greater food availability) (Kearney 2010). This has led to the 'Westernisation' of diets that are characteristically rich

in sugar, salt and saturated fat. The adoption of this diet has adverse health consequences, as evidenced by the growing incidence in nutrition-related non-communicable disease in developing countries (Global Burden of Disease 2016); a phenomenon described as the 'nutrition transition' (Popkin 2009). This dietary transition has negative consequences on the environment as well as health. Of particular concern is the rise in demand for meat and animal products, since livestock production has the largest impact on the environment (Steinfeld 2006; Weidema & Eder 2008, Gerber *et al.* 2013). Whilst the per capita rate of meat consumption patterns in western nations appear to be slowing, the per capita meat consumption in low-income nations continues to rise (Vranken *et al.* 2014).

1.1.2.3 Population growth

The health and environmental effects of the nutrition transition in developing countries is exacerbated by population growth. China, Brazil and Indonesia have the world's fastest growing economies and highest population growth rates and as such are witnessing the greatest shift in food patterns, particularly an increase in meat consumption (Pica-Ciamarra & Otte 2009). Since the world population is projected to rise to 9 billion in 2050 (FAO 2009b), it has been predicted that demand for food, particularly meat, animal products and processed foods, will continue to grow. The FAO has estimated that if changes in food consumption patterns persist, 60% more food would need to be produced by 2050 (FAO 2009b). It has been estimated that cereal production would need to increase by 50% and meat production by 85% between 2000 and 2030 to meet current demands (IPCC 2007). However, reducing food waste and overconsumption and adopting diets that contain fewer resource intensive products would alleviate this demand.

1.2 The concept of a sustainable diet

In view of the growing support for the need to change current food consumption patterns, there has been a concerted effort to define healthy and environmentally sustainable diets. However, this is challenging due to the complex nature of diets and the intricacies of the global food system. The first attempt to define a sustainable diet for intergovernmental policy development was in 2010 at a scientific symposium in Rome hosted by the United Nations Food and Agricultural

Organization and Biodiversity International. Here the first broad definition of sustainable diets was proposed:

“Sustainable diets are those with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources”. (FAO 2010a)

Whilst this broad definition encapsulates the essence of sustainability it has been criticised for suggesting that the various components of sustainability work together synergistically and ignores the inevitable trade-offs between them (Hoffmann & Baumung 2013). For example, a reduction in the consumption of one commodity may be considered sustainable in terms of its effects on the environment, but this may have adverse consequences on the economy through loss of trade with other countries and loss of jobs. There are also trade-offs to be made within a specific sustainability component. For example, fruit and vegetables are generally low in GHGE but some horticultural practises require large amounts of water for irrigation thus there is potential conflict between GHGE mitigation and water use objectives (Hess *et al.* 2014, 2015). As well as failing to address trade-offs, the FAO definition has also been criticized for not providing an indication of what a healthy sustainable diet may look like (Garnett 2014). Efforts have begun to measure the environmental impacts of foods and explore how current diets can be altered to accommodate all aspects of sustainability.

1.3 Measuring the environmental impacts of food

The Life Cycle Assessment (LCA) approach is widely used in agriculture and food industries as a method to evaluate the environmental impacts of a product, and to identify the resource and emission-intensive processes within a product’s life cycle (FAO 2010b). There are four main stages to LCA: i) goal and scope definition, ii) inventory analysis, iii) impact assessment and iv) interpretation (ISO 2006). The example of an LCA for cheese produced in the USA (Kim *et al.* 2013) will be used to illustrate the application of the LCA approach to food products.

1.3.1 Life cycle assessment: an example

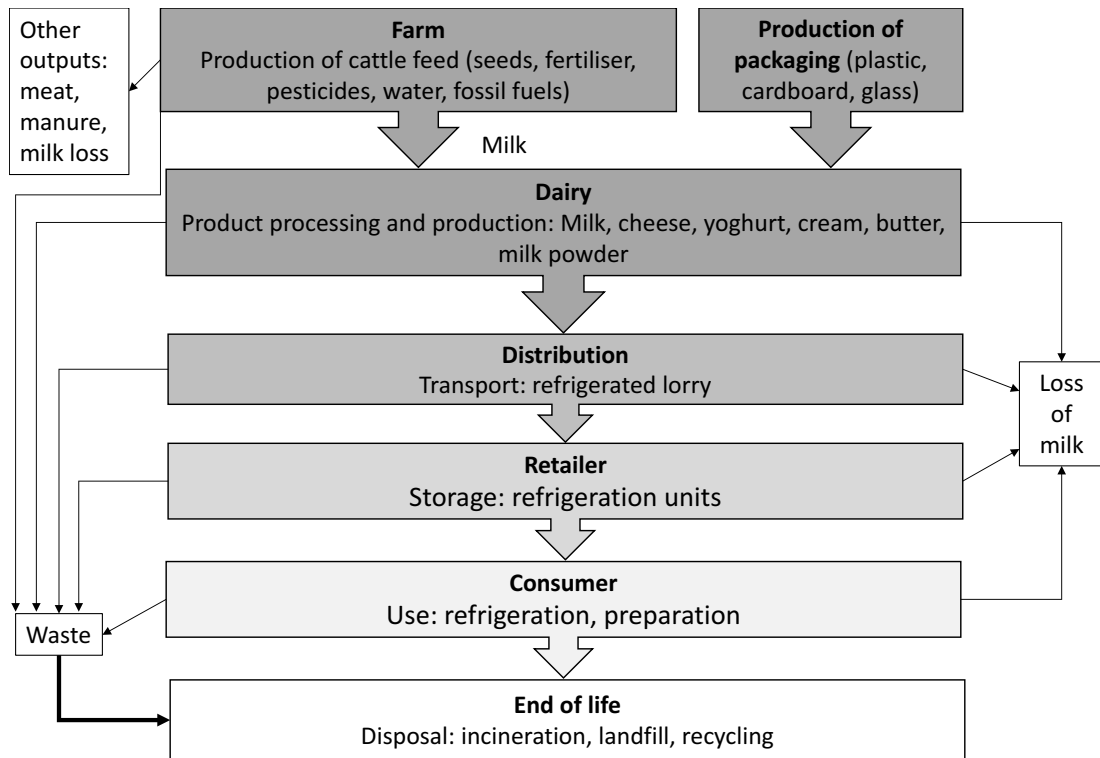
In the first instance the *goal* of the study is identified along with the intended application and intended audience. In this case, the goal of the study was to *'provide cheese industry stakeholders in the USA with information to support the incorporation of the environmental performance into decision-making, and support the development of innovative produce processes and services'* (Kim *et al.* 2013).

The *scope* of the study is also decided in this stage of the LCA. The system boundary, i.e. the phases of the product's life cycle to be included in the assessment is determined at this stage. In the example of cheese, the system boundary includes the production of raw milk (feed production and on-farm), cheese manufacturing in the dairy, packaging, transport, retail, consumption, and end-of-life (see Figure 1-2). The functional unit is another variable determined in this initial stage. A functional unit is the metric used to quantify the environmental impact measurement in relation to the system or product under examination. In the case of food LCAs, the environmental impact is usually expressed in relation to the quantity or volume of food consumed or produced. In this example, the functional unit is per tonne of cheddar cheese (on a dry weight basis). The environmental impact categories (e.g. global warming potential¹, eutrophication potential², water use etc.), which the LCA is going to measure is also decided at this initial stage.

¹ Global warming potential (GWP) is a measure of how much radiating force the emissions of one kg of greenhouse gas will have over a given time period, relative to the emissions of carbon dioxide (Edenhofer *et al.* 2014). The IPCC has published three assessment reports with different Global warming potential factors used to convert GHGE into CO₂ equivalents. For example, in the 4th report, carbon dioxide is weighted as 1, methane weighted as 25 and nitrous oxide weighted as 298 over a 100 year time frame (IPCC 2007).

² Eutrophication potential is a measure of nitrogen and phosphorus (kg PO₄³⁻ equivalents) present in waterways that can lead to excessive algae growth and decay resulting in oxygen depletion and loss of marine life (Webb *et al.* 2013).

Figure 1-2 System boundaries included in a life cycle assessment of cheese adapted from Figure 3.1 (International Dairy Federation 2009)



Some of the inputs (seeds, fertilizers, pesticides, water and diesel) and outputs (milk, meat, manure and loss of milk) of the agricultural phase of the cycle are highlighted. Measurement of loss of milk and waste at each stage of the system is important to account for in the estimation of the overall environmental impact.

The second stage of the LCA is the Life Cycle Inventory (LCI) in which data on inputs and outputs in each phase of the system boundary are collected. For example, in the case of cheese, inputs in the agricultural phase include the resources used in the production of fodder for the cows (which includes the amount of water, fertilizer and energy used to grow, harvest and process the crops) as well as the water and energy used in the maintenance of the dairy cows. Outputs in the agricultural phase include desirable outputs such as milk, meat and manure, as well as unwanted waste, water pollution and gaseous emissions arising from energy use and ruminant digestion, etc. Because this stage of the LCA process requires much data which are often unattainable, secondary data sourced from a third-party life-cycle-inventory database are often used as surrogate (Teixeira 2014). Many LCA databases exist which provide industry averages for non-product specific processes such as extraction of raw materials, the production of commonly used materials, such as plastic and cardboard, and also recycling and waste disposal (Roy *et al.* 2009). Kim *et al.* (2013) collected primary data on the electricity and material use, production (cheese and other products made) and

emissions (solid and liquid wastes) from several cheese processing plants in the USA and used this in combination with secondary data from the *Ecoinvent database v2*.

The third stage of the LCA is the Life Cycle Impact Assessment (LCIA) in which the LCI values are assigned to environmental impact categories, and the extent of the environmental impacts in each category are calculated. For example, the global warming potential of the emissions arising from agricultural phase will be calculated using the amount of methane, carbon dioxide and nitric oxide measured. The final stage of the LCA is the interpretation phase where the results of the LCI and LCIA are considered together to identify the processes that quantitatively contribute the most to the product's overall environmental impact (Wolf *et al.* 2012).

1.3.2 Life cycle assessment of food

A key strength of an LCA is its ability to provide a complete assessment of the production process in terms of resource use and environmental impacts, as it considers multiple environmental parameters (ISO 2006). Furthermore, the LCA approach can be used to evaluate the effect that changes within a production process may have on the overall life cycle balance of environmental burdens. This approach, known as consequential LCA, enables users to identify measures that could shift environmental problems from one phase to the next (FAO 2010b). Thus, LCA is predominantly used by organisations and businesses in the food and agricultural sector to inform environmental decision-making and inform reduction efforts (Roy *et al.* 2009).

The results of LCA studies have also been used to compare the environmental burdens associated with different foods. Comparative LCA studies have demonstrated that in general, meat and animal products have the greatest environmental impacts (in terms of primary energy use, global warming potential, eutrophication potential and land requirement) and the plant-based foods (grains, vegetables, fruits) have the lowest environmental impact (Clune *et al.* 2015; Foster *et al.* 2006; Nielsen *et al.* 2003; Tukker 2006; Williams, A.G. Audsley, E. Sandars 2006; Williams 2008).

However, there are several challenges to using the LCA approach to measure the environmental impact of food highlighted in the review by Hallström *et al.* (2015).

Firstly, LCA is data intensive in nature and requires many input and output measurements that are often difficult to obtain. For example, it is difficult to measure and model emissions from enteric fermentation in ruminants and nitrous oxide from soils (Garnett *et al.* 2016). Practitioners are frequently forced to simplify the process, which can lead to losses in accuracy. The use of secondary data that may be inaccurate or unrepresentative of primary data is a key source of error (Reap *et al.* 2008). Another simplification is to limit the system boundaries so that only part of the life cycle of the product is considered. For example, some food LCAs only measure the environmental impacts from farm to retail distribution centre and thus fail to account for the environmental impacts occurring from the transport, processing, preparation, storage and disposal of food (Hallström *et al.* 2015). Many LCA studies therefore do not provide an accurate estimation of the environmental impacts of food that consumers purchase (Foster *et al.* 2006). These simplifications create uncertainties in the data therefore caution should be made when drawing conclusions about the precise environmental impact of different foods.

A second challenge to collating data derived from LCA studies is that the system boundary, functional unit and environmental parameters selected are highly subjective thus subsequently variable (Hellweg & Canals 2014). Inconsistencies between studies makes comparisons thus meta-analysis is difficult which reduces confidence in the findings.

A further complication when using the LCA approach to compare the environmental impacts of food is that the results obtained are highly specific to the region under assessment (Reap *et al.* 2008). Farming practises and resource use vary considerably which makes the results of LCAs highly country specific. For example, a report by the FAO measuring the GHGE arising from the global dairy sector noted that regional difference range from 1.5 to 7.5 Kg CO₂-eq per kg of milk (FAO 2010b).

Nevertheless, despite numerous shortcomings and complexities, LCA is considered the best tool available for analysing the environmental impacts of food (Pluimers & Blonk 2011). Studies reporting standard error measurements have illustrated large variations within food product categories; largely due to the differences in measurement methods, agricultural practices, efficiencies and resource requirements in different countries (Clune *et al.* 2015; Poore & Nemecek 2018).

However, there are clear distinctions between food groups, as the error bars do not overlap. As Clune *et al.* (2015) assert, when there is no overlap between ranges of GHGE, the exact measurements of food items becomes less important, thus the data are sufficient to enable directional decisions to be made. Data derived from food LCA studies have been compiled and used to compare the environmental impacts of different diets to determine which are more environmentally sustainable. Data derived from food LCA studies have been compiled and used to compare the environmental impacts of different diets to determine which are more environmentally sustainable.

1.4 Environmental impacts of different diets

Data from food LCA studies have been used in computer modelling studies to explore the environmental impact of various dietary scenarios to identify those that are most environmentally sustainable. The majority of these studies have shown that diets that are lower in livestock products, particularly ruminant meat, have significantly less GHGE emissions (Audsley *et al.* 2010; Berners-Lee *et al.* 2012; Carlsson-Kanyama *et al.* 2003; Notarnicola *et al.* 2017; Pimentel 2003; Popp *et al.* 2010; Scarborough *et al.* 2014; Stehfest *et al.* 2009; Tilman & Clark 2014)

Whilst these studies have begun to explore the relationship between diet and environmental sustainability, they are limited since they only focus on one environmental impact (GHGE) and therefore do not consider other environmental impacts of food production and consumption, such as biodiversity loss, soil degradation and energy use. Most research in this area has focussed on reducing GHGE as part of global climate change mitigation efforts. At the Conference of Parties (COP21) in 2015, 200 nations signed the Paris Climate Change Agreement and agreed to aim to limit the global average temperature rise to 'well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius' (United Nations Framework Convention on Climate Change 2018). Research from Sweden suggests that GHGE, also described as Carbon Footprint, can be used as a proxy indicator for other environmental impact parameters, such as land use and eutrophication potential (Röös *et al.* 2013), However, a recent review that examined multiple LCA studies of foods and examined multiple environmental impact parameters, highlighted tensions between GHGE and water use. The authors conclude that it is

important to avoid the use of proxies in decision-making to prevent potentially harmful, unintended consequences (Poore & Nemecek 2018).

1.4.1 Water use of food

Approximately one third of the world's population is currently affected by water scarcity, the lack of fresh water to meet daily needs (International Water Management Institute 2007). It has been estimated that around 85% of water available in the world is used to grow food which has led to growing pressure on the agro-food industry to make conscious effort to conserve water (Jefferies *et al.* 2012). However, methods for measuring water impact are still under development and at present there is no fixed approach to measuring the water use of food products. Nevertheless, impacts on water resources across the life cycle of food products can be calculated by LCA or Water Footprint (WF) (Jefferies *et al.* 2012). Many food LCA studies to date omit water use, thus the most commonly used approach to measure impacts of water resources is Water Footprint.

A Water Footprint is a multi-dimensional indicator, showing water consumption volumes by source and polluted volumes by type of pollution. WF combines the amount of water withdrawn from ground or surface water sources (blue water), water evaporated from soil moisture supplemented by rainfall (green water) and volume of polluted blue water returned after production (grey water) (Chapagain & Orr 2008). All components of a total water footprint are specified geographically and temporally. The environmental impacts of water use occur at a local level therefore comparisons of WF values are more meaningful when they are considered in the context from which the water was withdrawn, and some argue when weighted for regional water scarcity (Ridoutt & Pfister 2010). Water scarcity varies considerably with seasons and weather patterns therefore such changes ought to be considered when interpreting the implications of water use in specific regions.

Whilst there have been relatively few studies to examine the water footprint of foods (Ercin *et al.* 2012; Eshel *et al.* 2014; Hoekstra & Förrer 2008; Mekonnen & Hoekstra 2010, 2012), they indicate that in general meat and animal products have a greater water footprint than plant produce. However, as with the measurements of GHGE, WF values vary considerable not only due to regional differences, but agricultural practises in those regions. For example, water use in the production of

livestock can be relatively low in rain-fed mixed production systems ($<20\text{Lkg}^{-1}$), or very high in systems using irrigated feed supply (3000Lkg^{-1}) (Ridoutt *et al.* 2012).

In comparison to GHGE, fewer studies have examined the water use of different diets (Aleksandrowicz *et al.* 2016; Jones *et al.* 2016). This is largely because there is a limited amount of food WF data available. Nevertheless, these studies have shown mixed results. One study that compared the WF of current food consumption in the European Union with a vegetarian diet and with a healthy diet (based on German dietary guidelines) (Vanham *et al.* 2013), noted that a vegetarian diet had the lowest water footprint, and that a reduction in meat consumption had the greatest effect due to the high WF per caloric value of meat products. In addition, this study highlighted that milk and milk-derived products (such as cheese and yoghurt) have the greatest water footprint (litres per capita per day) across all the water footprint components (Vanham *et al.* 2013) because they are consumed in greater quantities than meat. Their findings emphasise that it is important to consider the metrics used to measure the water footprint, as the quantities of the foods that are consumed are important in determining the contribution to the overall water footprint of consumption.

Another study by Jalava *et al.* (2014) compared the WF associated with global dietary change whereby animal protein were replaced with plant sources and found that blue and green water use was considerably reduced in some regions of the world, namely Middle East, North America and Australia, whereas dietary change made little difference to water use in South and South East Asia.

However, Meier & Christen (2013) examined the environmental impacts associated with dietary scenarios in Germany and noted that whilst the transition in the direction to recommendations, and meatless diets was associated with lower environmental impacts, the consumption of more plant-based foods (fruits) increased blue water use. Similarly, Tom *et al.* (2016) compared the energy use, blue water footprint and GHGE of current food consumption patterns with dietary recommendations in the United States (US). They found that restricting calories and shifting diets towards US dietary guidelines leads to a 10% increase in blue water footprint, largely due to the increase in fruit and vegetable intakes; a large proportion of which are grown in California, a region that requires large amounts of irrigation. This highlights the importance of geographical context when considering the water footprints of different foods from around the world.

The results of studies exploring the water footprints of food to date have highlighted that there are tensions between various environmental impact categories. Beef and livestock have the largest GHGE; food products with the largest water footprint are milk and dairy products. Furthermore, whilst plant-based foods generally have the lowest GHGE, they can have a large WF depending on the region of the world in which they are grown and horticultural practise. However, there have been few dietary scenarios studies to date that considered multiple metrics of environmental impacts simultaneously (Aleksandrowicz *et al.* 2016; Hallström *et al.* 2015; Jones *et al.* 2016).

1.5 Limitations and uncertainties of dietary change scenarios

Systematic reviews of dietary change scenario studies (Aleksandrowicz *et al.* 2016; Hallström *et al.* 2015; Jones *et al.* 2016) have highlighted several limitations of the dietary change literature connected to the use of data derived from LCA studies but also the methodology used to measure dietary change. Most environmental impacts of diets are quantified using data from LCAs of food commodities because very few LCA studies have been conducted on the full life cycle of foods as consumed. Furthermore, these LCA studies do not always account for food losses and waste that occur between production and consumption. For example, deductions for inedible parts of the food and weight losses in cooking ought to be accounted for to ensure accurate calculation of environmental impact. As such the extent of the environmental impacts associated with certain diets may differ by a factor of two or more (Hallström *et al.* 2015). It has been noted that although LCA is a useful tool for examining the total environmental impact of the food production-consumption chain, using LCA to analyse food consumption patterns may require more data than is feasible (Pluimers & Blonk 2011). Until an improved method for measuring the environmental impact of food is developed it is necessary to rely upon LCA, but interpret the data with caution.

The results of dietary scenario assessment studies are also subject to uncertainties regarding the nutritional data on which they base their dietary scenarios. In some instances, they are based on models of idealistic diets, which are considered nutritionally adequate, but not necessarily realistic (Aleksandrowicz *et al.* 2016). Other studies have used dietary data from empirical surveys which are based upon self-reported intake figures. These estimates may not accurately reflect the true

diets of the population; under-reporting may mean that the environmental impacts as calculated are underestimates.

In addition, much of the dietary change scenarios replace meat commodities with plant commodities. The extent to which this reflects a realistic scenario is unclear. Most hypothetical plant-based substitutions are based on raw plant food, such as pulses, cereals, salad, vegetables and fruit. It could be that consumers would replace meat with processed plants foods such as Quorn or tofu for example. Whilst these foods still have the same agricultural environmental impacts as raw plant material, they may accrue significant energy and water use in the processing. For example, processing soybeans to make tofu could add up to 43% to the estimate for soybean GHG emissions (Hamerschlag *et al.* 2011). Alternatively, it may be that other processed foods such as cheese would replace meat, which would have different consequences on both the nutrient profile of the diet and environmental impacts. Blonk *et al.* (2008) found that replacing meat with dairy products like cheese does not generally bring about a reduction in GHGE. Further exploration of meat substitutes in dietary change scenarios is therefore required.

Most studies comparing the environmental impact of different food describe the carbon footprint per 100g of food product. Functional units that express the environmental impact in terms of kcal or other nutrients have been proposed to provide better comparison. Indeed when GHGE are expressed in terms of kcal, fruit and vegetables have GHGE similar to those of animal products (Vieux *et al.* 2012). This is because fruit and vegetables are less calorific than meat and animal source products, therefore larger quantities are required to provide the same amount of energy. It has been argued that the quantity of vegetables required to replace the animal products (iso-calorifically) can contribute to similar levels of environmental impacts coming from the extra amount of land required and energy needed to grow the plant produce (Audsley *et al.* 2010). Furthermore, to provide enough plant produce to replace meat and dairy products, it would be necessary to use greenhouses or import more air-freighted food (Carlsson-Kanyama *et al.* 2003). Such energy use may not counterbalance the reduction in GHGE associated with reduced meat consumption. Despite these shortcomings there is growing evidence to suggest that in addition to environmental gain, dietary shifts may also help to reduce disease burden and improve health.

1.6 Health benefits and nutritional adequacy of low GHGE diets

Modelling studies examining the co-benefits of dietary change for the environment and health have found that diets associated with lower GHGE may reduce disease burden too (Aston *et al.* 2012; Milner *et al.* 2015; Scarborough *et al.* 2012). The majority of these studies have measured health outcomes in terms of all-cause mortality rate or risk (Aleksandrowicz *et al.* 2016), with health improvements reported ranging from <1% reduced mortality risk with vegetarian diets up to 19% for vegan diets (Tilman & Clark 2014). Springmann *et al.* (2016) measured the environmental and health effects of dietary change scenarios on a global scale. They found that the greatest health and environmental gains would be the adoption of a vegan diet, which could reduce total global mortality by 6-10%. However, some of these studies are limited as they do not assess micronutrient composition of dietary change and do account of the health effects of micronutrient deficiencies that may result from reduce meat and dairy consumption (Perignon *et al.* 2017). Meat and dairy products are rich sources of micronutrients. For example, red meat is a good source of heme iron—a key component of red blood cells (Hunt 2003). Vitamin B12 is important for nerve transmission and red blood cell production and is only available naturally from animal products. The bioavailability of micronutrients, such a heme iron is greater in meat and animal products than plant foods (Hurrell & Egli 2010). This is an important consideration that few of the dietary scenarios thus far have considered (Drewnowski *et al.* 2015). Adopting restrictive diets such as vegan or vegetarian diets may have negative health implications for those in the population are at risk of micronutrient deficiencies, such as adolescent females (Fayet-Moore *et al.* 2014) if the nutritional quality of the diet is not taken into consideration (Millward & Garnett 2010).

One study that explored the nutritional quality of self-selected low GHGE diets in France were found to be of poor nutritional quality relative to self-selected high GHGE diets (Vieux *et al.* 2013). However, Bälter *et al.* (2017) examined the relationship between nutrient intakes and GHGE emissions of self-selected diets in Sweden and found that those with low impact diets had comparable nutrient intakes to those with a high impact diet. Although the intakes of some important nutrients increased with greater emissions, this was not as profound as the results

of Vieux *et al.* (2013) suggest. This may reflect differences types of food consumed in different countries.

A recent review of the nutritional adequacy of actual and modelled low GHGE diets concluded that dietary scenarios that have lower GHGE compared with average consumption patterns may not result in improvements in nutritional quality or health outcomes (Payne *et al.* 2016). They found that low GHGE, containing less animal products, tended to be associated with higher intakes of sugar and reduced micronutrients. However, they did report that low GHGE diets appear to be associated with less saturated fat and salt intake. These findings suggest that tensions and synergies exist between nutrition and environmental concerns, and that trade-offs will have to be made to identify healthy and environmentally sustainable diets.

1.7 Synergies: health and environmental sustainability

Results of the UK National Diet and Nutrition Survey (NDNS) indicate that currently the diet of UK population is failing to meet the recommended guidelines for health (Roberts *et al.* 2018). Diets of UK adults are lacking in the certain micronutrients and exceed the Dietary Reference Value (DRV) for saturated fat and protein; the largest food group contributors to these nutrients are meat and animal source food (Bates *et al.* 2014). Consuming high levels of red and processed meat has been linked to increased risk of colorectal cancers (World Cancer Research Fund 2017). As such, the Department of Health recommends that individuals who consume more than 90g of red meat and processed meat should limit their consumption to no more than 70g per week (NHS 2015). Mean consumption of red and processed meat by men aged 19-64 years and 65-74 years exceeds the recommendation of not more than 70g/day, while mean intakes for women met the recommendation (Roberts *et al.* 2018). Dietary change is needed to optimise health, which has led some researchers to examine the extent to which the adoption of dietary guidelines for health would benefit the environment.

(Macdiarmid *et al.* 2012) used mathematical modelling to map diets of the UK population onto the '*Eat well plate*' to determine how it might be adapted to include environmental concerns. It was reported that a diet that met current health objectives (reducing meat-based protein and increasing vegetable consumption) could potentially reduce GHGE by 36%. Similarly, Green *et al.*,

(2015) used mathematical programming to demonstrate that UK diets could be adjusted to reduce GHGE by up to 40% and still meet WHO nutritional recommendations for health, though considerable changes to the diet would be needed e.g. less meat and dairy intake, slight reduction in fruit consumption, and increased consumption of sugary snacks. A similar study by Tukker *et al.*, (2011) demonstrated that existing European diets that comply with dietary guidelines for health have also been found to be less GHGE intensive. These findings have been noted in Germany (Meier & Christen 2013) and Australia (Hendrie *et al.* 2014). Estimated Average Requirements (EAR) of nutrients differ between countries, which along with differences in population food intakes and dietary assessment measures hinder the development of general conclusions about the nutritional adequacy of diets with a lower environmental impact. Nevertheless, it is apparent that if populations adhered to current national dietary guidelines for health this would help with climate change mitigation efforts. However, to achieve the greatest reduction in GHGE, further reductions in the consumption of meat and animal products would be needed. The extent to which such dietary change would be culturally acceptable, and therefore meets the FAO's criteria of sustainable, is unclear. Encouragingly, studies to date have noted it is possible to consume a diet that is nutritionally adequate and relatively low in GHGE without a net increase in cost and without eliminating meat or dairy products entirely (Green *et al.* 2015; Macdiarmid *et al.* 2012; Milner *et al.* 2015; Perignon *et al.* 2017; Seves *et al.* 2017).

1.8 UK policy and guidelines on sustainable diets

In 2010, the Labour government released the food policy 'Food 2030' which outlined its strategy to develop a sustainable, secure and healthy food system (HM Government 2010). A key priority was to “*encourage people to eat a healthy, sustainable diet*”. This policy was welcomed by the Sustainable Development Commission (2000-2011) who had conducted much work into defining the elements of a sustainable diet for government in their report: “*Setting the Table*” (Reddy *et al.* 2009). However, when the coalition government came to power in 2011 'Food 2030' was archived and the funding for the SDC was cut. Since then, efforts to develop a sustainable food system in the UK have primarily focussed on sustainable food production. The Department for Environment, Food and Rural Affairs (DEFRA) commissioned the 'Green Food Project', which brought together experts from the food and farming sector to discuss how the UK could produce

more food whilst simultaneously improving the environment in England. Sustainable food consumption was discussed during this project, but it was concluded that further work in this area was needed, including the need to define a sustainable diet and how it can be measured (DEFRA 2012). In a follow-up to the Green Food project, the 'healthy sustainable diets working group' chaired by Tara Garnett (Food Climate Research Network) and Maureen Strong (Agriculture and Horticulture Development Board) devised a set of eight key principles of a healthy sustainable diet (Green Food Project & DEFRA 2013) see Box 1. These principles were published by the Global Food Security thus are not formal government advice.

Box 1-1 Principles of healthy and sustainable eating patterns (Garnett & Strong 2014).

- Eat a varied balanced diet to maintain a healthy body weight.
- Eat more plant-based foods, including at least five portions of fruit & vegetables per day.
- Value your food. Ask about where it comes from & how it is produced. Don't waste it.
- Moderate your meat consumption & enjoy more peas, beans, nuts, & other sources of protein.
- Choose fish sourced from sustainable stocks. Seasonality and capture methods are important here too.
- Include milk and dairy products in your diet or seek out plant-based alternatives, including those that are fortified with additional vitamins and minerals.
- Drink tap water.
- Eat fewer foods high in fat, sugar and salt.

Further research to establish how best to address the trade-offs and overcome tensions that exist between different sustainability parameters, including health and environment is needed, as well as exploration of the economic and social implications of dietary changes for environmental protection. Nevertheless, these principles above provide a basis for developing policies and strategies to

encourage adoption of healthy sustainable diets (Green Food Project & DEFRA 2013).

In 2016, Public Health England published their latest dietary guidance for the UK, which incorporated environmental sustainability in so far as advising a reduction in red and processed meat consumption and increased consumption of plant sources of protein, and choosing fish from sustainable stocks. Whilst further work is needed to fully understand what a healthy environmentally sustainable diet looks like, in terms of how much of each food type is required for optimal nutrition, this provides direction as to what dietary changes are needed for health and the environment. It is important to ensure that dietary guidelines encompass the nutritional, environmental and resource needs of not only current, but future populations (Clonan *et al.* 2015). The Green Food Project concluded that understanding consumer motivations and concerns would help to inform strategies to bring about changes in dietary habits and that further work in this area is required (Green Food Project & DEFRA 2013) Good understanding of the need for these dietary change, along with positive attitudes towards dietary change will be needed for the widespread adoption of healthy sustainable diets.

1.9 Consumer knowledge, attitudes and beliefs of sustainable food consumption

In 2007, DEFRA conducted a study to explore the 'Public understanding of sustainable consumption of foods' with a focus on food purchasing behaviours and aspirations. It was noted that sustainability and the production of food was not something participants thought about when purchasing food (Owen *et al.* 2007). Many factors influence food choice and purchasing patterns including: cost, taste preferences, accessibility and religion- thus the extent to which sustainability concerns will affect food choices is unclear. The concept of sustainable food and a sustainable diet has evolved over the past twenty years. As such, research surrounding consumer's perception of sustainable food consumption has focused on various elements of food consumption that have been considered sustainable including: less packaging, local and seasonal produce, organic food, waste reduction and insect consumption (DEFRA 2011; Feldmann & Hamm 2014; Magnusson *et al.* 2001; Owen *et al.* 2007; Pelletier *et al.* 2013). The majority of these studies have noted that food packaging, method of farming (organic or conventional) and the geographical source of the food (air miles) are perceived to

have the greatest environmental implication associated with food consumption (Clonan *et al.* 2010; Tobler *et al.* 2011). However, a growing number of food LCA studies have found that in general, the agricultural phase of a food product's life-cycle tends to have the greatest environmental burden, whilst packaging and transport contributes less to overall impacts (Jungbluth *et al.* 2000; Foster *et al.* 2006; Nemecek *et al.* 2016). As a result, studies have more begun to focus on consumer perceptions of eating less meat and animal products and consuming more plant-based food for environmental concerns.

Lea & Worsley (2008) investigated the food-environmental beliefs of consumers in Australia, and noted that reducing meat consumption was considered the least environmentally beneficial amongst other sustainable consumption behaviours. Similarly, a UK study reported that less than 20% of responders agreed that it was better to reduce animal food consumption to reduce the environmental impacts of food production (Clonan *et al.* 2015). A study in the Netherlands explored consumer perception of a range of meat-reducing strategies and found that participants who showed a higher degree of willingness to adopt these strategies currently ate less meat, were meat substitutes users and were familiar with the concept of dietary change for the environment, the opposite was true for the least willing (De Boer *et al.* 2014). Similarly, a study exploring sustainable behaviours currently adopted by Dutch adult consumers found that there are different sub-groups within the population who are receptive to different dietary environmental impact reduction strategies: some favour curtailment strategies (e.g. meat-free day a week, less meat) and others favour sustainable foods (e.g. organic meat) (Verain *et al.* 2015).

It is unclear from these results whether these differences in attitudes stem from lack of knowledge or conscious denial of the benefits of dietary change for environment. Unawareness of the environmental impact of food was proposed as a key barrier to the consumption of climate friendly diets by students in Finland (Mäkinen & Vainio 2014). However, further analysis of the association between environmental beliefs and food choices suggested that disbelief in the climatic effect of food consumption had the greatest inhibiting effect on climate friendly food choices. Macdiarmid *et al.* (2016) noted that UK citizens were resistant to the idea of reducing meat consumption, inciting scepticism over in the scientific evidence provided thus rejecting the idea that this would benefit the environment.

Together these results highlight that people differ in their awareness, attitudes and beliefs about dietary change for the environment. It appears that there are subgroups that may be more open to change than others and that self-identity is an important behavioural determinant to address.

1.10 Strategies for shifting towards healthy and environmentally sustainable diets

In 2015, Garnett et al. (2015) published a review of the various strategies and policy options for shifting dietary patterns towards those that are more environmentally sustainable. Five intervention typologies were identified based on the Nuffield ladder of interventions (Nuffield Council on Bioethics 2007), DEFRA's sustainable development diamond (HM Government 2005) and International Institute for Environment and Development (Blackmore 2011) outlined below:

- i. Disincentives or incentive choices through fiscal measures
- ii. Change the governance of production or consumption
- iii. Encourage collaboration and shared agreements
- iv. Change the context, defaults and norms of production or consumption
- v. Inform, educate, promote or empower through community initiatives, labelling and other means

Most of the studies reviewed stemmed from the field of nutrition (in terms of encouraging healthy dietary behaviour), and psychology (in terms of encouraging pro-environmental behaviours). Garnett *et al.* (2015) concluded that much of the literature exploring fiscal interventions, for example Briggs *et al.* (2013), were based on computer modelling studies, which were criticised for being simplistic and unable to capture the multiple factors influencing food consumption. Real-world setting interventions were considered to have greater potential for understanding how changes in behaviour may be elicited. Institutions such as schools were suggested to hold promise for being able to influence the dietary habits of many. Furthermore, most studies tended to focus on health or the environment and there was a call for more integrated studies examining the effects interventions have on both health and environmental outcomes. Another report published by Chatham House in 2015 also highlighted the importance of fiscal and restrictive measures for changing dietary patterns (Bailey, R. & Harper 2015).

In follow up to the Green Food Project, it was stated that moments of change should be explored as a method to bring about consumer dietary behaviour change (Green Food Project & DEFRA 2013). The moment of change hypothesis is that there are certain stages in life where new habits are formed that provide opportunities to encourage pro-environmental behaviour (Thompson *et al.* 2011). It has been proposed that students starting university adopt and develop a new range of habits and behaviours, (including those related to food) and therefore are in a stage of life where pro-environmental behaviours can be adopted (Thompson *et al.* 2011). It follows therefore that it may be possible to encourage students to adopt environmentally sustainable eating habits.

1.11 Universities as settings in which to promote healthy sustainable diets

There are 167 higher education institutions in the UK with approximately 2.3 million students and over 400,000 members of staff (Higher Education Statistics Agency 2018). Universities offer huge potential to promote healthy and environmentally sustainable food consumption in emerging adult populations (Doherty *et al.* 2011). As part of a global movement, the UK Healthy Universities Network was set up in 2006, to support universities to use a whole systems approach to health, well-being and sustainability. The network '*seeks to build a strong movement of universities committed to creating health-enhancing cultures and environments; enabling people to achieve their full potential; and contributing to the wellbeing of people, places and the planet*' (Healthy Universities Network 2018). Universities can act as socially and environmentally responsible corporate citizens helping to shape the views and values aspirations and priorities of future decision-makers and community leaders (Healthy Universities Network 2018).

The growing recognition of the importance of Sustainable Development and the government's efforts for 'greening the economy' has led to many institutions including universities to devise their own food sustainability policies and strategies. The University of Sheffield has a sustainable food policy in which it acknowledges it has "*...a responsibility to offer healthy and sustainable food choices to our customers and incorporate environmental, ethical and social considerations into the products and services we provide.*" (University of Sheffield 2012, p1). Other universities have also developed sustainable food policies, which introduce the notion of reducing meat as part of climate change mitigation efforts. For example,

Cambridge University have now devised a low carbon menu the aim of which is to “create a wider awareness of the carbon impact of producing and serving food, and to subsequently encourage our customers to choose more carbon friendly meals.” (University of Cambridge 2015, p1).

Various Student Unions have also adopted strategies to address sustainability concerns, such as less meat initiatives, Meat Free Monday campaigns and ‘Veganuary’. Nottingham Trent University and others have adopted accreditation schemes such as the Food for Life Catering Mark, which focuses on sustainable food procurement, ensuring suppliers and foods meet specific criteria e.g. the use of free-range eggs, using local suppliers and meat with Red Tractor labels (Stahlbrand 2016). The University of Sheffield’s catered dining hall has a bronze award from the Sustainable Restaurant Association. However, these schemes do not provide establishments with direction for how best to encourage and support customers to adopt healthier and environmentally sustainable diets.

University students have been reported to engage in unhealthy eating behaviours, such as the high consumption of snack foods, and convenience foods and insufficient consumption of fruits and vegetables (El Ansari *et al.* 2011; Harker *et al.* 2010; Tam *et al.* 2017; Tanton *et al.* 2015). It has also been reported that students who spend more time on campus engage in eating behaviours that are more risky to health (Tanton *et al.* 2015). Roy *et al.* (2017) found that students that make more on-campus food purchases had a poor-quality diet compared to those who ate on campus less. An audit of the university food environment in Australia revealed that high-energy nutrient poor foods and beverages were readily available, accessible and promoted more than the healthy options (Roy *et al.* 2016b). Together this highlights the need for improvements to be made in the university setting food environment to support healthier, sustainable diets.

Food services and catering firms have been proposed as settings in which to promote and facilitate dietary change (Barling *et al.* 2016; Wahlen *et al.* 2012; Westhoek *et al.* 2014). A University food outlet is a promising setting in which to encourage students to make sustainable food choices. A report conducted by World Wildlife Fund in collaboration with the Rowett Institute of Nutrition and Health, concluded that retailers should promote food choices that make it easier for consumers to follow a sustainable diet and suggests they could be instrumental in facilitating change through consumer choice ‘editing’ (Macdiarmid *et al.* 2011).

1.12 Point-of-choice interventions in university food settings

There have been few studies to date that have been specifically designed to encourage students to make healthy and environmentally friendly food choices. Most studies have explored interventions to improve dietary choices for health or environmental gains independently.

A review of interventions in tertiary education to improve students' dietary choices (Roy *et al.* 2015) identified a range of single- intervention strategies that have been tested to improve food environments in university settings. Point-of-choice information such as signage of healthy choices or nutrition labels, increasing the availability of healthy foods by changing catering practises and portions sizes, and providing fiscal incentives to increase purchases of healthy food were identified as being potentially useful. Some studies used a combination of nutrition promotion or information with incentives such as price reductions or making healthier food more accessible. The review concluded that most point-of-choice interventions led to significant improvements of dietary behaviours, and those that showed greatest promise combined formal nutritional education with discounts targeting certain health food items (Roy *et al.* 2015) However, the extent to which these positive effects were sustained long-term is unclear as many did not report or conduct follow-up assessments (e.g. Peterson *et al.* 2010). Interventions that were reported to be unsuccessful in achieving positive dietary change concluded that unmotivated customers or lack of nutrition knowledge and understanding of healthy diets to guide them as the cause (Freedman *et al.* 2010; Hoefkens *et al.* 2012; Hoefkens *et al.* 2011).

Interventions that have been tested to achieve dietary change for environmental gains have focussed on reducing meat consumption or promoting vegetarian or vegan choices. Visschers & Siegrist (2015) revealed that increasing the proportion of meals that were climate friendly, (meat-less meals with a comparatively low GHGE), to the other meat containing dishes, and labelling them as such, increased the proportion of climate friendly meals purchased in university canteens in Switzerland. However, in the US, Godfrey *et al.* (2017) found that providing students with information about the water impacts associated with canteen food, and labelling the dish with the lowest water use, had no effect on students' dietary choices. Whether these contrasting findings are due to differences in student

populations and their understanding of water impacts and climate change, or different study designs it is not clear.

Campbell-Arvai *et al.* (2012) explored the use of default interventions in a campus university in the US to encourage more sustainable food choices, with a focus on encouraging meat-free food options. It was found that providing meat-free meal options as the default on a menu increased the probability that participants would choose a meat-free meal compared with those who received a no default menu. It was also noted that the presence of information on the menu was not a significant predictor of choice of a meat-free menu item. The authors of this study concluded that the use of defaults might be an effective strategy to counter habitual food choices that often come at the expense of environmental and health concerns. However, the extent to which default options can sustain behaviour change over time is unclear.

Kurz (2017) explored the use of nudge theory to reduce meat consumption in university cafeterias in Sweden. Improving the visibility of vegetarian dish on the menu order and in the canteen led to an increase in the selection of the dish by 6%. However, the corresponding reduction in meat dish purchasing was not reported. An alternative strategy to reduce meat consumption is to edit the choices available, i.e. to remove meat products. However, this has been shown to have unintended effects. For example, in Finland where a mandatory vegetarian day was introduced in schools, there was a reduction in the students using the school food outlets and an increase in food waste (Lombardini *et al.* 2013). Similarly, the introduction of Meat Free Monday into workplace cafeteria in Brighton Borough Council had to be revoked due to an outcry from employees (Ridgeway 2011).

Studies that have implemented point-of-choice interventions have measured the success of the intervention using various primary outcome measures including availability of food choices, nutrition knowledge and food/drink sales (for example. fruit and vegetables, low fat products etc.). However, others have measured changes in students' food preferences, motivations, barriers and attitudes or body mass index or reduced weight. Differences in intervention types and outcome measures make it difficult to draw firm conclusions about the most appropriate behavioural measure to assesses the success of the intervention and equally what type of intervention is most effective.

1.13 Development of dietary interventions

Reviews of dietary intervention studies in university settings (Deliens *et al.* 2016b; Kelly *et al.* 2013; Roy *et al.* 2015) and other worksite settings (Allan *et al.* 2016) have concluded that poor intervention design and implementation are the main reasons why some interventions have been unsuccessful. Furthermore, studies that have demonstrated an intervention effect have sometimes been limited by the scope of their evaluation and many do not satisfy quality requirements thus have low internal validity (Deliens *et al.* 2016b). This is consistent with the wider dietary intervention literature which conclude that many dietary interventions to date have been developed without adhering to theory or guidance (Atkins & Michie 2015). The UK Medical Research Council (MRC) published guidance on developing and evaluating complex interventions and advocates using theory in the intervention design (Craig *et al.* 2008). However, guidance on how to incorporate theory in the design process is not provided in this report. A systematic review of intervention development frameworks by Michie *et al.* (2011b) identified 19 different theoretical frameworks for intervention development, each with several weaknesses, including a lack of comprehensiveness and coherency.

The Intervention Mapping Approach (Bartholomew *et al.* 2016) and Behaviour Change Wheel (BCW) (Michie *et al.* 2011b) were amongst the most comprehensive frameworks identified. Both approaches highlight the need for using theory and evidence to inform intervention design and whilst very similar in practise, they differ in some respects. For example, both approaches encourage the user develop an ecological understanding of the health problem and their solutions. However, BCW draws from a single theory of motivation in context that is used to predict what aspects of the motivational system will need to be influenced in what ways to achieve a behavioural change (Michie *et al.* 2011b), whereas, IM draws on a range of theoretical approaches. IM uses theory to i) describe the unhealthy behaviour of the at-risk group in the population, ii) understand the health-promoting behaviours and environmental conditions, iii) describe the possible determinants of both risky and healthful behaviour and environment and iv) find methods to promote change in the determinants, behaviours and environmental conditions (Bartholomew *et al.* 2016).

IM has been predominantly used to develop health promotion programmes, including dietary interventions (Springvloet *et al.* 2014). However, it has also been adopted and used to develop interventions for pro-environmental behaviour change (Kok *et al.* 2011). Like most intervention development frameworks, the first step in IM is the needs assessment and the establishment of the determinants of the behaviour to be addressed by the intervention.

1.14 Theories of behaviour and behaviour change

Eating behaviours are highly complex and result from the interplay of multiple factors that are highly context specific (Contento 2011). The socio-ecological model is useful approach for considering how individual, interpersonal, environmental and policy factors can influence dietary behaviours (Story *et al.* 2008). This model illustrates the relationship between multiple theoretical constructs and that underpin food behaviours. The theories from which these constructs are derived can be used to help explain or change the behaviour of individuals, intervention beneficiaries, or the behaviour of 'environmental agents', individuals who are responsible for the health-related aspect of the environment (Bartholomew *et al.* 2016). Some theories can be used to help explain a given unhealthy behaviour and can be used to identify the specific constructs that need to be change to bring about behaviour change. Others focus on behaviour change and theorise what actions need to be taken to achieve change (Darnton 2008). However, some theories have elements of both types. This section will outline some theories that have been used to understand unhealthy and healthy food behaviours, theories of behaviour change and methods of change.

1.14.1 Theories of behaviour

The Theory of Planned Behaviour suggests that intention is the most important determinant of behaviour, which is influenced by three constructs: attitudes, subjective norms and perceived behavioural control (Ajzen 1991). An individual's attitude, described as a '*positive or negative evaluation of performing the particular behaviour of interest*' (Ajzen & Albarracin 2007) is a key determinant of the behaviour, which itself is determined by salient beliefs about the behaviour. Subjective norms are a person's perception that others who are important to them think they should or should not perform the behaviour in question (Ajzen 1991). Perceived behavioural control is the perceived easiness or difficulty of performing

a behaviour that is based on one's confidence in their ability to perform it (Ajzen 1991). The TPB has been succeeded by the Reasoned Action Approach (RAA), which incorporates control into the model (Ajzen & Albarracín 2007; Montaña & Kasprzyk 2015). Control is determined by environmental factors, for example in the case of health eating behaviours would refer to the availability of healthy food, and skills to deal with or overcome these environmental factors, such as the ability to prepare healthy foods. The TPB has been applied to understanding dietary behaviours (Ajzen & Albarracín 2007; Povey *et al.* 2001) pro-environmental behaviours (Abrahamse and Steg 2011) and pro-environmental dietary behaviours (Circus 2015; Vermeir & Verbeke 2006; Wyker & Davison 2010) (See section 5.3). For example, Wyker & Davidson (2010) revealed attitudes, subjective norms, and perceived behavioural control are significant determinants of readiness to adopt a plant-based diets among college students in the US. They noted that relative influence of each construct varying across stages of change. Similarly, Circus (2015) who surveyed a group of students in The University of Sheffield, found that perceived behavioural control and personal and moral norms predicted intentions to reduce meat consumption. The constructs of meat attachment and openness to vegetarianism were found to indirectly influence intentions to reduce meat consumption through the mediation of attitudes. This research shows that the theory of planned behaviour is useful for identifying determinants of dietary behaviours of students.

In addition to understanding behaviour, TPB and RAA can be used to understand behaviour change. According to this model, behaviour change is a planned process comprising three phases: eliciting the relevant beliefs, changing salient beliefs and subsequently intentions and by increasing skills or decreasing environmental constraints. Whilst the RRA does not directly suggest behaviour change methods, it refers to methods from other theories of behaviour change for example: eliciting relevant beliefs can be addressed using change methods such as anticipated regret, information about others' approval, providing opportunities for social comparison (Bartholomew *et al.* 2016).

However, a recent systematic review and meta-analysis found that TPB as a model either to understand health promoting and health-compromising food choices behaviours or serve as a basis for intervention development is limited (McDermott *et al.* 2015). This indicates that multiple theories are necessary to draw upon when

designing interventions to change behaviours, which is consistent with the Intervention Mapping approach (Bartholomew *et al.* 2016).

Social Cognitive Theory (SCT) is an interpersonal theory of behaviour as it considers both personal determinants and the socio-cultural determinants of an individual's behaviour (Bandura 1998). SCT considers major determinants of behaviour to be: outcome expectations, perceived and actual barriers, self-efficacy, self-regulation processes, perceived behaviour of others and the environment. Self-efficacy described as judgements of ability to perform an activity are synonymous with perceived behavioural control used in the RAA. Similarly, outcome expectations are similar to social norms in the TPB. According to SCT, people adopt the behaviour of others through observation, replication and experiencing positive outcomes (Bandura 1998) thus can be used to explain behaviours and identify environmental agents of change. SCT can also be used to identify methods of change. For example, social persuasion is one way to strengthen people's beliefs, self-efficacy, that they have what it takes to succeed. The change method of verbal persuasion can help people to realise that they have the capabilities necessary to master a given activity and are therefore more likely to sustain greater effort than if they exhibit self-doubts and dwell on personal deficiencies when problems arise (Bandura 1998). SCT has been used as a theoretical framework for exploring the barriers to the consumption of healthy foods by young adults (18-24 years), highlighting the social and physical factors influencing dietary habits (Munt *et al.* 2017). Similarly, normative beliefs regarding how much friends, family, and other colleagues believed the participant should follow a plant-based diet were also strong predictors of intentions to do so it has been used to predict the of the young adults adoption of plant-based diets (Wyker & Davison 2010).

Both TPB and SCT highlighted the importance role the environment can have on dietary behaviours. As such there has been a growth in experimental studies in which changes to the food choice environment have been explored to positively influence food choices, including the consumption of fruit and vegetables (Allan *et al.* 2016; Engbers *et al.* 2005). However, further work is needed to understand better the social and physical environmental correlates and predictors of behaviour (Brug *et al.* 2008). Whilst the variables of the TPB, RRA and SCT have been associated with eating behaviours, the finding that there is an intention-behaviour gap has led some to conclude that traditional socio-economic models

fail to account for dietary behaviours, which are often habitual (Vermeir & Verbeke 2006). Habits are associative learned responses to contextual cues that have been rewarded by satisfactory experiences in the past (Wood & R nger 2016). Habit has been suggested to act like a boundary condition to the validity of socio-economic models (van't Riet *et al.* 2011). (Khare & Inman 2006) suggested that to conserve cognitive resources, consumers make food choices habitually and based on contextual cues. Drawing upon the evidence that habit is important in food choice behaviour, van't Riet *et al.*, (2011) suggest that interventions designed to change situational cues, promote or inhibit habitual responses and change the contingencies that are associated with the behaviour may be most effective. They suggest that "rewarding healthy eating with positive contingencies can increase the chance that a given response develops into a habit" (van't Riet *et al.* 2011, page 590).

1.14.2 Theories of behaviour change

Stage theories can help to understand the range of different behaviours people exhibit in a specific context, as well as predict the uptake of health promoting behaviours (Bartholomew *et al.* 2016). The Transtheoretical Model of Behaviour Change (TTM) assumes that individuals in a population are in different stages in terms of their readiness to change and subsequently exhibit different behaviours. According the TTM, behaviour change occurs over time and unfolds through a series of stages (Contento 2011). People move from pre-contemplation (individuals are unaware and have no intention of making any change), to contemplation (individuals are considering the costs and benefits of changing their behaviour), to preparation (individuals intend to take action in the near future and have a plan), to action (individuals have started to engage in the new behaviour) and finally maintenance (individuals have incorporated the new behaviour into their way of life) (Prochaska *et al.* 2015). TTM highlights the importance of tailoring interventions to meet the needs of sub-groups within a given population at each stage of change. It is therefore useful for establishing the most appropriate change method to employ. TTM has been applied to changing dietary behaviours most commonly increasing fruit and vegetable consumption or dietary fat reduction (Spencer *et al.* 2007). However, more recently understanding the dietary change towards more plant-based diets. (Wyker & Davison 2010) found

explored the stages of change of young adult in the adoption of plant-based diets and noted that there is a divergence in the stage of change of individuals considering or currently eating more fruits and vegetables and those who are considering or following a plant-based diet. The authors suggest this implies that beliefs beyond the decision to eat more fruit and vegetables are driving the decision to eat more plant-based diet. (Weller *et al.* 2014) used the used to develop an instrument to measure environmentally conscious eating behaviour amongst college students and found that two-thirds of the sample were in the Pre-contemplation (37%) contemplation (30%) stage of change with only 15% in maintenance stage. (Tobler *et al.* 2011) have used the TTM to explore willingness of citizen in Switzerland to adopt more environmentally friendly eating behaviours including buying organic food, regional product and reducing meat consumption. The majority of participants in their study were in the pre-contemplation or action stage of change. Drawing upon the TTM theory these findings indicate that to assist those in the pre-contemplation stage to move to the contemplation stage, it is useful to focus on methods of consciousness-raising. However, the TTM has been criticised for not incorporating methods for changing environmental conditions that would be needed for longer-term behaviour changes (Brug *et al.* 2005).

In addition to understanding individual behaviour change, stage theories have also been used to describe organisational change. The Diffusion of Innovations Theory (DOIT) model (Rogers 1995) has been used to explain behaviour change on an individual and organisational level. Like individuals, organisations can be categorised according to their readiness to adopt innovations or interventions. According to the DOIT model, an organisation is theorised to move sequentially and linearly through seven stages as it adopts and institutionalises a health promotion intervention. The DOIT has been used to guide a study exploring the acceptability of point-of-purchase interventions aimed at portion sizes for obesity prevention (Vermeer *et al.* 2010).

1.15 Determinants of eating behaviours of university students

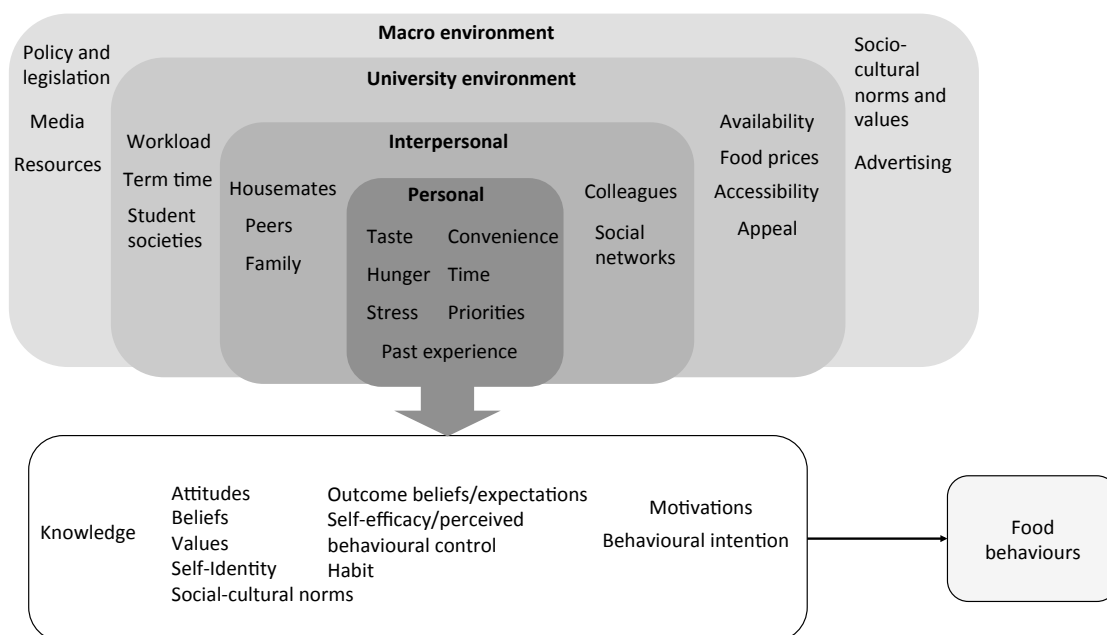
Understanding the factors shaping the eating behaviours of university students is needed to inform the development of strategies to improve them. Deliens *et al.* (2014) used a qualitative approach to identify the multiple factors at various ecological levels that influence eating behaviours of university students in Europe.

Focus groups with students in a university in Belgium identified four key levels of determinants: individual (taste, values, beliefs), social environment (social support, peer pressure), physical environment (availability and accessibility of foods) and macro environment (socio-cultural norms and values). University specific characteristics were also found to be influencing students' eating behaviours for example, student societies and exams. These findings are similar to the US literature on factors influencing students' diets and highlight many regulatory processes, including for example intrinsic (food preferences) and extrinsic (health awareness), motivations, self-discipline, time-management (Nelson *et al.* 2009). In light of their findings these authors recommend providing information and advice to students to enhance healthy foods choices and preparation, enhancing self-discipline and self-control, developing time management skill, enhancing social support and modifying the subjective and objective campus food environment, by making healthy foods lower cost (Deliens *et al.* 2014).

Quantitative studies exploring the main factors influencing food choices made on campus and revealed that taste, convenience and price are the key factors influencing students' food choices (Hebden *et al.* 2015; Marquis 2005; Tam *et al.* 2017). Studies from the US have shown that gender and race are also significant predictors of food choice on a college campus (Boek *et al.* 2012). A recent scoping review by Munt *et al.* (2017) highlighted several barriers and enablers to healthy food choices among young adults, including interpersonal factors, with the diets of family and friends having a strong effect on an individual's food behaviours.

Factors influencing university employees' food choices has been rarely explored, though one study in the US reported a call for healthier options to be available on campus (Freedman *et al.* 2011). A summary of determinants and theoretical constructs related to food choice behaviours in a university setting are outlined in Figure 1-3.

Figure 1-3 Outline of the determinants and theoretical constructs that underpin food choice behaviour in a university setting. Adapted from figure 1 (Contento 2011; Deliens *et al.* 2014; Story *et al.* 2008)



1.16 Students' attitudes towards sustainable food consumption

Few studies have explored the attitudes of students towards sustainable food, and even fewer have examined their perception of sustainable food consumption. However, one study by Vermeir & Verbeke (2008), which explored sustainable food consumption amongst college students in Belgium, reported that nearly half of participants felt that alternative food production practises (organic, local, sustainable, and non-processed foods) were important. Organic food was also found to be important amongst students in a North American study, and that students with this attitude were more likely act upon the beliefs they expressed toward organic food and eco-friendly behaviours (Dahm *et al.* 2009). It was also noted that there was a significant positive relationship about other eco-friendly practises and corresponding behaviours for example recycling and energy conservations (Dahm *et al.* 2009). However, this study relies upon self-reported purchases, which may not reflect true purchasing behaviours.

A study with college students in North America noted that messages about social and environmental implication of food practises (eating locally, or organic food) may be well-received (Pelletier *et al.* 2013). Moreover, it was found that after taking a course on the societal implications of food and food production, college students increased their intake of vegetable consumption and reduced their intake of high-fat dairy (Hekler *et al.* 2010). A senior honours project, conducted in the

University of Rhode Island, explored a web-based intervention to encourage environmentally friendly eating amongst students (Eastman 2012). It was found that the intervention did not change eating patterns significantly, however this study is limited by a small sample size.

A study in Belgium exploring student attitudes towards sustainable foods and purchase intentions reported that whilst students claim that they are interested in having more credible information about the environmental impact of food choices, this doesn't necessarily translate into purchasing intention (Vermeir & Verbeke 2006). Although this study did not measure students' purchases, only their purchasing intentions, it has been argued that purchasing intentions are strongly correlated with purchasing behaviour (Vermeir & Verbeke 2008). More research is required to explore the associations between pro-environmental attitudes and actual environmentally friendly purchasing patterns.

The author is unaware of any studies that have examined the knowledge and attitudes of university employees towards dietary change for environmentally sustainability.

In view of these studies it appears that University students may be receptive to information about sustainability issues related to food production and consumption. Furthermore, students are consumers of the future; thus embedding pro-environmental dietary behaviour in this population is likely to help achieve long term, sustainable patterns of food consumption. It has been postulated that Universities are in a unique position for adopting holistic approaches to healthy and sustainable food consumption and procurement (Doherty *et al.* 2011). It can therefore be suggested that Universities are a potentially good location in which to test interventions to encourage dietary change for health and environmental gains.

1.17 Thesis research question and objectives

This thesis explored the research question:

Can a point-of-choice intervention increase healthy and environmentally friendly food consumption in a UK university setting?

There were three main research objectives to address this question:

- To explore the environmental impact and nutritional quality of food choices available in university cafes. (Study 1)

- To develop a feasible and culturally acceptable intervention to encourage staff and students to make healthy and environmentally friendly food choices (Study 2)
- To evaluate a pilot intervention to increase the sales of environmentally friendly food choices in university cafes (Study 3)

2 CHAPTER 2: METHODOLOGY

This chapter describes the research setting, theoretical framework, epistemology and research objectives that underpin this thesis. It provides a summary of the IM approach taken, further detailed description of the development process is provided in Chapter 5.

2.1 Research setting

The setting for this research was the University of Sheffield (UOS). The UOS is a Russell Group University based in South Yorkshire that has over 27,000 students (undergraduate and postgraduate, full-time and part-time). Most students are undergraduate (19,661), under the age of 21. There is an even gender balance. Most students are from the UK or EU, 24% are from overseas many are from China (The University of Sheffield 2016). There are also 8,261 members of staff in the university, many of whom are international (20.4%) (The University of Sheffield 2016). There is an equal gender balance and majority of all staff, 53% are between the ages of 30-49 (The University of Sheffield 2016). The UOS is a multi-site university spread throughout the city of Sheffield and comprised of six academic faculties: Arts & Humanities, Engineering, International Faculty, Medicine Dentistry & Health, Social Sciences and Science.

Food provision on campus is predominantly via catering establishments owned by UOS. The University of Sheffield's department of Accommodation and Commercial Services (ACS), along with the university owned subsidiary company UNICUS, operate most food outlets as well as providing catering and hospitality for conference and events across the university. ACS has an annual turnover of £36 million (including accommodation and welfare support), and UNICUS has a budgeted turnover of £4.9 million and employs 106 people (The University of Sheffield 2018).

Most university food outlets emulate high-street cafes and fast-food outlets in terms of their business model, thus are set up for a 'grab and go' food and drink procurement. Food outlets are located within university buildings across the city and within the Students Union building situated in the most central site of the university. There are two dining halls serving hot meals prepared on site, one (The Edge) is located at halls of residence and the other ('Uni Central') is in the Students' Union building. The Students Union is as a separate organisation, which

also procures food and drinks for the university community. Most food outlets owned by the SU are located in the Students' Union building and include a salad bar, pasty shop, convenience store, a cafe-bar, coffee shop and bar.

There are around 500 catered students at The University of Sheffield that are provided with a £51.45 weekly food allowance. This allowance is provided as credit on a magnetic cash card called a GeniUS card. This credit is intended to cover the cost of two meals daily and can be spent in any of the university owned catering establishments on campus. The rest of the university community purchase meals with cash or debit/credit cards. Non-catered students and staff can sign-up to a loyalty rewards scheme run by the university owned food outlets. These customers are issued with a GeniUS card, which they scan at the till and collect 5 points for every pound that they spend. These points are redeemable in university outlets against future purchases, each point is worth 1p. Catered students with the GeniUS card also receive rewards points for their purchases. There are between 26,000-27,000 GeniUS cards registered, with 10,000 actively being used each month.

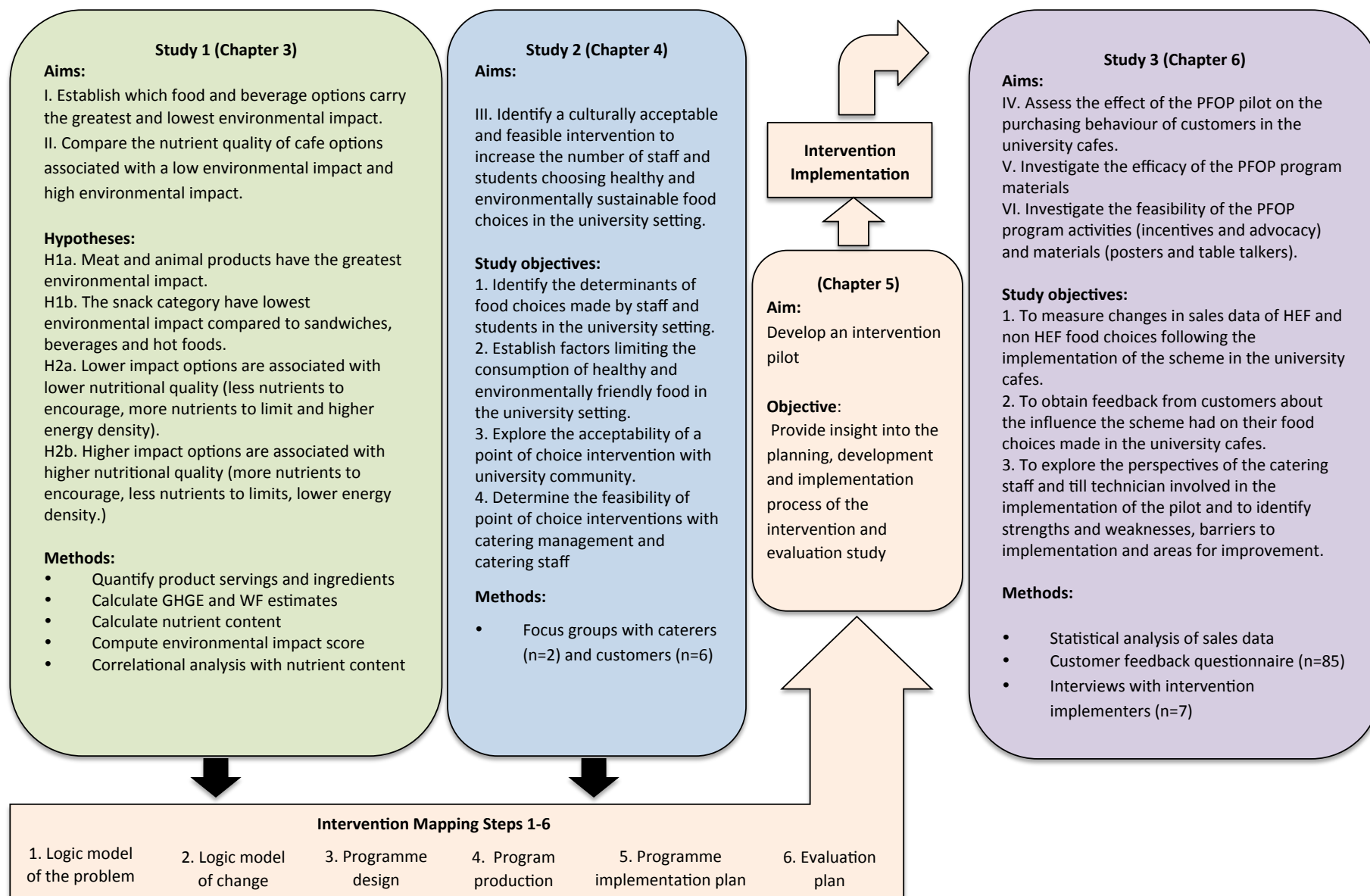
2.2 Theoretical framework

The overall aim of this PhD thesis was to develop an intervention to increase the consumption of healthy and environmentally friendly food. It focused on the development and evaluation of point-of-choice intervention to increase the consumption of healthy and environmentally friendly (HEF) food in a university setting. An intervention mapping approach (IM) was used as a theoretical framework to develop the intervention. The intervention mapping protocol comprised six steps, each consisting of several tasks. The completion of each task in each IM step generated information to inform the next stage. Whilst sequentially linear, this was an iterative process and required movement back and forth between the steps.

This thesis describes the three key research studies that were undertaken as part of the IM process. Studies one and two addressed research questions that informed the needs assessment and the development process of the intervention (steps one-five). Study three addressed the research questions developed through the IM process (step six of IM) designed to evaluate the intervention. Figure 2-1 outlines

aims and objectives of each study conducted as part of this thesis following the IM process.

Figure 2-1 Thesis outline



2.3 Ontology and epistemology

The process of intervention mapping is problem-driven; therefore, a pragmatic philosophical stance was adopted to address the research objectives of this thesis. This contrasts with the constructivist and post-positivist positions that require the researcher to adopt a specific ontological perspective about what constitutes 'truth'. Constructivists posit that social phenomenon are imagined constructs created by people through their subjective views (Creswell 2013). Therefore knowledge, or truth is subject to interpretation and as such constructivists tend to employ qualitative approaches to explore the meaning of social actions and experiences. Positivist approaches stem from the objectivists perspective that social reality exists externally (Creswell 2013). Researchers adopting this epistemological position use quantitative methodological approaches to measure, define and quantify the physical world to objectively gain knowledge.

Pragmatism rejects philosophical polarity and uses pluralistic approaches to derive knowledge about the social world (Creswell 2013). Pragmatists choose research methods they believe will address the research problem best. As a result, quantitative and qualitative approaches were used as part of the IM process to gain a comprehensive understanding of the research problems addressed.

2.4 Research design and thesis outline

This thesis has a mixed methods study design comprising three studies. Each study used a quantitative, qualitative or mixed methods approach to address separate research objectives that were designed to answer the overarching research question of this thesis (see Figure 2-1). As per Creswell's description of multiphase mixed methods design, the quantitative and qualitative data were collected sequentially, building upon the approach of the other to inform a common program objective (Creswell 2013). Quantitative and qualitative data was given equal status in this process.

Chapter 3 describes Study 1, which used a quantitative approach to calculate the environmental impact and nutritional profile of food choices available in a university setting. This deductive approach was used to test two hypotheses to identify cafe choices that were healthy and environmentally friendly, which could then inform the development of the intervention. The methods used to address the research objectives are discussed further in Chapter 3.

Chapter 4 describes Study 2, which used a qualitative approach to enable a greater understanding of factors influencing food choice behaviour in the university cafes. It was also used to identify a tolerable level of intervention burden and acceptable balance of intervention burden-to-risk based on community values. This inductive approach was used to refine the proposed intervention ideas prior to implementation. Methods used to meet these research objectives are outlined in Chapter 4.

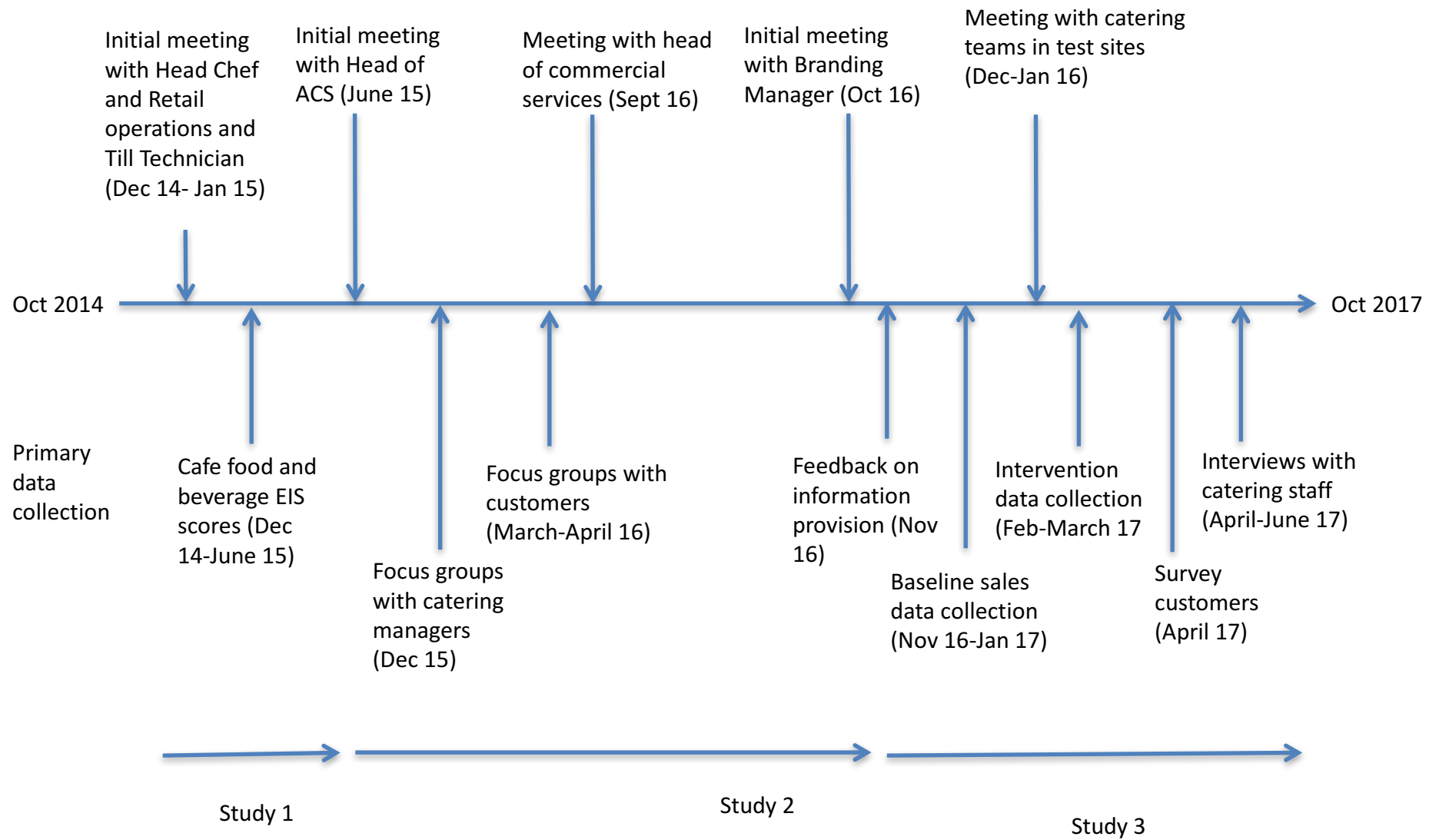
Chapter 5 provides an insight into how the findings of studies one and two were integrated and used to inform the development of the intervention. It details the IM steps one-six taken and provides examples of the tasks completed.

Chapter 6 describes Study 3, which employed a quasi-experimental study design to pilot the intervention developed using IM. The study was not of sufficient scale to be anything other than a pilot study. A mixed methods approach was used to evaluate the pilot. Mixed methods are often used for corroboration, confirmation or triangulation of data. It is also useful to produce a more nuanced understanding the topic allowing planners to increase the validity of their findings (Morgan 2006). A detailed description of the methods used for Study three is outlined in Chapter 6.

2.5 Study timeline and data collection

The IM process began in October 2014 and the evaluation was concluded in September 2017. Key data collection events are outlined in Figure 2-2.

Figure 2-2 Thesis timeline



3 CHAPTER 3: EXPLORING THE RELATIONSHIP BETWEEN ENVIRONMENTAL IMPACT AND NUTRIENT QUALITY OF FOOD AND BEVERAGES AVAILABLE IN UNIVERSITY CAFES

3.1 Introduction

This chapter describes Study 1 which explored the environmental impact and nutrient quality of food choices available in University cafes. There were two main study objectives, each with two hypotheses:

- 1) To establish which food and beverage options carry the greatest and lowest environmental impact.

H1a. Meat and animal products have the greatest environmental impact.

H1b. The snack category has the lowest environmental impact compared to sandwiches, beverages and hot foods.

- 2) To examine the nutrient quality of cafe options associated with low and high environmental impacts

H2a. Lower impact options are associated with lower nutritional quality (less nutrients to encourage, more nutrients to limit and higher energy density).

H2b. Higher impact options are associated with higher nutritional quality (more nutrients to encourage, less nutrients to limits, lower energy density.)

As discussed in Chapter 1, most environmental impact assessments of food and diets have focused on GHGE only (Hallström *et al.* 2015). Datasets for other environmental impact parameters, such as land use are limited to a small number of commodities that have not been converted into food as consumed. Therefore, this study focused on GHGE and water use, as the datasets available that include broader system boundaries or a larger number of food products. It was important to consider the nutritional quality of cafe options as some studies have highlighted that diets with a low environmental impact may not have improved nutritional outcomes (Payne *et al.* 2016). This study was conducted to inform the needs assessment of the intervention mapping process, to help understand the environmental problem more fully and to inform intervention outcomes.

This chapter describes the methods used to measure the environmental impacts of food and beverages in the cafes. The third section describes the results of the analysis. The final section discusses the findings considering the study hypotheses.

3.2 Methods

This section describes the steps taken to calculate the GHGE and water use of commonly consumed foods and beverages in the 18 university cafes at the University of Sheffield. The environmental impacts of the cafe options could not be assessed using the LCA approach, since this requires specific input data on a single food basis. It was not possible to trace the source of the ingredients of the various items back to the farms from which they had originated or establish the resources and agricultural methods used. Instead, approximate values of GHGE secondary data derived from LCAs of food products and food commodities consumed in the UK were used to estimate the GHGE of different food and beverage options. Similarly, a report outlining the Water Footprint Impact Indicator (WFII) values for foods as purchased in supermarkets derived from Water Footprint Assessment method (Fisher *et al.* 2013) was used to calculate WFII of cafe options. The first step in this process was to identify the most popular cafe options.

3.2.1 Identification of popular cafe choices

An annual sales report for all food and beverages purchased in the university owned food outlets (June 2014-July 2015) was retrieved from the till system data. FG, together with a member of the Accommodation and Commercial Service (ACS) staff, identified 'core' products common to all 18 food outlets. These items were categorised into four separate groups for analysis based on their common characteristics: pre-packaged sandwiches, hot food, snacks and beverages. (See Appendix A1 for list of products in each category).

3.2.2 Quantifying product servings and ingredients

To calculate the environmental impact and assess nutrient quality of the cafe options it was necessary to obtain the portion sizes and weights of their constituent ingredients. For the sandwiches, this information was retrieved from the product specifications provided by the supplier, Sandwich King, (Leeds, UK). For hot foods, which comprised mostly soups, literature on food portion sizes (Mills *et al.* 1993) was used to obtain the weight in grams of a portion of soup. The portions of soup were assumed to be 'large' based on the size of the bowls used in

the cafes. As the soups were not prepared on site and provided by multiple suppliers, it was not possible to obtain the actual recipes and therefore the weights of each constituent soup ingredient. Instead, a similar approach outlined by Scarborough *et al.* (2014) was used (see section 3.2.3). An online search for soup recipes was conducted using Google and the top three recipes returned were recorded and used to generate a final recipe. Ingredients that appeared in at least two of the online recipes were included in the final recipe. Where the weight of ingredient was not specified in grams, weights were taken from the Food Portion Sizes (Mills *et al.* 1993). For example, where the recipe was '1 small onion' it was converted into 60g. A mean weight (g) of those ingredients was used to create the final recipe. Any ingredient that comprised less than 5% of the total weight was discarded from the analysis, as it was unlikely they would contribute to the overall nutritional profile or environmental impact.

Default weights, based on Food Portion Sizes (Mills *et al.* 1993), for baked potatoes and their toppings were retrieved from the intake, recipe and menu nutritional analysis software NetWISP V4.0 (Tinuviel Software, Warrington, England). NetWISP default weights of pieces of fresh fruit, cookies, cakes and pastries were also retrieved for non-packaged snacks. For packaged snacks, e.g. mixed nuts and seeds, the ingredients list on the products packaging was used to identify the percentages of the main ingredients. This, together with the serving size, was used to determine the weight of each constituent ingredient.

Catering staff provided details of the composition of the beverages prepared in house, (coffees, smoothies, milk-based drinks, teas). For each beverage type, weights of shots of coffee and the weights (to the nearest gram) of drink powders (e.g. hot chocolate, frappe latté powder, chai latté powder) were measured using a digital weighing scale (GenWare, model number EK03B-5, Neville PLC, Kent). Three measurements of each beverage ingredient were taken and the average calculated. The weight and composition of the pre-packed frozen fruit used in the smoothies was obtained from the supplier's website. For pre-packaged beverages (for example Coca-Cola, Oasis) weight information was obtained from the manufacturers' labels.

3.2.3 Calculation of GHGE estimates

A database of GHGE values for 289 food commonly consumed in the UK (Scarborough *et al.* 2014) was used to calculate the greenhouse gas emission estimates of cafe sandwiches, hot food options, snacks and beverages made in-house. The database provided measures as kgCO_{2e} per 100g of food and beverage ingredients. Carbon dioxide equivalents are a common measure of climate impact used by the Intergovernmental Panel Climate Change (IPCC 2007). In this study the global warming factor published in 2007 was used which denotes the kg of GHG weighted by global warming potential over a 100-year time frame, with carbon dioxide weighted as 1, methane weighted as 25 and nitrous oxide weighted as 298. The GHGE estimates for beverages were calculated using three different GHGE datasets: Scarborough *et al.* (2014), Tesco Ltd. (2012) and Coca-cola (2012). Cafe beverages sold in plastic bottles were based on the mean value of GHGE values for equivalent products. For example, the value for Coca-Cola is an average of the value (0.33g/ml) from the Coca-Cola website for a '2l plastic bottle of Coca-Cola' (0.25g/ml) and the Tesco GHGE value for 'Cola 6X500ml multipack' (0.4g/ml). Where there were multiple plausible equivalent products within a single dataset, an average GHGE value was used. For example, the GHGE value for a 500ml bottle of Sprite was an average of the values for 'Cloudy lemonade 2l bottle', 'Sparkling lemonade 2l' and 'Premium Lemonade 2l'. In the calculations of GHGE values for beverages prepared on site, beverage ingredients were based on GHGE values from Scarborough *et al.* (2014). For plastic bottles of fruit juice and milk, an average of Scarborough *et al.* (2014) and Tesco (2012) values were used. Where milk was used as an ingredient, the value from Scarborough's dataset was used. Please see Appendix A3 for detailed description of GHGE data sources and final values used in the calculations.

A GHGE value for UK tap water was also estimated from a government document, which reports a value of 0.271 gCO_{2e}ML⁻¹ (Reffold *et al.* 2008). This estimate was used to calculate the impact of water and ice that were ingredients of the beverages made in-house.

The GHGE datasets differed with respect to the system boundaries included in the measurement of the GHGE. Data from Scarborough *et al.* (2014) reflect GHGE arising from the earliest stages of production to the retail distribution centre only. The GHGE estimates in the Tesco Carbon footprint summary and the Coca-Cola website reflects emissions arising from cradle-to-grave, i.e. they include emissions

arising from additional life-cycles stages: storage and retail, transport, storage and consumption and disposal. The GHGE for tap water was derived from an LCA study where the system boundary included water source abstraction and conveyance, water treatment, water distribution, water in the home and wastewater treatment (Reffold *et al.* 2008).

3.2.3.1 Derivation of GHGE values in the principle database

Scarborough *et al.* (2014) derived their food GHGE data from the values for 94 food commodities consumed in the UK published by Audsley *et al.* (2010). This section outlines the methods used; a detailed description of the methodology used to generate these data has been published (Scarborough *et al.* 2014).

GHGE associated with food production differ between countries due to differences in farming practises, resource use and energy sources. Given that the UK imports a large proportion of food from a range of countries the first step taken by Scarborough *et al.* (2014) was to produce a single estimate of GHGE for each food accounting for differences in GHGE by country of origin. These estimates were weighted for the proportion of home produce foods to imported food. This weighting was derived from empirical data from the FAO's food balance sheets for current import and export patterns (FAOSTAT, accessed July 2013).

3.2.3.2 Transforming food commodity data to food product data

The GHGE of 289 foods were derived from GHGE of 94 food commodities. These values therefore only indicate the emissions associated with the production of primary commodities (i.e. wheat, beef, pigmeat etc.) and do not reflect GHGEs associated with food products as purchased by the consumer (bread, corned beef, ham, bacon etc.) To account for this, Scarborough *et al.* generated GHGE estimates for a range of different processed foods using two techniques: *adjusting for density* and *estimating GHG emissions from recipes*.

Density adjustment involved estimating the weight of the raw commodity food from the final food weight. For example, to make 100g of cheese, approximately 1000g of milk were needed. The adjustment factors used were based on the published literature for cheese, fruit juices, soya milk and dried fruit. The value for the GHGE of cheese is based on that for milk, which has been adjusted by a factor of 10.1 (Berlin 2002).

To generate GHGE values for complex food items that are commonly consumed (consisting of more than one ingredient), recipes were collated and used to calculate the proportion of food constituent ingredients. Recipe information was largely obtained from the McCance and Widdowson's *The Composition of Food* (Food Standards Agency 2002). If recipes were unavailable from this source, a Google search was conducted and the first recipe in the search result was used. Only food ingredients that comprised 90% of the total were included. For example, as Table 3-1 shows, strong white flour and water comprise 90% of the weight for white bread, therefore only these two ingredients were included in the calculation (the remaining ingredients were ignored).

Table 3-1 Example of the calculation of GHGE associated with a complex food (bread) used by Scarborough *et al.* (2014).

Ingredient	Recipe weight	FSA weight	FSA Info	Weight (g)	Included?	Weighting	Emissions Equivalent	kgCO ₂ e/kg	
Strong white bread flour	500			500	y	0.625	Wheat	1.0377142	0.649
Butter	40			40					
Fast action yeast	12			12					
Salt	2tsp	10	level tsp 5g	10					
Tepid water	300			300	y	0.375	Assume zero	0	0.000
Olive or sunflower oil	a little	11	1tbsp oil	11					
			Total	873	800		See white bread		0.649
			90%	785.7					

3.2.3.3 Calculations of cafe option GHGE estimates

The GHGE for the 289 food items provided in kgCO₂e/100g was converted to gCO₂e g⁻¹. The gram weight of each individual cafe option component ingredient was then multiplied by equivalent food GHGE (gCO₂e g⁻¹) values for that food. In cases where there was no GHGE value for a constituent ingredient, the closest equivalent food item was used. For example, tortilla wraps were calculated as white bread. Similarly, for sandwich component ingredients that were complex foods, the ingredient list was consulted and the GHGE of the largest food component used. For example, 'cool salsa sauce' did not have a GHGE value, thus 'raw tomatoes' was used.

Sandwich constituent ingredients with a weight less than 1 gram were excluded from the calculation. Similarly, for the soup recipes, ingredients that comprised less than 5% of the total portion weight were excluded from the calculation. These minor ingredients were removed on the basis they were unlikely to contribute significantly to the overall environmental impact of that cafe item. The total GHGE per food portion or beverage serving was calculated from the sum of the

constituent ingredient GHGE estimates. See Appendix A2-A3 for list of GHGE estimates for ingredients and their source. GHGE values were based on emissions arising in the production of raw commodities and were not adjusted for processing or cooking. These values are therefore an underestimation of the true GHGE arising from the consumption of those foods.

3.2.4 Water Footprint Impact Indicators

The Water Footprint Impact Indicators (WFII) for individual grocery items published by the Product Sustainability Forum in their report: '*An initial assessment of the environmental impact of grocery products*' (Fisher *et al.* 2013) were used to calculate a total WFII of each cafe option.

3.2.4.1 Derivation of water footprint indicators

Fisher *et al.* (2013) used UK import statistics to determine the top five countries from which the UK imports a range of grocery products. Country specific green, grey and blue water footprint values for key life-cycle stage of each grocery product was collated and used to calculate an average global water footprint for each product. Life cycle stages included in this assessment were: the raw material production, packaging production and manufacture of the finished product.

The impact of water consumption varies considerably across different regions of the world. To account for this, Fisher *et al.* (2013) developed and incorporated country-specific water scarcity factors into their water footprint impact indicators. These scarcity factors were derived based on the following parameters from the World Business Council for Sustainable Development's Global Water Tool:

- Total renewable water availability per capita for each country in 2025
- Population trends
- Total water withdrawn from the available supply

The amount of water withdrawn from a country's available supply to produce food products has a direct effect on the amount of clean drinking water and water available for sanitation. As such, these social factors were also included in the scarcity measurement to indicate the social impact of the water footprint of UK consumption.

These country-specific scarcity factors, (ranging from 0.1-1.5) were used to inflate (or decrease, if relevant) the water footprint to numerically account for global

variations in water availability (see p117-112, Fisher *et al.* 2013) Countries where water is scarce, with growing populations and a poor water supply/sanitation facilities have a scarcity factor greater than one. Other countries where water availability is sufficient, have a stable population with good water supply/sanitation facilities have a factor less than or equal to one.

For each of the grocery products assessed, three impact indicator values were calculated:

- a) Internal water footprint impact indicator (based on food grown and sourced in in the UK).
- b) External water footprint impact indicator (a weighted average based on the share of UK imports of each product from the top five import countries and the global average water footprint.
- c) Weighted water footprint impact indicator (based on the share of volumes produced in the UK, plus imports).

3.2.4.2 Calculations of cafe option water footprint impact indicator

The scarcity weighted water footprint impact indicator values (scarcity weighted litres/kg) were converted to scarcity weighted litres/g; and used to calculate the water impact indicator of the ingredients of each food and drink component following the same methods as described for GHGE estimates in Section 3.2.3. As with the GHGE estimates, similar or equivalent foods were used when ingredient data were unavailable. An adjustment calculation as described in section 3.2.3 was calculated for drinking chocolate and mayonnaise.

For simplicity, this scarcity-weighted metric of water consumption will be referred to as the Water Footprint Impact Indicator (WFII) in the rest of this thesis. Each food or beverage ingredient WFII was summed to produce a WFII for each food or beverage per portion, (scarcity weighted litres/portion). (See Appendix A4 for WFII of ingredients used in calculations.)

WFII estimates were based on water used in the production of the manufactured product some of which were consumed uncooked, whilst others required cooking. However, these values were not adjusted for cooking or processing of the ingredients required for consumption therefore they are an underestimation of the true water use of these foods.

3.2.5 Categorisation of cafe options

The four categories of cafe options were analysed separately. This is largely because choices tend to be made within categories. Each category was subdivided further to explore differences in environmental impact within each food group (see Table 3-2). These subcategories were used as labels in the analysis.

Table 3-2 Table of cafe option categories and subcategory labels

Cafe option category	Sub category label
Sandwiches	Vegetables, eggs, cheese (only), fish, poultry, pork, beef, cheese & meat, mixed meat.
Beverages	Coffee (milk-based), coffee (water-based), tea, smoothie, soft drink, bottled water, other (milk-based), fruit juice.
Hot food	Veg soup, pork soup, chicken soup, cream of chicken soup, lamb soup, beef soup, meat substitute, pork sausage sandwich, veg BP filling, seafood BP filling, cheese BP filling, beef BP filling,
Snacks	Biscuit, chocolate confectionary, non-chocolate confectionary, fruit general, nuts and seeds general, savoury snacks, pastries, breads, cakes.

(BP=baked potatoes. Veg= vegetable)

3.2.6 Environmental Impact Score

Earlier studies that have measured GHGE and water use of foods have found the two impact parameters to be positively correlated, yet tensions exist between them, i.e. some choices may have a low GHGE but high water use and vice versa. The aim of this study was to identify cafe options with the greatest and lowest environmental impact, to inform the development of intervention targets. It was therefore necessary to accommodate for discrepancies that may arise. To overcome any potential tensions, GHGE and WFII estimates were combined into a single Environmental Impact parameter using Principle Component Analysis (PCA). PCA is a data reduction technique that is equivalent to orthogonal regression and is used to convert a set of original variables into a smaller set of linear combination while preserving as much variability as possible (Jolliffe & Cadima 2016). For each cafe option category, PCA was performed which used the correlation matrix of the raw GHGE and WFII estimates to extract only a single component that explained the majority of the variance. The correlation matrix was used as it is appropriate to use when changes in scale are conceivable for each variable (Jolliffe & Cadima 2016), such as with GHGE and WFII units of measurement.

The fit of the orthogonal regression line measures the perpendicular distance of the data points to the line. This is different to the classical regression line where the fit is measured parallel to the y-axis. The advantage of using orthogonal regression is that it accommodates for variables with unknown errors (Jolliffe & Cadima 2016). Unlike simple linear regression (least squares regression), both the response (Y) and predictor (X) contain measurement error. As both the GHGE and WF estimates calculated contained errors of unknown magnitude, orthogonal regression was used so that the roles of the variables had little influence on the results (GHGE and WFII was given equal weighting).

The single principle component provided each cafe option with a regression value denoted Environmental Impact Score (EIS). A higher EIS equated to a greater environmental impact. EIS data were then plotted against raw GHGE and WF estimates for each cafe option category (sandwiches, hot foods, snacks and beverage) using the ggplot2 plotting system in RStudio Inc. version 1.0.153 (2009-2017).

To address hypothesis H1b, all cafe option GHGE and WFII estimates were subsequently combined into a single dataset and a PCA performed to produce an overall EIS for each cafe option so that comparisons could be made across cafe option categories and intervention targets could be identified.

3.2.7 Exploration of nutrient quality of low impact and high impact choices

Nutritional information for each sandwich was provided in the product specification from the suppliers. For the rest of the cafe options, the Nutrient analysis software NetWISP V4.0 (Tinuviel Software, Warrington, England) was used. NetWISP consolidates the nutrient composition data from UK Office of Public Sector Information (OPSI): McCance and Widdowson's *The Composition of Foods* - 6th Edition (2002), 5th Edition and supplements (Food Standards Agency 2002). For cafe options comprising more than one ingredient, i.e. drinks made in-house, soups, baked potatoes with topping etc. the weight of each food ingredient was inputted as a recipe and the nutrient content of the final dish was computed. It was assumed that milk-based drinks were made using whole milk as that was the default option used by caterers to prepare drinks in-house. Recipe ingredients were selected as cooked. For example, for carrots included the soup recipes, 'old carrots boiled in salted water' was selected.

For pre-packaged drinks and snacks, the product was found in the NetWISP database and the serving weight of the product was inputted to calculate the nutritional information for that serving size. When a specific product did not exist in the database a nearest equivalent was used (e.g. Lucozade was used as a substitute for Red Bull).

The association between environmental impact and nutrient quality of cafe options was examined by exploring the relationship between EIS and eleven 'nutrients to encourage' and three 'nutrients to limit' that are derived from dietary recommendations and form the basis of the nutrient profiling technique described by Fulgoni *et al.* (2009). Nutrients to encourage included (protein, fibre, calcium, iron, vitamin A, C, E magnesium and potassium, vitamin B12, and zinc) and nutrients to limit were: saturated fat, sodium and Non-milk extrinsic sugars (NMES)³. These nutrients were the focus of the investigation as this combination has been found to predict the nutrient quality of diets particularly well. These nutrients under-represented in the US diet and include those of concern for specific populations groups, including women of child bearing age (Fulgoni *et al.* 2009). The relationship between EIS and energy density (calories per portion) was also explored to help understand the nutritional quality of options with a lower EIS score. The relationship between EIS and portion size was also considered to inform the development of intervention outcomes.

Scatter plots were generated to visualize the relationships between EIS and nutrients to encourage/limit and energy density. As the EIS were ranked data, Spearman's Rank Order Correlation was used to assess their relationship. Spearman's rho is a non-parametric test for use when data are not normally distributed, such as with nutrient contents. Rho values were interpreted as: a weak correlation was defined as $r=0.1-0.29$, a medium correlation as $r=0.30-0.49$ and a strong correlation as $r=0.5-1$ (Cohen 1988). SPSS V22.0 (SPSS Statistics, IBM, New York) was used for all statistical analyses.

³ Fulgoni et al (2009) measured added sugars in their assessment of nutrient quality. However, there is limited information on the added/ free sugars of food in the UK therefore the relationship between the NMES and the environmental impact score was explored instead.

3.3 Results: Environmental impacts of food and beverages sold in university cafes

3.3.1 Characteristics of cafe choices

Pre-packaged sandwiches comprised 11.3% total sales in university cafes between June 2014-July 2015. There were 101 sandwiches identified and sub categorised according to the protein source of the filling. (See Table 3-3). Poultry sandwiches (28.0%) comprised the largest proportion of the sandwich selection whilst vegetable/salad source protein sandwiches comprised the smallest (1.5%). There was a smaller range of sandwiches made on site in some of the cafes but they were excluded from the analysis, as they were not available in every outlet.

Hot foods comprised 2.6% of total annual sales July 2014-2015. Hot foods were labelled by meat type and variety comprising soups, baked potatoes with hot and cold fillings and hot-filling sandwiches (See Table 3-3). Most soups were vegetable based (n=15) with others containing meat and animal products (n=10). Most baked potatoes had fillings containing meat or animal products. Hot-filling sandwiches were mainly pork with one meat alternative option, Quorn. Vegetable soups comprised the greatest proportion of hot food sales, followed by baked potatoes with vegetable filling, and pork sandwiches. The hot food option that comprised the least amount of sales was the Quorn sausage sandwich.

Snacks comprised 15.4% of total annual sales for 2014-15. The snacks with the largest variety were the savoury snacks (crisps and popcorn) see Table 3-3. The most commonly purchased snack items were in the biscuit category (cookies, flapjack and cereal bars). The least popular snack choices were in the breakfast cereal category (porridge pots).

Beverages were the most popular item sold in the university cafes, comprising 46.3% of total sales. The most popular drinks were coffee (milk-based) drinks, with smoothies comprising the smallest proportion of total drink sales.

Table 3-3 Annual sales (July 2014-2015) of cafe food and beverage options by category

Label	No.	Description	Annual sales (no. sold)	% of total category sales
Sandwiches				
Poultry	23	Chicken, turkey	17435	28.0
Cheese & meat	13	Ham & cheese, bacon & cheese, mozzarella & pepperoni, brie & bacon	12436	20.0
Cheese (only)	20	Red Leicester, cheddar cheese, cream cheese, brie	10374	16.7
Pork	12	Bacon, ham, sausage	7264	11.7
Seafood	14	Tuna, prawn, salmon	5840	9.4
Beef	7	Roast beef, corned beef, chilli beef	3298	5.3
Mixed meat	4	Chicken & bacon, turkey & ham, chicken & chorizo	2860	4.6
Egg	6	Egg mayonnaise, Egg & veg	1861	3.0
Vegetables	2	Salad, hummus & veg	937	1.5
TOTAL	101		62,305	
Hot food				
Vegetable soup	15	Butternut squash, tomato and basil, Red Pepper & tomato, Thai Veg, carrot & coriander, spiced carrot, spiced parsnip & honey, cream of tomato, wild mushroom, leek & potato, minestrone, highland	9447	19.7
Baked potato with veg	2	BP with beans, coleslaw	8024	16.7
Baked potato with cheese	2	BP with cottage cheese, BP with cheddar cheese	7449	15.5
Pork sandwich	2	Bacon Sandwich, Sausage sandwich	6418	13.2
Baked potato with fish	2	BP with tuna mayo, BP with Tuna	5655	11.8
Baked potato with Beef	1	BP with beef chilli	4477	9.3
Chicken soup	5	Cock a Leekie, Chicken & veg, creamy chicken	3345	7.0
Beef soup	1	Beef goulash soup	1722	3.6
Pork soup	3	Lentil & bacon, tomato & pancetta, pea & ham,	1345	2.8
Lamb Soup	1	Scotch broth	45	0.1
Meat substitute sandwich	1	Vegetarian sausage (Quorn) sandwich	1	0.0
TOTAL	35		47,928	
Snacks				
Biscuit	5	Cookie, flapjack, cereal bars	114,065	45.5
Fruit, general	6	Apple green, apple red, banana, orange, pear, plum, dried mixed fruit	50,573	20.2

Savoury snacks	13	Crisps, popcorn	40,365	16.1
Cakes	3	Muffin	12,916	5.2
Pastries	2	Croissant, chocolate croissant	12,603	5.0
Nuts and seeds, general	3	Mixed nuts, fruit & nuts, yoghurt peanuts	8,184	3.3
Chocolate confectionery	5	Chocolate bar, chocolate raisins	6,742	2.7
Non-chocolate confectionery	1	Bagged sweets	2,331	0.9
Breads	2	Toast	1,576	0.6
Breakfast cereal	3	Porridge	1,114	0.4
TOTAL	43		250,469	
Beverages				
Coffee (milk-based)	9	Cappuccino, latte	225232	29.5
Coffee (water-based)	6	Americano, espresso, macchiato	122064	16.0
Soft drink	14	Coca-Cola, Diet Coke, Sprite, Sprite Zero, Fanta, Fanta Zero, Cherry Coke, Glaceau Multi V, Glaceau Power C, Glaceau Triple X, Oasis Light Summer Fruit, Oasis Mango Medley, Oasis Summer Fruit, Red bull	95287	12.5
Bottled water	3	Life Water Still, Life Water Sparkling, Life Water Sport Cap	95061	12.4
Other (milk-based)	24	Frappe latté, Mocha Frappe latté, Salted Caramel Frappe latté, Strawberry Crème, Caramel Crème, Hazelnut Crème, Hot Milk Steamer, Pint of Milk, Chi Latte, Hot chocolate, Mocha	90941	11.9
Tea	8	Yorkshire Tea, Earl Grey, Organic Green tea, Peppermint tea, Redbush tea, Wild Berry tea,	85381	11.2
Fruit juice	4	Apple juice, Orange juice, Freshly Squeezed, Tropicana smooth	40390	5.3
Smoothie	8	'Grape Escape', 'Berry Burst', 'Tropical Bliss', 'Perfect Day'	10109	1.3
Total	76		764,465	
BP-baked potato				

3.3.2 Comparison of environmental impacts, weights and energy of food categories

Table 3-4 outlines the range and mean GHGE, WFII, pack weights and energy content of the cafe choices by cafe option category. The sandwich category had the greatest mean GHGE; the snack category had the lowest. The beverage category had the greatest mean WFII; the hot food had the lowest WFII. Overall the range of GHGE estimates was greater than the range of WFII estimates across all categories. (See.5 for the GHGE and WFII data of every cafe option per portion/serving in each cafe option category.)

Table 3-4 Greenhouse gas emissions, water footprint impact indicators, pack weight, energy value (minimum, maximum, range, mean and standard deviation) and portion/serving size of cafe choices by category.

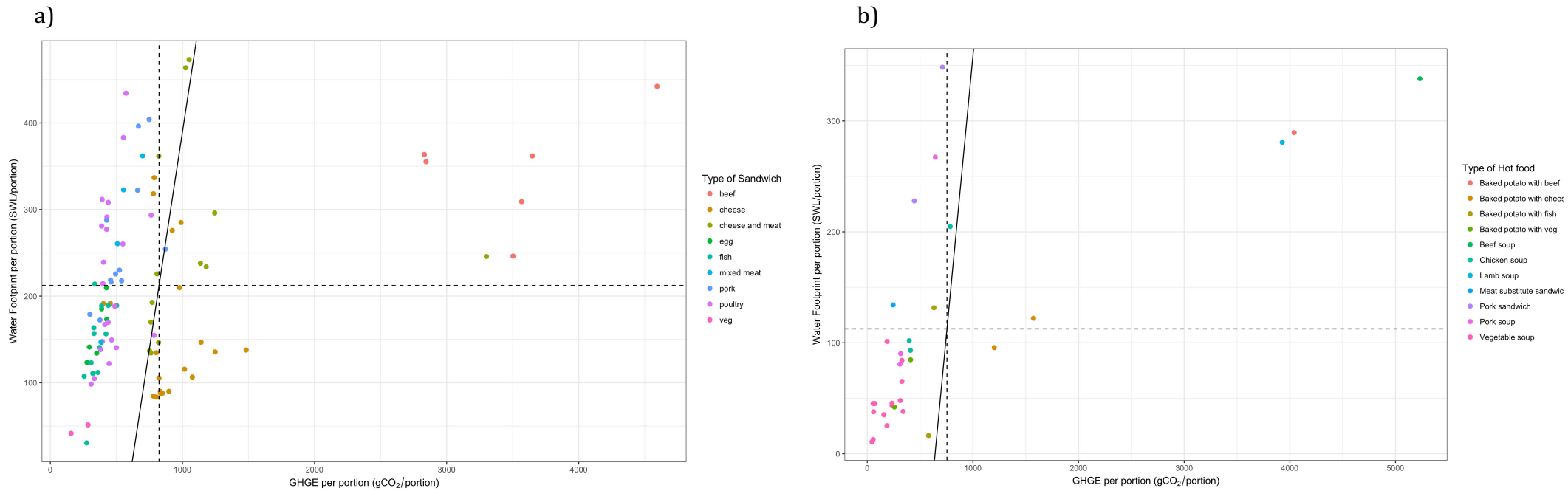
	Sandwiches (n=101)		Hot Food (n=34)		Snack (n=43)		Beverages (n=76)	
	Min-Max (range)	Mean (SD)	Min-Max (range)	Mean (SD)	Min-Max (range)	Mean (SD)	Min- Mix (range)	Mean (SD)
Greenhouse gas emissions (gCO ₂ e/portion)	156.8 -4593.2 (4436.4)	823.0 (817.9)	44.9- 5230.5 (5185.6)	754.6 (1209.2)	11-219.3 (208.3)	89.8 (55.7)	6- 959 (953)	418.3 (293.2)
Water footprint impact indicator (SWL/portion)	30.5- 473.1 (442.5)	212.3 (100.4)	10.7 -348.5 (337.8)	112.6 (97.8)	32.9- 895.3 (862.4)	205.8 (244.9)	0-936 (936)	239.4 (215.1)
Portion size (g/portion)	118- 250 (132)	167.3 (33.0)	138- 520 (382)	299.4 (62.4)	20-210 (190)	75.9 (43.7)	22-750 (728)	435.2 (131.4)
Energy (kJ/portion)	763- 2780 (2017)	1581.5 (470.0)	240- 2217.0 (1977)	944.3 (587.4)	132 - 2563 (2431)	1087.9 (576.1)	0-2760 (2760)	932.2 (829.4)

3.3.3 Environmental impact scores and rankings

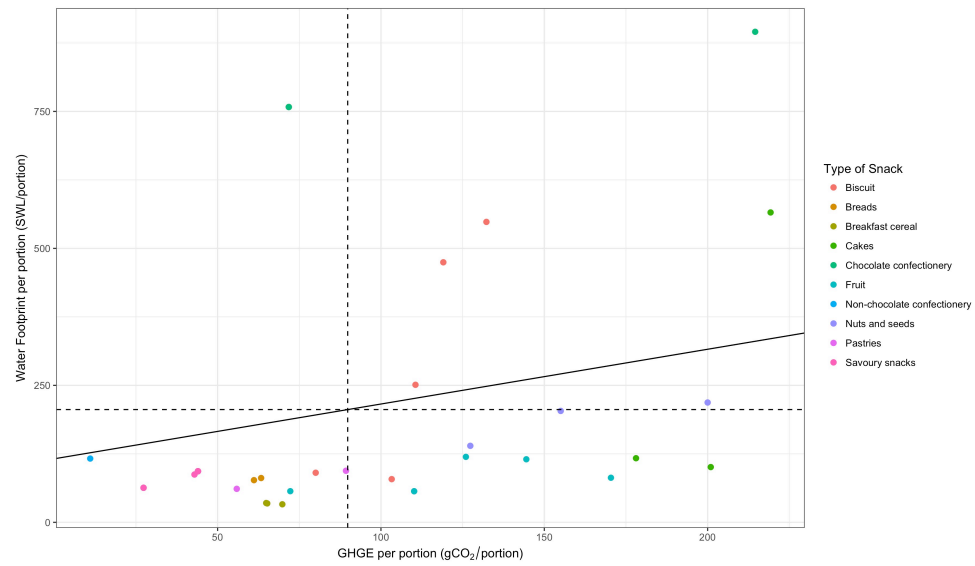
Figure 3-1 illustrates the relationship between GHGE and WFII estimates per portion/serving of a) sandwiches, b) hot food, c) snacks and d) beverages. The solid line of the graphs represents the first principle component extracted by PCA, i.e. the strongest pattern between these two correlated variables. The dotted horizontal and vertical lines on the graphs represent the mean score for GHGE and WFII. Data points in the top right hand quarter record high values for both GHGE and WFII, whilst data points in the bottom left hand quadrant record low value for both GHGE and WFII. (See Appendix A5 for the EIS score of each cafe option in each category ranked from lowest to highest.)

Figure 3-1 Relationship between GHGE and WFII estimates of a) sandwiches b) hot food options c) snacks d) beverages.

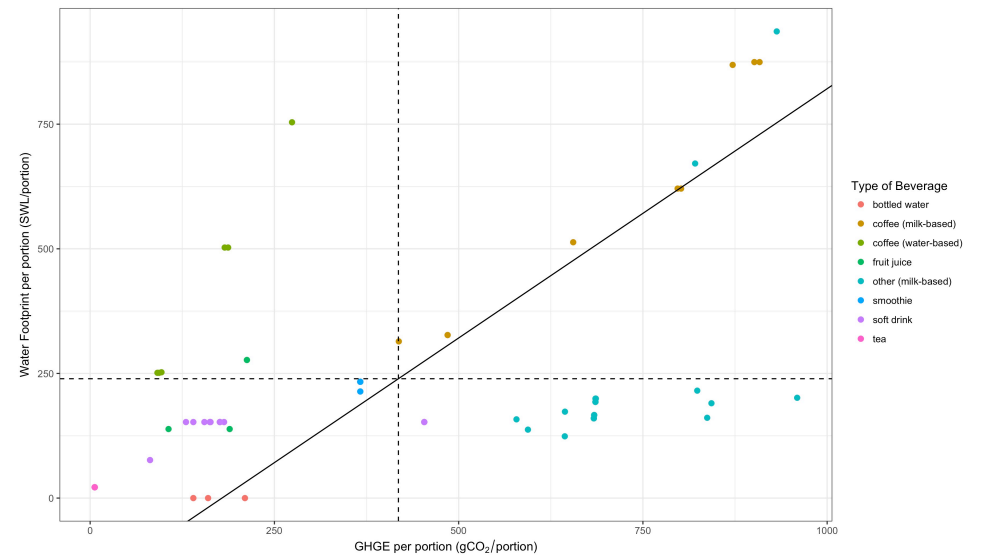
The dashed lines are the mean values of GHGE and WFII respectively. The solid black line is the principle component extracted and represents the EIS score. This accounts for 74% of the variance the total variance in of the PCA of the sandwich graph (a) 85.2% of the total variance in the PCA of hot food (b) 65.9% of the total variance in the PCA of the snacks (c) and 65.9% of the total variance of the PCA of the beverages (d).



c)



d)



The variation in GHGE values associated with different sandwiches was approximately 30-fold, whereas WFII values that varied 15-fold. This suggests that sandwiches substantially differ both in terms of their GHGE, and WFII, with the former showing the greatest variation. The variation in GHGE values associated with different hot meals was large (1209 gCO₂e/portion) as was the variations of WFII values (std. deviation, 97.4 SWL/portion). The variation in GHGE values associated with different snacks was only 20-fold. Similarly, the variation of WFII was only 27-fold. The variation in GHGE estimates associated with different beverages was less (160 fold) than the variation in WFII estimates (1291-fold). This suggests that beverages substantially differ both in terms of their global warming potential, and their water footprint, with the latter showing the greatest variation.

Cafe options in the top right quadrant of the graphs are those that had a high GHGE and high WFII. 'Beef' and 'corned beef' sandwiches had the greatest GHGE, considerably more than any of the other sandwiches. 'Beef' sandwiches also had a relatively high-water footprint. However, the WFII of 'beef' sandwiches is comparable to some of the 'pork' sandwiches; the 'pork' sandwiches with the highest water footprint were 'ham and egg', 'ham salad' and 'ham and honey mustard'. Hot options with the greatest GHGE and WFII were the 'Beef' soup, baked potato with 'beef' and 'lamb' soup and baked potato 'with cheese'. These options had much greater GHGE than all the other hot food options, but had a similar water footprint to 'bacon' and 'sausage' sandwiches. Snacks with the greatest GHGE and WFII values were 'chocolate confectionery' and 'biscuits'. The 'chocolate raisins' and 'chocolate muffins' had the greatest GHGE overall, the 'chocolate cookies' had GHGE comparative to some of the 'non-chocolate confectionery' but had high water footprints. Drinks with the greatest GHGE and WFII were the large 'coffee milk-based' drinks (latte, cappuccino) and 'other milk-based' drinks (mochas).

Cafe options in the top left quadrant of the graph are those that had a comparatively lower GHGE but high WFII. Most sandwiches in this quadrant have a similar GHGE value though there is a large variability in the WFIIs. It appears that 'pork' sandwiches have the highest WF followed by 'poultry', then 'cheese and meat' sandwiches. In the hot food category, hot 'sausage' and 'bacon' sandwiches, 'pea and ham' soup and 'Quorn sausage' sandwich. The 'Quorn sausage' sandwich

had a low GHGE and WFII much lower than the pork options, comparative to that of a baked potato with 'tuna mayonnaise'. Snacks with low GHGE but high WFII scores were the 'chocolate confectionery' (chocolate bars). Beverages with a relatively low GHGE and high WFII are the 'Coffee water-based' drinks (Americano etc.)

Options in the bottom right quadrant of the graphs are those associated with a comparatively high GHGE but low WFII. Most sandwiches in this quadrant tended to be 'cheese' or 'meat and cheese' sandwiches. Hot meals with high GHGE but comparatively low WFII are baked potatoes 'with cheese' filling. The GHGE associated with this option was still much less than for the options containing beef. Snacks with a relatively high GHGE and low WFII were the 'nuts and seeds' and 'fruit' subcategories. Beverages with a relatively high GHGE and low WFII are the 'other milk-based' drinks (frappe lattes, crème).

The bottom left quadrant of the graphs indicates cafe options that had the lowest GHGE and lowest WFII. Sandwiches in this quadrant were 'fish', 'egg' and 'poultry' sandwiches and 'vegetable based' sandwiches (plain salad sandwich, roast vegetable and hummus have the lowest score.) Most hot food options are in the bottom left-hand quadrant indicating most have a low GHGE and WF. The hot food graph shows predominantly 'vegetable' soups, some 'chicken' soups and baked potatoes 'with baked beans' or and 'tuna' toppings. In the bottom left quadrant, with the lowest GHGE and WF, were 'non-chocolate confectionery' (bagged sweets) and 'bread' (toast) and 'savory snacks' (popcorn and crisps). Beverages with the lowest GHGE and lowest WFII were 'bottled water', 'tea', 'soft drinks' and 'fruit juices'.

Table 3-5 provides an overview of overall environmental impact score of cafe choices by cafe option category. The EIS were calculated from a PCA of cafe options when all the categories were combined. Cafe options are grouped into quintiles based on the number of option in each category. (See Appendix A6 for rankings of all cafe options based on the overall EIS scores.)

Table 3-5 Description of food choice in each environmental quintile of Environmental Impact Score ranking

Product Category		Lowest environmental impact score (Most EF)	Moderate impact score			Highest environmental impact score (Least EF)
		Q1	Q2	Q3	Q4	Q5
Pre-packed sandwiches	EIS	-1.50 to -0.72	-0.71 to -0.46	-0.44 to -0.15	-0.15 to 0.46	0.53 to 4.11
	Description	Vegan options, low calorie (tuna, turkey), eggs	Tuna, prawn, chicken, eggs	Chicken, ham, bacon	Cheese, ham, bacon, sausage,	Ham, cheese & meat, beef
Hot food	EIS	-0.88 to -0.69	-0.68 to -0.56	-0.45 to -0.26	-0.21 to 0.54	0.54 to 3.31
	Description	Vegetable soups	BP with coleslaw, BP with tuna,	Tomato soups, BP with beans	Lentil & bacon soup, chicken & veg soup, Quorn sausage sandwich, BP with cheese	Bacon sandwich, chicken soup, sausage sandwich, Scotch broth, BP with beef chilli, beef goulash soup
Hot/cold drinks	EIS	-1.35 to -0.78	-0.75 to -0.198	-0.198 to 0.14	0.25 to 0.38	0.39 to 3.40
	Description	Tea, 250ml cans ³ /bottles, bottled water	500ml bottles, small coffees	Regular, large smoothies	Frappe lattes, Crème drinks	Large, hot milk-based drinks (mochas, lattes, cappuccinos)
Snacks	EIS	-1.10 to -0.79	-0.79 to -0.66	-0.64 to 0.18	0.25 to 1.00	1.19 to 3.11
	Description	Sweets, popcorn, crisps	Crisps, pastries, porridge	Toast, apples, plums, oranges, cereal bars	Pears, bananas, dried fruit, cookies, muffins	Chocolate bars, nuts, chocolate cookies, chocolate muffins, chocolate raisins

Choices in each category were ranked highest to lowest ranking then divided into quintiles. Options in Q1 have the lowest environmental impact score; options in Q5 have the highest environmental impact scores. EF, Environmentally Friendly. BP, Baked Potato 'Cheese & meat' sandwiches were predominantly ham and cheese or bacon and cheese.

3.3.4 Results: correlational analysis of the Environmental Impact Score and nutrient profile of cafe options

The nutrient content of cafe options by subcategory is available in Appendix A7-A10. Table 3-6 outlines the results of the correlational analysis of EIS with energy and nutrient content of foods in each cafe option category.

Table 3-6 Relationship between Environmental Impact Score and energy and nutrient content of cafe options by category

Per portion	Spearman's correlation coefficient				
	Sandwiches (n=101)	Hot meals (n=34)	Snacks (n=43)	Beverages (n=76)	All categories (n=254)
Nutrients to encourage					
Protein (g)	0.449**	0.621**	0.361*	0.826**	0.550**
Fibre AOAC (g)	0.084	-0.127	0.145	0.061	0.050
Iron (mg)	0.441**	0.549**	0.396**	0.363**	0.330**
Calcium (mg)	0.150	0.209	0.573**	0.773**	0.578**
Potassium (mg)	0.285**	0.152	0.126	0.610**	0.307**
Magnesium (mg)	0.009	0.412*	0.199	0.624**	0.282**
Vitamin A, Retinol (µg)	No data	-0.116	0.267	0.752**	0.356**
Vitamin C (mg)	No data	-0.056	-0.309*	0.205	0.093
Vitamin E (mg)	No data	-0.119	0.009	0.467**	-0.074
Vitamin B12 (mg)	No data	0.500**	0.298	0.758**	0.585**
Zinc (mg)	No data	0.691**	0.437**	0.748**	0.519**
Nutrients to limit					
Fat of which saturated (g)	0.374**	0.398*	0.342*	0.788**	0.540**
NMES (g)	0.443**	-0.231	0.371*	0.086	0.296**
Sodium (mg)	0.666**	-0.140	-0.403	0.750**	-0.048
Energy (kJ)	0.493**	0.407*	0.318*	0.583**	0.514**

*Statistically significant (P<0.05), **Statistically significant (P<0.001) † NMES, Non-Milk Extrinsic Sugars. A weak correlation was defined as r=0.1–0.29, a medium correlation as r=0.30–0.49 and a strong correlation as r=0.5–1

In the sandwich category, there was a moderate positive correlation between EIS and energy. With regards to nutrients to encourage for health there was a weak correlation between EIS and potassium, a moderate correlation between EIS and

protein and iron. There was no correlation with fibre, calcium or magnesium. With regards to nutrients to limit, EIS was strongly positively correlated with sodium, moderately correlated with saturated fat and NMES content.

In the hot meal category, there was a moderate positive correlation between EIS and energy. Regarding nutrients to encourage, there was a strong positive correlation with protein, iron, vitamin B12 and zinc. There was a moderate correlation between EIS and magnesium, but none of the other nutrients to encourage. Regarding nutrients to limit, EIS was moderately correlated with saturated fat but not with sodium or NMES.

In the snack category, there was a moderate correlation between EIS and energy content. Regarding to nutrients to encourage, there was a strong correlation between EIS and calcium content, moderate correlation between EIS and protein, iron, vitamin C and zinc. There was no correlation with other nutrients to encourage. With regards to nutrients to limit, there was a moderate correlation with saturated fat and NMES content but not sodium.

In the beverage category, there was a strong correlation between EIS and energy. With regards to nutrients to encourage, there was a strong positive correlation between EIS and protein, calcium, potassium, magnesium, vitamin A, vitamin B12 and zinc. There was a moderate correlation between EIS and iron and vitamin E. There was no correlation between EIS other nutrients to encourage. Regarding, nutrients to limit, EIS was strong positively correlated with saturated fat and sodium but not with NMES content.

Sandwich EIS was also positively correlated pack weight, ($Rho= 0.551$, $p<0.001$). Hot food EIS was not correlated with portion size, $Rho=-0.129$, ($p=0.469$). Snack EIS was positively correlated with snack weight, ($Rho= 0.551$ ($p<0.01$) but not correlated with beverage serving size ($Rho= -0.10$. $p=0.933$).

The overall EIS score, produced when cafe options were ranked together, was strongly correlated with all nutrients to encourage (apart from fibre, vitamin A and vitamin C.) Overall EIS was also positively correlated with saturated fat and NMES content but not sodium.

3.4 Discussion

This study calculated the environmental impacts and nutrient content of popular university cafe choices. It used a novel approach to combine GHGE and WFII to create an environmental impact score for each product. The EIS was then used to identify cafe choices with the greatest and lowest environmental impact, thus potential intervention targets. EIS was also used to explore the relationship between environmental impact and the nutrient quality of cafe choices to highlight any implications that choosing low impact options may have on nutrient intake.

3.4.1 Principle findings in relation to the literature

The results of this study support hypothesis that cafe options containing meat and or animal products have the highest EIS. Sandwiches and hot foods containing beef and or cheese, snacks containing chocolate and milk-based beverages ranked higher than other options in the categories. Furthermore, there was a clear gradient in sandwich and hot food EIS scores according to meat type with beef having the greatest impact followed by lamb, pork and then chicken. For the categories that did not contain meat, there was a gradient with dairy content. Snacks containing large amounts of milk chocolate had the greatest EIS whereas those without chocolate were much lower (crisps, popcorn and sweets).

The results of this study do not support the hypothesis that snacks have the lowest environmental impact compared to sandwiches, hot foods and beverages. The results indicate that there was no single cafe option category that dominated the highest or lowest EIS ranking. Milk containing beverages such as lattes and mochas ranked as highly as beef sandwiches, as did some of the chocolate confectionary snacks and hot meals containing beef. Similarly, cafe options which ranked lowest in terms of their EIS were beverages; such as tea, water and soft drinks, savoury snacks; such as crisps, popcorn and sweets and fruit, hot meals; such as vegetable soups and sandwiches with vegetable fillings. Beverages and snacks containing milk chocolate had a similar EIS to the beef sandwiches and dishes containing beef or lamb. This suggests that meat should not be the only focus of strategies to reduce environmental burden. To reduce environmental impact of food consumption on campus it is necessary to target multiple cafe options across a range of cafe option categories, i.e. sandwiches, hot food options snacks and beverages.

The findings of this study align with literature which indicates that foods containing meat and or animal products have the largest environmental impact (Chen *et al.* 2016; Fisher *et al.* 2013; Roy *et al.* 2009; Tesco Ltd 2012). Chen *et al.* (2016) measured the GHGE, land and water use associated with the meals served in a university cafeteria and found that meals containing beef and cheese had the greatest environmental impacts whilst the vegan dish required the least amount of water and land. This is because livestock production carries the highest environmental burden (Steinfeld 2006; Gerber *et al.* 2013). Consistent with the findings of Chen *et al.* (2016), this study found that the differences in EIS of cafe option to reflect the different livestock types (de Vries & de Boer 2010; Gerbens-Leenes *et al.* 2013; Herrero *et al.* 2015; Mekonnen & Hoekstra 2010). The GHGE value of bovine meat used in these calculations was relatively high, (68.8kgco_{2e}/kg) which is almost 10 times higher than other meat commodities such as pigmeat (7.9kgCO_{2e}/kg) and poultry (5.3 kgCO_{2e}/kg) (Audsley *et al.* 2010). The water footprint values also differed between different types of meat (beef had a value of 4313 litre/kg, pork had a value of 3672 litres/kg and poultry had a value of 1485 litre/kg) (Mekonnen & Hoekstra 2010).

Ruminant animals are known to have the greatest environmental impacts due to low feed conversion rate (Steinfeld 2006). On average 8.6kg of feed is required to produce 1kg of bovine meat, whereas poultry only require 2kg of feed to produce 1kg meat (Audsley *et al.* 2010). More natural resources and land are required to produce bovine meat; the production of which is also associated with higher levels of GHGE from the release of methane during ruminant digestion. A systematic review of the environmental impact of dietary change scenarios noted that replacement of ruminant meat by poultry and pork could reduce the GHGE by up to 35% (Hallström *et al.* 2015). Furthermore, it has been suggested that replacement of 75% of ruminant meat with pork and poultry in UK diets can reduce the land demand by 40% (Audsley *et al.* 2010). Together these findings suggest that these gradients in environmental impact by meat type ought to be countenanced when developing interventions to encourage environmentally friendly food choices. These results suggest that it is not necessary to avoid all meat choices to reduce the environmental impact of lunchtime meal.

This study has revealed the important contribution that dairy products make to the overall environmental impacts of a food or beverages, which is consistent with

the findings of others (Werner *et al.* 2014). The study by Chen *et al.* (2016) found food dishes in the university cafeteria containing cheese had impacts 2-12 times greater than other dishes that contained chicken or eggs, which were comparable or lower than plant-based ingredients. Cheese is often used as a substitute for meat, and most of the vegetarian sandwiches available in the university cafes contained cheese. Espinoza-Orias *et al.* (2018) investigated the carbon footprint of a selection of sandwiches and found that egg sandwiches had a lower GHGE compared to the others containing cheese. The results of these studies suggest that substituting beef and lamb options with lower impact protein sources such as chicken instead of cheese would be more environmentally beneficial. Furthermore, studies examining the environmental impact of snacks and beverages also noted that those that were predominantly plant-based (crisps and sweets) had a lower environmental impact compared to those which contain milk (Nilsson *et al.* 2011; Smedman *et al.* 2010).

This study has also revealed that some plant-based ingredients can have important environmental impacts, particularly with regards to water use. Milk-based drinks containing coffee and cocoa had a higher EIS score than those containing only sugar. This is partly because these plant ingredients originate from countries with high levels of water scarcity. This indicates that whilst meat and animal products do require large amounts of water, other plant foods also use large amounts of water in their production and can carry a larger water footprint depending upon the region and agricultural processes involved (Jalava *et al.* 2014). This highlights the importance of clarity around food supply chains, as it is the countries of origin that are important for understanding the extent of the environmental impact.

The results of the correlational analysis between EIS and nutrient content provides some support, but not full support for hypothesis 2a, (that low impact options are associated with lower nutritional quality), and hypothesis 2b, (that high impact option options have higher nutritional quality). There was a positive relationship between EIS and nutrients to encourage for health. EIS was positively correlated with protein, thus choosing lower impact products could reduce intakes of essential amino acids which could have implications for health depending on the broader diet. EIS was also positively correlated with calcium (beverages, snacks), iron and vitamin B12 (hot foods, beverages), which have important physiological roles in bone strength, oxygen transportation and DNA synthesis, respectively.

However, this study indicated that cafe options with a lower environmental impact score also contained lower amounts of nutrients to limit for health. The results of the correlational analysis revealed that there was a positive correlation between sodium (sandwiches and beverages), saturated fat, and NMES (sandwiches and snacks only). These findings therefore do not necessarily support the hypothesis that cafe options with a high environmental impact have a higher nutritional quality.

EIS was positively correlated with portion size of sandwich, hot meal and snacks. Choosing smaller portions of these cafe choices may also reduce nutrient and calorie intakes. Size of beverage was not correlated with EIS, which suggests that it is the type of drink, more specifically whether it contains milk, which determines the extent of its environmental impact. There was no relationship between EIS and NMES content of beverages because sugar has a low environmental impact score compared to milk. Choosing a milk-based drink over a sugar sweetened beverage is more advantageous for health but less environmentally friendly. Similarly, fruit had a comparatively high EIS compared to other foods in the snack category, thus choosing a bag of crisps over a banana would more advantageous for the environment but less so for health. Together these findings highlight possible tensions between nutritional quality and environmental sustainability of food choices. Strategies to overcome these tensions will need to be employed when developing an intervention to encourage healthy and environmentally friendly food choices.

This study revealed that cafe options with lower environmental impacts contained fewer calories and nutrients, both those to limit and encourage for health. The results of this study are consistent with others which found that foods and beverages associated with low GHGE contained fewer nutrients whilst foods with higher GHGE were more nutrient dense (Drewnowski *et al.* 2015; Masset *et al.* 2014; Smedman *et al.* 2010). However, unlike Drewnowski *et al.* (2015) this study revealed a positive correlation between calorie content and EIS indicating that low impact choices were less energy dense. This discrepancy is perhaps because this study focussed on a small selection of cafe options per portion, whereas Drewnowski compared a broad range of food groups that have more varied nutrient and energy profiles per 100g. Although Drewnowski and colleagues only considered the environmental impact in terms of GHGE, our study accounting for

water use, still supports their conclusion that choosing food with a lower environmental impact may affect nutrient intakes and that consideration of the environmental impacts of foods ought to be linked to concerns about nutrient density and health. Finding the point at which the environmental impact of nutrient dense foods is offset by their nutritional value should be a priority area for research (Drewnowski *et al.* 2015).

Whilst only a small sample of cafe options was examined in this study, the findings suggest that choosing foods with low GHGE may reduce intakes of calories, saturated fat and NMEs, which have health benefits. As 69% of the UK adult population are not consuming the recommended five portions of fruit and vegetables a day (Roberts *et al.* 2018), interventions to encourage the consumption of more low impact plant-based food may help to achieve this. Furthermore, avoiding cafe options with red meat may also help customers adhere to the NHS dietary guidelines for health in so far as moderating the consumption of red and processed meat to lower colorectal cancer risk. However, these choices may also lower intakes of micronutrients, particularly calcium and vitamin B12, which may raise concerns for those in the population susceptible to micronutrient deficiencies. For example, pre-menopausal women are susceptible to iron deficiency anaemia. The results of this study highlight the importance of ensuring that interventions that strive to reduce the environmental impacts of food choices do not adversely affect micronutrient intakes. It is therefore important to ensure that the low impact options promoted, have a comparatively good nutritional profile for health. It poses an important challenge to policy makers, when developing consumer messaging around healthier and low environmental impact options.

3.4.2 Methodological strengths

A key strength of this study is the approach taken to measure the environmental impact of cafe choices by combining GHGE and WFII estimates. The large variation in the residual values of GHGE and WFII suggests that using GHGE or WFII alone is insufficient to provide a holistic view of the environmental impact. To focus on GHGE alone would lead to an intervention that focussed on avoiding meat, specifically beef and lamb and choosing more plant-based foods. To focus on WFII alone, the intervention would focus on avoiding cafe choices that combine milk, chocolate and coffee (mochas, hot chocolate and lattes) since they have a considerably high water footprint. Combining GHGE and WFII parameters was

therefore a useful strategy to give an overall indication of the environmental impact of cafe choices. It allowed further analysis of the association between environmental impact and nutrient quality of these choices, an important consideration when developing an intervention to encourage healthy and EF food consumption. Having a single scoring system helped to simplify the complex interaction between environmental impact parameters, which proved useful when identifying which foods should form the intervention targets. It would also be useful when communicating food environmental impact messages to customers helping to reduce the number of trade-offs customers would otherwise be presented with at point-of-choice.

The EIS was calculated based on GHGE and WFII estimate per portion which is potentially the most helpful way to compare the environmental impact of cafe options, rather than by weight (g) or energy (kcal), which can dramatically influence the interpretation of results (Drewnowski *et al.* 2015). Presenting the information per portion is most useful for identifying lower impact options amongst different cafe option categories.

3.4.3 Methodological limitations

A top-down approach was used to calculate the GHGE and WF of cafe options. Datasets of food commodities weighted by trade at a national level and the water footprints of food consumed in UK supermarkets were used. This limits the accuracy of the estimates, as they do not account for the type of agricultural production method used. Production methods can have a large influence on the magnitude of the environmental impacts (Poore & Nemecek 2018). A recent meta analysis revealed that organic systems can use more land cause more eutrophication but use less energy than conventional systems per unit of food produced (Clark & Tilman 2017). Agricultural production methods are closely linked to the region of the world in which the food is produced. For example, the GWP of lamb produced in Australia and New Zealand is almost half that of lamb produced in the EU due to differences in production practises (Clune *et al.* 2015). As it was not possible to trace the supply chains of each food and beverage product in the cafe it was not possible to calculate a more accurate indication of the true environmental impact. This study attempted to overcome this by ensuring the data most closely reflected various the agricultural processes in the regions of the world the food items originate.

The GHGE estimates used to calculate the GHGE of the cafe food did not include the full life cycle of either foods or commodities; rather they estimated the GHGE from the earliest stages of production to the retail distribution centre. They therefore do not include impacts arising from the processing, transport, cooking, storage or waste processing of these items. Despite failing to account for the environmental impacts occurring throughout the products entire lifecycle, generally the agricultural phase of the food products lifestyle is known to have the greatest environmental impacts of all stages. Espinoza-Orias & Azapagic (2018) found that the agricultural production of the sandwich ingredients contributed the most (37.3-67.1%) to the total carbon footprint of the sandwich, though the preparation and refrigeration during the retail stages were also significant, 13.1-24.6% and 12.4-24.2%, respectively. It can be argued that these data provide a good indication of the relative environmental impacts of these products, even though the values are inaccurate. It is the ranking of the cafe choices in relation to each other that has the greatest application in this study. Chen *et al.* (2016) included the provenance and transport in the calculations of the environmental impacts of cafeteria dishes. They found that locally procured items were not necessarily those with the lowest emissions, and that country of origin of the meal ingredients explained the overall impact more so than the mode of transport or the method of production. This further reiterates the importance of considering the full supply chain of products when calculating the environmental impacts of foods.

As the GHGE values for beverages were calculated from multiple LCA datasets that have different system boundaries, there are inconsistencies in the accuracy of the values calculated, which could have affected the overall rankings of the beverages in relation to each other. Some of the drinks that were based on Scarborough *et al.* 2014 data alone (which had a smaller system boundary) were an underestimation of the total GHGE arising during the full life-cycle of the product. Furthermore using an average of the values for drinks where there were multiple sources will have introduced further error in the calculations. This may have led to ranking these drinks lower than others that were based on datasets with a broader system boundary, or an average value. Nevertheless, most of the drinks that included GHGE data from LCA studies with a greater system boundary (bottled soft drinks and fruit juices) still ranked lower than those based on GHGE values from LCA

studies comprising a smaller system boundary (coffee and milk-based drinks). This lends further support to the notion that it is the agricultural phase of a products life that underpins the overall environmental impact. In light of this, inconsistencies in the system boundaries of GHGE data are likely to have affected the accuracy of the values calculated for emissions arising from specific beverages but are unlikely to have affected the overall ranking of the beverages in relation to each other.

Similarly, is plausible that some of the beverages may not have ranked as highly as some of the food options had the dataset used to calculate food GHGE included emissions arising from the later stages of the life-cycle. However, since emissions arising in these latter stages of the product's life cycle contribute less to the overall impacts arising from the agricultural phase, it is unlikely to have affected the overall ranking of the products in relation to each other. Nevertheless, future studies ought to ensure that LCA data include GHGE arising from all stages of the lifecycle to ensure more accurate measurements and give more confidence to the overall ranking of different types of product in relation to each other.

Another limitation is that there were no GHGE estimates for drinking (tap) water in the dataset of (Scarborough *et al.* 2014). In the calculations of beverages and hot meals a value was taken from a government report which calculated the overall water supply system of the UK (Reffold *et al.* 2008). This value was included in the study but the extent to which value is comparable with the other methods used is unclear. Nevertheless, the value for water used was very small therefore it was unlikely to have had a major effect on the overall rankings of cafe choices by EIS.

The GHGE for the ingredients of the sandwiches were only approximate, and in many cases equivalent values were used in the calculation. For example, there was only one GHGE value available for bread, thus the value calculated by Scarborough *et al.* (2014) for white bread was also used for wholemeal, tortilla wraps and paninis. The closest approximate food was decided by FG, which introduced a level of subjectivity into the calculations. Similarly, the value for 'pigeat' was used for 'ham' and 'bacon' sandwiches; realistically there are likely to be different GHGE associated, arising from the processing and manufacturing of these different foods. Nevertheless, the published data (Audsley *et al.* 2010) has provided the most comprehensive list of GHGE parameters of food items consumed in the UK to

date (Macdiarmid *et al.* 2012). Until further data are available for more food products, including processed foods, such calculations will remain flawed.

The WFII data used in this investigation included water used in the packaging, production and manufacture of the finished supermarket products. These values therefore provide a greater indication of the overall water footprint of the products compared to the GHGE data. Furthermore, water footprint values are available for a wider range of ingredients, which enables more precise scrutiny of the water footprint of cafe option ingredients. For example, a water footprint value was available for canned meat products, which that meant that 'corned beef' sandwiches were distinguishable from 'roast beef' sandwiches in our analysis. The corned beef sandwiches had a higher water footprint value suggesting that processing of meats incurs additional environmental impact. However, more data would be required to explore this hypothesis further.

On the other hand, the WFII data are limited, since they do not include a value for 'fish' or 'seafood'. Thus, the values for the sandwiches containing 'seafood' (i.e. tuna and prawn) are unrealistic. The reason for this is because there is no suitable water data or proxy available for the water used in the processing and manufacture of fish products at present (Fisher *et al.* 2013). It is therefore critical that the conclusions made with respect to the environmental impact of 'seafood' sandwiches are made with caution. Similarly, there was no WFII value for tap water so the WFII of beverages are an under estimation. The use of import data to determine the locations where the products were last traded will have introduced error as it is possible that this is not the same country where it was produced. Fisher *et al.* (2013) suggest that this may be particularly pertinent for fruit juices and processed foods. This lends further support for the need to improve the transparency of supply chains in order to be able to calculate environmental impacts of specific products accurately.

Although there is an immeasurable amount of uncertainty in the accuracy of the environmental impact of the cafe choices, there is no reason why the errors should systematically differ across foods (Berners-Lee *et al.* 2012). It is therefore possible to compare the environmental impact values even if the absolute values are in error. Ranking food and beverages by EIS had the greatest application in this study as enabled one to identify cafe options that are least and most environmentally friendly, thus informs intervention target development.

Only two environmental impact parameters were included in the calculation of the EIS of cafe options in this study. Whilst this provides a broader sense of the environmental impact, additional impact parameters should be included to better understand the relationship between environmental impact and nutrient content of food. For example, land use change, biodiversity loss and eutrophication potential. However, full life cycle assessment data that provide indicators of specific foods as consumed is limited.

3.4.4 Implications for intervention development in this thesis

Based on the EIS of cafe choices, an intervention should be designed to increase the consumption of sandwiches and hot meals containing vegetable, poultry and fish and reduce the consumption of cafe options containing beef, lamb and cheese. (See Chapter 5 for detailed explanation of intervention outcome development). Chicken sandwiches were the most popular option in the sandwich category comprising 28% of the sales followed by 'cheese and meat' and 'cheese only' sandwiches. The 'cheese and meat' sandwiches had a relatively large EIS, therefore intervention designed to reduce the consumption of these choices may offer promising environmental gains.

Since smaller sandwiches were found to have a lower environmental impact, an intervention to reduce the portion size of the sandwiches available was considered a potential intervention strategy. Reducing the portion size of foods available in worksite cafeterias has been found to be considered an acceptable health promoting strategy (Vermeer *et al.* 2009).

Only 29% of the sandwiches on offer were lacto-ovo vegetarian and less than 1% were vegan. Similarly, a large proportion of the beverages contained milk. The limited availability of plant-based choices may have hindered efforts to encourage pro-environmental food consumption. To enable users to make more sustainable food choices in the university cafeterias, an intervention to expand the amount and variety of vegetarian and vegan options available was discussed with catering managers during the focus groups in Study 2.

The results of the study suggested that avoiding milk-based drinks that contain coffee and cocoa would also be a desirable intervention outcome. Similarly, limiting the consumption of chocolate-based confectionaries that had a high environmental impact would be a desirable behavioural intervention outcome that

would be beneficial for health too. As beverages and snacks, particularly coffees and milk-based drinks and cookies, comprised the largest proportion of total sales, it was apparent that the greatest environmental gains would come from shifting the consumption of options within these cafe option categories. However, the popularity of beverages and snacks meant that they were a key source of income to the catering service, thus discussions with caterers were necessary to explore potential financial implications of reducing beverage and snack consumption.

3.5 Conclusion

This study has revealed that there is a considerable variation in the environmental impacts associated with different food options in the university cafes. Whilst animal products were associated with the greatest environmental impact, there was a gradient with animal type; beef and cheese were the highest, chicken and eggs were lowest. Moreover, dairy products, particularly in the beverage and snack category were associated with high impacts thus interventions to reduce the environmental impact of food consumption on campus should consider targeting not only meat but dairy products too. However, avoiding these options may reduce intakes of important micronutrients such as calcium, iron and vitamin B12.

This study has revealed that it may be necessary to alter the amounts and types of food options available in the cafes to enable customers to make more environmentally friendly choices. When expanding the plant-based selection, it is important to ensure that the micronutrient content of the new options are maximised. The social and economic implications of such intervention targets need to be considered with stakeholders, (i.e. catering staff and consumers) to ensure the interventions tested are economically viable, culturally acceptable and essentially sustainable.

3.5.1 Next Steps

The results of Study 1 highlighted key cafe options that carry the greatest environmental impact. The selection of these choices in the university cafes was therefore the problem behaviour that the intervention sought to change. This helped to inform the logic model of the problem, as per step one of the IM approach (see Chapter 5). The results of this study also informed the development of some intervention ideas that were discussed with caterers and customers in Study 2.

4 CHAPTER 4: DEVELOPING A CULTURALLY ACCEPTABLE AND FEASIBLE INTERVENTION TO INCREASE HEALTHY AND ENVIRONMENTALLY FRIENDLY FOOD CHOICES (STUDY 2)

4.1 Introduction

Study two was conducted to inform steps one to three of the intervention mapping protocol. This study was designed to formalise the involvement of programme beneficiaries and implementers in the development process and to generate primary data (Bartholomew *et al.* 2016). The consumption of cafe options with a high environmental impact was identified as the behavioural problem to be addressed by the intervention. The next stage was to explore the determinants of this behaviour, so that the logic model of the problem (step 1), and the logic model for change (step 2) could be generated to inform the design of the programme (step 3) (see Chapter 5).

It was important to involve key stakeholders in this process so that the programme addressed concerns of the university community. Involving stakeholders brings greater skills, knowledge and expertise to the programme, which increases the effectiveness of the intervention and can help to improve external validity (Bartholomew *et al.* 2016). Customers of the university food outlets were identified as key stakeholders in this intervention. As programme beneficiaries, customers would provide invaluable information about the factors influencing their food choices on campus. They could also provide insights into the reasons for consuming high impact products on campus and reveal barriers to changing this behaviour. Gathering their views about the intervention goals and possible strategies would help to ensure that the intervention developed was culturally appropriate. The university catering services management and staff were also identified as important intervention stakeholders. They could provide invaluable insights into the feasibility and practicalities of implementing change in the cafe settings. They were also able to provide insight about the financial risks and restrictions commerce can have on such endeavours, thus were able to determine an acceptable balance of intervention burden-to-risk.

The overall aim of study two was to identify a culturally acceptable and feasible intervention to increase the number of staff and students choosing healthy and environmentally sustainable food choices in the university setting.

There were four key study objectives:

- To identify the determinants of food choices made by staff and students in the university setting.
- To establish the perceived barriers to choosing healthy and environmentally friendly food choices in the university setting.
- To explore the acceptability of a point-of-choice intervention with the university food outlet customers and caterers.
- To determine the feasibility of point-of-choice interventions with university caterers.

4.2 Methods

A qualitative approach was used to address the objectives of this study. Qualitative methods allow the researcher to explore topics in-depth and probe participants for deeper meaning underlying their responses (Mason 2002). A qualitative approach was appropriate for this study because it was important to not only gather the points of views of the intervention stakeholders, but also understand the reasons they thought as they did. A benefit to using a qualitative approach is that it enables people to represent themselves and their own views without subjecting them to predetermined or biased conditions (Richie & Lewis 2003). Qualitative research evidence is theoretically generalizable in the sense that it generates understanding which can be used to develop concepts that are relevant to other settings and groups of individuals (Yardley 2017)

To address study objectives 1-3, focus groups with customers of the university food outlets were held. To address study objective 4, focus groups with catering service management and staff were conducted. Focus groups offer the researcher the opportunity to explore people's experiences, opinions and concerns (Barbour & Kitinger 2001). Focus groups are uniquely suited to allowing the researcher to understand motivations with a degree of complexity that is not typically available with other methods (Morgan & Krueger 1993) Unlike one-to-one interviews, focus groups allow the researcher to compare different points of view that participants exchange during interactions in the meetings. These group discussions help

participants to clarify for themselves what their opinion depends on, including the presence or absence of some set of circumstances (Morgan 1993). This is particularly pertinent when trying to identify the determinants of food choices, a complex behaviour which depends on a combination of many factors, including attitudes, knowledge and beliefs. It can also be argued that focus groups provide more realistic accounts about what people think because they are made to reflect on their own opinions and possibly revise their views when challenged by others in the group (Barbour & Kitzinger 2001).

4.2.1 Ethical approval

Ethical approval to hold focus groups with customers was granted by the University of Sheffield's Medical School Ethics Committee on 14/12/2015, (see Appendix B1). Ethical approval to hold focus groups with caterers was granted by the University of Sheffield's Medical School Ethics Committee on 07/07/15 (see Appendix B2).

4.2.2 Focus groups with food outlet customers

Focus groups with university food outlet customers were held to explore their views of factors influencing food decisions made on campus. They were also used to gather their perspectives about a point-of-choice intervention to encourage healthy and environmentally sustainable eating on campus, as well determine the acceptability of some initial intervention ideas.

4.2.2.1 Recruitment

As this study focused on the dietary habits and perspectives of customers of food outlets at The University of Sheffield, purposive sampling was used. Participants were selected based on whether they were a student or member of staff at the university and whether they used the university food outlets at least twice a week. This was to ensure the participants were familiar with the setting and were likely to share the same views as the intervention beneficiaries.

Initially customers were recruited using a poster advertisement (Appendix B3) placed in the food outlets across campus in February 2016 (at the start of semester 2). This poster outlined the criteria for participation and stated that participants would be reimbursed for their time with a £10 high street-voucher. However, only two people expressed an interest in the project. Subsequently, an email (Appendix B4) was sent to all staff and students across the university inviting university food

outlet users who were interested in participating in a research project around food choice on campus to contact the researcher via email. The value for the high street-voucher to reimburse participants for their time was increased to £20 to stimulate more interest in the study. This information was included on the advertisement. Customers that responded to the advertisement were subsequently sent a participant information sheet (Appendix B5) and consent form (Appendix B6). After agreeing to participate, participants were asked to indicate whether they were a member of staff, undergraduate student or postgraduate student and were assigned to a focus groups based on their vocation. Focus groups were stratified by vocation to avoid participants' responses being unduly influenced by more senior members of the group. For example, an undergraduate student may not participate in the group discussion to the same extent if a professor was present in the group. Focus groups comprised participants from mixed academic years and disciplines so that a variety of university experiences were shared. This generated a greater diversity of opinions in each focus group. A maximum of 9 participants were allocated per group on the assumption that there may be some drop outs, which would still leave an adequate number of participants per group. The number of focus groups held was decided pragmatically. The use of theoretical data saturation was considered but due to insufficient time to transcribe and analyse the data between groups, it was more important to complete the data collection to allow the intervention mapping process to progress.

4.2.2.2 Data collection

Focus groups were held on campus in university meetings rooms during office hours and were recorded using a Dictaphone. Prior to the start of the focus group, each participant completed a short series of questions that were designed to contextualise their responses (See Appendix B7). They were asked to indicate their usual eating habits on campus, which cafes they tended to visit and what they tended to purchase. They were also asked about dietary choices (e.g. vegetarian, vegan etc.) and whether they belonged to any environmental sustainability group in the university, such as the national Green Impact Initiative (NUS 2018). This information was used to better understand the different responses and opinions provided in the focus groups and to gather information on the dietary backgrounds of participants. Studies have demonstrated that people who are more

environmentally conscious are more willing to reduce their meat consumption for environmental reasons (de Boer *et al.* 2007).

Focus groups began with a general introduction to the topic of the environmental sustainability of food, and the reason why the study was being undertaken. The term 'environmentally friendly' was used by the researcher to describe foods with a lower environmental impact as it was believed customers would be more familiar with this term than 'environmentally sustainable'. A topic guide was used to direct the researcher during the focus group (see Appendix B8), which consisted of four key topic areas. The first topic explored the participants purchasing habits in the university. Participants were asked to discuss the factors that motivated them to purchase items on campus. The second topic explored factors that influenced their food and drink choices on campus including the perceived healthiness of the choice. The extent to which the environmental impact of food production influenced their food choices was also explored. Since this topic may have been unfamiliar to some participants, general information about the environmental impact of different food categories was provided verbally. (See prompts in Appendix B8). Following this, some initial intervention ideas were proposed and participants were asked to provide their opinions and views about these ideas. All focus groups were held by FG to ensure consistency in the topics discussed. Open questions were posed in to stimulate discussion amongst group members. Closed questions were used to probe participants for further explanation.

4.2.2.3 Data analysis

The audio files of the focus groups were fully transcribed into a Microsoft Word document. Participants were given a unique identification number to ensure they were not identifiable in the transcripts. The researcher transcribed all the focus groups herself to increase familiarity with the dataset. The transcripts were checked for accuracy against the audio files and subsequently printed out for analysis.

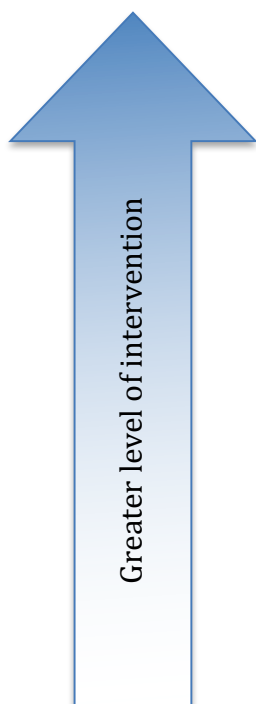
The focus groups were analysed thematically following the 6-phase reiterative process outlined by Braun & Clarke (2006). Transcripts were read through several times and initially coded using an inductive approach. The codes were sections of transcript deemed meaningful considering the study objectives, rather than being

selected using a predetermined coding framework or the researcher’s analytic preconceptions. Transcripts were then re-read following the initial coding procedure to ensure that all the relevant information was included and the codes were consistent. Codes were then grouped together to generate themes. Often codes fit more than one theme. Codes within a theme were grouped into subthemes. Codes were moved between themes and often themes were revised to reflect more accurately those codes. Excerpts of data were re-read to ensure that the themes accurately reflected meaning of the data and were coherent. A thematic map was produced which illustrated the interconnectedness of the themes and subthemes. The computer software NVivo version 11.4.1 (QSR International Pty Ltd, Doncaster, Australia) was used as a tool to index the electronic version of the transcripts according to these emerging themes.

4.2.3 Focus groups with catering service staff

Focus groups with catering managers in the University of Sheffield were held to explore their views about the feasibility of testing an intervention in the university food outlets to encourage environmentally friendly eating behaviours. Intervention ideas were devised using the results of Study 1 and guided by the Nuffield bioethics ladder of intervention (Nuffield Council on Bioethics 2007). See Box 2.

Box 2-1 Adopted from Local Government Association- Changing behaviours in public health: to nudge or to shove? (Adapted from Box 3.2, page 42 (Nuffield Council on Bioethics 2007))



Eliminate choice: regulate to eliminate

Restrict choice: regulate to restrict the options available to people.

Guide choice through disincentives: use financial and or other disincentives to influence people to not pursue certain activities.

Guide choice through incentive: use financial and other incentives to guide people to pursue certain activities

Guide choice through changing the default: make healthier choices the default option for people.

Enable choice: enable people to change their behaviours.

Provide information: inform and educate people.

Do nothing: or simply monitor the current situation

This framework is used to assist the thinking about the acceptability and justification of different policy initiatives to improve public health (Nuffield Council on Bioethics 2007). There are eight policy options presented on the ladder that range from individual freedom, to information provision ,to state intervention for gains in population health as one moves up the ladder. This tool was applied to the context of the university food outlets and catering service. Intervention ideas on the lowest rungs of the ladder were least intrusive and primarily concerned with providing information. Intervention ideas on the highest rungs of the ladder were the most intrusive and concerned with legislation to restrict e.g. Meat Free Mondays or eliminate choices. The ladder of intervention ideas generated for focus group discussion is available in Table 4-1 (and Appendix B9). Focus groups were used to explore the feasibility of these proposed intervention ideas and to better understand the university catering services practises and procedures.

Table 4-1 Intervention ideas based upon the Nuffield ladder of intervention proposed to catering managers and caterers for discussion during focus groups

Intervention level	Description of intervention
Eliminate choice	<ul style="list-style-type: none"> • Omit the least environmentally friendly food items from what is on offer in the canteens for the duration of the intervention.
Restrict choice	<ul style="list-style-type: none"> • 'Eco-day' - remove the least eco-friendly food items from the shelves/ menus for one day of the week. Customers will be provided with information as to the reasons for this. • 'Meat-Free day' remove the meat products from the shelves/ menus for one day of the week.
Guide choice through disincentive	<ul style="list-style-type: none"> • Increase the prices of the least eco-friendly products by a significant amount. • Make the larger drinks/sandwiches considerably more than the regular/small. • Customers do not receive points on their GeniUS cards for high environmental impact purchases.
Guide choice through incentive	<ul style="list-style-type: none"> • Reduce the cost of the most eco-friendly items. • Have a discounted healthy, eco-friendly meal deal, which excludes items with a high impact score. • Sell reduced cost vegetable soups made from supermarket cast offs/local, seasonal produce. • Rewarded customers with extra points on their GeniUS cards for making eco-friendly choices in the canteens.
Guide choice through changing default	<ul style="list-style-type: none"> • Have only the most environmentally friendly food items available, displayed, promoted, at the front of the counters. Least friendly food items are available on request, i.e. they are not on display or promoted. • All drinks served are one regular size (medium). Larger drinks are available on requested, but they are not advertised on the menus/boards. • All the sandwiches in the counters are smaller; larger sandwiches are available on request.
Enable choice	<ul style="list-style-type: none"> • Increase the variety of the more eco-friendly food items on offer, (i.e vegan and vegetarian sandwiches/soups etc.) and provide a clear indication that they are environmentally friendly options. • Reformulate/broaden the vegetarian options even further to make them more appealing. • Provide smaller portions/servings of the high impact products.

Information provision

- Display eye-catching posters in the cafes presenting information about food sustainability issues and general information about the principles of healthy sustainable eating patterns proposed to help ameliorate these problems.
 - Use LED screens in food outlets to show footage of food supply chains and the environmental impacts of food production. These films would also provide guidance as to what a healthy environmentally friendly eating patterns are.
 - Use notice boards to portray general information about the eco friendliness of food and drink products.
 - Labelling counters/menus with environmental impact rating high, medium, low based on an impact score based on a combination of their carbon and water footprint estimates. This will give consumers an indication as to which items have a high or low impact scores.
-

4.2.3.1 Recruitment

Initially a meeting was held with the Head of Accommodation and Commercial Services (ACS) to obtain permission to invite members of staff involved in university catering to participate in the research project and confirm that a cafe-based intervention would be permitted in university food outlets. The head of ACS provided contact details of the senior commercial services management team. An organisational chart of retail operations was obtained to enable identification of the retail operations managers and food outlet managers (team leaders). Potential participants were invited via email (Appendix B10). A participant information sheet (Appendix B11) along with a consent form (Appendix B12) was sent to participants and they were given 7 days to respond to the email. Participants were contacted by telephone if there had been no response. Catering managers that agreed to participate were sent background information about the environmental impact of food production, a summary of the environmental impact of cafe options calculated in Study 1 and the proposed intervention ideas (Appendix B9) one week prior to the meeting to enable them to consider the issue and ideas proposed. One focus group was held with senior commercial service management, another with retail operations management and then two separate meetings were held with team leaders. The number of focus groups held was determined pragmatically by the number of caterers willing to participate in the study.

4.2.3.2 Data collection

Focus groups were held within working hours on campus, either in the office of the catering manager, or in a bookable meeting room located close to their place of work. Focus groups between senior commercial service managers, retail operation managers and team leaders were held separately to avoid any influence seniority might have over responses and reduce bias. All focus groups were held by FG to ensure consistency in the topics discussed.

A topic guide was devised to prompt the researcher during the focus group to ensure key topics were covered during the discussions (see Appendix B13). FG began with a short introduction about the topic of environmental sustainability and reasons why the research was being conducted. She also outlined the purpose of focus group and what information she intended to gain from the meeting. The

first questions in the interview guide were designed to be open with a view to gathering the opinions and views of catering manager about the implementation of a point of purchase intervention in the cafes. Provided the general response was positive, the subsequent questions related to each intervention idea in turn and comments on the feasibility and practical implications of each idea were invited.

4.2.3.3 Data analysis

Focus groups were recorded using a Dictaphone and the audio files were transcribed and analysed using the approach described in section 4.2.2.3.

4.2.4 Role of the researcher: reflection and position

When conducting research it is important to strive for objective neutrality by avoiding obvious, conscious or systematic bias and to be as neutral as possible in the collection, interpretation and presentation of the data (Ritchie et al. 2014). However, it is recognised that all research will be influenced by the researcher and there is no completely neutral or objective knowledge. It is important to reflect on potential sources of bias and report on these during an investigation. To do this, I made notes after each focus group describing how I felt the discussions had gone. I noted any unforeseen issues that were encountered and how I dealt with them. I noted anything that I may have said that could have influenced the discussion. I considered these points, and the context in which the data was collected, when conducting thematic analysis of the transcripts.

The concept of environmentally sustainable food is relatively new. Research studies in this field have only just started to emerge. I was conscious that participants might not have been as familiar or informed as I was with the topic of sustainable diets. I realised this disparity in our knowledge might have caused participants to feel naive or inferior when I asked questions around environmental friendly foods. This could have reduced their willingness to share their honest views and opinions. As a white, middle-class, postgraduate student of the University of Sheffield, I share several commonalities with the participants, especially the undergraduate and postgraduate students, which helped to build rapport increasing the likelihood of honest and open answers.

As a frequent customer of the university cafes it is possible that I may have been biased in my interpretation of meaningful data in the transcripts. I was familiar with the setting and the choices available and had my own beliefs and views about the

food served. It is possible that I focussed on intervention ideas I believed would be most effective to implement in the university. There was growing popularity and publicity about Meat Free Mondays around the start of my PhD, therefore it is possible that I focused discussions around this topic above other intervention ideas posed by customers and catering staff. I assumed that participants had heard of Meat Free Mondays, which many had not which took me by surprise. Whilst I attempted to remain neutral throughout the discussion it is possible that my line of questions would have influenced the responses of others.

In the focus group discussion with catering staff, where intervention ideas were presented and discussed, it is not clear whether they understood how the intervention was intended to work and what exactly it would involve. This highlights a key problem that was not resolved fully in the meetings. For example, the ideas to use defaults and or nudges in the cafe environment were perhaps not fully understood by the catering staff. In hindsight, it may have been more appropriate to provide the caterers with an explanation about how the intervention ideas would work and what would be expected of them. Where necessary, it may have been useful to provide examples or case studies where they had been successful. This may have helped their understanding about what would be required of them, which could have enabled them to provide a greater insight into the feasibility of the ideas. It may also help to overcome some of the concerns about effectiveness. It was also not clearly established in the meetings whether I was proposing to implement these changes long-term in the university setting, or whether I was using the university setting to conduct some research short-term. Had it been clarified that I wanted to pilot an intervention to inform future implementation then perhaps they would have been more open to trialling different interventions.

In my role as facilitator of the focus group, I was required to judge when to respond to direct questions about the environmental impact of foods and when to allow discussions to continue about a topic area participants considered to be important for environmental sustainability. For example, many groups discussed the importance of recycling of food product packaging and the use of disposable cups and plates on campus and believed that to be the greatest environmental issue relating to food. I also had to judge when to intervene to correct participants about misconceptions. For example, some participants acknowledged that soya production in South America was having a detrimental impact on the environment, but were

under the impression that the growing demand of soya was for human consumption, when soya production is most commonly grown for animal feed. My confidence in correcting such misconceptions varied depending on the participants in the focus group and their conviction. I did not want to argue with participants as this may have altered the dynamic of the group, but similarly, I did not want others in the group to be misinformed. I intended to provide clarification about some of the misconceptions after the focus groups but this was not always viable.

Furthermore, there was one postgraduate participant in the focus groups who was very vocal, and expressed opinions that contrasted with those shared by the rest of the group. There were occasions when other participants tried to expand and justify their views but this tended to escalate towards an argument that was sometimes heated. As the mediator of the group I had to rectify this, either by moving onto the next topic or by encouraging others in the group to speak. I presented quotes from the participant throughout my results where appropriate to highlight the variety of views held by participants. However, I made a conscious effort to ensure these isolated views were not over represented in the findings.

I analysed the results of the focus groups with customer and caterers separately since different methodological approaches were used to explore different topics. However, in the discussion I highlighted where the views of the customers and caterers overlap to give a broader view of the perspectives of university community members. Whilst not intended to be a formal triangulation approach, I did this to provide a broader understanding of the key acceptable and feasible considerations to make when developing a point-of-choice intervention in the university setting.

4.3 Results: Focus groups with cafe customers

4.3.1 Participant characteristics and overview of dietary choices

There were six focus groups held in total between March-April 2016; two focus groups of undergraduate students, two groups of postgraduate students and two groups of university staff members. Each group had between six and nine participants and each lasted between 45 and 90 minutes. There were 45 participants in total, the age range was between 18 and 58 years, and the majority were female (n=34). Most participants were British, although 7 out of 13 postgraduate student participants were from overseas. Participants came from all departments and faculties across the university.

Most participants indicated that they used the food outlets in the university once or twice or week, 23 reported using them at least once a week and 14 participants used them less than once a week (eight were unknown). The cafe options commonly purchased by most participants were snacks (n=30), followed by hot drinks (n=24) cold drinks (n=15). Just under half of participants indicated that they consumed hot meals on campus. Food outlets located in the students' union building were most commonly used by participants

Most (n=28) of the participants consumed an omnivorous diet, with five following a vegetarian or vegan, and five adopting a pescatarian diet or avoided red meat. See Table 4-1.

Table 4-2 Characteristics and dietary choices of focus group participants. UG=undergraduate, PG=postgraduate, MS=member of staff.

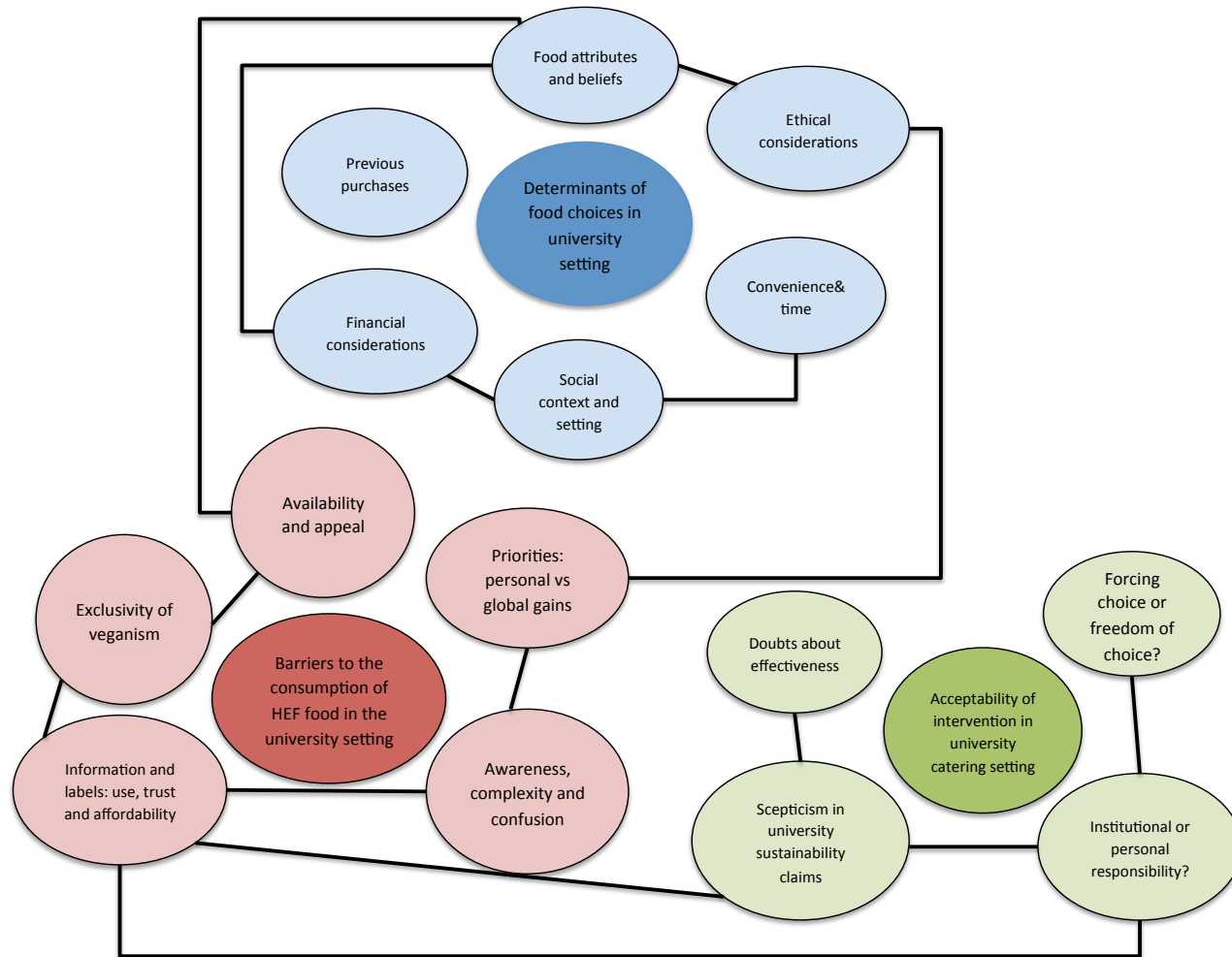
Code	Age	Gender	Nationality	Diet	Member of environmental society	Green Impact initiative participant?
UG1	23	M	British	Omnivorous	None	No
UG2	20	F	British	Other	None	No
UG3	22	F	Romanian	Omnivorous	None	Yes
UG4	20	F	British	Vegetarian	None	No
UG5	23	F	British	Other	None	No
UG6	22	M	Canadian	Omnivorous	None	Yes
UG7	23	M	Burmese	Omnivorous	None	No
UG8	19	F	British	Omnivorous	None	No
UG21	22	F	British	Omnivorous	None	No
UG22	19	M	British	Omnivorous	None	No
UG23	20	F	British	Vegetarian	None	No
UG24	18	F	British	Vegan Lactose	People and Planet	No
UG25	20	F	British	Free	None	No
UG26	19	F	British	Other	None	No
PG1	28	F	Indonesian	Pescetarian	None	Yes
PG2	22	M	British	Omnivorous	None	No
PG3	26	F	Brazilian	Omnivorous	None	No
PG4	26	F	Chinese	Omnivorous	None	No
PG5	32	F	Japanese	Omnivorous	Save our sandwiches	Yes
PG6	25	F	Iranian	Other	None	No
PG21	25	F	British	Omnivorous	None	No
PG22	25	M	British	Omnivorous	None	No
PG23	23	F	Chinese	Omnivorous	None	No
PG24	24	F	British	Omnivorous Lactose	None	No
PG25	22	F	British	Free	None	No
PG26	25	F	British	Omnivorous	None	No
PG27	25	M	Mexican	Other	None	No
MS1	45	M	British	Omnivorous	None	Yes
MS2	43	F	British	Omnivorous	None	No
MS3	27	M	British	Vegan	None	No
MS4	24	F	British	No red meat	None	Yes
MS5	43	F	German	Omnivorous	None	Yes
MS6	23	M	British	Omnivorous	None	No
MS6	51	F	British	Omnivorous	None	Yes
MS7	37	F	Chinese	Omnivorous	None	Yes
MS8	58	F	British	Omnivorous	None	No
MS21	56	M	British	No red meat	None	No
MS22	52	F	British	Pescetarian	None	No
MS23	39	F	British	Omnivorous	None	No
MS24	55	F	British	Omnivorous	None	No
MS25	47	F	British	Omnivorous	None	No
MS26	28	F	British	Pescetarian	None	No
MS27	26	F	British	Omnivorous	None	No
MS28	32	F	British	Omnivorous	None	No
MS29	21	F	British	Vegan	None	No

Green Impact is a nation-wide initiative run in universities to promote pro-environmental behaviours

4.3.2 Overview of themes and subthemes

Analysis of the focus group data revealed three key themes: 1) factors influencing food choices on campus, 2) factors limiting the consumption of healthy and environmentally friendly choices on campus, 3) acceptability of cafe-based interventions. These themes, comprising several sub themes, are summarised in Table 4-2 and Figure 4-1 and discussed in detail below. These three themes are presented as separate constructs and yet many themes and subthemes overlap. For example, the subtheme 'food attributes' includes perceived healthiness of food, which was acknowledged to be an important factor influencing the food choices of some participants. However, focus group discussions revolved around reasons for not choosing healthy options, thus it is reported as a subtheme of the broader theme 'perceived barriers to consuming healthy and environmentally friendly foods on campus'.

Figure 4-1 Thematic map of theme and subthemes from customer focus groups.



Different colours denote separate constructs. Themes are darker circles, subthemes in lighter circles.

Table 4-3 Themes and subthemes that emerged during the thematic analysis of focus groups with university cafe customers.

Theme	Subtheme	Codes
	Financial considerations	Price Value for money, meal deals Affordability (food expensive, overinflated prices) Treat (guilty purchasing daily) Revenue/supporting the university
Factors influencing food choices in university setting	Convenience & time	Convenience Time Avoid queues Quick, easy to get to, close proximity to work/study space Lack of space to consume meals away from the desk (staff)
	Healthiness and other food attributes	Tastiness Appealing Healthiness Filling Warming Intolerances etc.
	Ethical considerations	Meat avoidance- quality, ethically sourced, religion, animal welfare, free-range, environmental protection Sustainably sourced fish Free range eggs
	Social context and setting	Social occasion, lunch-meeting friends/colleagues Pleasant and enjoyable atmosphere/ space Variety of food outlets and choice available Customer service
	Previous purchases	Connections with cafe Experience and expectations
Perceived barriers to consuming healthy and 'environmentally friendly food' in the	Awareness, complexity and confusion	Environment is not a consideration at present Environmental concerns –packaging of foods/localism/air miles/Fairtrade/free-range. Doubts about plant-based diets- soya/almonds 'Bogged down by complexity' Concerns-'unknown social and economic' implications of dietary change for the environment Belief – other pro-environmental behaviours 'offset' EF impacts of food

university setting	Priorities: personal vs. global	EF abstract concept, difficult to comprehend Health vs. environment: immediate and long term personal/shared benefits
	Information and labels: use, trust and affordability	Lack of information regarding origin of food (local vs. distant) Lack of nutritional information about food choices Unclear dietary information-halal, kosher, vegan, vegetarian Use of labels – credibility/trust suppliers/information providers/accountability Food labelled EF food perceived as more expensive (local) Suggestions: Raise awareness-promotions/advertising/campaigns/labels
	Exclusivity of veganism	Social norm is to consume meat and animal products Part of your dietary habits/ identity Traditional meals and meat centric diets Vegetarians and vegans- exclusive values
	Availability and appeal of healthy and plant-based foods	Limited availability (healthy or vegan options) Suggestion: increase the variety and choice of EF food available Vegetarian and vegan food is less appealing and unsatisfying Suggestion: opportunities to try vegetable foods
Acceptability university cafe intervention	Institutional or personal responsibility?	Commercial enterprise should not be influencing dietary choices 'Fitting with university Green Impact initiatives' Buying power of universities, make a real difference
	Scepticism about sustainability claims	Sceptical about university 'sustainability' agenda Suggestion: procure more/ only EF choices, policy level requires trust and confidence in information provider/university Suggestion: campaigns, promote, reduce price Remove unhealthy choices- more effective the providing choice
	Forcing change or freedom of choice	Meat Free Mondays- anger, backlash, annoying, dictating, preachy, offensive, heavy handed, unfair, forcing (Effective/ineffective/risk to custom) Morality-'feel good' choosing EF food Altruism
	Doubts about effectiveness	Meat Free Monday a gimmick, making a profit Unlikely to alter lifelong dietary habits.

4.3.3 Factors influencing food choices in university setting

This theme encompasses the various factors influencing customer food choices on campus. There were six main subthemes which emerged from this analysis, which included 'financial considerations', 'convenience and time', 'healthiness and other food attributes', 'ethical considerations', 'social context and setting' and 'previous experiences'. These subthemes were intricately linked and customers reported prioritising or compromising these considerations depending on the time available and specific occasion.

4.3.3.1 Subtheme: Financial considerations

Cost was a key factor influencing food decisions on campus. It underpinned where food was purchased, how frequently and ultimately what choices were made. Many participants believed cost was a barrier to purchasing food items on campus every day.

"I don't think I would be able to afford it everyday, because even though it is a sit down meal, I think it could be quite expensive, like six or seven pounds a day... so usually I just opt for like a sandwich and a packet of crisps, like a meal deal really. So price is the main thing for me." (UG8)

Others believed outlets and products on campus were too expensive and subsequently avoided purchasing food from them:

"...I try to avoid buying food at the university, it's completely overpriced. Like the prices are completely inflated just compared to the local supermarkets of which there are many around this area, and the same for the Students Union, I think it's completely overpriced." (PG24)

Some students and staff believed that by purchasing food in the outlets on campus they were financially supporting their University, thus were less concerned about the additional cost and considered it an altruistic act.

"...If that money is reinvested in the union then I don't mind. If that helps to buy new computers for the Union, or buy new furniture then it's absolutely fine." (UG3)

"I feel like it's supporting the university as well, that is, that I'm playing my part as a member of staff." (MS4)

One participant also implied that they are prepared to pay more money for food if it means that the employees are paid minimum wage.

“I guess at the same time, like there's people need to be paid a wage, and I'd rather people get paid a living wage that are working there than me save like X amount of money.” (UG1)

Many participants expected the cafes and eateries on campus to be cheaper than the high street since they were catering for low-income students. Staff members believed the catering service was focussed on making a profit with little regard for the financial situation of the students and staff it served. Participants believed they should be entitled to a discount as it's their place of work, and suggested that reducing the cost or providing discount would make staff more likely to use the university owned outlets.

“I was very surprised...when I came here [to the university] thirty years ago everything was focused on students with no money. But now it seems to be focussed on, ‘well we'll have as much money off you as we can’.” (MS21)

“I was surprised that they don't do a like a staff discount or something like that... I think that would probably motivate me to go there more often I think.” (MS26)

This suggests that focus groups participants believed that the university catering service does not put the interests of customers (students and colleagues) ahead of its own commercial interests; something which they disliked. This may help to explain the scepticism about sustainability claims (discussed in later Section 4.3.5)

However, postgraduates mentioned that the loyalty rewards scheme run by university outlets and the Students' Union was something that positively influenced their decisions to choose to purchase food and drink on campus.

“I think my choice is kind of biased by ⁴GeniUS cards, cause I've got that card and I tend to go to cafes that I could collect points.” (PG4)

Undergraduate students reported that the decision to purchase meals on campus was influenced by the amount of money they had in their budget for spending on food.

UG21: “I think it depends on what you're having for dinner in the evening. That can influence if you're buying lunch. So if you're going out for dinner you might just have a sandwich at home or something, try and save money.”

⁴ GeniUS cards are electromagnetic cards that customers can use at point of purchase to collect points, 5 points for every £1 spent. These points can be collected and redeemed to receive discount on future purchases in the university outlets.

Perceived 'value for money' was also an important determinant of food choice. The values weighed against cost of the food included: taste, quality of the ingredients, portion size and the sensation of fullness.

"if you want to have like a hot meal, or something compared to going elsewhere in Sheffield, I think that's quite reasonable, but if you're buying... sandwiches and crisps and things from the Union shop, then, like you say, it is expensive". [In response to another participant.] (PG26)

4.3.3.2 Subtheme: convenience and time

Convenience was a key motive for purchasing food and drinks in the university outlets. Being able to purchase food and beverages near their office or place of study was advantageous as it reduced the amount of time and energy required to find the foods allowing them to spend more time studying or working. It also meant they did not have to prepare food at home which participants often did not have the inclination to do.

"Yeah that's the thing, you can just run down to Students Union or Krebs [university cafe] or whatever grab your food and go back up to have your lunch... it's easy so that's why I get my lunch there maybe once a week... because I normally make my lunch, but I can't be bothered sometimes, so I get a meal deal or a snack, it's just easy." (PG25)

"It's all convenience for me. So I expect to spend five pounds a day on my lunch, and if I can get that as easy as possible I will." (PG22)

The amount of time available to purchase and consume the food was a key factor in deciding what type of food to buy and where to buy it. Staff and postgraduate students described 'grabbing a sandwich' from the nearest outlets so they could return to their desks to eat. Similarly, undergraduate students' decisions depended on the amount of time they had before or between lectures. In these instances, food choices were made with the amount of time it would take to eat the food in mind.

"I tend to buy cold food but that's more [due to] time restrictions, cause I don't tend to have a lunch break so I just have something at my desk and that's easier to have a sandwich." (MS5)

"I think it depends on the gap that you have. If you only have an hour, you can't really go into the sit down places to eat." (UG2)

The amount of time it would take to obtain food was mentioned as reason for avoiding certain outlets on campus and changing food decisions. Reaffirming that time heavily influences which factors are prioritised when purchasing foods.

"I think it depends how busy it is as well, cause sometimes 'wrap and go', around lunchtime, is absolutely packed and the queue is like out the door. So if it is, I just go and get a meal deal. It's just quicker. I think, than just queuing for ages..." (UG5)

4.3.3.3 Subtheme: Healthiness and other food attributes

The perceived tastiness, and visual appeal of the food was reported as a key factor influencing the food choice of customers. Healthiness of food was an important consideration reported by many participants who explained that they actively sought healthy choices on campus but that they were sometimes limited by what was available.

"I tend to buy cold food, but mostly that is dictated by the fact that the cold food tends to be slightly healthier. I find the hot options are not something that I would choose, you know I try to eat a bit more healthily, be a bit more conscious about what you're eating but I find it's quite limited so that dictates what I end up having." (MS8)

The healthiness of food choices was a consideration made by some students but very often this was outweighed by other factors such as price and how filling it was perceived to be.

"I think it's like weighing out [the pros and cons]... if you're paying like three or four quid you want to be relatively full....if it was a little bit unhealthier but it was going to keep me fuller for longer, I would go for that over completely healthy but I knew that in like two hours I'd be starving kind of thing." (UG23)

One participant explained that the effect the food would have on their ability to concentrate in the lecture influenced their decision around what to have and often meant avoiding hot meals which were more filling.

"Also like the time of day as well... it really depends on what time you go to have the food. Because like sometimes you have... for example, like you have a 12 o'clock lecture and you want something before hand, so probably don't want something really heavy, probably like a New Leaf [salad] would do." (UG6)

Other participants explained that they did not consider health when choosing food in the outlets. This was largely because they viewed it as a treat and therefore were more likely to prioritise taste over the healthiness.

"I don't really think that much about the healthy thing because I just think, well this is a treat really, a bit of a luxury, so erm, I wouldn't probably choose based on healthiness of it, I'd just go chips, whatever." (MS22)

"I'm not very healthy, [smiles] I don't think about health for many of my food [choices], unless it's something really sweet like cake or chocolate. But I don't mind, like greasy foods, so I would say health is not my main issue, I'd say taste and quality is more important than health" (UG26)

Some focus group participants had food allergies or food intolerances and therefore made food choices in the canteens primarily based on the content of these items. Health, in terms of avoiding illness, was therefore the main factor influencing their food behaviours, which was prioritised over price.

"I think for me, my diet kind of dictates a lot of what I buy. So like cheese, yoghurts, milk, all that stuff is out of the picture, So if I can go down to Krebs and there's something that is dairy free I can get a meal deal, I can get my soya latte everything, then that's great. Yeah so I guess that dictates what I buy, and often to get dairy free stuff, you do have to pay a bit more but that's just life." (PG25)

4.3.3.4 Subtheme: Ethics: Animal welfare, environment and religion

Some participants identified as vegan or vegetarian and subsequently made food choices accordingly. The decision to avoid certain food outlets and foods on campus stemmed from their personal beliefs relating to issues of ethics and morality. One member of staff who avoided eating meat on campus explained this was because they were not Halal, so he tended to choose the vegetarian options. Another member of staff who avoided meat on campus expressed concerns over the quality of meat and the welfare of animals in the production of 'cheap' meat.

"I don't tend to eat meat in outlets where I don't know where the meat is from or what the quality is like, but that's why I tend to go for more vegetarian [food], and since the View [cafe] is now totally vegetarian I eat a little bit more." (MS5)

4.3.3.5 *Subtheme: Social context and university setting*

Participants described choosing different types of food depending on whether they were consuming food with peers or in isolation. This was closely linked with the time available to purchase and consume lunch. One member of staff preferred to purchase a sandwich as it conveniently enabled him to return to his department and consume lunch with colleagues.

"I mean it's also nice from a sort of community perspective, again as a member of staff... it's nice to be able to just pop down to the cafe, pick something up for lunch, and then go and meet people somewhere around the building for a lunch meeting or you know just to [chew the fat]." (MS3)

Similarly, when students and staff had more time they were more inclined to choose to eat in one of the bars or cafe and where they could socialise with peers. In these more leisurely instances, they tended to purchase hot meals opposed to convenience foods.

"...I really like Interval [Bar] as a place, I think it's a really nice atmosphere, and me personally, I quite like [it] because if I know I'm staying [on the university campus], I like having things on a plate, rather than in boxes to take-away. Cause I think it's nice to have that option but sometimes if you do want to just sit, and especially if you're with a group of people, I think having more of a restaurant kind of feel is nicer for me personally". (UG1)

Members of staff and postgraduates also described using the university outlets for socialising when there was less time pressure, such as after work. This additional time allowed more consideration over the taste and quality of the food, rather than the healthiness and price. Choices made on these occasions were considered a treat.

"I think it's reasonably good value in places like The View Deli where it's more freshly prepared, you can eat it in a quite nice location, it's somewhere which I quite enjoy taking other people to if they're visiting me, and I think for evening meals, especially in the Interval Bar can be very good value." (PG21)

Postgraduates and members of staff also reported using the university cafes for informal work-related meetings as they enjoyed the pleasant environment and variety of food and beverages choices available.

"I think as PhD students...we have meetings quite a lot and cafes are really good for that kind of thing. And they're not always formal meetings so you can

do that. So, that's a big one, it's quite nice to do, given that there's so much choice and they're all quite nice to be in." (PG2)

Members of staff also reported choosing some food outlets over others as they were concerned they did not want to share the social environment with younger students. Some suggested they would like a protected space for staff members only, as they believed this would reduce the amount of time they have to spend queuing for food.

"...I think it's quite a nice environment, it's quite informal and also I don't feel too old. Cause some of the venues, you know, I feel like oh my god, everyone else is so young. So the Interval is a bit of a mixed kind of atmosphere." (MS22)

"we spend a lot of time standing in queues and a lot of time looking for somewhere to sit because the students want to chill and catch up on some reading or some research while they're having the lunch or whatever. But it's no good when you've got half an hour to get, get something nutritious and get out again." (MS8)

4.3.3.6 Subtheme: Previous purchases

Participants recalled differences in the types of food products available in the various food outlets across campus. This knowledge was used to decide which outlets to visit to purchase a specific item. Previous experience informed the decisions of participants with restricted diets, such as vegetarians, but also by customers who preferred a specific type of food. This suggests that customers decided what they wanted to eat before visiting the food outlets.

"I guess people have that connection though with the cafes, that it's not healthy... if you wanted to be healthy you'd go to Grill and Go or New Leaf really..." (UG23)

"I'm a vegetarian so I wouldn't go there because I'd expect that they've got meat." (UG23)

4.3.4 Perceived barriers to consuming healthy environmentally friendly food in the university setting

This theme encompasses four key conceptual barriers to consumption of healthy and environmentally friendly foods on campus. These reflect personal knowledge, attitudes and beliefs but also shared norms and values of the wider university community.

4.3.4.1 Subtheme: Awareness, complexity and confusion

Apart from some of the vegetarian and vegan customers, most participants did not mention environmental sustainability as a factor influencing their food choices. When asked directly whether the environmental impact of food had any bearing on their choices, they explained that it had not occurred to them. Customers also were unsure what was meant by the term 'environmentally friendly'. Most of the discussions around environmentally friendly (EF) foods focussed on food packaging, localism, air freighted food and Fairtrade. Participants believed that they were unable to choose EF food in the university because they were not provided with sufficient information to do so.

"I don't quite understand the idea of what sort of things might be environmentally friendly? Is Fairtrade one?...That's something I've noticed as a label on different products, that I thought, well if they've got some special label then perhaps it is better so I got for that. But for environmentally friendly food they don't actually have single [label for that] saying this product is greener, so I wouldn't say I pay a lot of attention at the moment." (PG6)

"I've never actually thought about it to be honest. I suppose if something... says it's locally grown or made or whatever I probably would be more inclined to buy that, but I don't seek it out." (MS28)

"I don't think that information is available. We don't know if it's travelled the country twice or come from next door. It's obvious that if you're choosing Jamaican beans that have come from... but generally that information is not there. Are they locally produced eggs? I don't know." (MS21)

Reasons given for having little knowledge about the environmental impact of food was due to limited sources of information about the environmental impact of foods more broadly and the reliance on food industry labels.

"Unless you know, you're watching documentaries and stuff that's about as far as you can go. It's the information we're presented with I guess." (PG2)

A minority of participants explained that they actively avoided meat and chose a plant-based diet on the grounds of environment protection. However, some participants raised concerns over the economic and social implications of the movement towards plant-based diets. This confusion appeared to stem from mixed messages they had read or heard in the media.

“But for me personally, anyway, I think I get sort of bogged down in the complexity of the thing, because I thought, oh yeah vegetarian is the way to go and everything, and then you read an article about soya beans causing detrimental impacts in the areas where people were previously growing their own food and they stopped doing that, and they're doing cash crops, and that's having a bad impact on the country. So you know, you kind of think, oh god, you don't know what to do for the best.” (MS22)

“...I drink almond milk and I've read about how terrible that is producing the almonds and stuff in terms of the water consumption, which is one of the reasons, obviously, meat consumes a lot of water when your producing it. It does kind of feel, [like you're exchanging] one bad thing for another.” (MS29)

One participant rejected the notion of adopting plant-based diets on the grounds of this uncertainty and implied that the university should not be supporting the consumption of environmentally friendly food choices since it was not clear what foods are sustainable and such changes could be causing more harm than good.

“one thing that has happened, as a result of moves towards more vegetarian and vegan diets, is that there's other exploitations being created...the move to it has meant that we now have a massive demand on thing like soya, which is having a massive impact on the environment, and we have a massive demand for other grains like quinoa, which has had a massive, detrimental effect [on] economies in South America because it was once their crop to eat and now they've been having to export masses of it so middle class people can make themselves feel really good that they're being all environmentally friendly [when they] just create other environmental problems elsewhere” (PG24)

4.3.4.2 Subtheme: Priorities- personal vs global gains

Many participants implied that they considered the healthiness of a food above environmental friendliness. Undergraduate students suggested the reason for prioritising health was that responsibility for one's health depends on the individual, whereas the responsibility for planetary health is shared with millions of other people. Also, the effects of food choices can be felt immediately whereas the effect your choices have on the planet are not so apparent.

“I think that like health impacts would be more at the forefront of my mind anyway when I was buying something, and then yeah maybe the environmental thing would maybe be an afterthought rather than the main reason...” (UG22)

"It's probably because it's more prominent in your life, your own health, than like, you think about the environment but it seems like an abstract concept, whereas your health is right, obviously, it's everyday." (UG23)

Another reason given for prioritising health over environmental concerns when it comes to choosing food was suggested to be because the environmental impacts associated with food was off-set by other pro-environmental activities.

"I feel that health is more important than the environment, but that's because I do quite a lot of environmentally friendly things anyway so it kind of offsets ... the environmental impact of the food. At least that's what I say in my head..." (MS1, male)

Some participants made comments that revealed an internal conflict they were facing when asked to reflect on their food choices. For example, during discussions around Fairtrade coffee, one participant revealed that they did not consider Fairtrade when making decision but rejected feelings of guilt about it.

"I mean I'm less ethical than you [PG21] maybe because I still buy it, but I feel like... I try and be a good person in life, but actually... everything is exploitative isn't it. Sorry, I'm cynical." (PG24)

4.3.4.3 Subtheme: Information and labels- use, trust and affordability

Several participants expressed the belief that if products had labels to indicate that they were 'local' or 'environmentally friendly' then they would be more inclined to consider purchasing it. Participants suggested that University efforts to support environmentally friendly food choices should focus on providing information and sourcing products that are labelled environmentally friendly.

"If I saw it said 'locally sourced', then I would be more keen. But I don't think about it other than that. If they had something around that then I'd be more drawn to it." (MS22)

"I think that's an important first step, whether you're a staff member or a student, you want to be able to do these things, but if you don't have the information, then you can't... so I think that certainly in terms of information campaigns, that would be useful..." (MS3)

"... I don't think people in general are aware of the impact of the food choices that they make. So if [the information] was there that would already get people to think about it and have people go, 'oh why not have the environmentally friendly option?' so that I guess would be a start." (PG3)

However, not all participants believed that having labels on products to indicate environmental sustainability would influence their food choices. One participant explained that when she had little time to choose, she picked foods that looked most appealing.

“Personally I don't think if food was...[labelled] environmentally friendly, I don't think it would affect me at all... when you're... [short of] time it's a matter of, it's just getting food and whatever looks nice.” (UG7)

“But I just wonder...[about the]... general public, or students in general, whether they would pay that much attention to that sort of thing when they're hungry and trying to get some food. They might just consider price, taste and that's it.” (PG7)

Furthermore, several participants expressed concerns over the additional cost of products that were labelled local, organic and free-range or MSC. They believed that other university customers may be less inclined or able to purchase these labelled items if they were considerably more expensive.

“I guess there's a danger, cause as I say, I suspect that the least environmentally friendly stuff is also, often the cheaper stuff. There a danger there that' you're pricing people out. But like I said they can go elsewhere but you know, maybe they can't.” (MS3)

Furthermore, concern over the extent to which one could trust the labels was raised by some participants who believed they did not have sufficient knowledge to identify an environmentally friendly option without them.

“I probably wouldn't know unless it was written somewhere. I mean it could be a lie, but at least we'd notice. I probably wouldn't... be able to tell whether it was environmentally friendly unless it's in my face.” (PG3)

4.3.4.4 Subtheme: Exclusivity of veganism

The proposal to implement an intervention to reduce the consumption of meat on campus was interpreted as promoting vegetarianism and veganism. Undergraduate students expressed concerns over the reaction that most customers would have to this idea; expressing shared belief about the exclusivity surrounding these diets.

“...a lot of people who are vegetarian and vegan are shouting about the benefits of this and many people who aren't convinced [of the benefits of these dietary choices] are even more annoyed by this... I think that's the problem

that vegetarian and veganism has a whole...people just feel excluded by it.”
(UG3)

This view was shared by one pescatarian who explained that she felt she would be socially excluded from the vegetarian and vegan society for not adhering to their strong moral beliefs about omitting animal products from their diet. It was implied that this perception of exclusivity extended to vegan and vegetarian food options which should only be consumed by those that shared the same moral values and beliefs.

“I’m part of the vegetarian and vegan society and I know all the committee are vegan, and I feel like I can’t tell them that I actually eat fish as well... I do understand how people feel, and I think people who turn vegetarian think that is something [you] have to subscribe to [your] whole life or at least for a prolonged period of time, whereas, if you... don’t put the label vegetarian, people see that as just another food option that is available to them.” (UG4)

4.3.4.5 Subtheme: Appeal and availability of healthy and plant-based choices

Some participants believed that foods labelled vegetarian and vegan were avoided as they were perceived to be less tasty and less filling. It was suggested that unless people tried the options themselves, and realised that these options were pleasant, they were unlikely to select them from the range available.

“I also think a lot of people don’t think it’s going to be a substantial meal, if there’s not meat and that actually they’ll be hungry straight away afterwards, kind of thing. I think they think it’s going to be a salad basically.” (UG5)

Considering this, it was suggested that an intervention should focus on encouraging people to try new foods but without using the labels vegetarian and vegan. Providing people with an opportunity to try plant-based meals was proposed as a way to enable people to overcome any misconceptions about plant-based foods.

“...I went for a meal with my wife, it was this burrito in the Students’ Union, and I chose the meat one, and she chose the vegetarian one, when he brought it, he muddled them up, and I started to eat hers, and then when she realised she was horrified and we had to swap back, but I’d eaten a good portion of hers already [laughs] but I preferred it, and now I always have the vegetarian one.” (MS21)

Vegetarian and vegan participants expressed mixed views about the availability and appeal of vegetarian and vegan options on campus. One vegetarian student

explained that they try to choose the vegan options as far as possible, but the vegan options on campus tend to be tasteless so they chose to consume dairy products.

"...if there's alternatives to like, cheese or dairy products I'll and go for them, but if there's literally nothing that would appeal to me then I'll go for cheese and stuff... cause otherwise I'd find it bland." (UG23)

For other vegetarians, the limited number of healthy vegetarian options on campus led them to choose less healthy lunchtime food choices.

"With me personally, because I don't eat meat, sometimes I find that the kind of unhealthy stuff ...looks a bit more appetising than the vegetarian stuff on offer... there's not really that much to choose from, so like I might sometimes end up going for like a piece of cake instead of like a sandwich that I don't find appealing." (MS26)

There were also mixed views about the availability of appealing healthy options by participants more broadly. Some members of staff expressed frustration at the lack of healthy options on campus.

"I think there definitely needs to be healthier options overall. I think if you were to eat low calorie but still filling, then that is very very difficult" (MS5)

"I feel that the university is investing in an awful lot of money in trying to promote a healthy work force by the Juice project etc. But no way is that reflected in the food offer across the campus. It just seems to be in complete contrast. I think for me, personally there are very few places that I would actually find something that I really really wanted to buy and enjoy. In any of the outlets." (MS8)

Students believed there were options available when you wanted to choose healthy but they were limited.

"I think for me it really lacks healthy options actually. I don't think the University food is particularly healthy...New Leaf does offer salads which is true but that's, I think, pretty much I think the only place." (PG24)

This highlights that the availability and tastiness of healthy and environmentally friendly options is an important factor to consider when developing cafe-based intervention in the university setting.

4.3.5 Acceptability of a university cafe intervention

This theme captures the beliefs and attitudes customers expressed towards the intention to implement an intervention in the university food outlets to support healthy and environmentally friendly food consumption. It highlights their reactions to some intervention ideas proposed and reports some of their suggestions. There were four subthemes that emerged: 'Institutional or personal responsibility?', 'Skepticism about university sustainability claims', 'forcing change versus freedom of choice', 'doubts about effectiveness'.

4.3.5.1 Subtheme: Institutional or personal responsibility?

One participant expressed concern over the notion to encourage environmentally friendly food consumption in the university, arguing that it was not the role of the university to influence people's dietary choices. They expressed the opinion that the university was an institution that provided food for commercial gains, therefore should not be involved in influencing the dietary habits of consumers. They were also concerned about the unknown potential social and economic consequences of the proposed dietary shifts causing problems in other countries.

"I don't think it's actually the university's business to tell people how they should eat and do things, if they're making a profit on the food that people buy... I'm not saying the University can't start discussions or shouldn't talk about things, but I do feel wary when these big institutions tell us how we should be doing things... I don't think the university should be saying anything personally. I actually really don't." (PG24)

However, most participants did not share this view and expressed support towards a university based intervention to encourage environmentally friendly food consumption. They implied they were in a strong position to raise awareness about environmental issues related to food and could endorse EF products. Some believed that it fits well with the ethos of the university and other pro-environmental behaviour initiatives. Some believed by procuring only EF foods, the university would have a large benefit on the environment.

"I can't think why not, nobody's going to suffer from not having un-environmentally friendly food on offer so, I can't see that it's a bad thing, I think it's fitting." (MS2)

"Especially when you're looking at the procurement side of it, the Universities across the board have got so much buying power that they could collectively make a real difference I think couldn't they." (MS1)

Several participants implied that they would prefer to be absolved of the responsibility to purchase EF food by responsible food procurement.

"...so the consumer doesn't have to make that choice, you don't have to go in and be bombarded with information, you have to pick out where's the V, where's this. If you knew you could go to a place and while, all the ingredients are ethically sourced you don't have to make that decision and you feel good about yourself." (MS3)

"I think if you want to make it more environmentally friendly then, you shouldn't give us a choice, you should just enforce it." (UG7)

However, the extent to which the information used by the university to identify environmentally friendly food was accurate and trustworthy was a concern raised by some participants.

"[removing the least EF foods] seems quite heavy handed and it would require a lot of knowledge on the part of the university in terms of, being able to trust the information about the supply chain, about ingredient sources and things like that, that providers have." (MS3)

4.3.5.2 Subtheme: Scepticism about sustainability claims

Most participants suggested the university should run campaigns to raise awareness of the environmental impacts of food, and provide guidance around which choices were more EF friendly. However, several customers expressed doubt and distrust about the existing claims that the university was making about the sustainability of products available.

"I don't get excited about the university's claims about being sustainable and environmental. Like the university switched it's milk, it now gets milk from Our Cow Molly, because it's branded with 'Made in Sheffield'. Its supplier before that was a big place in Hillsborough I believe, that was also made in Sheffield, but because it didn't have nice branding of Our Cow Molly, they just cut their contract with them so that they could get one that says' it's from Sheffield. I mean it had always been milk from Sheffield... that must have been a terrible loss for [the original suppliers] to lose that contract. So it's all for show isn't it. It's fashionable to care about the environment now." (PG24)

"It's like the Sheffield teas in coffee revolution. I said, 'are you sure? Sheffield teas?' and then they went and checked and they said 'oh they're blended in

Sheffield' and I said 'oh right, there isn't a greenhouse somewhere growing tea' [laughs]." (PG21)

4.3.5.3 Subtheme: Forcing change versus freedom of choice

The proposal to implement a Meat Free Monday, where meat options would not be available to purchase from university food outlets on a Monday was met with a mixed response. The most common view was that whilst they personally would be in support of the initiative, there would be a great deal of upset amongst other staff and students who would perceive it as removing their freedom of choice. This view was expressed most commonly by vegetarian and vegan participants.

"... it seems very heavy handed but I suppose that the end-point, is to change the perceptions of people that eat meat seven days a week and think that they couldn't live without it. Maybe that's not such a bad thing. Again, I'm a bit of an extremist about these things but, yeah if that's the end goal then maybe that isn't such a problem." (MS3)

"In principle, I think it would be wonderful if everyone ate less meat in general and that Meat Free Monday is a great incentive to do this. Yet I fear that it can backfire if it was imposed. At my undergraduate Uni, they had a 'Meat Free Monday' at the canteen in the halls of residence as part of environment week and there was a lot of grumbling because the option of meat was not available." (PG21)

Some participants rejected the idea of an intervention that restricted the availability of meat as they did not want to be 'aggressively forced' into choosing a meatless option. They preferred the idea of positively endorsing the meatless options and proposed using competition to motivate customers to engage with the initiative.

"Yeah I think making it more as a kind of reward and not stop you having the choice, is probably going to be less aggressive in a way, so people would have the choice to go for the Meat Free Monday..." (PG4)

Others suggested that gradually introducing plant-based options would be more favourable as it would elicit less of a negative reaction. Providing a greater proportion of meatless options alongside some meat options would appease those who liked to consume meat whilst increasing the profile of plant-based options. Using this strategy, the shift towards plant-based choices may go unnoticed and customers would feel less slighted provided they were given enough notice and information about it.

"I think it would be better rather to provide more diverse choices, for example, spicy chickpea tagines, and introduce vegetarianism more by stealth." (PG21)

"we could put like three months for the transition period, like cutting down from processed meats to... meat itself, so gradually. I believe within a year we could just apply.... one day of no meat at all, in all cafes but still we need this introduction and reasons behind it." (PG1)

However, some participants implied they would prefer the meat options to be taken away from them as part of a Meat Free Monday campaign. Some believed that this would increase the chances of them choosing a meatless option, whilst for other it meant that the ethical deliberation was no longer theirs to make. They implied that removing meat options one day a week should not be considered an insult as people still have a food options available and if they did not like them they could purchase meat elsewhere.

"I'd never, normally consider having [Quorn], so... if it's a meat free option I would be like 'oh well, why not'. But if there's that and a meat option, I would probably go for a meat option. So yeah I like the idea of being forced into being environmentally friendly sometimes." (PG3)

"I would rather be forced into making more environmentally friendly choices... I wouldn't really get angry about it because what am I being angry about? ... I mean it seems ridiculous to me... having slightly less choice than having meat, and having healthy choice[s] isn't really an affront to your right of eating whatever you want." (PG2)

Choosing an environmentally friendly choice on campus was perceived to be the morally right thing to do. One participant explained that knowing they were choosing well would give them a sense of satisfaction that they were doing a good thing.

"I think from an environmental perspective I felt like I was choosing a more environmentally friendly lunch, then, that would be a big decider for me I think... again, the feeling like I'm doing some good in a very miniscule and ineffective sense [laughs]." (MS3)

However, one participant was concerned that it was morally wrong for the university to be removing meat choices, since it was not providing clear guidance and information to customers about the environmental impact of meat. Furthermore, they did not believe there was sufficient evidence to support a reduction in meat consumption.

"...that's the matter with it [Meat Free Monday], it doesn't actually give us a lot of knowledge and allow us to make decisions with it, it influences us in a way that they [the university] don't think is appropriate and it might omit a lot of information." (PG24)

There was also some concern that the action of removing meat on Mondays send a message to customers that consuming meat is morally wrong, and directing blame for environmental degradation.

"I think in banning things, you're kind of saying, 'you're eating meat on a Monday... you're bad, you're what's wrong with society', when it could be more like, 'we can actively do more to help the environment,' and just be aware of the negative impacts rather than kind of forcing people to [choose a meatless option]..." (UG1)

4.3.5.4 Subtheme: doubts about effectiveness

One participant believed a Meat Free Monday would not be an effective strategy to shift people towards plant-based diets, and that the only gains to be made would be by the university in terms of its reputation. Meat Free Monday was believed to be a publicity stunt to evoke the impression that the university catering service and their customers were altruistic. This reflects the cynicism some staff and students have about food provision in the university.

"What's the university going to achieve by doing Meat Free Monday? Where is it going to sustainably source all the rest of its food? It's tokenistic isn't it? 'ooo look at us, we're not making things bad by having meat.' Where do they get ...their other food products from? ...It doesn't actually prove sustainability or being environmentally friendly does it... It looks good, but it's a gimmick. And actually it's really annoying, what's wrong with eating meat?" (PG24)

Another participant also expressed scepticism over the long-term effectiveness of such an intervention and that education around plant-based alternatives to meat from a young age would be more effective strategy to instil more sustainable dietary practices in the long term.

"...if you told me that at a younger age I could start changing the way I act now, but the university trying to change me now, I'm twenty five, I'm pretty set in my ways, so, is it really going to have an effect on me? No, not really. And I might do it for the university every Monday and not eat meat but as soon as I leave university after a few months, of kind of nine till five...I'm just going to throw something [meat] in the oven." (PG22)

4.4 Results: Focus groups with caterers

Four focus groups were held in total, each lasting between 60-94 minutes. A total of 6 commercial service managers, 6 retail operations managers and 5 food outlet managers (team leaders) were interviewed. There were between two and six participants in each focus group (See Table 4-4). Meetings with caterers were held between December 2015 and March 2016. The emergent themes and subthemes from the focus groups with catering staff are summarised in Figure 4-2 and Table 4-5.

Table 4-4 Participant information of caterers in focus groups

Focus group	Gender
Focus group 1 (n=6)	
C1, C4, C5	Female
C2, C4, C6	Male
Focus group 2 (n=6)	
C23, C25	Female
C21, C22, C24, C26	Male
Focus group 3 (n=2)	
C31, C32	Female
Focus group 4 (n=3)	
C41, C42, C43	Female

Figure 4-2 Thematic map of results from focus groups with caterers

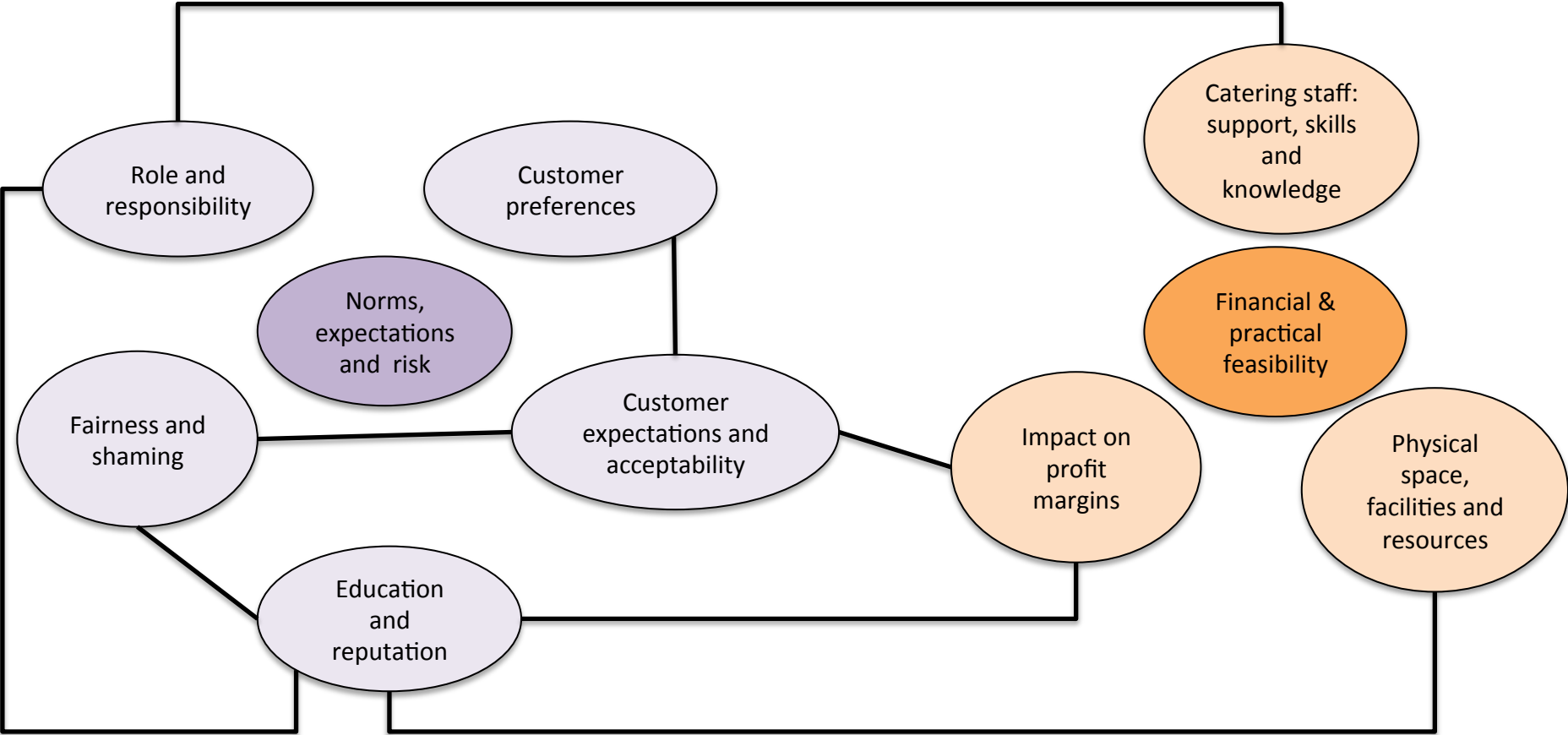


Table 4-5 Themes, subthemes and codes from focus groups with caterers

Themes	Subthemes	Codes
Norms, expectations, risks	Role and responsibility of university catering service	Recognise role in enabling customer to make healthy choices Provide options/choices Provide healthy and sustainable options (Public health responsibility deal, current sustainability endeavours, sustainable restaurant award) Commercial business Not responsible for customer health (beyond remit) Don't dictate customer choice for health Respond to customer demand (role) Bottom up approach (customers drive change themselves) Risk to business
	Information, education and marketing	Educate customers (within remit) Information provision appropriate Raising awareness/championing current endeavours/ doing the 'right thing' Marketing sustainability- branding/endorsement from the Grantham Foundation/linking with COP21 Avoid shaming- risk to reputation and loss of custom- labels, videos
	Customer preferences	Rise in popularity of vegetarian and vegan options Expanded range of sandwiches to cater for all dietary requirements Most customers prefer meat Customers prefer non-healthy choices
	Customer expectations and acceptability	Outlet branding- key marketing strategy Customer expectations- unwilling to change choice (doubts in POP effect) Remove meat options- tensions with outlet branding/identity
	Fairness and shaming	Fairness Unfair to customers
Practical and financial feasibility	Physical space, facilities and resources	Space for posters Insufficient plasma screens GeniUS cards Pre-packaged foods, pre-approved suppliers
	Catering staff support,	Catering staff support- requires additional time, skills and knowledge.

	skills and knowledge	'People are better than posters' Caterings staff confusion and uncertainty (Fairtrade, packaging) Attitudes: plant-based sandwiches less appealing, 'bring my own'
	Impact on profits-protecting finances	Alignment with business model (vegetarian options less costly, could potentially reduce price) Tension (upsell large hot drinks) Perceived additional cost of specific dietary requirement choices Extra work (large start-up costs, maintain database of labels, keep up to date with new/changing products). Information provision quick to implement

4.4.1 Norms, expectations and risk

This broad theme encompasses the shared views and beliefs held by catering staff about the proposed intervention ideas to encourage customers to choose healthier and more environmentally friendly cafe options. There were five subthemes that emerged, 'Role and responsibility of university catering service', 'Information, education and marketing', 'Customer preferences', 'Customer expectations and acceptability' and 'Fairness and shaming'. These subthemes are presented as distinct subthemes though they too are interconnected.

4.4.1.1 Role and responsibility of university catering service

Most managers expressed support for the notion of using university food outlets to encourage more environmentally sustainable food consumption. It was acknowledged that the catering trade has a role to play in assisting the adoption of more sustainable patterns of food consumption and achieving food security.

"I mean obviously, we're in support of it... food security is important, particularly because we're in the catering trade so anything we can do, to assist with that, or to change people's buying habits, is good." (C1)

They also acknowledged their role in enabling customers to make healthy choices on campus. One manager recalled the Public Health Responsibility Deal and the work they had implemented in the university dining hall to make the food choices healthier. The same dining hall had also recently been awarded a bronze Sustainable Restaurant Association award reflecting their achievements in procuring sustainable products and ingredients for example free-range eggs and MSF-certified fish. It was explained that they had expanded their efforts to procure products considered more ethical and environmentally sustainable in their all their food outlets, including the university cafes. All focus groups discussed their procurement of locally sourced milk and Fairtrade coffee. Participants believed they were actively supporting the consumption of environmentally friendly food through these efforts. Commercial service managers implied they were open to exploring what further actions the catering service could take with regards to environmental sustainability.

"I'm keen to test the market, test the feedback and see how it works and about raising awareness of ethical and environmental issues as well." (C2)

Interventions ideas higher up the ladder of intervention, using more intrusive measures to direct customers towards healthier and environmentally sustainable food choices, received mixed responses. Some participants believed this was beyond their remit as a catering service, especially when it conflicted with their interests as a commercial enterprise. The suggestion to reduce or remove the least healthy and environmentally friendly choices was perceived negatively by most participants who believed such interventions forced customers to make choices, which was against the ethos of business.

“From our point of view, we are a commercial team. The clue is in the title, and the one thing we've always set out to do is listen to our customers and find out what our customers want...And the one thing that is counter in this to what we've always tried to do, is that we don't dictate to our customers.”
(C24)

Caterers believed that their responsibility lay with responding to customer demand and adhering to customer preferences and ultimately it was up to the customer to decide whether to choose a healthy and environmentally sustainable option or not. Commercial managers believed that individuals should be educated about food and given the freedom to choose from what is available. They believed that this view was shared with their customers and therefore to limit the choices available would displease customers and could pose a significant financial risk.

“We've had this debate previously whether we should sell healthy or healthier products, or things that people want like chocolate muffins. So we can put the choice there and people can choose, they're educated to make that decision.”
(C2)

“The education bit is so important because...if the education side works, [the customers] will drive change themselves.. Because we will automatically change according to customer behaviour and purchasing habits.....” (C1)

“I just think if you [provided] a more environmentally friendly product in first place then, why would you then tell people what to eat?” (C32)

4.4.1.2 Information, education and marketing

Of the intervention options proposed, those within the perceived remit of the catering service were those based on information provision. Catering staff and managers believed the interventions ideas that aimed to educate and advise

customers about sustainable food choices were low cost and potentially advantageous if used in line with their marketing strategy.

“...I think there's a lot we can do from a comms [communication] perspective and try to be, kind of, habit forming ourselves...rather than taking everything off the shelves on a Monday if we're kind of running promotional campaigns that say, have you thought about Meat Free Mondays? And trying to move people from one type of product to another still in our outlets.” (C22)

They considered this type of intervention to be an opportunity to showcase their sustainability efforts and use endorsement from the Grantham Foundation to promote products in their outlets. However, some participants were wary that such marketing strategies were not very effective in increasing sales and agreed that customers did not look and respond to messages on posters.

“I mean we do display posters anyway, for our deals and things that we sell but I don't think customers always look at posters to be fair.” (C31)

“... who the heck reads a poster? Nobody. Posters is not the way of getting like a message like [this across], I think it's important to do this but I don't think marketing's the way personally.” (C32)

4.4.1.3 Customer preferences

Catering managers implied one of their main priorities was to protect customer choice and ensure there was a range of options to suit a variety of preferences and dietary requirements. This was the reason they had recently changed sandwich supplier; to expand their vegan and vegetarian options and introduce a gluten-free and Halal range. Caterers acknowledged that there had been a growth in popularity of vegetarian and vegan options amongst university outlet customers. The recent re-branding of the food outlet, ‘The View’ in the Students’ Union building as a vegetarian- vegan restaurant was partly a response to this trend along with their efforts to provide more choices on campus to those with specific dietary requirements. Hospitality had also received and responded to a request from one department for entirely vegan foods. However, it was still believed that only a minority of customers wanted vegan options and considered environmental sustainability when choosing food in the university cafes. In light of this the catering services weren’t inclined to change the proportions of meatless options available.

"I think for me it is about the fact that, at this stage... it's a very small minority of people that do want to make the environmental and ethical choice. ...I think everyone wants to be seen to doing the right thing, including ourselves, but if it comes down to, would they go with...a vegan sandwich roll [rather] than a triple decker BLT or whatever, it's whether people do make that choice, obviously some people do but I think... it's quite a small percentage at the minute". (C5)

Some catering staff expressed the opinion that a canteen-based intervention would not be an effective strategy to change dietary behaviours of customers. They did not believe an intervention would successfully change the attitudes and wishes of their customers.

"I think there are things we can actually do to try and redirect people, [but] I suppose my point is that we can't change what people desire." (C24)

"We can't change the mind set of all of our customers, we can offer choice, we can offer more environmentally friendly options, but I think that to actually take away, or to minimise some of the other choices could be quite dangerous." (C5)

Participants believed that most customers preferred food options containing meat and or animal products. Team leaders reported that customers preferred the hot dishes that contained meat to the vegetarian and vegan options available, particularly international students. International students were reported to be more inclined to consume meat in the university outlets as it is readily available which may contrast with their experiences of meat availability in their home country. The vegetarian and vegan sandwiches were considered the least popular choices. They expressed the view that whilst it made little commercial sense to serve them, it was necessary to ensure those with specific dietary requirements were catered for.

"we have a vegetarian curry and we have tofu and sweet and sour and things like that, that never gets touched... but the option is there... but they tend to go for the meat, the chicken, the beef." (C43)

"Yes, you've got to [have them available]. Even if you don't sell them, you have to have them because obviously people are different....If I'm left with any [sandwiches] it's more vegetarian, vegan, gluten free type things...But I can't not have them." (C31)

Since most customers at present preferred and purchased animal based produce it was counter-intuitive from their perspective to replace these options with plant-based foods that were not as highly demanded. Furthermore, some of the team leaders expressed the view that the plant-based sandwiches were not as appealing as the meat-based options and believed if they had a specific dietary requirement that they would not purchase them in from a university food outlet.

“Yea If I had a food allergy or I were a committed vegetarian... or vegan... I'd make my own... I wouldn't rely on going in somewhere and buying a sandwich. If I were that committed to that then I would do that.” (C32)

These findings highlight concerns and tensions between enabling customers to choose HEF choices and avoiding food waste and loss of sales.

Catering staff believed that customers chose foods based on perceived value for money and how filling it was.

“The students basically, they want value for money. That's it. The ones that have got a GeniUS card, only get a limited amount of money on the card... which gets topped up every week. So basically, they just want a big hefty plate full of food for as little as possible.” (C31)

4.4.1.4 Customer expectations and acceptability

During focus groups discussions, it was apparent that the University outlets were branded and carefully marketed to ensure that customers were aware of the variety of different food options available on campus. The caterers created an identity for each outlet to attract and maintain their customers. It was suggested that this branding helps customers to associate specific food options with certain outlets and therefore customers would visit specific outlets with the expectations to purchase a certain product. Intervention ideas that restricted choice or removed the availability of these options would disrupt this process and were therefore considered a great risk to custom and subsequent income and profits.

“...things work so much better when people can walk in and not have to think too hard, you don't have to walk into McDonalds and have to think about what you're going to buy. You know the product range, you know what they sell...we've tried to develop that with what we do within in the University so that the customers are absolutely clear about what they're coming in and what they expect from us. My concern is, they might walk in on a Monday morning expecting to be able to buy a coffee and a bacon sandwich, and we

immediately put them on the back foot, and ourselves on the back foot, by saying actually we're not doing it today or any Monday herein after..." (C24)

Team leaders believed that customers were reluctant to change their food choices on arrival in the outlet. This was a concern raised when discussing Meat Free Mondays. Caterers thought customers would be inclined to visit another outlet if there was no meat available. One participant recalled the 'Vegetarian Day' run by the university outlets where they publicised the vegetarian choices on offer. In their experience, customers were not interested in choosing the meatless options because they had already decided before reaching the outlet that they were going to purchase a meat dish and were intent on making that purchase.

"...it was Vegetarian day so we did actually promote our falafel, and peri peri quorn,...So I [asked a customer], why don't you try it, it's vegetarian day, and he's like 'nah nah nah I came for the chicken'." (C43)

Managers implied that presenting customers with only healthy and environmentally friendly choices by default would not be acceptable to their customers and would subsequently lose customers to other outlets in the university or off campus. Their main concern was that once customers had found a new outlet, they would be more inclined to re-visit it with the expectation the choices they wanted would be available, unlike the university outlets where their preferred choices may not be available. These ideas were described as economically dangerous and could lead risk the livelihoods of the catering service employees.

"I think there's a huge danger there. I mean even if you kind of did it holistically across the University it's not a far walk to go off campus to a high street retailer that's going to do it. ... I think there's a real significant danger of habit changing." (C22)

"I wouldn't want to get to a situation of forcing people down a route, simply because, if they choose differently they will choose and external caterer". (C1)

Not providing customers with the choices they expected to be able to purchase was considered to be counter-intuitive to business. There was little doubt that such interventions would result in a loss of customers and it was suggested that not selling meat products was a needlessly self-destructive reaction to a problem.

"I understand that it's a good trend... to move away from meat as far as sustainability goes, but, by just not selling it are we just, cutting off our nose despite our face." (C24)

However, not all catering managers shared this view. One commercial service manager implied that they would be willing to consider removing meat from the shelves one day a week, so long as it was introduced and supported with an explanation and educational material.

"...you know eliminating choice, sounds quite harsh on here, but actually if we had to introduce something along the lines of educating people and making Meat Free Mondays, that's a far more positive way... than going 'we're just not going to do it anymore'. And that's something that we would absolutely consider." (C1)

Similarly, another team leader believed that so long as there was some variety of options available to customers, that were appealing and included meat, then it would be possible to remove the high impact products (outlined in Q5 participant information sheet, Appendix B9) from the shelves without too much impact on customer choice. Similarly, removing the large size drinks from service and offering only a regular sized drink was considered feasible and environmentally beneficial, as this would reduce the amount of packaging. It would also be advantageous as it would reduce their workload as they would no longer have to stock different sized cups.

4.4.1.5 Fairness and shaming

In addition to restricting or limiting choices, other intervention ideas around the centre of the intervention ladder were believed to be unfair on customers. There were concerns that a meal deal that included only eco-friendly options could anger customers, as it would greatly increase the price of the sandwiches customers currently choose causing them to purchase sandwiches elsewhere.

"... I don't think it would go down very well because I think people will feel penalised... because my meal deal is £3.50... the other [purchases outwith the meal deal] we're talking nearly £5-£6. ..." (C43)

Similarly, not advertising the availability of non-environmentally friendly options was considered just as financially risky as removing them from the shelves because customers were not inclined to ask for food options that are not visible.

"...Sometimes if we're running low on sandwiches we might only have a pre-packed square sandwich, we'll not have our baguettes and Panini's. And they'll walk in see the fridge and think uh [disappointed] and walk out." (C31)

Not rewarding customers with double GeniUS points was also considered unfair as it was believed that it would discriminate against those that preferred meat.

"I think that would cause a fuss. I definitely think that would cause a fuss... Cause they do like the GeniUS cards, a lot of people do save them up and save them up. One of the students, he saves them up till a couple of days before pay day, because he's never got no money, and he does it that way, so he knows he's got his points to spend just before pay day and he does it every month." (C43)

Labelling items according to the extent of their environmental impact (low, moderate, high) was considered financially risky as it may cause customers who usually consume high impact products to feel ashamed, thus discourage them to return.

"I am slightly... conscious of like shaming customers as well, you know if you go to pick up something and you see your impact rating and you're like 'oh' [disappointed], you'll feel bad." (C22)

4.4.2 Practical and financial feasibility

Three key subthemes emerged relating to the practical and financial feasibility of the intervention ideas. These were 'physical space, facilities and resources', 'catering staff skills, support and knowledge' and 'impact on profit margins'.

4.4.2.1 Physical space, facilities and resources

Intervention ideas that provided customers with information about health and environmental sustainability were considered practically feasible. Notice boards and posters were considered a good way of communicating information about environment and sustainability endeavours in the university cafes and were considered easy and quick to implement.

"Then the notice boards...having something on there that says these are the cafes, what we already do and raise that awareness, we could do that quite easily and I think that's a pretty quick one." (C4)

However, lack of space in the outlets for poster and notice boards to provide information such about the environmental impacts of food was given as barrier to the implementation of interventions requiring information provision.

“In some places we have space. Some places we....don't have enough space for all the material we want to put in ourselves let alone anything kind of er...secondary or tertiary.” (C22)

“I mean, in [my venue], our marketing if you like is very limited because they won't allow us to put up posters and things like that.” (C32)

Similarly, the use of plasma screens to run promotional videos relating to food sustainability issues was also questionable in light the limited number of plasma screens available and not in every outlet.

Another practical feasibility issue was the lack of space and facilities to prepare food on site. Some team leaders explained that they used to prepare sandwiches on site but more restrictions around staffing and time meant that pre-packed foods were introduced. To revert to preparing sandwiches on site was unfeasible with the current catering practices.

“Well from my point of view ... I ain't got a prayer. It wouldn't work. Because I haven't got the manpower... I haven't got the space. It's not that kind of [sandwich] counter where you pick [make] your own sort of thing. It's just a grab and go.” (C31)

Whilst unable to control what ingredients used to make the pre-packaged sandwiches, catering managers did agree that they could change the sales mix to increase the quantity and variety of vegan and vegetarian sandwiches that were available. Intervention ideas to enable customers to choose more environmentally friendly options, e.g. increase the proportion of vegan and vegetarian sandwiches, was therefore considered viable as this was practically feasible.

“...we don't have any ability to dictate to [the suppliers] what goes into the sandwich, we've got the ability to choose what sandwiches we sell, so if we're wanting to change the sales mix we could”. (C2)

Although as discussed before, the extent to which this would work considering the potential food waste and risk of customers defecting was questionable.

The proposal to prepare a low-cost vegetarian meal onsite using misshapen vegetables from supermarket cast offs was not considered feasible for several

reasons. Firstly, the catering service can only use certain suppliers that have been approved by The University Catering Organisation, therefore they wouldn't be able to access supermarket suppliers. Secondly, because most food available in the canteens is bought pre-packaged, not every outlet has space and facilities to prepare the food. What's more, preparing food on site requires catering staff time and skills that would incur a considerable expense.

"...it would take somebody to prepare the vegetables, it would need somebody to then cook the soup, we may not have the equipment in a particular area to do that, so the cost actually would be higher." (C4)

Intervention proposals that utilised existing resources and aligned with current catering practise were considered more practically feasible. For example, incentivising eco-friendly options using the electronic loyalty rewards system, (GeniUS card) was considered feasible by catering management and team leaders. This was a system that was currently in place and commonly used for promoting specific products in the cafes.

"... It's easy to do. We've done it before on different things. Like on offers. So yea it's feasible that." (C31)

"I think that if you had posters up in the venues, where people can see that they'd collect points if you buy eco-friendly sandwich...I think that is a great choice, I think it would work, definitely." (C43)

However, other participants expressed the view that whilst it was feasible, they were not convinced that it would influence customer choices, as they believed that not all customers were interested in collecting GeniUS points.

4.4.2.2 Caterings staff support, skills and knowledge

Some of the intervention ideas required additional work and staff support, which raised concerns about their practical and financial feasibility. The extent to which it was feasible to use labels, either product or counter, to indicate environmental impact of products was debated. Some catering managers implied it would be too time consuming, labour intensive and too difficult to make accurate. Others expressed concerns about accuracy of the environmental impact values presented by the researcher as they did not account for the fact the milk was locally produced. Another concern was that it would not be practical to use counter labels as the products and menus change frequently and it would not be possible to keep

up with the changes. Other intervention ideas based on information provision were considered more practically feasible. The implementation of posters required relatively little additional work from staff and would not impact on their workload. However, several staff expressed the view that posters would work best if they were supported and endorsed by catering staff in the outlets.

“..with the best will in the world, you can do a lot of posters, and it might raise awareness, but it, there's nothing more impactful than when you're stood at a counter and are undecided what to eat and the staff say, 'have you tried the choice of the day? It looks great'. (C1)

“You know the staff working there... it's their involvement as well...if you stick a poster on the wall, if you ask the guy behind the counter, 'what's that about?' and he just shrugs his shoulders, well then your posters not [going to work]... its' about staff involvement as well... they've got to have the product knowledge as well haven't they to be able to sort of back up. Otherwise...it is just another poster on the wall isn't it.” (C3)

Whilst it was acknowledged that catering staff involvement would be needed to support the delivery of messages about posters and notice boards, there was little discussion about the impact this would have on their workload. However, the catering managers acknowledged that it would require their input to make sure that the catering teams embraced the intervention and were implementing the programme as agreed. The extent to which this would be feasible in the long term across multiple outlets was questioned.

“...also from our point of view, it's making sure that the teams embrace it on those days... there's twenty odd outlets, and do if you tried to do it everywhere you wouldn't necessarily get everybody nailing it like you'd want them to, so we have to put some input in from our side to make sure it's delivered as well”. (C24)

For catering staff to be able to verbally support interventions it would be necessary to have sound knowledge of the environmental impact of food options. Some catering managers and team leaders expressed a lack of understanding around what constitutes environmentally friendly food and why. There were several occasions where the researcher was asked to explain the reason why the food choices were ranked as they were. There were also instances where catering staff offered examples of environmental sustainability efforts which were of little environmental benefit.

"I don't understand why it's so, if you're talking about, like the sustainability as far as using wheat and things, why is that more environmentally friendly than having a field full of cattle?" (C32)

"But we do a lot of fair trade, so we are helping the environment in that way by what we do is fair trade ... A lot of our things are fair trade." (C43)

4.4.2.3 Impact on profit margins

Implementing an intervention to encourage sustainable food consumption was perceived as financially feasible by some commercial service managers who expressed the view that financial gains could be made through an intervention in the university cafes.

"Equally, well interestingly, obviously for us, anything that impacts margins is important... and all the items that fall into the highest environmental impact are actually our highest, probably our highest purchase prices items... So anything we actually do to reduce that is a good thing. So it's good for business, it's good for the environment, and for me it's, you know, we'll be in support of it." (C1)

"...the products that we're talking about here [that] are less environmentally damaging can be cheaper products, it's just that it depends on whether they're advertised and marketed in the right way... so if there is that incentive that those products are better, then obviously it's a win-win in that case." (C26)

However, other catering managers and team leaders expressed concerns over the impact an intervention could have on profit margins, especially the ideas to guide choice through disincentive and increase the price of products with a high environmental cost. Hot drinks were a very popular cafe choice and a key strategy employed by the catering department to boost profits is to ask customers if they would like to purchase the larger serving at the till- upsell.

"...I'm looking at some of the lists [of high impact products] and my first thought was, how are we going to achieve sales if we take away, Coca-Cola and large drinks. You know we're always trying to up sell to encourage people to buy bigger... more expensive and more... tempting items."(C2)

Similarly, the idea to have an eco-friendly meal deal was not feasible due to the perceived impact this would have on the profit margins. Altering prices evoked concern, as catering outlets were already in competition with much larger retailers for customers, and given that price is such an important factor influencing food

choices, any changes to prices would not be well received by customers. These intervention ideas were therefore considered too great a financial risk to be feasible. Furthermore, concern over additional financial costs of procuring environmentally friendly products were raised by two catering managers.

"Wherever possible where we can make an ethical purchase we will. But sometimes, well, most of the time, we have to protect the finances as well."
(C2)

"There's a misconception that they're a cheaper option if it's meat free or something like that, a lactose-free product for example...it costs us more to produce that for a particular client or event, so the margins are already less because those kinds of things do cost more." (C4)

Table 4-6 Summary of caterers' views of the intervention ideas proposed

Intervention idea	Summary of caterers views
Information provision	Posters and notice boards were considered most favourable in terms of being a continuation of their marketing strategy, informing people about environmentally friendly options. They were least likely to affect custom and they could help improve their reputation. They were also considered least costly in terms of resources requires and staff. However, lack of space was a practical consideration reducing their feasibility. Similarly, their efficacy in engaging customers and influencing choices was considered limited. Labels were considered less financially feasible due to the additional expenditure required to calculate the environmental impact of the cafe choices and keep this information up-to-date. They would also require considerable staff time and in ensuring the labels were fixed appropriately and visible. There was also a risk of shaming customers, which could have a negative impact on custom and income.
Enabling choice	There was limited scope for increasing the amount and variety of eco-friendly options, partly because much of the food available was pre-packed and there were no facilities to prepare food on site. Team leaders were apprehensive over changing the proportion of vegan and vegetarian sandwiches over concerns they would be left with more food waste.
Guide choice through changing default	Promoting only the eco-friendly products and having only them visible in the cafes was considered unfair and highly likely to deter customers. Providing smaller portion sizes and servings did not align with their business model to provide a large range of choice to customers and was in tension with their marketing strategy to 'upsell' larger drinks.
Guide choice through incentive	Altering the prices of cafe options was likely to affect profit margins therefore there careful consideration of which items would be affected was needed. Since most of the vegetarian vegan sandwiches were in the lower price bracket anyhow, reducing the price of these items was unlikely to have a large impact on sales. Rewarding EF choices with GeniUS points was considered more financially feasible, and more practically feasible as it was a system they currently had in place and commonly used to promote products. However, concerns over the effectiveness of such a scheme were raised by some team leaders.
Guide choice through disincentive	Increasing the prices of popular items was considered unfair to customers and too financially risky- likely to reduce of number of customers.
Restrict choice	Restricting the number of days in which the high impact and/or meat products were sold in the cafes was considered unfair and financially too risky. Catering staff believed it could damage their reputation and they would lose customers to other outlets/businesses.
Eliminate choice	Removing items was not financially feasible and was not considered an option by catering managers. Most team leaders disregarded it too as they wanted to protect customer choice. However, two thought it might be feasible to remove some of the high impact options, provided there was still variety in the choices available.

4.5 Results: An acceptable and feasible intervention

This section compares the views of the customers and caterers to help identify the characteristics of an acceptable and feasible intervention idea.

Most customers and caterers expressed support for the implementation of an intervention to encourage environmentally friendly food consumption on campus. University caterers were actively working to procure goods that were certified with sustainability labels, and were willing to extend this work further. Many customers welcomed the provision of HEF foods and implied improving their access to sustainable food would enable them to make better choices, provided there was no additional cost. Similarly, caterers were willing to procure EF foods provided they could do so within the financial restraints in which they operate. This highlights that both customer and caterers consider university food outlets to be in a strong position to support HEF food consumption and should act to do so but were conscious that such actions should have minimal cost implications.

However, some caterers believed that using the catering establishments to influence customer food choices for health and environmental gains was beyond their remit as a food service provider. They believed that their purpose was primarily to provide foods and generate income, which they could only do effectively by providing customers with options they preferred. They believed the health and environmental implications of food choices were the responsibility of the customers, and that they should be educated about the environmental sustainability issues regarding food. They believed their responsibility was to respond to customer demand and therefore that when customers began to demand EF foods, they would respond accordingly. This view was shared by one customer who expressed the belief that personal dietary choices should not be manipulated by institutions, such as the university, as this was beyond their remit as a commercial enterprise. This demonstrates that there are a variety of views held by the university community, and that some believe that food choices are based on personal freedom. It also highlights that some may resent or oppose interventions that appear to remove or restrict personal choice.

Customers and caterers both supported the idea of an intervention to increase awareness and provide information about the choices available in the university food outlets. However, customers expressed scepticism in the reliability of food

labels and implied it would be difficult for the university to trust the suppliers and the information they were being provided with. Similarly, catering staff also expressed concerns over labelling products with their environmental footprint expressing doubt over the accuracy of data presented by the researcher. They also expressed concerns that labels might shame customers into avoiding products, which may have an impact on return custom thus income. Lack of trust in information about food and supply chains is a key challenge to dietary interventions, and may be reflective of persistent ill feelings following relatively recent food authenticity scandals. For example, the Horsemeat scandal of 2013 (Barnett *et al.* 2016). Providing credible and trustworthy information regarding environmental impact will be important to effectively influence food choices on campus.

Catering staff believed that their sustainability efforts were not publicised enough and that extra work could be done to rectify this. They perceived a point of purchase intervention as an opportunity to extend their sustainability efforts, and raise the profile of their current endeavours. Catering staff agreed they could support an intervention to raise awareness about sustainability issues with customers and believed it aligned well with their marketing strategy. However, several customers expressed doubts in the sustainability claims of university caterers. Whilst information provision may be tolerated, intrusive interventions based on these sustainability claims may be less readily acceptable and could cause animosity amongst customers, thus potentially having adverse financial implications.

The acceptability of interventions to alter the choices available varied depending upon the number and variety of options available. Time pressures and multiple trade-offs at point of purchase were key reasons that customers believed they would rather be 'forced' into choosing an environmentally friendly option through the provision of only EF foods. However, when discussions focussed on interventions to restrict the availability of meat products (Meat Free Mondays) participants expressed less enthusiasm. The most common argument against this proposal was that, whilst they personally would not object, their peers would consider it unfair, aggressive and forceful. This language implies that customers perceived it to be a direct attack on one's identity and values as a meat-eater. One participant responded: '*would you then do a no vegetable Tuesday?*' (MS29). This

indicates that the perspective and purpose of the intervention was lost and rather than reducing the environmental impact associated with food choices on campus, it was about influencing personal beliefs and values. Some students expressed the belief that it would be wrong if customers took offense to the lack of meat availability implying that it questioned one's morality. MFM appears to cause one to reflect on the consumption of meat, and question whether it is morally right to eat meat, which can cause discomfort and aggression. Even vegetarian customers perceived the intervention as 'heavy-handed', but welcomed the idea.

Caterers were also conscious that restricting or eliminating the meat choices would not be acceptable to customers who valued having their preferred choices available. Most catering managers believed that implementing a Meat Free Monday, in which meat options were removed from the shelves on a Monday, was not acceptable considering the financial risks involved. They did not believe it viable to provide only plant-based options, even if it was just for one day a week. However, there was some support from catering managers who believed it could be feasible provided there was still a variety of appealing options available. Any action to reduce the consumption of meat and animal products was supported by vegan and vegetarian customers who hold strong moral beliefs about the consumption of other animals. This suggests that one of the motivations for choosing environmentally friendly food is for moral reasons and for the feeling of doing a good deed, an altruistic, selfless act.

Doubts about the effectiveness of a point of purchase intervention were expressed by both customer and catering staff. Despite requesting information provision, customers expressed doubts over the influence it would have on their choices that were made in time pressured environment, where other ideals and values tended to prevail. Similarly, catering staff did not believe customers acknowledged the marketing material installed in the university food outlets. Caterers also implied that whilst a point of purchase may help to raise awareness about environmental concerns, it was unlikely to influence customer preferences. They also believed that it was unlikely to change the choice of the customers at point of purchase, since most customer had decided what they intended to eat prior to visiting the outlet. One customer also expressed doubt over the extent to which a point-of-choice intervention would affect their long-term food choices, implying that their dietary habits were formed at a young age and therefore implementing a Meat Free

Monday was unlikely to change this. This reveals that whilst most participants in this study supported the idea to raise awareness of EF food, very few believed that this would effectively change their dietary practises.

4.6 Discussion

This study aimed to identify a culturally acceptable and feasible point-of-choice intervention to implement in the university catering service to support environmentally friendly food consumption. To do this there were four study objectives: i) to identify determinants of food choices made by staff and students in the university setting ii) to establish the perceived barriers to choosing healthy and environmentally friendly food choices in the university setting, iii) to explore the acceptability of a point-of-choice intervention with the university food outlet customers and caterers, iv) to determine the feasibility of point-of-choice interventions with university caterers.

The following section summarises the principle findings of the study in relation to the literature that explored the views of university students and employees in similar workplace settings. Strengths and weakness of the study are discussed and the final section outlines the implication these findings had for the intervention development process.

4.6.1 Summary of principle findings

4.6.1.1 Determinants of food choices in university/workplace settings

Customer food choices on campus were influenced by multiple factors including personal values, attitudes and food beliefs (previous experience, food attributes) that were shaped by the social-cultural norms (ethical considerations), social occasion and the university setting (social occasion and setting, convenience and time, financial considerations, food availability). Whilst six distinct subthemes emerged from the analysis, these themes were prioritised or compromised according to specific circumstance. However, salient food beliefs, such as those underpinning veganism, were never compromised. Most participants adhered to an omnivorous diet, thus the social norm was to eat meat and animal products yet some participants avoided them for religious or ethical reasons. This highlights that food choices on campus are influenced by multiple factors on various ecological levels. This is in keeping with existing ecological models of food choice, which have identified various personal, interpersonal and environmental factors

influencing food choices (Contento 2011; Deliens *et al.* 2014; Story *et al.* 2008). Together these findings demonstrate that an intervention to support HEF eating on campus will need to address multiple determinants of food choice behaviours, on individual and environmental levels. This reiterates the importance of the university setting to create supportive, healthy, and environmentally sustainable eating environments.

Taste, convenience and price were reported to be the main drivers of food choices on campus. This is consistent with the findings of others who have explored determinants of students' food decisions in university settings in Australia (Tam *et al.* 2017) and North America (Marquis *et al.* 2005, Boek *et al.* 2012) and food eaten outside the home more generally (Hebden *et al.* 2015). Convenience has also been reported to be an important driver of food choices by customers in other workplace settings in Europe (Price *et al.* 2016) and the USA (Blanck *et al.* 2009). Financial considerations were reported to be important by both staff and students, with the perceived value for money being a key part of the decision-making process. It was not considered financially viable to purchase food on campus every day due to the cost of the food available, and many reported bringing food from home or purchasing off campus. There was some resentment amongst staff and students at the cost of the food, which was considered by some to be of poor or average quality. Price has been found to be one of the most influential factors of food choices across a variety of populations and settings including a university (Tam *et al.* 2017). Reducing costs of healthy choices has been proposed as an effective strategy to improve food choices within a university setting (Roy *et al.* 2015; Tam *et al.* 2017).

Healthiness of choices was considered important by some participants, yet this was often compromised depending on eating occasion and time available. Participants reported intentions to make healthy choices on campus but explained that healthiness was a lower priority when faced with multiple trade-offs at point of purchase. For example, healthiness was considered less of a priority when socialising with friends or colleagues where choices were considered a 'treat' or when participants were hungry and wanted something filling to keep them going throughout the day. This supports the findings of other (Marquis 2005; Nelson *et al.* 2009) who reported that the healthiness of food choices often becomes a lower priority for college students or when they experience competing commitments.

Some participants noted limited availability of appealing healthy options, specifically hot healthy choices, to be a key barrier to the consumption of healthy food on campus. Availability and appeal were considered important barriers to eating healthily in cafeterias in workplace setting (Price *et al.* 2016). The lack of variety and tastiness of vegetarian sandwich options has been noted as a key barrier to people wishing to make more environmentally sustainable food choices in supermarkets. *Eating Better*, (an alliance for sustainable food consumption) conducted a survey of sandwiches available in 8 leading supermarkets and 4 high street chains and noted that only 17% of sandwiches were vegetarian and that <3% were vegan (Eating Better 2015) . Together these results indicate that to enable customers to choose healthy and environmentally sustainable choices it is important that the catering service provides EF choices that are visually appealing, tasty, filling, convenient and affordable.

This study revealed that compared to health, the relationship between food choices and the environmental impact of food is rarely considered. Only some vegetarian or vegan participants cited the environmental concerns as a key factor influencing their dietary choices prior to being asked. This is consistent with the work of Hoek *et al.* (2017), who interviewed Australian consumers and found that only one highly motivated participant spontaneously mentioned environmental impact of food as influencing food decisions.

Food choices were largely informed by previous experience of the outlet and choices available. Participants insinuated their food choices were made prior to visiting the outlets where they knew specific options would be available. Team leaders described instances where customers arrived expecting to purchase a specific food and were reluctant to change their choice upon reaching the outlet. These findings reflect the effective 'branding' marketing strategy used by the university caterers to encourage return custom and to instil habitual purchasing habits. The results of this study suggested that food outlet marketing strategies do influence customer food choices and decisions.

4.6.1.2 Perceived barriers to environmentally sustainable food consumption

The study identified multiple perceived barriers to the selection of HEF choices in the university setting. Barriers discussed were physical barriers, such as lack of availability of HEF options, lack of information/labels to identify HEF options, but

also conceptual barriers, such as low appeal of HEF options, poor knowledge and awareness of HEF choices and perceived exclusivity of veganism. This highlights that changes are needed in the university food environment to overcome the physical barriers to HEF foods such as making them more accessible, but that attitudes, beliefs and values need to be addressed to overcome the conceptual barriers to the consumption of HEF foods on campus.

Few studies have explored the barriers to HEF food consumption in university settings. However, studies that have examined the availability of healthy food on university campus have revealed that the majority of food choices available are energy dense and nutrient poor (Roy *et al.* 2016). In addition, students have reported wide availability of unhealthy options to be a key factor influencing their food decisions in a university setting (Deliens *et al.* 2014).

Studies have also implied that poor knowledge of nutrition is a barrier to the selection of healthy options in a university setting (Roy *et al.* 2015). In this study, customers cited lack of awareness and information or labels as a key barrier to the selection of HEF foods on campus. This suggests that low awareness and understanding of environmentally friendly food were key barriers to their consumption on campus. This is in keeping with the results of a survey of Finnish students who scored high costs, poor supply and lack of knowledge as the important barriers to climate friendly foods (Mäkinen & Vainio 2014). Most participants in the present study discussed the environmental implications of food choices in terms of localism, airmiles and food packaging. This is consistent with the findings of (Tobler *et al.* 2011) and (Clonan *et al.* 2010) who found that customers in Australia and the UK consider air miles and packaging to be the most important environmental issues regarding food. This indicates that customers are not aware of the emerging evidence that the transport and packaging of foods, such as sandwiches, contributes a much lower proportion total environmental impacts than the agricultural phase of production (Espinoza-Orias & Azapagic 2018). It also indicates that customers are less aware of the differences in the environmental impact of products between food categories, i.e. meat and animal products have a greater environmental impact than plants foods. Hoolohan *et al.* (2013) found that eliminating meat consumption reduced food related GHGE by 35%, whereas avoiding air-freighted and hot housed food reduced it by only 5%. The findings of this study are consistent the results of a YouGov Survey

commissioned by the Eating Better Alliance which found that only 28% of a representative sample of the Great British public agreed that livestock production had significant impacts on the environment (Dibb & Fitzpatrick 2014). Similarly, a study in the US, found that less than 10% of the college students sampled associated meat consumption with climate change (Truelove *et al.* 2012). Together these results suggest that raising awareness and knowledge about the environmental implications of meat and animal products with customers and caterers will be necessary to support the consumption of more HEF foods on campus.

Customers and caterers in this study expressed doubts over the environmental benefits of a dietary shift towards plant-based diets. This is consistent with the results of a survey of Flemish consumers, which revealed that many underestimate the environmental impact of meat production and were most reluctant to reducing or replacing meat for environmental sustainability concerns (Vanhonacker *et al.* 2013). The British YouGov survey found that 30% of participants were not willing to reduce their meat consumption (Eating Better Alliance 2013). Similarly, a qualitative study by Macdiarmid *et al.* (2016) found that UK consumers were less inclined to reduce their meat consumption for environmental reasons with scepticism in scientific evidence, exacerbated by media reports, given as a key reason why people were not willing to reduce their meat consumption for environmental reasons. The portrayal of sustainability issues in the media was identified as cause of confusion amongst customers in this study, who were left uncertain about what dietary advice to act upon. These findings highlight the important role the media has in influencing food decisions, and how mixed messages can confuse and deter customers from following healthy dietary advice.

In addition to media influences, some participants explained they believed that they did not consider the environmental impact of food choices because they were already performing other pro-environmental behaviours such as recycling. This supports the idea of 'compensatory green beliefs' whereby people believe that pro-environmental behaviours off-set the negative effects of behaviour that is detrimental to the environment (Kaklamanou *et al.* 2013). For example, not eating red meat reduces carbon emissions and can therefore compensate for those generated by flying abroad on holiday (Hope *et al.* 2018). It presents a key challenge to address when developing behaviour change interventions. This

reaffirms the importance of clearly communicating to customers how important dietary choices are for the environment sustainability, and which food choices are most beneficial for health and the planet.

A perceived barrier to the consumption of HEF foods on campus was an absence of, and lack of understanding of sustainability labels. Customers and caterers appeared to consider ethical labels, such as animal welfare or Fairtrade to be synonymous with environmentally friendliness. This indicates that at present there is much confusion over what foods are healthy and environmentally friendly. Whilst clearly labelling foods to indicate whether they are environmentally friendly may be considered useful, sustainability labels are not commonly utilised by customers (Grunert *et al.* 2014) an admission made by participants in the focus group. Use of sustainability labels has been found to be related to motivation and understanding, which are affected by demographic characteristics, human values and country differences (Grunert *et al.* 2014). However, a study in France found that providing Environmental Information Cards in a an experimental market setting appears to have the potential to effecting steer consumers towards more EF food purchases (Vlaeminck *et al.* 2014). Moreover, labelling foods with their carbon footprints has also found to effectively influence customer food choices in a supermarket setting (Vanclay *et al.* 2011). However, the extent to which such labels work in a cafeteria setting requires further investigation.

Customer attitudes and beliefs about sustainable foods are important determinants of their food choices behaviours. As such interventions to change dietary behaviours will need to address the values and beliefs to be effective. The perceived exclusivity surrounding vegetarian and vegan foods is also important to overcome to address the widespread selection of more plant-based foods.

4.6.1.3 Acceptability and feasibility considerations of workplace interventions

This study revealed differences in opinion amongst the university population over the extent to which the university should or could be promoting environmentally friendly food choices in the university cafes. Whilst most catering managers agreed that they should, and believed that they were already supporting HEF food choices on campus, the extent to which they should start to alter or reduce the availability of unhealthy options was disputed. Some caterers expressed reservations over implementing a workplace intervention to influence food choices as this was

perceived to be the responsibility of the individual, rather than the institution. This supports the findings of Linnan *et al.* (2007), whose survey of managers revealed varied beliefs with regards to health promotion at work. This could have implications for the extent to which the scheme is supported and implemented effectively by caterers.

Most customers in this study expressed support for a university intervention to promote healthy and environmentally sustainable eating. This is consistent with the findings of other who found that employees believed that the public sector should promote healthy eating at work (Devine *et al.* 2007) and ought to consider sustainability and environmental issues in their food provision (Pridgeon & Whitehead 2013). In the university setting, Howse *et al.* (2017) found that 95% of students surveyed agreed that the university should promote the health of its students and staff. However, they also found that whilst most participants in the study supported the notion to regulate sugar-sweetened beverage consumption, their support varied with the type of intervention proposed. Interventions requiring higher levels of personal choices such as information provision and incentives were considered more favourable than those which were perceived to remove personal freedom. This is consistent with the findings of this study whereby interventions that removed choice, for example MFM, were perceived to be unacceptable to some customers, as they perceived them to be forcing choice and removing personal freedom to choose. Some participants did not consider it the 'role' of the university to determine access to certain food choices, which suggests they believed customers should take full health and environmental responsibility for their food choices. Together these findings suggest that at present, environment-centred interventions may be less acceptable to university populations who express strong beliefs in personal freedom of choice and individual responsibility. However, as Howse *et al.* (2017) argue, such views ignore the powerful environmental cues that reduce the ability of people to make 'free' choices and suggest that information campaigns should focus on challenging the concept of free choice in the food and beverage environment whilst teaching skills of critical analysis of marketing.

Whilst most customers expressed the belief that the university had a responsibility to encourage HEF food consumption, (when HEF options were considered local produce), when discussions focused around restricting the availability of meat

options, more customers tended to change their position towards favouring interventions with higher personal responsibility. This is consistent with others who have found that some people are less willing than others to reduce their meat consumption (De Boer *et al.* 2014). An undergraduate study in Canada exploring the acceptability of cafeteria intervention to reduce meat consumption of food found that MFM were considered least acceptable to university students and caterers (Gao *et al.* 2014). The most acceptable strategy was replacing a greater proportion of lamb and beef with other meat alternatives such as chicken, pork or fish, followed by reducing portion sizes of lamb and beef dishes with a concomitant reduced price. This affirms the growing body of literature around the concept of meat-attachment, where people express an attachment towards meat that reduces the likelihood of them accepting strategies to reduce meat consumption (Ao Graça *et al.* 2015). Men tend to be more reluctant than women to endorse meat reduction and reduce their meat consumption (Ruby & Heine 2012).

Information provision was favoured as an acceptable intervention by both customers and caterers. This is consistent with the findings of Turconi *et al.* (2012) where students reported having nutritional information at point of purchase useful and allowed them to plan their meals according to a more balanced diet. However, another key finding with regards to the acceptability of the information provided was the trustworthiness of the information provided. Whilst participants expressed doubts over trustworthiness of labels, customers welcomed information provision. This is consistent with the findings of Price *et al.* (2016) who noted that although nutritional information and labels are not always utilised, they are important as they provide transparency and reassurance to the consumer. In addition, labels are used by those actively seeking them, thus are useful for making informed decisions (Grunert *et al.* 2014). However, the finding of this study highlight that labels need to be credible and trustworthy to be acceptable and effective in the university setting. Restaurant managers have acknowledged providing information about the social and environmental qualities of food served could appeal to their customers, but that limited resource availability was a primary barrier to capitalise on menu labelling (Filimonau & Krivcova 2017). Personal views and perceived obligations are important factors influencing the caterer's intention to adopt sustainable practises (Chao-Jung *et al.* 2011).

Financial considerations were the main priority of caterers when discussing point-of-choice interventions. The perceived additional cost of some of the intervention ideas reduced their feasibility. This is a similar finding to Smith *et al.* (2017) who noted tight budgets were a perceived barrier to providing healthy choices by intervention implementers in workplaces in the North East of England. Furthermore, the financial risk associated with providing only healthy or environmentally friendly options was a key concern of caterers. This is consistent with the results of Park & Lee (2015) where the need to adhere to customer preferences for financial viability was a key barrier to the implementation of reduced sodium meals in worksite cafeterias in Korea.

Caterers considered the use of the existing loyalty rewards scheme more financially viable than reducing costs of cafe options. Customers considered the use of the GeniUS rewards points to be an acceptable strategy to promote HEF options in the university cafes. This finding supports that of (Ni Mhurchu *et al.* 2012) who explored the acceptability of economic incentives to promote healthier food purchases in New Zealand. Their study revealed that delivery of the incentive and magnitude of the incentive was factors that would influence their uptake of the scheme. Electronic swipe cards were considered the most convenient mode of delivery of the incentive the with 10% cash back or vouchers for items other than healthy foods considered the most desirable form of incentive.

Practical concerns relating to the university catering environment including lack of space, facilities and resources determined the feasibility of intervention ideas, and subsequently limited the number that were considered feasible. The relatively recent move from freshly prepared foods towards the procurement convenience foods had limited the number of facilities, resources and skilled staff available to reformulate implement some of the intervention ideas proposed.

Caterers believed that the success of the intervention would depend on the verbal advocacy and support of the catering staff in the cafes. It was acknowledged that this would require additional time and effort from the middle management. However, there was little consideration of the additional training, guidance and support needed for caterers in the outlets. Training of caterers has been noted to be essential for effective intervention implementation and evaluation (Holdsworth & Haslam 1998).

4.6.2 Methodological strengths and weaknesses

As far as the author is aware, this is one of the first qualitative studies to explore the acceptability and feasibility of an intervention to increase healthy and environmentally sustainable food consumption in a university setting in the UK. Other studies have examined factors influencing the acceptability of a university-based intervention to support healthy choices (Howse *et al.* 2017) and identified factors influencing healthy behaviours on campus (Nelson *et al.* 2009; Tam *et al.* 2017) or in the workplace (Thomas *et al.* 2016). Some studies have explored student attitudes towards sustainability initiatives on campus (Emanuel & Adams 2011), and strategies to reduce meat consumption (Gao *et al.* 2014), but this is the first to consider HEF food consumption specifically. Understanding the key drivers of food choices on campus help to identify the key behavioural determinants that the intervention should address and can ensure that any information provision or promotion that forms part of the intervention aligns with customer preferences and values.

This qualitative approach allowed the identification of potential barriers to the consumption of HEF foods on campus. It enabled the researcher to probe participants for deeper understanding about the acceptability and feasibility of intervention ideas to inform the intervention development process. Consideration of these concerns shared by those in the specific context in which the intervention was to be implemented helped to increase the likelihood of success.

However, there are several limitations to this study. Firstly, only members of the catering management team were included in the study. It would have been useful to obtain the perspectives of catering staff at all organisational levels. However, the amount of time catering staff had to participate in this study was limited by work commitments. Whilst several intervention ideas were presented to caterers, this meant that there was limited time available to discuss the ideas thoroughly. In addition, whilst some intervention ideas were proposed in the focus groups with customers, not all intervention ideas were discussed. Future studies should propose fewer intervention ideas for discussion to allow the collection of more in-depths insights into the reasons why the ideas are considered acceptable and feasible or not.

Around 11% of the customers who participated in the study were vegetarian or vegan which is much greater than the 3.25% of the British population reported by the Vegan Society (2016). This suggests that sample may have been biased towards those who are more conscious about what they eat. Furthermore, most of the customers in the focus groups were female. Gender differences have been noted in knowledge, attitudes and beliefs around food choices, particularly with regards to healthy eating and reducing meat consumption (Clonan *et al.* 2015; Vanhonacker *et al.* 2013). Women are more likely to exclude certain food groups, especially meat, due to health concerns or other beliefs such as animal welfare (Ruby & Heine 2012). Furthermore, very few participants were affiliated with any environmental groups within the university. People that have stronger environmental beliefs have been shown to be more willing to reduce their meat consumption for environmental gains (Ao Graça *et al.* 2015), and express more support for pro-environmental food policies, pro-environmental food purchasing and intention of purchase pro-environmental foods (Worsley *et al.* 2015).

Whilst the focus groups were stratified by occupancy to avoid unintentional influences, some participants were friends or colleagues, which may have affected the dynamic of the group discussions and influenced the responses of other participants more strongly. Furthermore, the preliminary questionnaire at the start of the focus groups revealed that some participants used the university outlets less often than specified on the recruitment poster. It was assumed that those who responded to the advertisement met the recruitment criteria; therefore further screening was not undertaken. This may have implications for the findings in so far as some of the participants may have been less familiar with the food and beverages available in the university food outlets and therefore may have held opinions and views about the food choices available that were different to regular cafe users. Nevertheless, this sample was not intended to be representative of the university population and the views of these customers were still valid and included in the analysis. It is possible that there were only few university staff or students that used the university cafes more frequently than once a week; future work should seek clarification on this point.

The topic of sustainability and environmental protection can be perceived as an ethical and moral issue, which may have elicited responses perceived to be socially acceptable, rather than open and honest. Participants may not have been

deliberately trying to deceive or lie, but simply unaware of their tendency to give the more socially desirable response (Streiner *et al.* 2015). This may have been apparent, particularly when expressing their views and beliefs about the importance of environmental protection. They may have expressed views that they do not necessarily have because they think it is more socially desirable. Similarly, participants were aware the study was being conducted by a researcher in the Human Nutrition Unit, therefore it is possible that participants may not have responded truthfully to questions about their eating habits on campus. For example, they may have avoided reporting unhealthy food choices. To overcome these issues, participants were reminded at the start of the focus groups that there was no right or wrong answers to the questions, they were encouraged to provide honest views and opinions, and given reassurance that their responses were all valid and valuable.

Thematic analysis was undertaken by a single researcher (FG), thus the themes generated are potentially subject to bias. Without a second coder, the themes produced reflect only one individual's interpretation of the transcripts. This introduces bias and reduces confidence in the accuracy of the themes generated. Having a second researcher to read the transcripts and identify the key themes that emerged from the data would have increased the reliability of the data interpretation. Nevertheless, to ensure the themes were data driven, FG followed a robust analytical procedure and regularly met with her supervisory team to discuss the analysis and emerging findings.

One of the key methodological issues faced during discussions with both customers and catering staff was the ambiguity over the term 'environmentally friendly foods'. Despite having been provided with information explaining that dietary shifts away from meat and animal products towards plant-based options and sustainable sourced fish was environmentally beneficial, participants were often confused. There was no clear definition provided around what constitutes EF food which hindered the discussions as it wasn't always clear what the focus of the discussion was, whether it was about the packaging of foods, or whether it was the distance the food had travelled or whether it was about plant-based choices. This left focus group participants confused about whether the intervention was about reducing meat consumption, or whether it was about reducing products with the most packaging, or providing only local product. Whilst it was useful to understand

what the term 'environmentally friendly' meant to participants, clarification about what cafe option were EF was necessary to elicit further insights into acceptability and feasibility concerns.

A pilot focus group would have helped to identify the issues above prior to data collection. However, a pilot focus group with members of catering staff was not carried out because there were insufficient caterers in the university to pilot the questions with. Piloting the questions prior to data collection may have influenced their responses. Time restrictions and the need to progress the study contributed to the decision not to pilot the focus group with customers. Piloting the topic guides would have revealed that there were too many questions to cover in a single focus group. Whilst large amounts of useful data were captured, using more follow up questions may have helped to generate a deeper understanding of the responses of the participants.

4.6.3 Implications for intervention development in this thesis

The findings of this study highlighted key acceptability and feasibility concerns the intervention should address. Key behavioural determinants of customers and caterers were identified and used to construct matrices of change objectives and a logic model of change (IM steps 2 and 3) and outcome and performance objects for programme use (IM step 5). Three main priorities were made when developing the intervention: i) to raise knowledge and awareness, ii) to maintain customer choice, and iii) to protect finances. These priorities were based on convergent views held by most customers and caterers about the acceptability and feasibility of a cafe-based intervention.

4.6.3.1 Need to raise knowledge and awareness

Focus groups revealed that customer knowledge and awareness about the environmental implications of their food choices was low. It followed therefore that the intervention should be designed to raise awareness and understanding about the environmental costs of different foods, thus allowing customers to make informed decisions. Whilst it has been demonstrated that knowledge and intention to purchase sustainable food is not sufficient to bring about changes in behaviour (Vermeir & Verbeke 2006), it was important that customers understood the purpose and benefits of the intervention. Whilst increasing knowledge is usually insufficient to change behaviour, it is a pre-requisite for behaviour change as

people need to understand why their current behaviour is detrimental, and also how they can change their behaviour (Contento 2011). Calorie and nutritional information at point-of-choice has been shown to have a beneficial effect of students' food choices in the university setting (Buscher *et al.* 2001; Nikolaou *et al.* 2014; Peterson *et al.* 2010). Furthermore, the results of a survey of people in and around a university campus in New Zealand indicated that information provision about the climate impacts of meat consumption was associated with significantly higher levels of concern about the climate impacts of meat consumption and lower intentions to eat meat (Graham & Abrahamse 2017). Caterers also expressed uncertainty over the environmental impacts of different food choices. Baldwin *et al.* (2011) found that the greatest environmental gains for a food service provider in the USA would be through changing food procurement (reducing the amount of meat containing products). Similarly, a study of the environmental impacts of school food provision in Italy also revealed that reductions in the provision of meat dishes would achieve the greatest reductions in GHGE associated with their service (Cerutti *et al.* 2016). It is not clear whether all the university caterers in this study were aware that the largest environmental gains would be through procuring fewer meat options. It therefore followed that the intervention should be designed to increase the knowledge and self-efficacy of the caterers to ensure they were able to support the implementation of the intervention.

4.6.3.2 Need to maintain customer choice

Both customer and caterer focus groups revealed that the provision of choice was an important and valuable aspect of university catering. Customers valued having a range of food outlets and options available on campus and admitted food outlets that provided fewer options were less attractive. Most participants believed that any intervention should focus on maintaining or increasing choices, (more health and environmentally friendly options) rather than restricting or eliminating choices. Catering staff were aware that their customers preferred having a variety of options available and expressed concerns over interventions that limited choice, perceiving them as risky for business. This implied that interventions to support the consumption of EF choices should focus on enabling customers to choose EF options and promote these options to customers. However, a small number of customers and caterers held divergent views and expressed the belief that removing high impact options would have a greater effect on customer behaviour.

It follows therefore that not all points of view were incorporated into the design of the intervention. This may have affected the extent to which some caterers implemented the intervention as intended, as they may have believed that their views had not been considered in the development of the intervention. Similarly, some customers may not have responded positively to the intervention that was implemented, as they did not consider the intervention to be effective. It is plausible that customers and caterers may have responded differently to other intervention types that they considered more acceptable and potentially more effective than the one chosen in this study.

4.6.3.3 Financial constraints

Catering staff expressed concerns over the financial feasibility of some of the intervention options proposed. Similarly, customers revealed that their food choices were influenced by the cost and perceived value for money of the purchases. The acceptability and therefore efficacy of the intervention was dependent on ensuring no extra costs to the customer or vendor, and that the catering service would ideally make a profit. Customers suggested reducing the cost of the HEF options. Whilst this was not considered financially viable by the catering staff, they did consider it feasible to use the existing loyalty rewards scheme, GeniUS, to financially incentivise the HEF options.

Focus group participants were from diverse cultural backgrounds and as such there was a range of opinions about what was considered an acceptable intervention to implement. Most focus group participants considered the removal of high impact food choices (meat and dairy-based options) from shelves or restricting food options as least acceptable, indicating that fairness and free choice are shared values of the university's culture. Information provision and incentives were considered acceptable to all participants, and welcomed by most, thus this type of intervention was deemed to be largely consistent with norms and values of the university population.

The following chapter describes how the findings from this study and the literature informed the development of the intervention programme design.

5 CHAPTER 5: PLANNING AND DEVELOPMENT PROCESS OF THE PILOT: 'POINTS FOR OUR PLANET'

5.1 Introduction

This chapter provides a detailed insight into the use of the Intervention Mapping (IM) process and the integration of the results of studies 1 and 2 in the design of the intervention. The IM approach is an iterative process and presented sequentially in this thesis. However, there was much movement back and forth between steps during the development process. Details about the methods taken to pre-test and refine the intervention's programme components and materials are outlined towards the end of this chapter.

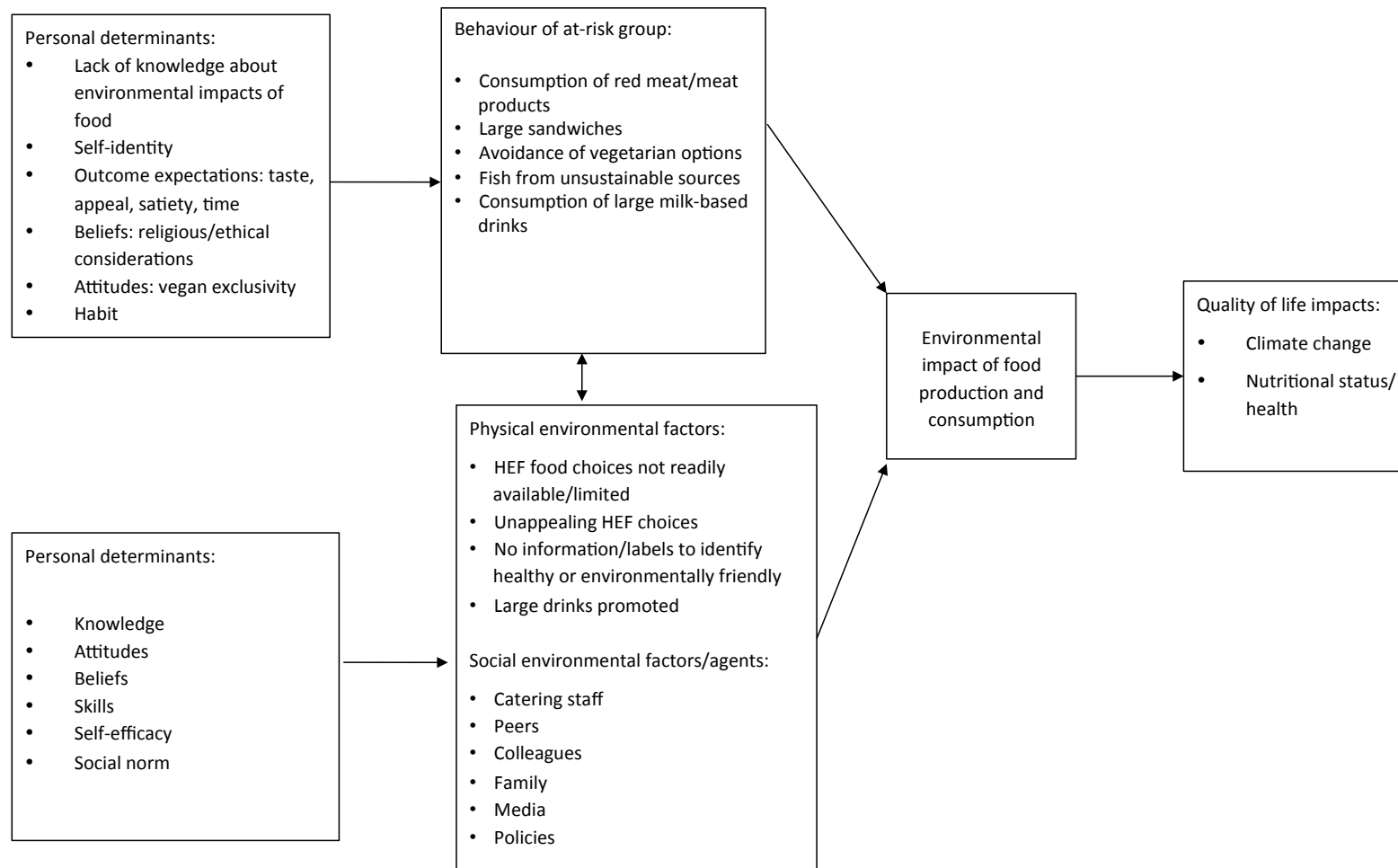
5.2 Logic model of the problem (IM Step 1)

The lead researcher, FG, conducted a needs assessment to analyse the environmental and potential health problems related to the overconsumption of resource intensive food and determine their cause. The evidence cited in the introduction to this thesis serves as justification for focusing on food choices made by staff and students in a university setting. Pertinent literature was reviewed to identify theoretical constructs that best predict student food choice behaviours (Contento 2011; Deliens *et al.* 2014; Munt *et al.* 2017; Story *et al.* 2008) including plant-based foods (Wyker & Davison 2010) and pro-environmental behaviour (Whitmarsh & O'Neill 2010). Literature was also review to determine which intervention strategies are most frequently used as part of successful interventions to promote healthy eating in the university setting and workplace cafeterias (Chan *et al.* 2017; Geaney *et al.* 2013; Kelly *et al.* 2013; Roy *et al.* 2015; Deliens *et al.* 2016).

To understand the environmental impacts of food choices made in the University of Sheffield, a quantitative research study was conducted to identify which food choices contributed the greatest environmental impact and posed greatest implications for health (Study 1, Chapter 3). To understand the behavioural determinants of food choices made by customers in the university cafe settings, and the factors underpinning the practises of the caterers, a qualitative study was conducted (Study 2, Chapter 4). Key determinants of behaviour and theoretical constructs were identified as described in Chapter 1.16 (Bartholomew *et al.* 2016).

The results of Study 1 and study 2 along with the current literature relating to the determinants for the consumption of unhealthy food, meat and animal products (Clonan *et al.* 2015; Mullee *et al.* 2017; Piazza *et al.* 2015; Ruby & Heine 2012), informed the development of the logic model of the problem (Figure 5-1).

Figure 5-1 Intervention Mapping Step 1: Logical model of the problem. Choosing to eat unhealthy, environmentally unfriendly food in university cafes.



5.3 Programme Outcomes and Objectives (IM step 2)

Study two revealed multiple interpersonal and environmental factors influence food choices on campus. However, it was necessary to narrow the focus of this thesis, such that only two intervention outcomes were selected (Table 5-1). It was decided that the intervention would focus on increasing the consumption of healthy and environmentally friendly foods choices in the university cafes (behavioural outcome) and creating an environment conducive to choosing HEF food choices (environmental outcome).

Performance objectives were subsequently identified for each of these intervention outcomes. Performance objectives were generated by asking the question: 'what do the participants in this programme need to do to perform the behaviour or to make the environmental changes stated in the behavioural and environmental outcomes?' (Bartholomew *et al.* 2016)

Table 5-1 Intervention mapping step 1: Programme outcome and performance objectives

Behavioural outcome: Cafe customers will choose to eat HEF food choices in university cafes

Cafe customers (University staff and students)

PO1: Customer plans to choose a HEF option in the university cafes

PO2: Customer identifies HEF choices in university cafes

PO3: Customer chooses to purchase HEF choices in University cafes

Environmental outcome: University catering service will create an environment conducive to choosing HEF food choices

Catering service (Catering management team/ team leaders/caterers)

PO4: Team leaders modify purchase orders to ensure there are sufficient HEF options supplied to meet demand

PO5: Team leaders modify the catering outlet promotional material in-line with a healthy and environmentally friendly eating messages

(Install promotional material- FG DID THIS)

Caterers

PO6: Catering outlets will promote HEF choices using GeniUS card rewards system

PO7: Catering staff will advocate choosing to HEF choices in the cafes

HEF- Healthy and environmentally friendly, PO-performance objective

The multiple determinants of these performance objectives were identified informed by focus groups with customers and caterers and the theories of behaviour. FG determined important and changeable determinants of these health behavioural and environmental outcomes that were feasible to target within this thesis (Underlined in Table 5-2, Table 5-3).

Table 5-2 Intervention mapping step 2: determinants of programme outcome 1; cafe customers will choose to eat healthy and environmentally friendly (HEF) food choices in university cafes.

Theory/Evidence	Determinants/Construct	Importance	Changeability
<u>TPB/RAA- precondition for personal attitude</u>	<u>Knowledge: understand why choosing HEF options is important for environmental conservation and health</u>	±	+++
<u>TPB/RAA precondition for personal attitude</u>	<u>Knowledge: identify HEF options</u>	±	+++
<u>TPB/RAA precondition for personal attitude</u>	<u>Awareness: Acknowledge food choices have implications for health and environmental sustainability</u>	±	+++
Habit	Learned response: purchase of HEF choices is associated with contingent reward and satisfactory /positive experience	++	+++
RAA/SCT	Normative belief: believe that eating HEF options in the cafes will help to reduce environmental burdens	++	+
RAA/SCT	Normative belief: believe that it is normal to purchase HEF options on campus.	++	+
SCT	Self-efficacy: feel confident enough to plan to eat a HEF food choices, identify HEF food and purchase HEF options on campus	+	+
Value belief norm theory (Whitley <i>et al.</i> 2016)	Values: value environmental protection and health	+	+
Self identify (Whitmarsh & O'Neill 2010)	Self- perception: identify as someone who consumes HEF choices	++	+
SCT	Outcome expectation: perceive the consumption of HEF choices to have positive health and environmental outcomes	++	++
TPB/RAA	Attitude: express a positive feelings towards eating more environmentally friendly food options on campus	++	+

Determinants underlined were selected for intervention development.

+ means: not very important/changeable, ++ means: important/changeable, +++ means: very important/changeable

TPB- Theory of Planned Behaviour, RAA- Reasoned Action Approach, SCT- Social Cognitive Theory

Table 5-3 Intervention mapping step 2: determinants of outcome 2; catering service creates and environment in the cafes conducive to customers choosing healthy and environmentally friendly options.

Determinants	Importance	Changeability
<u>Knowledge: understand why choosing HEF options is important for environmental conservation and health</u>	±	++
<u>Knowledge: identify HEF options</u>	±	++
<u>Awareness: Acknowledge food choices have implications for health and environmental sustainability</u>	±	+++
<u>Self-efficacy: Feel confident enough to answer questions from consumers about HEF meals.</u>	++	++
Normative belief: believe that eating HEF options on campus will help to reduce the environmental burden of food production.	++	+
Normative belief: Believe that it is normal to purchase HEF options on campus.	++	+
Values: value environmental protection as much as other determinants of food choices	++	+
Outcome expectation: perceive the consumption of HEF choices to have positive health and environmental outcomes for their customers	+	+

Determinants underlined were selected for intervention development.

+ means: not very important/changeable, ++ means: important/changeable, +++ means: very important/changeable

The literature was consulted to identify theory and evidence based methods to change these determinants of the individual and environmental agents' behaviour (see Step 4). Matrices of change objectives for each ecological level to be included in the intervention were devised (Table 5-4, Table 5-5). A logic model of change, outlining the programmes strategy was developed. (See Figure 5-2).

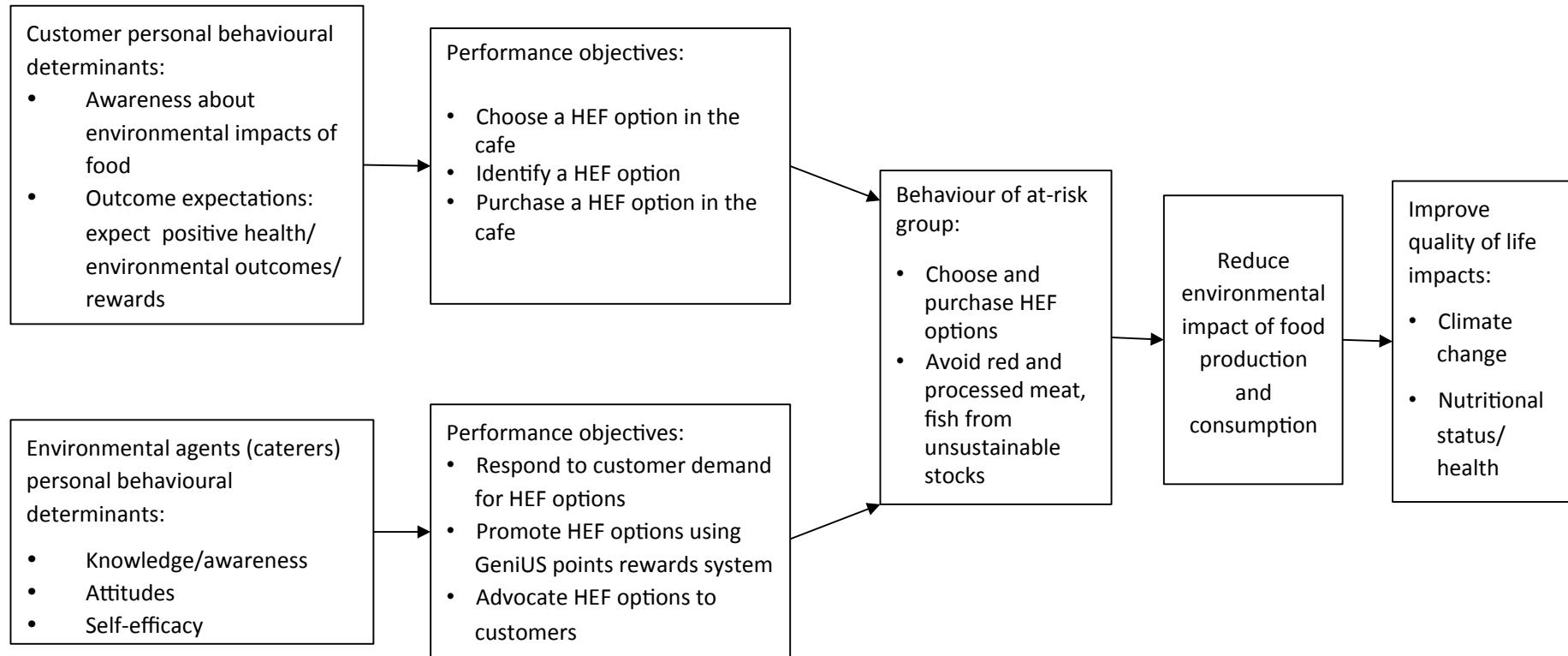
Table 5-4 Matrix of change objectives for customers at the individual level to address intervention behavioural outcome 1: customer choose healthy and environmentally friendly meals in university cafes

Cafe customer performance objectives	Personal determinants		
	Knowledge	Awareness	Outcome expectation
PO1. Plan to eat HEF food options in university owned cafes	<p>K1a. Describe the health and environmental benefits of choosing HEF food choices</p> <p>K1b. State the environmental benefits of choosing a HEF food choices</p>	Aw1. Acknowledge food choices have implications for health and the environment	OE. Expect the selection of HEF food choices on campus to have positive health and environmental outcomes.
PO2. Identify HEF choices in university cafes	K2. Describe what a HEF choice is	Aw2. Acknowledge that some foods are HEF and others not.	
PO3. Choose a HEF food option in the university cafes	<p>K2a. Identify which food options are HEF.</p> <p>K2b. Lists where the HEF food options can be bought.</p>	<p>Aw1. Acknowledge food choices have implications for health and the environment</p> <p>Aw2. Acknowledge that some foods are HEF and others not.</p>	OE. Expect the selection of HEF food choices on campus to have positive health and environmental outcomes.

Table 5-5 Matrix of change objectives for caterers at the environmental level to address intervention outcome 2; University catering staff create and environment conducive to purchasing healthy and environmentally friendly food

Catering managers/outlet managers performance objectives:	Personal determinants			
	Knowledge	Awareness	Attitudes	Skills/Self-Efficacy
P04: Modify food order to ensure demand for HEF foods are met.	K1. State the environmental benefits of choosing HEF options on campus. K2. Recognise the important role the university has in supporting HEF food choices	Aw1. Acknowledge food provision in the university outlets has implications for health and environmental sustainability	At1. Express positive attitudes towards providing and promotion HEF options in the university outlets	Se1. Demonstrate ability to respond to customer demand for HEF choices
P05: Team leaders modify the catering outlet promotional material in-line with a healthy and environmentally friendly eating messages	K1. State the environmental benefits of choosing HEF options on campus. K2. Recognise the important role the university has in supporting HEF food choices K3. Identify how to alter promotional material in line with HEF eating messages	Aw2. Acknowledge promotional material can influence customer food choices	At1. Express positive attitudes towards providing and promotion HEF options in the university outlets	Se2. Demonstrate ability to modify outlet promotional material
P06: Catering outlets will promote HEF choices using GeniUS card rewards system	K4. Identify what HEF choices are	Aw2. Acknowledge that HEF options are promoted by GeniUS cards	At1. Express positive attitudes towards providing and promotion HEF options in the university outlets	Se3. Demonstrate ability to promote HEF choices using GeniUS rewards system
P07: Catering staff will advocate choosing to HEF choices in the cafes	K4. Identify what HEF choices are K4. List ways to motive/communicate HEF choices to colleagues/customers		At1. Express positive attitudes towards providing and promotion HEF options in the university outlets	Se4. Express confidence in ability to advocate/promote HEF choices

Figure 5-2 Intervention Mapping Step 4: Logic model of behaviour change



5.4 Intervention Design (IM step 3)

Intervention ideas were initially generated based on the Nuffield Ladder of intervention. Key components of the intervention were selected based on their feasibility of implementation, cultural acceptability and resource constraints, guided by the feedback on intervention ideas obtained from customers and caterers in Study 2 (see Chapter 4). Key intervention characteristics were: the need to raise awareness, protect customer choice and protect finances. The intervention idea that most closely aligned with these requirements was that which incentivised healthy and environmentally friendly choices using the GeniUS rewards system, and provided information about the environmental impacts of foods. This intervention was judged to be most practically feasible with the lowest burden-to-risk ratio. Information provision and price incentives have shown promise in supporting the consumption of healthy foods in university cafeterias (Deliens *et al.* 2016a; Michels *et al.* 2008). Examples of theory based change methods and applications used to address the determinants of the change objectives at the individual level- knowledge are provided in Table 5-6. (See Appendix C1-C2 for further details).

Table 5-6 Intervention Mapping Step 3: Examples of change methods and applications used to address behavioural determinants of change objectives at the individual and organisational level.

Individual level	Methods	Theory	Applications
Change objectives: Aw1. Acknowledge food choices have implications for health and the environment	Consciousness raising	TTM	Provide information about the implications of choosing non-HEF food choices.
	Using imagery	Theory of information processing:	Posters and table-talkers Provided customers visual aids to help conceptualise environmental impacts
Organisational level	Methods	Theory	Applications
Change objective: Se4. Express confidence in ability to advocate/promote HEF choices	Verbal persuasion	RAA/SCT	Meetings with catering staff to highlight and discuss the benefits of choosing HEF choices.

TTM: Transtheoretical Model, RAA: Reason Action Approach, SCT: Social cognitive theory

Whilst multiple theories were used, the principle behaviour change theory underpinning the intervention design at the level of the individual is the TTM of behaviour change. Studies exploring student readiness to adopt plant-based diets (Weller *et al.* 2014), together with the focus group discussions suggest that most cafe customers were in the pre-contemplation or contemplation stage of behaviour change. As such the intervention was designed to support the transition of cafe customers towards 'contemplation' or 'action' stages of change. The TTM was selected as it has been used to inform the development of successful nutrition workplace interventions (Steyn *et al.* 2009) but further research is needed to determine if employing the TTM to plan dietary interventions is the most effective way to promote healthier dietary behaviours (Spencer *et al.* 2007).

The information provided on the table tents was used to help raise awareness of the environmental impact of food. According to the TPB, this would help to create positive attitudes towards HEF food choices, which would result in greater intention to select and subsequently choose HEF choices. This information was provided to support customers moving from pre-contemplation to contemplation.

However, there is mounting empirical evidence to suggest that providing information alone is insufficient in changing behaviour (Seymour *et al.* 2004; Volkova & Ni Mhurchu 2015). Social cognitive theory posits that environmental determinants are important factors influencing food choices thus the intervention was designed to create an environment conducive to selecting HEF food choice. There is growing empirical evidence to suggest that financial incentives and rewards have the potential to influence food choices positively (An 2013), but the theory underpinning much of this literature is scarce. Building on the research areas of habitual behaviour (theories of learning) and marketing incentives, Chan *et al.* (2017) found that loyalty rewards systems can help to support healthier dietary choices. Given that caterers and customers in this study considered the use of GeniUS points an acceptable and feasible strategy to support HEF choices, they were incorporated into the design of the intervention. The theory is that these contingent rewards would help to stimulate a positive experience or association with HEF food choices, which, with repetition overtime, would become a habit.

The first step was to create specific programme goals, which required identification of the healthy and environmentally friendly food options to be included in the promotion.

5.4.1 Identification of 'healthy and environmentally friendly' cafe choices to promote

It was decided that the intervention should focus on common lunchtime meal choices: pre-packaged sandwiches and hot meals. Snacks were excluded from the promotion as they were not considered a meal choice and those with the lower EIS score (crisps and popcorn) were energy dense processed foods, which are counter to health eating messages. Whilst fruit is strongly encouraged by the EatWell Guide, fruit options available in the university canteens were not local, seasonal produce and ranked in the middle of the EIS index. Similarly, drinks were not included in the promotion. The results of Study 1 indicated that tea without milk and bottled water had the lowest environmental impact. However, it was not appropriate to incentivise bottled water albeit that the guidelines around sustainable food consumption are to avoid bottled water and drink tap water (Garnett & Strong 2014). Moreover, caterers raised concerns over the financial impact incentivising hot drinks would have on profit margins since sales of beverages generated the most income.

5.4.1.1 Low environmental impact choices

Foods items that ranked in the lower environmental impact quintiles of the sandwich and hot food categories were proposed as environmentally friendly food options. In the sandwich category, the ten sandwiches with the lowest environmental impact score were: seafood, vegan, poultry and egg. Since it was unclear whether the seafood was from a MSC certified source, and since the environmental score calculations did not include a water footprint value for fish, it was decided to exclude fish/seafood items from the list of 'environmentally-friendly' products. In the hot meal category, vegetable soups comprised the majority of choices in the quintile with the lowest impact. However, since the soups options were not consistently available across all the cafes, they were excluded from the list of 'environmentally-friendly' choices. The products in the lowest EIS quintiles were the Baked Potatoes (BP) with 'Tuna', 'Coleslaw' and 'Baked Beans' fillings. 'Tuna' was excluded, along with 'Coleslaw' because it was

not available in all the cafes. BP with baked beans was therefore the only hot food option included in the promotion.

5.4.1.2 *Healthy choices*

Caterers introduced a new range of sandwiches at the beginning of 2015. These sandwiches were similar in size to the previous supplied but their fillings were more elaborate and varied and included halal meat, vegan and vegetarian. There were 150 different sandwiches types (fillings) available across campus. The difference in the proportion of sandwiches available by filling type from the new supplier compared to the old supplier is available in Table 5-7. It was necessary to identify which of the new sandwiches were healthy.

Table 5-7 Range of sandwiches by filling type of new supplier compared to previous supplier

Protein Source	Old sandwich supplier (n)	(%)	New sandwich supplier (n)	(%)
Vegetables/salad	2	2	8	5
Egg	6	6	9	6
Cheese (only)	21	21	35	22
Fish & seafood	14	14	15	9
Poultry	24	24	38	24
Pork	14	14	13	8
Beef & corned beef	8	8	5	3
Cheese & meat	9	9	20 (chicken, tuna, pork)	13
Mixed meat	3	3	7 (poultry, pork)	4
Total	101		150	

Nutrient profiling was used to identify sandwiches that could be deemed ‘healthy’ and ‘less healthy’. There are many Nutrient Profiling Models that have been developed for a variety of purposes, including the identification of foods that should not be marketed to children (Rayner *et al.* 2013). Some models produce a numerical score for a food such as the Nutrient Rich Food Index (Fulgoni *et al.* (2009), which allows the indexing of foods according to the scores of nutrients and energy density. Calculating the nutrient scores of these lunchtime choices available in the university food outlets was not feasible because the nutritional information provided by the new sandwich suppliers did not include micronutrients. The UK Department of Health’s Nutrient Profile model required the percentage of fruit, vegetable and nut content of each food option, which was unavailable. The percentage fruit, vegetable and nut content could be estimated from the sandwich name but this would introduce error. The European Nutrient Profile Model (Pan American Health Organization & WHO 2016) was used to identify sandwiches and

baked potato options that were 'unhealthy'. This model provides thresholds for the content of specific nutrients, which is used to identify foods that are less likely to be part of a healthy diet. The model is used to identify products that should not be marketed to children for reasons of preventing disease and promoting health. The Model was chosen for this analysis because it included specific thresholds and instruction for pre-packaged foods; including pre-packaged sandwiches. Marketing to children is not permitted for any product in this category that exceeded per 100g: 10g total fat, 4g saturated fat, 10g total sugars, 1g salt, and 225kcal (Pan American Health Organization & WHO 2016). The nutritional information was firstly expressed per 100g. However, the weights of these new sandwiches were unknown. Gram weights of equivalent sandwiches from the previous supplier were used as a proxy indicator of the sandwich weight and the nutrient values for each of the new sandwiches were adjusted accordingly.

The WHO nutrient thresholds were applied to the pre-packaged sandwiches nutrient content per 100g. The sandwiches were marked with a star corresponding to the number of nutrient thresholds exceeded. Sandwiches that exceeded three or more nutrient thresholds were deemed 'less healthy', those with two stars or less were deemed 'Healthier' (See Appendix C3). The characteristics (filling type) of the low impact sandwiches deemed 'healthy' based on the WHO scores was noted. Some of the sandwiches with a low environmental impact score (vegan, egg and chicken mayonnaise) exceeded nutrient thresholds for energy, fat and salt thus were deemed less healthy. However, to ensure that the messaging around which items were healthy and environmentally friendly was clear, and to avoid labelling individual sandwiches, it was decided to include all vegan sandwich options in the promotion. Vegan sandwiches were packaged slightly differently therefore would be easily identifiable. Since most of the sandwiches that did not meet the 'healthy' criteria included mayonnaise it was decided to exclude sandwiches that included 'mayonnaise' in their description from the promotion. For example, 'Chicken mayonnaise' sandwiches were excluded, but 'Chicken Salad' sandwiches were included. However, some of these 'no mayo' sandwiches exceeded the cut-offs for 'healthy' yet were included in the list of incentivised items as the messaging on the posters may have caused customer confusion.

Examination of the till data revealed it was impossible to tell how many and what combination of toppings were sold with each BP. For example, it was not possible

to distinguish between the sale of BP 'with beans' and BP 'with beans and cheese'. However, it was still possible to measure any increase in sales of any specific topping.

In sum, lunchtime meal choices deemed healthy and environmentally friendly were:

- Vegan Sandwiches,
- Egg (no mayo) sandwiches
- Poultry (no mayo) sandwiches
- Baked potato with beans

The full list of all HEF choices is available (Appendix C3). Whilst the smaller sandwiches tended to have the lower environmental impact score, all 'no mayo' sandwiches that contain chicken, vegan produce or egg were included in the promotion so that the price did not influence customer choice and there was still a variety of options available.

5.4.2 Financial incentive- GeniUS points

It was deemed acceptable and feasible to customers and caterers to use the existing GeniUS rewards scheme to incentivise HEF choices. (See section 2.1 for more information about GeniUS rewards cards.) Customer profiling is not feasible at present, but anecdotal evidence provided by caterers suggest that most GeniUS cards users are female students. Customers tend to collect GeniUS points on their card on average twice a week, and are used in around 60% of total transactions that take place. FG met with the till technician to discuss the intervention and what till data would be required for the intervention evaluation. A list of the HEF sandwiches was provided. It was agreed that the till technician would provide FG with weekly sales reports, for the period between November to April (baseline and intervention period). These reports would have the sandwiches itemised with their full product name visible so types of sandwiches that were HEF or not HEF could be identified.

5.5 Intervention production (IM step 4)

Once the scope and sequence of the intervention had been decided a pilot plan was devised and materials were produced.

5.5.1 Intervention materials

FG worked with the Branding Manager of ACS to develop and produce the most appropriate materials and channels for implementing the intervention. A total of 3 meetings were held between November 2016-February 2017. In these meetings, it was decided that large A0/A1 posters and table talkers (tri-folded A4 card) were the most feasible means of communication to customers in cafes. These materials were commonly used to communicate existing promotions to customers, thus were familiar and currently used by cafe users. There was also space in the cafes to install the materials. In addition to promoting HEF options, general information around the environmental impact of food production and consumption was incorporated into these materials to help raise awareness. The academic literature and existing popular material communicating sustainable food choices was consulted to inform the content of the information provision (Fischer & Garnett 2016; Friel *et al.* 2009; Garnett & Strong 2014) and revised with the target group in mind. This included messages around reducing the consumption of animal products and increasing the consumption of more plant-based foods. For example the ‘Characteristics of low environmental impact diets consistent with good health are those that are based around: minimally processed tubers and whole grains; legumes; fruits and vegetables – particularly those that are field grown, “robust” (less prone to spoilage) and less requiring of rapid and more energy- intensive transport modes” (Fischer & Garnett 2016, page 1). This point was condensed into the phrase: ‘Pick plants; enjoy lots of seasonal fruit and veg and starchy staples.

Literature relating to nutrition education and health communication were also consulted and used to develop messaging around the environmental and health implications of food choice (Contento 2011; National Institutes of Health 2004). The researcher produced a creative brief for the branding manager who was tasked with producing the information provision that aligned with the current marketing materials. (See Appendix C4).

5.5.2 Theory and evidence-based change methods for raising knowledge and awareness

5.5.2.1 Consciousness raising

Theories of Information Processing include several concepts that suggest methods for successfully conveying information. Literature on raising awareness of the health problems revealed that they should be accompanied by solutions. One face

of the tri-fold table talker was therefore designed to introduce customers to the environmental implications of food production with regards to Water use and GHGE (as per Study 1 of this investigation.) The second side highlighted the cues to actions; what consumers can do to reduce their carbon and water footprint created from their dietary pattern. The third side, was designed to inform customers that should they choose to make a HEF choice then they would be rewarded with double rewards points on their GeniUS cards (See Figure 5-3).

Figure 5-3 Information provision for the pilot Points for Our Planet, tri-fold table talker

Do you know the environmental footprint of your food?

1kg of...			
Carbon Footprint			
	1x	20x	130x

Fresh Water Use			
	1x	22x	63x

Food production & consumption accounts for up to 30% of global greenhouse gas emissions & uses 73% of the world's fresh water

Points for our Planet

Eat well for yourself and our planet and receive DOUBLE GeniUS points!



Designed & Operated by US

Choose the following foods that have a lower environmental impact and good nutritional profile for health to **gain double GeniUS points:**

Sandwiches: Vegan Egg* Poultry*	Jacket potato with beans * offer excludes sandwiches with mayo
---	---

Choose to make a difference; pick well, do good, feel great!

Eat well for yourself and our planet

- P**ick plants; enjoy lots of seasonal fruit & veg and starchy staples
- L**imit red & processed meat; eat more beans, nuts and pulses
- A**lways choose sustainably sourced fish
- N**ever waste your food
- E**at a balanced & varied diet *do not overeat!*
- T**ry tap water over bottled

Study conducted by PhD student in the Grantham Centre For Sustainable Futures.
For more information email tegraham1@sheffield.ac.uk

Grantham Centre
For Sustainable Futures

5.5.2.2 Tailoring messages/Personalised risk

According to the literature, direct public education must be personally relevant, memorable, understandable and easy to process (Contento 2011). Relating dietary choices to disease has been reported to work by provoking anxiety and an emotional response, but unless it is personally relevant it is short-lived and the success depends on tailoring of the message to the target group (Brinberg *et al.* 2000).

5.5.2.3 Message framing

Buscher *et al.* (2001) recommend using benefits-based messages in a university setting to improve engagement. Focus groups highlighted that many customers strived to make healthy choices in the university cafes, therefore the messages were focussed on positive health outcomes. Focus group participants also perceived the action of selecting EF choices or behaving in a pro-environmental manner was to gain a sense of altruism and feeling of 'doing the right thing'. Therefore, the message 'Choose to make a difference: pick well, do good, feel great' was the tag line to encourage a positive outcome expectations. This was also used to provide customers with a simple, achievable, beneficial solution to the environmental problem and emphasis the benefits of change.

5.5.3 Developing materials

Guidance was taken from the literature about developing print materials (National Institutes of Health 2004). For example, the title was bold and instructive. Information was delivered in chunks rather than in long prose to help with memory. Active and instructive words were used so that the customer could follow the message clearly. To help store information to memory, a mnemonic was created using the first letter of each bullet point to spell the word 'PLANET'. Information about the carbon and water use of food was conveyed as they informed the environmental impact scores by which the cafe option were ranked. Graphics matching the messaging were used to help convey information about the environmental impact of food quickly. The words 'our planet' was used instead of 'the planet' to give customers a sense of shared responsibility for reducing environmental impacts associated with food consumption on campus.

5.5.3.1 Theoretical methods

Stage theories, including the Transtheoretical Model of behaviour change imply that people pass through a series of stages as they transition towards and adopt a new behaviour. Most customers in the focus groups said that they did not consider the environmental implications of their food choices. Some said that it was not something they had thought about before, whilst others said they were not provided with sufficient information to make an informed decision. This suggests that most customers are in the pre-contemplation or contemplation phase of behaviour change according to the TTM. Messages were therefore designed to raise awareness and encouraging contemplation and preparation with cues to action. Whilst unrealistic to expect the intended audience to change behaviour based on new information alone, it was believed that raising consciousness would help move the intended audience through the stages of change.

5.5.3.2 Credible source

Buscher et al. (2001) recommended creating programme materials that have a professional marketing look to help engage students. The results of study 2 revealed that many catering staff wanted to ensure that the information installed in the outlets aligned with their branding, which they believed to provide credibility. As customers expressed scepticism in the sustainability claims by the university, the information provision included the logo of Grantham Centre for Sustainable Futures in the attempt to elicit trust. The final graphic design was created by the university branding manager. The researcher's contact details were on the information so any customer who wanted to contact the researcher for more information could do so.

5.5.3.3 Concept testing (Content validity)

FG produced draft materials (posters) and met with her supervisory team to discuss the concepts, key phrases and visuals proposed to portray the main ideas. The concept behind the poster and each of the table talker faces was explained and supervisors were asked to comment and propose alternative ways to convey the information.

5.5.3.4 Readability testing

To ensure the information was accessible by customers, the Gunning FOG readability test was conducted (Gunning 1952 in Webster-Gandy et al. 2006 p321).

Using the average sentence length and word syllables, this test calculated the age required to read the materials was eight years which is appropriate for information provision for the public (Gandy *et al.* 2006).

5.5.4 Pre-testing materials with customers and caterers

The materials were drafted and pre-tested with customers. An evaluation form was developed (Escalada 2007) to collect their views about the purpose of the materials, the clarity of the message, the attractiveness of the poster (Appendix C5). The researcher sat in two main break rooms of her department over two separate lunchtimes with the draft materials and evaluation forms. Users of the break room that expressed an interest were invited to complete the form about the draft materials. This approach was taken so that customers in the test sites were not exposed to the materials prior to the intervention and therefore were not likely to be primed which could have affected the results of the study. Eight evaluation forms were completed for each poster/table talker face by staff and postgraduate students.

The researcher also visited the catering teams in cafes to discuss the pilot study, its purpose and what it would entail. One-to-one meetings were held so that caterers could ask questions of the researcher that they may not have felt comfortable asking in front of others. The purpose of these meeting was to support caterers with the implementation of the pilot so they had the knowledge and skills to be able to advocate the promotion and explain the purpose of the rewards to customers. Caterers were also asked to complete the evaluation form relating to posters and table talkers. Not only did this help to provide the pilot implementers a sense of ownership of the project and involved them in the design of the material, but is also helped to test the clarity of the message. They were given the opportunity to ask questions about the environmental impact of food and more specifically about the posters if there was something they did not follow. Most feedback was received during face-to-face meetings but where time did not allow, feedback via email was supplied. A total of 6 meetings were held between December 2016 and January 2017 and twelve catering managers and caterers completed the information provision evaluation forms.

The completed evaluation forms were compiled and common issues and suggestions were addressed in the new material produced by the branding

manager. The information provision was then printed using a research grant from the Grantham Centre for Sustainable Futures. Catering managers agreed not to incentivise any other food item in the cafes for the duration of the period. Comparison cafes operated business as usual for the duration of the intervention period.

5.6 Intervention implementation plan (IM step 5)

The fifth step in the intervention mapping process was to develop a programme implementation plan. The retail operations manager, along with the catering managers worked with FG to identify programme adopters, implementers and maintainers. Many of those involved in the adoption and implementation of the intervention were involved in the development of the initial intervention ideas or in the programme material production thus were invested and supportive of the project (see Table 5-8). This helped to create a sense of ownership amongst the staff, particularly the managers, which increased the likelihood of this intervention being effective. Each person had multiple roles in this implementation plan. The senior management teams and team leaders were also decision makers and stakeholders. The catering assistants were stakeholders, and were involved in the design of the programme material thus were also decision makers too. The till technician had an integral intermediary role in which he set up the systems so that one could identify the types of sandwiches sold and therefore measure the food choices made by customers.

Table 5-8 Role of adopters and implementers

Adopters and implementers	Roles and responsibilities; decision power	Involvement stage and role
FG	Researcher	Organise meetings with the appropriate people to disseminate accurate information and overall plan for the intervention Provide the funding for the information provision From the outset through to evaluation
Head of retail operations	Agree to implement and support managers with the implementation of the intervention	From the outset
Food outlet retail manager	Agree to implement and support catering staff with the implementation of the intervention	From the outset
Catering managers	Agree to implement and support team leaders and catering team with the implementation of the intervention	In the design of the intervention phase
Team leaders	Agree to implement and support catering teams with the implementation of the intervention	In the design of the intervention phase
Catering assistants	Agree to implement and support the intervention	In the design of the programme material
Till Technician	Agree to implement the intervention and make the necessary changes to the till system set-up to enable sales to be measured	From the early stages- allowing access to the till system data. In setting up the till system to enable the identification of the products sold in the university cafes

An implementation plan outlining the outcomes and performance objectives for the adoption, implementation and maintenance of the programme was generated (Appendix C6). The determinants of these performance objectives were then generated and methods and applications to accomplish the change objectives for adoption, implementation and maintenance were identified (Appendix C7-C8)

5.7 Programme Evaluation Plan (IM Step 6)

The matrices of change objectives were used to develop process and effectiveness questions to evaluate the intervention. Indicators and measures to assess the selected effect and process evaluation questions were identified (see Table 5-9 for an example and Appendix C9) and an evaluation study designed. Study 3 (Chapter 5) describes the evaluation of the pilot programme developed using the IM protocol.

Table 5-9 Example of indicators and measured used for evaluative assessment

Behavioural and environmental outcomes: Effect Evaluation Plan					
Performance objective	Measure	Sources	Data collection, Timing and Resources	Data Analysis	Reporting
(B01) Cafe users choose to purchase HEF choices in University cafes	Sales data	Till	Researcher collects data via email from till technician on a weekly basis.	Changes in sales data between baseline, during and after intervention. Compare changes with comparison sites.	Research team to provide feedback to retail operations managers

5.8 Chapter summary

This chapter outlined how the results of Study 1 and 2 informed the development process of the intervention programme following the intervention mapping protocol. The implementation plan and evaluation plan was used to guide the implementation of the pilot programme in the university cafes in 2017. The following chapter describes the evaluation of this pilot intervention.

6 CHAPTER 6: EFFECT AND PROCESS EVALUATION OF THE INTERVENTION PILOT: 'POINTS FOR OUR PLANET' (STUDY 3)

6.1 Introduction

This chapter describes the evaluation of the intervention pilot, Points for our Planet (PFOP) that was developed using the intervention mapping protocol. As per the evaluation plan, generated in step 6 of the IM approach, (see Appendix C9) the evaluation study comprised two parts: an effect evaluation and a process evaluation. The purpose of the effect evaluation was to determine whether the intervention had the desired effect on the behavioural outcome of the customers as intended (i.e. whether more customers purchased healthier and environmentally friendly (HEF) food choices in the university cafes). The process evaluation was conducted to identify any problems relating to the adoption and implementation process, which would help to understand why the behavioural outcome was present, absent or suboptimal.

There were three aims and objectives of this pilot evaluation.

Effect evaluation:

Aim: Assess the effect of the PFOP pilot on the purchasing behaviour of customers in the university cafes.

Objective 1: To measure changes in sales data of HEF and non HEF food choices following the implementation of the scheme in the university cafes.

Process evaluation:

Aim: Investigate the efficacy of the PFOP programme materials

Objective 2: To obtain feedback from customers about the influence the scheme had on their food choices made in the university cafes.

Aim: Investigate the feasibility of the PFOP programme activities (incentives and advocacy) and materials (posters and table talkers).

Objective 3: To explore the perspectives of the catering staff and till technician involved in the implementation of the pilot and to identify

strengths and weaknesses, barriers to implementation and areas for improvement.

The first part of this chapter describes the multiple methods used to conduct the effect and process evaluation of the intervention scheme. The second part describes the results of these studies. The third part of this chapter discusses effectiveness of the intervention considering the evaluation aims and objectives.

6.2 Methods

A multiple methods convergent parallel design was used, as described by Creswell (2013), to address the research aims and objectives of Study 3. Both qualitative and quantitative data were collected at roughly the same time and the results were integrated in the interpretation of the overall results. Aims 1 and 2 were addressed using quantitative approaches, as this best provides an indication as to the impact of the intervention, whether it has significantly affected the numbers of HEF food choices being chosen and approximates the number of customers that were exposed to and engaged with the programme. Aim 3 was addressed using a qualitative approach, because this allows one to capture the experiences of catering staff, thus generated knowledge about the feasibility of the programme and the implementation process. The purpose of using both quantitative and qualitative approaches was to add breadth and scope to the evaluation. Whilst the effect of the intervention is important, the qualitative methods were useful for generating theories and knowledge about the programme and how it can be improved for future use. Therefore, the qualitative component of this study had priority. The findings of the quantitative and qualitative methods are combined in the discussion at the end of this chapter.

6.2.1 Effect evaluation

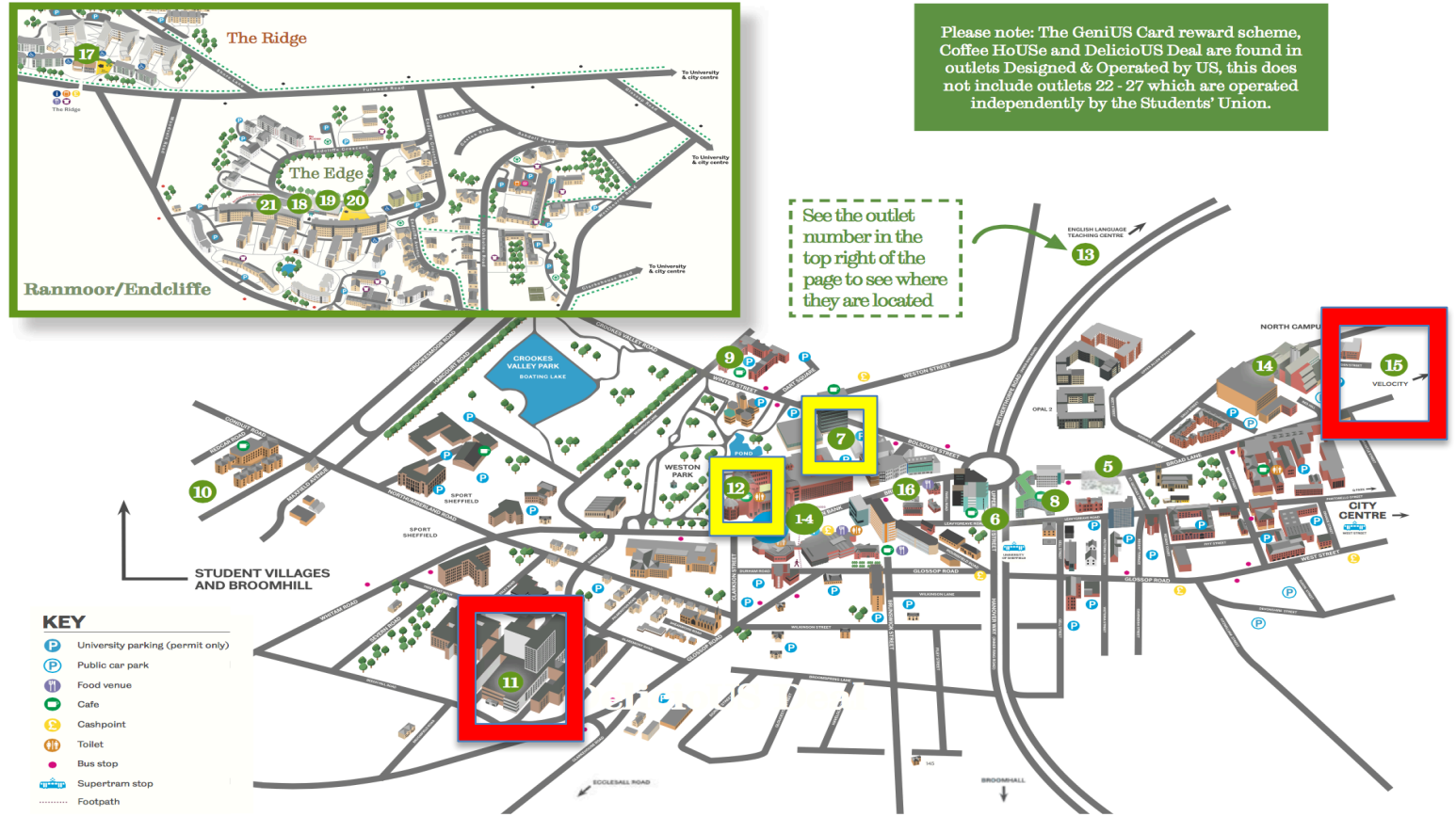
The effect of the intervention on customer behaviour was measured using a quantitative pre-test-post-test, quasi-experimental study design.

6.2.1.1 Study design and setting

The study involved four university cafes; two 'test' cafes (Cafe 1828 and Velocity Cafe) where the scheme was implemented, and two 'comparison' cafes (Art's tower cafe and Krebs cafe) where it was not. The two test sites were selected based on their location on campus. Both sites are on the periphery of the central campus and

it was believed that the customer base in these locations was more consistent as there are less alternative eateries in the vicinity. There was also less crossover of customers between venues, thus less 'contamination' of the control sites. See Figure 6-1. Comparison cafes were selected to also closely match the annual sales of the sandwiches in the test cafes. The comparison cafes continued to trade business as usual. Further details of the cafes are provided in Appendix D1.

Figure 6-1 Map of cafe locations across the univeristy central area (Red boxes- Test cafes, yellow boxes- comparison cafes) Source: Food & Drink Guide, Hustle and Bustle, University of Sheffield (2016).



The scheme was implemented for 6 weeks at the start of semester 2, (6th February- 17th March 2017). Tri-fold table talkers were placed on each table in the test cafes. Large A1/A0 posters were installed in the poster holders in the window of the cafes and two A4 posters were placed on the counter tops near the sandwiches. The impact of the scheme was determined through the collection and analysis of the sales data, focusing on changes in the number of HEF choices sold compared to non-HEF choices in the test and comparison cafes at baseline and during the intervention period.

6.2.1.2 Data collection

Weekly sales reports for the test and comparison cafes were generated using the University's Magnetic Card Reader (MCR) system. Six weekly sales report for each cafe were collected at baseline (28th November 2016-3rd February 2017). These reports reflected total cafes sales towards the end of semester one and immediately after the winter vacation. A further six weekly sales reports were retrieved for each cafe during the intervention period, which began at the start of the second semester (6th February 2017-17th March 2017). These weekly sales reports were imported into Microsoft Excel and the sales of sandwiches and baked potato sales were retrieved. Sandwich sales and baked potato sales were analysed separately.

6.2.1.3 Sandwich data

The number of each sandwich type sold in each cafe was counted and summed for each study period. Sandwiches were labelled on the till system as either Healthy and Environmentally Friendly, (HEF) or not HEF as described in Chapter 5.3. The total number of sandwiches sold in each cafe at baseline and during the intervention period was recorded and percentage change in these sales was measured.

6.2.1.4 Baked potato data

The number of baked potato sales and baked potato toppings was counted and summed for the baseline and intervention period. The till system provided the number of baked potatoes sold and the number of toppings sold. The number of toppings sold exceeded the number of potatoes sold, suggesting that more than one topping was added to a single baked potato sale. It was not possible from this

information to determine the sales of baked potatoes with beans only. It was assumed that the number of 'toppings beans' reflected the number of baked potato sold with beans only and therefore these sales were labelled HEF. This number was subtracted from the total number of jacket potatoes sold to provide an indication of the number of other toppings sold, which were labelled not HEF.

6.2.1.5 Statistical analysis of sales data

The Statistical Package for the Social Sciences (SPSS) version 24 (SPSS Statistics, IBM, New York) was used for the statistical analysis of the sales data. The number of sandwiches and baked potatoes sold was in the form of count data, which is commonly analysed using Poisson regression analysis. The following assumptions for a Poisson Regression model were tested to check for violations (Lund Research Ltd. 2018):

- I. The dependant variable consists of count data;
- II. One or more independent variables can be measured on continuous, ordinal or categorical variables;
- III. Each observation is independent of the other observation;
- IV. The distribution of the counts follows a Poisson distribution;
- V. The mean and the variance of the model are identical.

Both the sandwich and baked potato sales data were over dispersed. For example, for the sandwiches the variance (343.7) was much greater than the mean (22.1). Similarly, for the potatoes, the variance (133.9) was greater than the mean (15.11). The results of a one-sampled Kolmogorov-Smirnov Test indicated there was a significant difference between the Poisson distribution and the data pattern ($p < 0.001$) for both sandwiches and potatoes, therefore the assumption the count data followed a Poisson distribution was violated. As assumption IV and V were violated, a negative binomial regression model was used to explore the effect of the scheme on sales of sandwiches in the test cafes compared to the control cafes during the intervention period.

Not all sandwiches were available each week of the study period due to differences in procurement between and within cafes. To account for this, the number of weeks each sandwich was available for in the six weeks at baseline and six weeks during the intervention was counted. It was assumed that if at least one sandwich was sold that week then the sandwich was available. Sandwiches for which there

were no sales recorded during the six-week period, i.e. weeks available= zero, were removed from the dataset on the assumption that the reason they were not sold was because they were unavailable to purchase. (See Appendix D2) It was unfeasible to identify which sandwiches were available in the cafe at any given time, as the delivery of sandwiches varied, and catering staff stocked the shelves with the different deliveries over the course of the week.

To accommodate for variation in availability of sandwiches over the study period, an exposure variable of the natural logarithm of the number of weeks available was included in the model using the offset function. This meant that the model essentially calculated the rate of sandwich sales per week, even though the outcome was the number of sandwiches sold.

For baked potatoes, it was assumed that there was no variation in the availability of HEF and non HEF toppings throughout the study period therefore the negative binomial regression models the actual number of sandwiches sold opposed to the rate of sandwiches sold.

A variable indicating whether the sandwich was HEF or not HEF was included in the model as a covariate to determine whether the PFOP promotion increased the sales the HEF items compared to the non-HEF items. To determine whether the number of items sold during the baseline or intervention period significantly affected the number of sandwiches sold, a variable 'study period' (baseline or intervention) was incorporated into the model as a covariate. Similarly, whether the number of sandwiches sold was affected by 'cafe type' (test or comparison) was also included in the model.

Price was deemed to be a plausible factor likely to influence the sales of sandwiches, therefore a second model was run in which sandwich price was incorporated into the model as a covariate. The price of baked potatoes did not differ considerably with filling type; therefore, price was not included in the model for analysis. See Box 6-1 for model equations.

Box 6-1 Equations for sandwiches analysis (model 1 and 2) and baked potato analysis(model 3)

Model 1

Log (No. sandwiches sold) = offset(log (weeks available))+Cafe type + Sandwich type+ Study period+ intercept+ error

Model 2

Log (No. Sandwiches sold) = offset (log (weeks available))+Cafe type + Sandwich type+ Study period+ Price+ intercept+ error

Model 3

Log (No. Sandwiches sold) = Cafe type + Sandwich type+ Study period+ intercept+ error

When significant interactions were identified between variables, these interactions were then plotted using a tool for plotting two-way interactions for generalised linear models (Dawson 2014). A simple slopes analysis was conducted to understand the relationship between the two variables.

6.2.1.6 Diagnostics

The model fit was evaluated. Deviance residuals were plotted against predicted values to check for non-linearity and heteroscedacity (Coxe *et al.* 2009). Cook's Distance was calculated and plotted to check there were no obvious cases having an undue influence on the results.

6.2.2 Process Evaluation

According to Steckler & Linnan (2002) there are seven key process evaluation components to address: i) Context: aspects of the larger social environment that may affect implementation, ii) Reach: the proportion of the intended audience to whom the programme is actually delivered, iii) Dose delivered: the amount of intended units of each programme component that is delivered, iv) Dose received: the extent to which participants engage with the programme, v) Fidelity: the extent to which the intervention was delivered as intended vi) Implementation: the extent to which the programme was implemented and received, vii) Recruitment: a

description of the approach used to attract programme participants. (Not applicable to this study).

This evaluation was only able to partially explore the context, reach, dose delivered and dose received due to time and resource constraints. To investigate the efficacy, reach and dose of the PFOP programme materials, feedback regarding the visibility and influence of the posters and table tents on food choices was sought from cafe customers. To determine the feasibility of the PFOP programme activities and the acceptability of programme materials, perspectives of catering staff involved in the implementation process were explored. Together this information was used to improve and develop the pilot for future implementation.

6.2.3 Ethical approval

Ethical approval was obtained from the University of Sheffield's School of Health and Related Research Ethics committee on 30/11/2016. (See approval letter in Appendix D3).

6.2.3.1 *Cafe customer feedback*

A self-completion structured questionnaire was designed to capture whether or not customers were aware of the promotion and therefore the extent to which it influenced their food choices (see Appendix D4). A self-completion questionnaire was used because it allowed customer feedback to be obtained quickly. It was important to capture feedback from customers immediately after the intervention so that they could remember what they had purchased in the cafes in the past 6 weeks and whether the promotion had influenced their food choices. Self-completion questionnaires are also advantageous as the researcher is absent during the data collection and is therefore less likely to influence the response (Bryman 2012).

The questionnaire comprised closed questions that enabled the quantification of the number of customers surveyed that: a) had chosen a HEF choice, (vegan sandwich/ chicken no mayo sandwiches/ egg no mayo sandwich/ baked potato with beans), b) that had seen the promotion (posters/ table tents) and c) that had been influenced by the promotion (yes/no). Respondents were asked to indicate the main reason the promotion had/ had not influenced their food choices from a selection of predetermined responses. An open field was provided to enable to customers offer their own response. This was to ensure that the questionnaire

captured reasons other than those posed by the researcher. Anonymous participant information was requested: occupation (staff/student/visitor) and gender (male/female). This was captured to determine whether there was a difference in the effects of the intervention on different customer groups.

6.2.3.2 Data collection and analysis

The researcher visited the test sites during lunchtime service (between noon and 2.00pm) in the weeks following the implementation of the scheme (Medical School Cafe, 20th-25th March, Velocity Cafe, 3rd-6th April 2017). Customers in the test-sites were approached by the researcher who explained the purpose of the survey and what it entailed. Customers were asked if they had visited the cafe during the period that the scheme was implemented. Those that had visited the cafes were invited to complete the questionnaire and deposit the completed, anonymous form in a sealed box located in the cafe area.

The aim was to gather feedback from approximately fifty customers in each test cafe on the assumption this would give a roughly representative view of customers using the cafe during the lunchtime period. Feedback from customers in Velocity cafe was captured in the third week post intervention. Students were on vacation in the two weeks following the intervention period and the cafe was operating shorter trading hours therefore FG believed collecting data during this time would not capture the customers who had been exposed to the scheme.

Survey responses were compiled and coded using Statistical Package for the Social Sciences (SPSS) version 24 (SPSS Statistics, IBM, New York). Descriptive statistical analysis was used to identify the most common responses from customers.

6.2.3.3 Catering staff recruitment

Catering staff and team leaders in the test sites, and the till technician who implemented the intervention were initially invited to participate in a focus group with others in their team to discuss their views of the intervention and how they found the implementation activities and programme materials. Focus groups enable participants to share their experiences and is useful for allowing participants to generate their ideas and priorities on their own terms in their own vocabulary (Barbour & Kitzinger 2001). However, caterers were unable to participate in focus groups due to time pressures and the need to collect information during working hours. A £20 high street voucher was offered should

the focus group take place outside of working hours, however this was not taken up. Instead, semi-structured face-to-face interviews were conducted with catering staff involved in implementing the scheme.

Catering outlet managers were provided with Participant Information Sheets (Appendix D5) and Participant Consent Forms (Appendix D6) to distribute to their team of caterers. Managers were instructed to reiterate that participation was voluntary and to caterers who were interesting in participating to email FG with any questions that they had and to arrange a suitable day and time to meet. An interview schedule comprising the evaluation questions developed in the evaluation planning stage was created for the team leaders, catering staff and till technician (see Appendix D7). These interview schedules comprised similar questions to ensure comparability between subjects. Questions were generally open, to allow the interviewee to interpret the question and follow their own lines of reasoning. However, shorter follow up questions were also used to clarify and encourage elaboration. The interview questions were shared with the supervisory team and it was agreed that they had face validity.

6.2.3.4 Data collection and analysis

Interviews with catering staff took place in a university meeting room near to their place of work in the University. They were recorded using a dictaphone and the audio files were subsequently transcribed into a Microsoft Word document. The researcher, (FG) transcribed all the interviews herself to increase familiarity with the dataset. Participants were given a unique identification number to ensure they were not identifiable in the transcripts. The transcripts were checked for accuracy against the audio files and subsequently printed out for analysis.

The interviews were analysed thematically following the 6-phase reiterative process outlined by Braun & Clarke (2006) described in detail Chapter 4.2.2). The computer software Nvivo v11.2.7 (QSR International Pty Ltd, Doncaster, Australia) was used as a tool to index the electronic version of the transcripts according to these emerging themes.

6.2.4 Reflection and positionality

Having designed and developed the pilot scheme myself as part of my PhD research it is possible that I had an inherent bias and desire for the scheme to have been successful. Since I conducted the interviews myself, transcribed and analysed the

results may have introduced a researcher bias. To reduce this bias would require an independent researcher to conduct the interviews and thematic analysis on the transcripts. I met with catering staff on several occasions during the preparation and installation of the information provision so built a rapport with participants. This may have led to responder bias. When I was conducting the interviews, I got impression that participants were trying not to say anything too negative about the scheme so as not to offend me and undermine the work and effort I had made. I suspect that the 'illusory halo' effect may have occurred. This is the phenomenon whereby judgments made on an individual's performance are influenced by the rater's overall impression of the person (Streiner et al. 2015). In this study, I got the impression that catering staff thought I was highly knowledgeable about subject area and therefore rated the scheme and information provision more highly than it was. During the interviews, several caterers apologised when they expressed negative opinions about the success of the scheme and aspects of the scheme they felt had not worked. When discussing weaknesses of the scheme they described them as a 'failure on our part'. This highlights that the caterers felt responsible for the success of the scheme and believed that I would be disappointed by null results and hold them accountable. I attempted to reassure participants that this was not the case during the discussions to elicit more truthful response. I also took this reflection into account when interpreting the results of the interviews.

6.3 Results: Impact evaluation- sales of HEF choices

6.3.1 Mean sales of HEF and Non HEF options

Table 6-1 provides the number of HEF, Non HEF and total sandwiches sold in each cafe during the baseline and intervention period. The Medical School cafe sold the greatest number of sandwiches during the study period (5,054) and Velocity cafe sold the least (2,577). There was an increase in the sales of total sandwiches between the baseline and intervention period in all cafes. (See Appendix D8).

Table 6-1 Total number of sandwiches sold in each cafe at baseline and intervention period with percentage change

Cafe Type	Cafe	Category	Baseline, n (% of total)	Intervention, n (% of total)	Percentage change (%)	Total
Test cafes	Medical school	HEF	769 (32%)	946 (35%)	23.0	1715
		Non HEF	1608	1731	7.7	3339
		Total	2377	2677	12.6	5054
	Velocity	HEF	672 (56%)	842 (61%)	25.3	1514
		Non HEF	530	533	0.6	1063
		Total	1202	1375	14.4	2577
Comparison cafes	Art's Tower	HEF	585 (26%)	663 (27%)	13.3	1248
		Non HEF	1622	1764	6.1	3386
		Total	2247	2427	8	4674
	Krebs Cafe	HEF	408 (31%)	422 (28%)	3.4	830
		Non HEF	917	1099	19.8	2016
		Total	1325	1521	14.8	2846

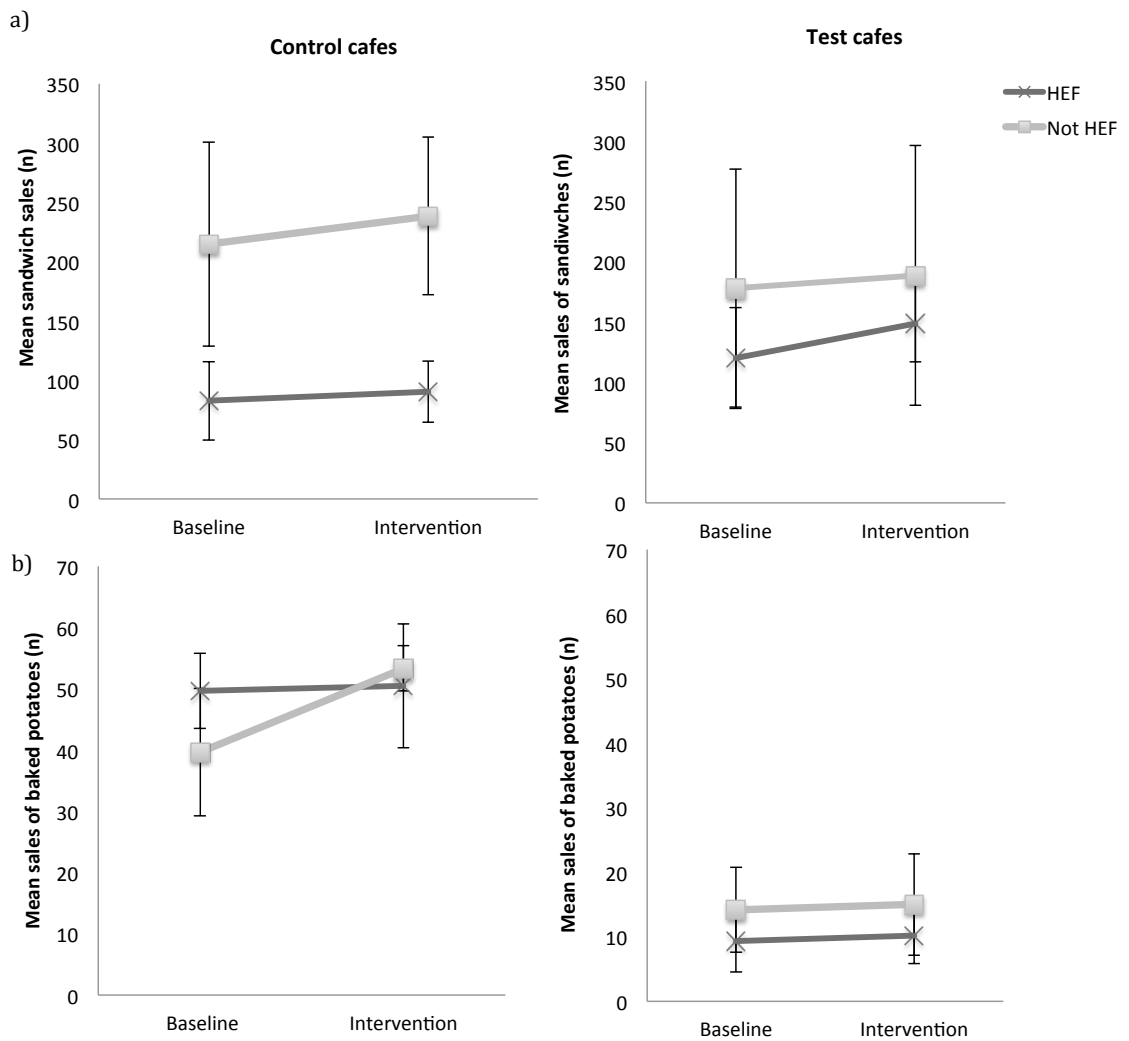
Table 6-2 presents the number of baked potatoes sold with HEF and non-HEF fillings in each cafe at baseline and during the intervention. Art's Tower cafe sold the greatest number of baked potatoes during the study period, with Velocity cafe selling the least. Overall baked potato sales increased in the Medical school and Art's Tower between baseline and intervention period whilst overall sales declined in Velocity and Krebs cafe.

Table 6-2 Sales of baked potatoes with HEF and non-HEF fillings

Cafe Type	Cafe	Category	Baseline, n (%of total)	Intervention, n (%of total)	Change (%)	Total
Test cafe	Medical school	HEF	45 (37%)	49 (36%)	8	94
		Non HEF	77	88	14.2	165
		Total	122	137	12.2	259
	Velocity	HEF	11 (58%)	12 (86%)	9	23
		Non HEF	8	2	-75	10
		Total	19	14	-26.3	33
Comparison cafe	Art's Tower	HEF	173(55%)	195 (55%)	12.7	368
		Non HEF	141	159	12.7	300
		Total	314	354	12.7	668
	Krebs Cafe	HEF	125 (57%)	108 (60%)	-13.6	233
		Non HEF	96	71	-26	167
		Total	221	179	-19	400

Figure 6-2 illustrates the mean number of HEF and Non HEF cafe options sold during the baseline and intervention period. Overall there were more non-HEF sandwiches sold than HEF sandwiches sold during the study period. Overall there were more HEF BP sold in the control cafes than in the test cafes.

Figure 6-2 Mean sales of sandwiches (a) and baked potatoes (b) sold at baseline and intervention in control cafes and test cafes.

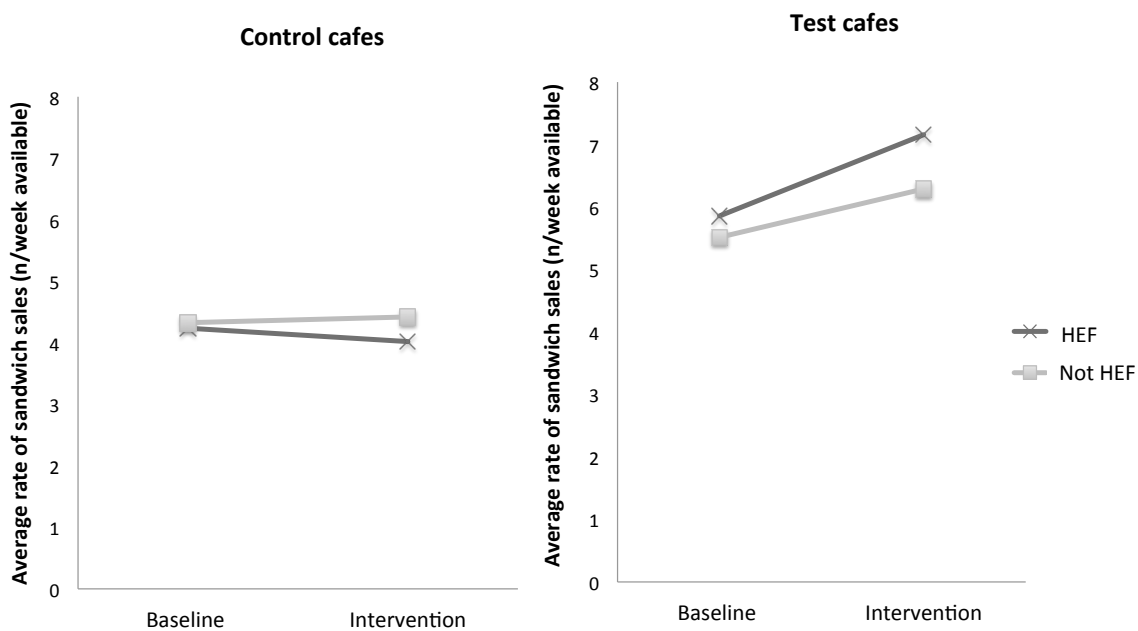


Standard error bars representation the standard deviation of the sales over each 6-week period. HEF, Healthy and Environmentally Friendly

6.3.2 Rate of sales of HEF and Non HEF options

Figure 6-3 illustrates the average rate (no. sales per week available) of HEF and non-HEF sandwiches in the control and test sites baseline and intervention.

Figure 6-3 Average rate of sandwiches sold in the control and test cafes during the study period.



HEF, Healthy and Environmentally Friendly

6.3.3 Results of the negative binomial regression analysis

6.3.3.1 Regression model 1

Table 6-3 provides the results of the negative binomial regression for the sandwiches, Model 1.

Table 6-3 Result of the negative binomial regression of factors influencing rate of sandwich sales, Model 1

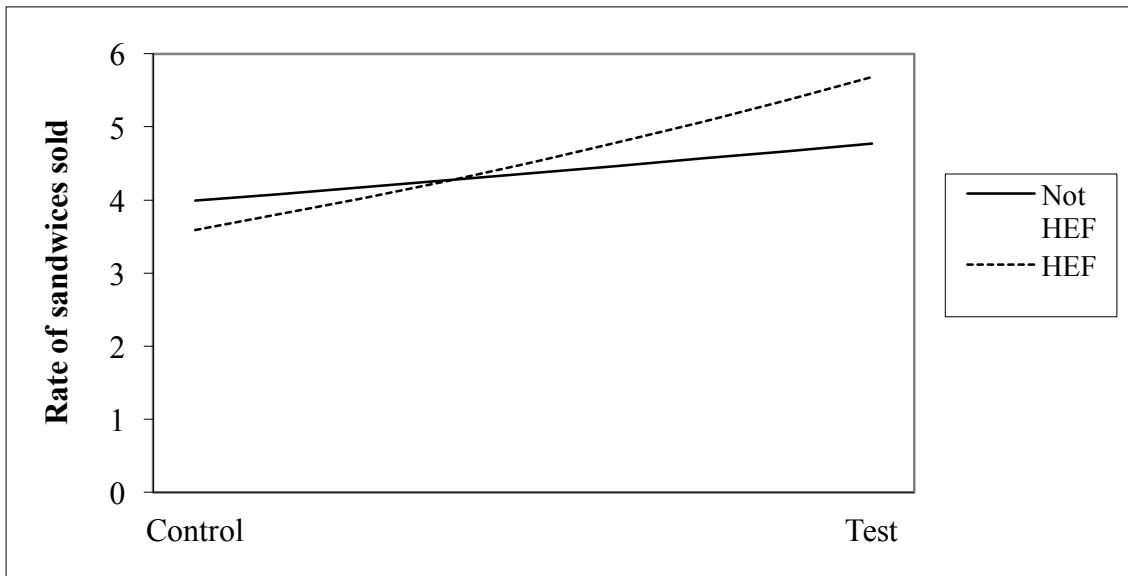
Independent variable (Reference category)	P value	EXP (B)	95% Wald CI		Sig.
			Lower	Upper	
Intercept	.000	4.041	3.710	4.400	**
Cafe type (Test)	.002	1.198	1.071	1.340	*
Sandwich type (HEF)	.191	.917	.804	1.044	NS
Study period (Intervention)	.382	1.041	.951	1.139	NS
Cafe type*Sandwich Type (Test*HEF)	.004	1.326	1.095	1.607	*

The dependent variable was the number of sandwiches sold. The offset function was the natural logarithm of the weeks available. Negative binomial theta value =0.304. 95% Wald Confidence Intervals for EXP (B). **p<0.001, * p<0.05, NS p>0.05. Cafe type= test/control, Sandwich type= HEF/not HEF, Study period= baseline/intervention. HEF, healthy and environmentally

Study period did not significantly affect the rate of sandwich sales (p=0.382). The rate of sandwich sales at baseline and during the intervention was the same. The results indicate that cafe type significantly affected the rate of sandwich sales (p=0.002). The rate of sales in the test sites was 19.8% greater than the rate of sandwich sales in the control cafes when all other variables are held fixed. There was a significant interaction between cafe type and sandwich type (p=0.004). There was no significant interaction between study period and cafe type (p=0.194), study period and sandwich type (p=0.708) or cafe type, study period and sandwich type (p=0.378). (Models not reported here.)

Figure 6-4 illustrates that the rate of sandwich sales overall is greater in the test site compared to control and that this effect is greater for the HEF sandwiches.

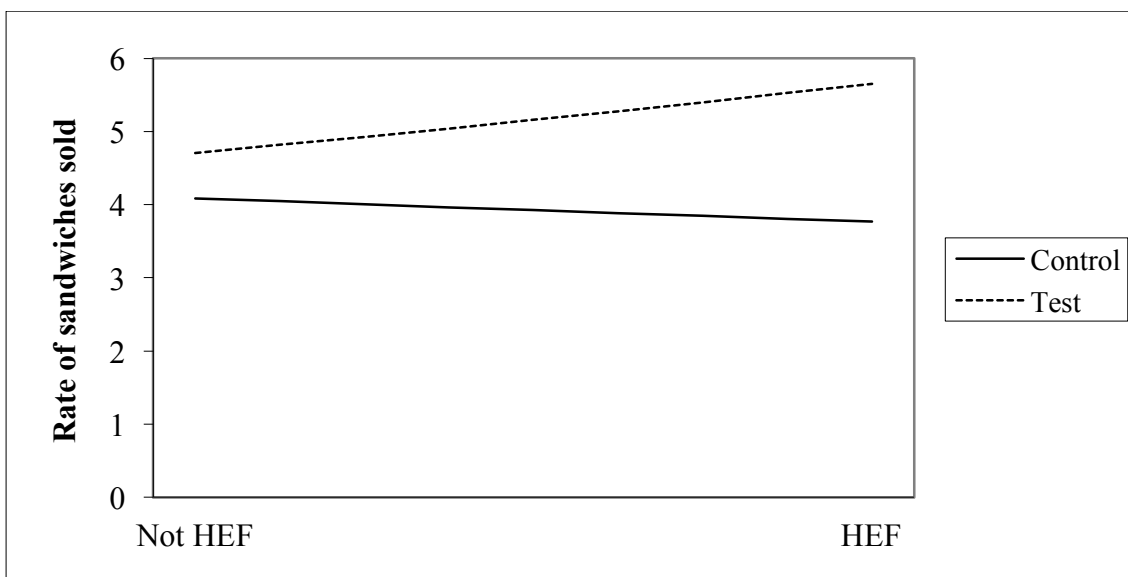
Figure 6-4 A plot of the interaction effect between cafe type and rate of sandwich sales with sandwich type as the moderator (Model 1).



The results simple slopes test found that the rate of HEF sandwiches sold in the test site was 37.1% greater than in the control sites ($p \leq 0.0010$). The rate of non-HEF sandwiches sold in the test sites is 19.8% greater than in the control cafes ($p = 0.002$) when all other variables are held fixed.

Figure 6-5 illustrates that the rate of HEF sandwich sales increased in the test sites and the rate of non-HEF sandwiches declines slightly in the control sites.

Figure 6-5 A plot of the interaction effect between sandwich type on the rate of sandwiches sold with cafe type as the moderator (Model 1).



The results of the simple slopes test found that in the control cafes, there was no significant difference in the rate of HEF and non-HEF sandwich sales ($p=0.191$). However, in the test cafes, the rate of HEF sandwiches was 17.7% significantly greater than the non-HEF sandwiches ($p=0.006$) when all other variables are held fixed.

The results of the investigation indicate that rate of HEF sandwiches sold in the test site was significantly greater than the rate of HEF sandwiches sold in the control sites. However, this was also true for the non-HEF sandwiches. Furthermore, the rate of HEF sandwiches sold was significantly greater than the non-HEF sandwiches sold in the test sites. As there was no significant interaction of study period with either cafe type or sandwich type the scheme did not successfully increase the rate of HEF sandwiches sold in the test sites during the intervention period compared to the baseline.

6.3.3.2 Regression Model 2

Table 6-4 summarises the results of regression model 2 which includes sandwich price as an independent variable.

Table 6-4 Output of negative binomial regression the factors influencing the rate of sandwich sales including price, Model 2.

Independent variable (Reference category)	P value	EXP(B)	95% Wald CI		Sig.
			Lower	Upper	
Intercept	.000	10.516	7.556	14.637	**
Cafe (Test)	.015	1.146	1.026	1.280	*
Sandwich type (HEF)	.452	.952	.837	1.082	NS
Study period (Intervention)	.315	1.046	.958	1.142	NS
Price	.000	.714	.638	.798	**
Cafe type*Sandwich type (Test*HEF)	.001	1.383	1.146	1.669	*

The dependent variable was the number of sandwiches sold. The offset function was the natural logarithm of the weeks available. 95% Wald Confidence Intervals for EXP (B). Negative binomial theta value= .286. ** $p<0.01$, * $p<0.05$, NS $p>0.05$. Cafe type= test/control, Sandwich type= HEF/not HEF, Study period= baseline/intervention. HEF, healthy and environmentally friendly.

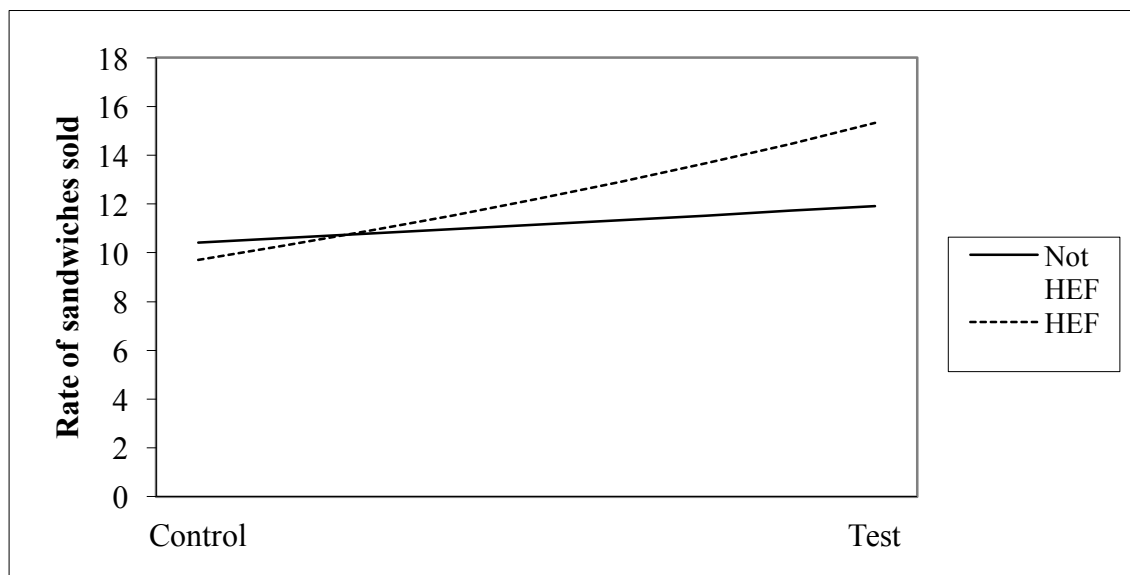
Study period did not significantly affect the rate of sandwich sales ($p=0.315$). The rate of sandwich sales at baseline and during the intervention was the same.

Price significantly affected the rate of sales ($p < 0.001$). For every £1 increase in price, the rate of sandwich sales decreased by 28.6% when all other variables are held fixed. There was a significant interaction between cafe type and sandwich type ($p < 0.001$).

There was no significant interaction between study period and cafe type ($p = 0.178$), study period and sandwich type ($p = 0.729$) or between study period, cafe type, and sandwich type ($p = 0.377$). (Models not reported here).

Figure 6-6 illustrates the relationship between cafe type and rate of sandwich sales was positive and that this effect was greater for HEF sandwiches than non-HEF sandwiches.

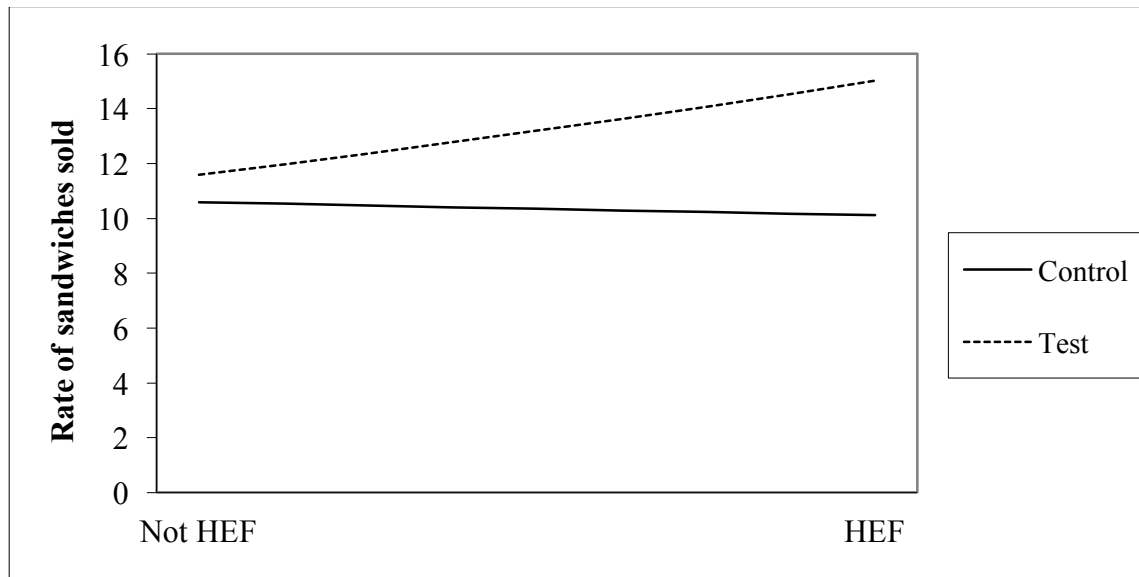
Figure 6-6 A plot of the effect of cafe type on rate of sandwich sales with sandwich type as the moderator (Model 2).



The results of the simple slopes test exploring the relationship between cafe type on rate of sandwich sales indicated that the rate of non HEF sandwich sales in the test site is 14.6% greater in than in the control cafes ($p = 0.015$) when all other variables are held fixed. The rate of HEF sandwiches sold was 36.9% lower in the control cafes compared to the test cafes ($p < 0.001$).

Figure 6-8 illustrates the relationship between sandwich type and rate of sandwich sales. Rate of overall sandwich sales was greater in the test cafes and similar or slightly lower for sales in the control sites.

Figure 6-7 A plot of the effect of sandwich type on the rate of sandwich sales with cafe type as the moderator (Model 2).



The results of the simple slopes tests indicate that there was no significant difference in the rate of HEF sandwiches compared to non-HEF sandwiches ($p=0.452$) in the control cafes. However, the rate sales of non-HEF sandwiches were 24.1% lower than the HEF sandwiches ($p<=0.001$) in the test cafes.

6.3.3.3 Regression Model 3

Table 6-5 outlines the results of the negative binomial regression of the baked potato sales.

Table 6-5 Results of the negative binomial regression analysis of baked potato sales Model 3)

Independent variable (Reference category)	P value	EXP(B)	95% Wald CI		Sig.
			Lower	Upper	
Intercept	.000	24.427	18.378	32.467	**
BP type (HEF)	.367	.878	.662	1.165	NS
Cafe type (test)	.000	.249	.188	.331	**
Study period (intervention)	.443	1.116	.843	1.479	NS

Negative binomial theta value = .398). 95% Wald Confidence Intervals for EXP (B). ** $p<0.001$, * $p<0.05$, NS $p>0.05$ Cafe type= test/control, BP type= HEF/not HEF, Study period= baseline/intervention. HEF, healthy and environmentally friendly.

The results of the regression indicate that BP type (HEF/non-HEF) did not significantly affect the number of BP sales ($p=.367$) because the number of HEF and non-HEF BP sold was not significantly different.

Cafe type significantly affects the number of BP sales ($p<0.001$). The number of BP sold in the test cafes was 75.1% less than the sales of BP in the control sites when all other variables are held fixed.

Study period did not significantly affect the number of BP sales ($p=.443$). (The number of BP sales during the intervention did not differ from the number of BP sales at baseline.)

There was no significant interaction between BP type and Cafe type ($p=.088$) or BP type and study period ($p=.633$) or between Cafe type and study period ($p=.800$).

6.4 Results: Process evaluation- feedback from customers

This section presents the results of the feedback from customers about the visibility of the programme materials and their effect on food choices.

6.4.1 Profile of respondents

A total of 85 feedback forms were completed in the test cafes; 53 in Cafe 1828 and 32 in Velocity Cafe. Half the respondents were female ($n=47$). The majority of respondents were students ($n=64$) followed by staff ($n=16$) with only 1 visitor. 46% of respondents had purchased at least one HEF lunchtime choice during the intervention period.

6.4.2 Visibility of promotion

Around one third of respondents indicated that they had seen the posters ($n=28$). Approximately one quarter of participants indicated that they had seen the table talkers ($n=21$).

6.4.3 Influence on food choices

Ten of the respondents indicated that the promotion had influenced their food choices in the cafe compared to 67 who said the promotion had not.

Of the eight respondents who indicated that the promotion had influenced their food choices, four indicated that the main reason was ' I like collecting GeniUS points' followed by two who indicated ' I felt I was choosing well for my health',

and one who indicated ‘I felt I was choosing well for the planet’.

Of the 62 respondents that indicated that the promotion did not influence their food choices, the almost half (n=30) indicated that the main reason was ‘I did not see or was unaware of the promotion’, followed by 12 that indicated ‘I was not interested in the promotion’. (See Table 6-6). For ‘other reasons’ provided See Appendix D9 and Appendix D10.

Table 6-6 Results of customer survey. Main reasons Points For Our Planet did not influence meal choice

Main reason	N
I did not see the posters/unaware of the promotion	30
I was not interested in the promotion	12
I would have chosen the promoted choices anyway	6
I don’t have a GeniUS card	6
I did not understand the poster/promotion	3
See ‘other reasons’	5

6.5 Results: Process evaluation- perspectives of implementers

6.5.1 Sample characteristics and overview

A total of seven implementers were interviewed. This included the team leader (manager) in each test cafe, four catering staff from one of the test cafes and the till technician who had implemented the changes on the till system and provided till reports. Each face-to-face semi-structured interview was led by FG and lasted between 17-25 minutes. See Table 6-7 for participant profiles.

Table 6-7 Profile of catering staff interviewed

Participant number	Gender	Nationality	Age (years)	Full-time/part-time	No. years working in current cafe
IM1	Female	British	17	Part-time	2
IM2	Female	British	20	Part-time	1.5
IM3	Female	Asian	36	Full-time	2
IM4	Female	British	21	Part-time	1.5
IM5	Female	British	39	Full-time	4
IM6	Female	British	29	Full-time	1
IM7	Male	British	27	Full-time	N/A

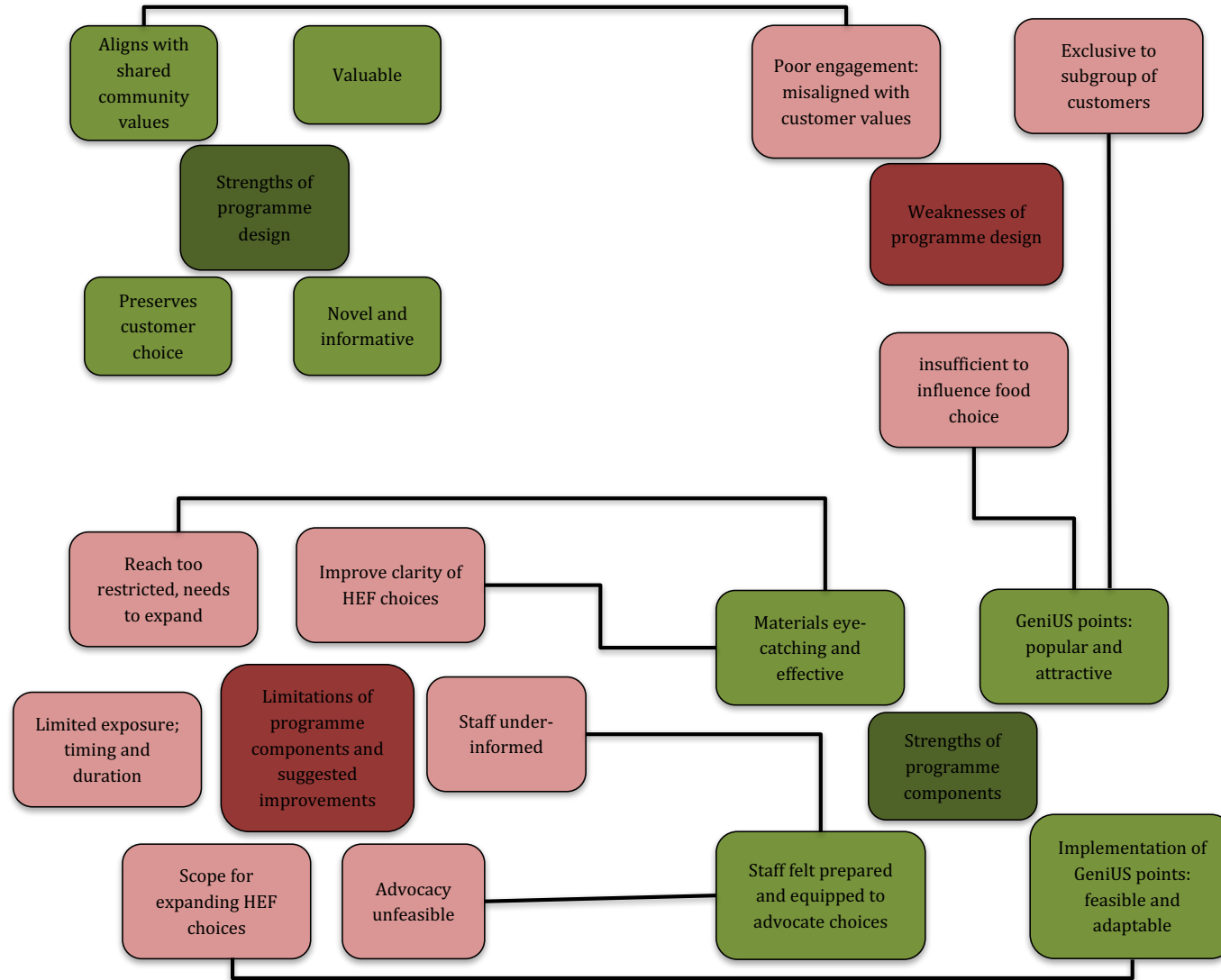
6.5.2 Overview of themes and subthemes

Themes and subthemes that emerged are outlined in Table 6-8 and Figure 6-8, which are the beliefs and assumptions of caterers about the scheme.

Table 6-8 Themes and subthemes to emerge from thematic analysis of interviews with caterers.

Theme	Sub-themes
Strengths of programme design	<ul style="list-style-type: none"> Novel and informative Valuable Aligns with shared community values Preserves customer choice
Weaknesses of programme design	<ul style="list-style-type: none"> Poor engagement: misaligned with customer values and priorities Exclusive to a sub-group Ineffective Unintended effects
Strengths of programme components	<ul style="list-style-type: none"> Materials eye-catching and effective GeniUS points: popular and attractive Implementation of GeniUS points: feasible and adaptable Staff felt prepared and equipped to advocate choices
Limitations of programme components and potential improvements	<ul style="list-style-type: none"> Reach too restricted; needed to expand Limited exposure; timing and duration Improve clarity of promoted choices Scope for expanding promotion Advocacy unfeasible Staff under-informed

Figure 6-8 Thematic map of themes and subthemes from interviews with caterers



6.5.3 Perceived strengths of the scheme design

Catering staff perceived the scheme to have several strengths relating to the overall concept and its design. The subthemes described here reflect how the scheme aligns with their beliefs about the premise of the scheme and values shared with customers.

6.5.3.1 Novel and informative

Participants described the intervention as novel in providing a different perspective to their daily job. As such, they supported the scheme informing customers about such issues.

...“we just buy sandwiches to sell, but for us to see a different point of view, about how it can impact the planet, I thought were really good.” (IM5)

PFOP was considered a good way to encourage customers to think about the environmental impact of food production and raise awareness of HEF options available in the canteen. It was also considered a useful way of introducing customers to the environmental impacts of foods, who may not have thought about it before or may have negative beliefs about HEF foods.

... “I think it's teaching people... how stuff does affect our planet... I do think it opens people's minds a bit... to what they do eat and what they can buy as an alternative that's not always, a horrible alternative is it [laughs] it can be quite as nice...” (IM5)

6.5.3.2 Valuable; has potential to help to reduce environmental impact

One participant expressed the view that the scheme has the potential to reduce the environmental impact associated with the university catering service, which can have significant benefits to the environment.

... “if there is a higher trend in people wanting the incentivised items, then we will stock more because there will be a higher demand so I think it will actually end up making quite a significant difference to the planet, especially if you can get it across all of the cafes” ... (IM4)

6.5.3.3 Preserves customer choice

Providing customers with a variety of food options was considered to be an important part of the role of the catering service. Some catering staff expressed the view that a positive aspect of the scheme was that it did not remove meat choices from the cafes, which may have had a negative impact on custom. One explained that she knew of students that valued having meat and unhealthy food choices

available to purchase in the canteen and was under the impression they disliked being told what to eat. She suggested that a positive aspect of this scheme was that it was not directly affecting choices, it was simply providing information that could be utilised by those to whom it appealed to and subsequently inform their choices and was therefore 'fair'.

"I reckon there's always some people who are pro-meat and unhealthy things, and they always get annoyed when people tell them what to do. But I think this is quite subtle. It's not being like, you have to eat this and stuff so I don't think it would put anyone off coming to the cafe, as long as, if they've got both options available to them but this one has some bonuses if you do want to go for it, I think it's a good way of doing it". (IM2)

6.5.3.4 Aligns with shared community values

The university setting was considered a good location to run a scheme about health and planet as many people could be exposed to the information. They also felt that customers who value health and the planet were more likely to take an interest in schemes that encourage healthy and pro-environmentally friendly behaviour. Since many people in the university share these values they felt this scheme would directly appeal to them.

"But I also think amongst students, there's a big proportion of people that want to be environmentally friendly, so that's probably a good market to go for, for that kind of scheme... because I think, there's tonnes of like, Vegan Societies... so, I do think there'd be a lot of people persuaded by it." (IM2)

The two catering team members who were also university students described the growth in popularity of veganism and vegetarianism. This was also believed to increase the number of customers who would be interested or attracted to the scheme.

"I have noticed that the vegetarian and vegan options have become more popular, I'm not sure if that's going with the general trend at the moment, or if that is specifically to do with the fact these items were incentivised." (IM4)

6.5.4 Perceived weaknesses of the programme design

Participants identified several weaknesses in the design of the scheme. These issues related to the extent to which a cafeteria promotion could successfully engage and inform customers about environmental issues and subsequently bring about changes in customer food choices.

6.5.4.1 Exclusive to a sub-group of customers

One member of the catering staff expressed the concern that the financial incentive was exclusive to GeniUS cardholders and therefore only a sub-group of customers were going to take an interest and stand to make financial gains from adhering to the scheme. This was considered potentially problematic in terms of the number of customers the scheme may appeal to or exclude.

"...The only thing that, I mean it's only slight, but the people that don't have GeniUS cards didn't get any form of award... it's just whether or not staff or students who didn't have a GeniUS card might have been left out" (IM4)

6.5.4.2 Poor engagement: misaligned with customer and priorities

The catering team in Velocity cafe expressed the opinion that the customers did not engage with the scheme in their cafe, as most did not value health and environmental protection like other customers did in the wider university.

"It's not working here. But maybe in other places, other cafes it might work. Yeah, because the customers here are different from others [in other University cafes]." (IM3)

"At the minute...they're not bothered, I doubt they would be bothered about healthy eating and looking after the planet...I might be wrong, but, that's the impression I get." (IM6)

Similarly, customers in Velocity were believed to be too young to take an interest in the message the posters and table tents were trying to convey 'serious' issues like health and the environment.

"Maybe our age, maybe thirties or forties, they might think 'oh we should protect the environment... as much as possible... to avoid..., our children's children, living in a bad way'. But they are so young, in this age, I think ...[there is a] really, really limited number that will think about this question, or this issue". (IM3)

As well as not sharing the health and environmental ideology of other customers in the university, customers in Velocity cafe were said to be disinterested in the GeniUS card loyalty scheme and did not collect points. Caterers were of the impression that students in Velocity would not be interested in the PFOP scheme because it was not relevant to them as they express little interest in any monetary incentives.

“When I say, they're not interested in any of the offers, or information. Not just your offer but our offers...I think they're quite happy to just buy what they want, so just burgers and what have you”. (IM6)

Velocity catering staff suggested that more customers would have taken an interest in the scheme in cafes in the SU or those that were based more centrally on campus. Their justification was that customers in these cafes valued health and the environment more so that customers in their own cafe.

“I think it would have... worked a lot more in the SU and The View, cause it's all vegetarian at the minute in that place... they have a lot of staff and students who are interested in eating healthier and eating to help the planet in there. I think the SU is all about that idea, of just promoting stuff like that, so I think it would work more at central campus”. (IM6)

Caterers believed that customers more likely to choose an environmentally friendly option had disparate values to those who collected GeniUS points. It was implied that monetary incentives would not be sufficient to influence food choices. They believed that the scheme would help support those already interested in healthy eating or environmental awareness, but not necessarily those who did not already share such values.

... “I think that the people who are more likely to go for more environmentally friendly options aren't necessarily people who are like 'oh I want tonnes of points'... I think a lot of the time, people that want to eat, like good for the environment, they just do it cause they want to, they're not going to be persuaded by more points.” (IM2)

It was also suggested that the health and environmental gains made by choosing HEF choices may be counteracted by using the GeniUS points to make unhealthy purchases thus limiting the efficacy of GeniUS points rewards to instil healthy eating habits.

... “I know I save my points for like bad things like cookies and coffees... so I dunno, maybe people who eat unhealthily are more likely to want the double points.” (IM2)

6.5.4.3 *Insufficient to influence food choices*

Caterers expressed the view that the scheme was insufficient to alter the values and beliefs that customer held. Whilst it was believed it may make customers aware of health and environmental issues, it would take time for them to process this information and subsequently change their dietary habits; thus acknowledged the limitations of interventions that just provide information.

"I just think, unless people realise something by their own mind or heart, they will, no matter how many millions of people are telling them... humans should protect the environment.... Everybody holds the key to open the door for change, no-one can use the key, only themselves." (IM3)

Whilst caterers expressed interest and support to the scheme in principle, when discussing their own position on the scheme, some staff implied that it would not affect their own food choices, despite agreeing with the principles of the scheme.

"I probably wouldn't buy a vegan option, just because I'm going to get double points... I mean people who are maybe like, that are slightly vegan, or trying to be a bit more environmentally conscious would be persuaded by it, more so than if it wasn't on at all." (IM2)

"I think the only thing that does influence me is just to be healthier, rather than the planet being healthier...I just want to be healthy. After reading it all, I wouldn't change much of my habits really... Which is, I'd change it cause I wanna, for me, I'd want to be healthier as well...Cause you think, you're a small fish in a big ocean, will it make any difference?" (IM6)

When discussing the food options available in the promotion, the catering staff expressed the view that the items included in the promotion were already popular choices and therefore they were unlikely to see a change in the sales of those items as they were already good sellers. Since they stock a variety of options to cater for all tastes, and did not change their sandwich orders it is unlikely that a change in the sales of the promoted items would be measurable.

"To be honest with you, I have a variety of stuff anyway, so that list [of items included in the promotion] that you sent through, it wasn't much different really to what [I usually order], I didn't change my order at all really... Nobody actually came to me and said I want this sandwich and this [type] has all gone." (IM5)

6.5.5 Perceived strengths of the programme components

Catering staff highlighted promising aspects of the programme components i.e the programme materials (posters and table tents) and the financial incentive (GeniUS points). Some believed that they effectively engaged customers with the scheme. Whilst unable to comment on the implementation of the programme materials in the test sites (as this was done by FG) the implementation process of the financial incentives was deemed to be practically feasible.

6.5.5.1 *Materials eye-catching and effective*

Most catering staff held positive views about the information provision and expressed the view the message was clear and accessible to the students. A key concern during the pre-implementation phase was concern about the clarity of the message for students with poor English literacy. Two participants said that they had witnessed customers reading the information provision.

“I really liked the posters and stuff, I thought they were actually quite informative and very accessible. I think one of the things I was a bit concerned about when you brought the idea to me was that... people in the cafe wouldn't necessarily understand it, being younger students from, multitude of different countries but....I think the information was put forward very clearly, and ... it was quite obvious what you were trying to get across and they seemed to absorb the message I think.” (IM4)

“I saw a lot of people, you know with the table talkers, a lot of people actually pick it up and read it. So a lot of people did look at it... We didn't necessarily get any questions. But they did look at it. And read it... while they were waiting for their coffees and things”. (IM5)

Some staff believed that it did make customers think about their food choices more and subsequently they purchased HEF choices.

“...I think for a lot of people... it made them think, and it made them make conscious decisions to not go for products that they would normally get, and instead go for the vegetarian and vegan options and the ones with the lower carbon footprint... yea I think in a lot of cases it was, a choice that they made after having read the stuff.” (IM4)

However, others felt that customers acknowledged the message presented in the promotion but that this didn't necessarily influence their decisions in the cafe, it simply provided them with knowledge about the environmental impact of food.

"I think that... when they have their food sitting down there, when they read this one [the table tent], they might think 'oh, if I have beef burger that's beef the meat, that used a lot of water or something, produce these things' They just have the idea ... but I don't know whether the inside of them has been impacted or not. But I think they at least have the idea about it now yeah." (IM3)

One member of the catering team in Velocity described the positive reaction of one customer to the scheme who asked questions and demonstrated support and delight in the existence of the scheme and the motivation to inform her peers about the scheme.

"But her friend wanted her to eat more healthier and because of the planet, and carbon footprint and she noticed [the table talker], and was like... 'oh...I want to take a photo with this and tell my friend what we're doing'"(IM2)

This highlights the scheme has the potential to prompt communication amongst customers about their food choices, health and the planet thus is useful for raising awareness of these issues.

6.5.5.2 GeniUS points: popular and attractive

All participants commented on the popularity of the GeniUS card rewards scheme and how there were very few customers without a loyalty card, (particularly in the Medical School cafe). They also expressed the belief it was a good way to attract customer's attention to the scheme and use it to link points to healthy and the environmentally friendly options. For example:

"I think it were a good idea [to use GeniUS rewards points], because I think if you'd just given no rewards for it or not an incentive, I don't think anyone would have done it." (IM5)

Using the GeniUS points rewards system was perceived as a positive aspect of the scheme because it had dual benefits for both the scheme and the cafes. It helped to raise the profile of the loyalty scheme, so there were perceived added benefits for the catering team besides those from the intervention.

"If it works, it gets more people using the GeniUS stuff as well so it works both ways I guess... if they see 'oh I get double points for doing this', and they themselves might think 'oh I'll get myself a card and sign up... so it's good for the university and the cafes, and for your Points for our Planet scheme as well. So I think it's a good idea to use it." (IM7)

6.5.5.3 Implementation of GeniUS points: feasible and adaptable

The catering team found the intervention practically feasible in several ways, including ease of implementation and its adaptability. Setting up the till system to reward double GeniUS points was not believed to be a difficult task, though time consuming in the first instance.

[Implementation]... “wasn’t too difficult in all honesty, it was just sometimes a little time consuming that’s all... The easiest thing was getting the tills to be set-up in the correct way and having the double points working. That part was pretty straightforward because we’ve done it before for other promotions and stuff so we already knew what we had to do for that.” (IM7)

The greatest challenge was adapting to changes in sandwich supplies, which meant that the system needed updating, but this was not considered a difficult problem and was acted upon quickly. This illustrates the adaptability of the intervention to changes in cafe procurement.

... “That was the only thing that might have made it a bit more difficult, is... the products that we sell changing, which it did for a little bit but, it was quick to fix...” (IM7)

6.5.6 Limitations of intervention components and suggested improvements

Whilst the information provision and financial incentive of HEF choices was believed to engage some customers, catering staff identified several limitations of the programme and proposed some strategies to improve it.

6.5.6.1 Reach of the scheme too restricted; need to expand

Most of the participants believed that the number of customers aware of the scheme was limited and that the profile of the promotion could be improved. It was suggested that the promotion be rolled out across all the university cafes, including those in the Students’ Union.

“I think [the scheme] is a good idea, but I think it needs to be more obvious that it’s happening, I don’t think anyone really knows that much [about it.] ... I think if it was more widespread across all the cafes... right across the Uni, I reckon it would take off more.” (IM2)

6.5.6.2 Limited programme dose; exposure and duration

The position of the table tents, (on the tables in the cafes and on the counter tops), were perceived to reduce their influence over food choices as they were read by customer who had already made their food choices. Members of the catering team

in Velocity described customers being 'pleasantly surprised' to find they were awarded with double GeniUS points at the till for making HEF choices.

"I think the posters are better than the table things, cause I think people tend to push it aside and not really look. Because by the time you've sat down eating, it's too late." (IM2)

To help to raise the profile of the scheme and inform food choices, it was suggested to email customers about the scheme or use social media. Twitter was considered a helpful advertising tool, currently used by the cafes to raise awareness of their promotions.

"...maybe we could have something on ours Twitter page.... Maybe see if they could, change our profile picture... to Points for our Planet or something like that... cause we do have our own Twitter page, and we have got loads of followers." (IM5)

Length of the scheme (6 weeks) was generally seen as sufficient, but running the scheme for longer could have helped to convey the information to a larger number of customers, giving them longer to process the information inform their choices.

"I think it could have probably been longer, but like I say, it seemed quite successful, and people did seem to notice and were pleasantly surprised by it. Maybe a little longer, in order to give people a chance, to sort of fully understand what was happening and sort of to ask questions and for it to sink in." (IM4)

Time-pressure is considered a key factor influencing the food decision-making process of cafe customers. Catering teams expressed the view PFOP would have a greater impact on customers who had longer to think about their purchases, when there was less time pressure on them.

"I think when people have the time to wander through and sort of take time in making a decision, and to notice things, then people tend to be a lot more receptive to things like this." (IM4)

One team member suggested that the promotion may be more effective if it had included hot meals, suggesting customers spend longer deciding on which hot meal to select that they do a sandwich.

"Cause a lot of the time people are buying a sandwich, it's more like for ease, quick, on the go, so people probably aren't going to stop and think, 'oh which ones the more environmentally friendly' and stuff. But if someone were to

come in and see hot food options, and see meat or environmentally friendly, they're going to be thinking about what they're eating more, so maybe that would work better?" (IM2)

6.5.6.3 Improve clarity of HEF choices

Another problem with the pilot raised by caterers was that it was unclear which cafe items were included in the promotion. It was suggested that it was difficult to identify which sandwiches were included in the promotion based on the information on the posters and table tents, particularly for international students with English as a second language. They thought that this may have been the key problem preventing customers from choosing the HEF choices. Two participants suggested that the use of labels would help to customers identify HEF options. One participant proposed the idea of having a designated shelf or box for the HEF choices to be placed:

"maybe even if you took, one of those feet [symbols from the table tent] and put it on a green sticker and used that to put on items, something that sort of becomes like a logo or somehow becomes synonymous with sort of being environmentally friendly. Something like that the students could instantly sort of recognise and see as a positive thing. Maybe that would be an even simpler way of sort of letting them know what items are better for the environment and which ones are slightly worse." (IM4)

Improving the identification of the promoted items would also reduce dependency on the staff to verbally endorse or explain the scheme to customers. This was considered advantageous as it would negate the need of caterers to speak to customers about a scheme which they may not be receptive to and which the staff have little time to communicate to customer in the cafes during the busy lunchtime period.

"... I think the most useful thing would be, if we had like the list of sandwiches and then had a section of the fridge set aside for them, with a sign, and they all just went in there, then we don't really have to do anything. Once they're out it's just up to the customer to make the decision...Then it's not as much like someone forcing them to, we don't have to go, 'why don't you try the vegan option instead' cause people may not respond well to that." (IM2)

Two of the catering staff suggested promoting HEF choices by incorporating them into a promotional 'meal deal'. They suggested that meal deals were popular with customers therefore aligning HEF choices with this familiar and existing scheme would help customers to better understand the promotion suggesting they may find this type of monetary incentive more attractive and memorable than the double GeniUS points rewards.

"... if you can work out some sort of incentivised meal deal, where there were three items like, drink, sandwich or main food and a snack that were all... good in terms of the carbon footprint and the impact on the environment then people would definitely go for that, because it's three items, and it costs three pounds fifty so it's easy to memorise, easy to get their heads round." (IM4)

6.5.6.4 Scope for expanding promotion

Most catering staff believed there was a good selection of HEF food choices included in the promotion but that it would be beneficial to expand it. However, it was recognised that the extent to which the promotion could be expanded was limited. Two members of the catering team expressed the view that there weren't many vegetarian or vegan options available in the cafes.

..."Vegetarians, they don't have many like hot options I don't think. The only one that we've really got is sandwiches... or an onion bhaji burger really." (IM1)

..."I think... the Cafe could do with a more broad range of vegetarian and vegan things." (IM4)

There was also the suggestion that the number of options included in the promotion were limited because there aren't many foods that are healthy and environmentally friendly available in general, rather than it being an issue of food procurement in the cafes.

"...I dunno it seems quite limited. But I don't know if that's just cause the types of food that are good for the environment are limited..." (IM2)

One member of staff insinuated their dependence on pre-packaged food was a hindrance to their ability to serve tasty and healthy meals. One team leader described how she strived to respond to customer requests to serve healthy options but because she depended upon pre-packed salads from the suppliers, which were often unpleasant, she felt unable to. She also mentioned that she was

intending to prepare a salad on site but was concerned that the additional cost of the freshly prepared salad may be a barrier to customers choosing this option.

"We have got people asking for salads all the time, but they're just not nice to buy in... I don't want to put something in my cabinet that I don't like the look of myself., and they don't sell.... it depends if people want to pay that price."
(IM5)

This indicates that staff felt their capacity to serve healthy and HEF meals was restricted. This is likely to have affected their self-belief in their ability provide HEF choices to customers which may reduce their advocacy of the programme and belief in the effectiveness of the scheme.

6.5.6.5 Advocacy unfeasible

Catering staff described lunchtime service as highly time pressured and that their priority is to serve as many customers the food and drinks efficiently as possible. It was believed that this may have reduced the effectiveness of the scheme since catering staff were unable to communicate with customers and answer queries they had about the scheme. They reflected that it was difficult to explain the promotion to customers and respond to their queries when there they were trying to serve customers on the till.

"... It's so fast-paced. It's really difficult to stop and have a conversation and explain things to people.... they tend to come in, grab whatever they can in the time they've got and have to leave for lectures and things...." (IM4)

Not having the time to interact with customers about the scheme was considered a key reason the scheme had limited success; an issue raised by both team leaders in the test sites. Staff in Velocity Cafe were concerned that the international students may not have understood the materials and felt that they had 'failed' by not providing additional verbal endorsement of the scheme. Furthermore, there was an influx of new students in Velocity cafe during the study period that meant that it was very busy. This was also believed to impede their ability communicate with the customers about the schemes.

"I think maybe... if it was over a quiet period... because it was so busy when we planned to implement it as well... maybe if there weren't as many [students]... we could have took the time more to get that message through to them...So I

wouldn't say they're not interested. They might be interested but, getting it across to them when we are busy, is definitely our failure. Not theirs.” (IM6)

One of the team leaders suggested that FG attend the cafe to advocate the scheme as FG would be more knowledgeable and have the time to communicate the promotion to the cafe users. This implies that the catering staff did not have the knowledge, self-efficacy and time to verbally endorse the scheme.

... “I think it might have got a better response, having somebody personally communicating with them behind the counter... we could serve them but you could have that conversation whilst we’re doing the coffee..., instead of us doing [it]...cause you could explain it better than what we could. Cause you know the ultimate goal of what it could reduce, facts and figures of what they might be interested in where we wouldn’t have all that.” (IM6)

6.5.6.6 Staff knowledge and understanding

Whilst all the catering staff said that they felt equipped to answer questions from customers, one suggested FG hold an informative workshop for the team so they could learn more about the HEF food choices. Furthermore, two participants explained that they had read around the subject after the initial discussions with the researcher so that that they were able to provide customers with more information about HEF choices should they be asked any questions.

“...it's been something that I've been sort of interested in...and something I sort of read through quite carefully because I wanted to make sure I didn't tell [the customers]... anything that wasn't true [laughs]. ...So yea, I made quite a conscious effort to make sure that I... sort of knew what I was talking about...” (IM4)

This suggest that the catering staff did not feel confident about verbally endorsing the scheme to customers which would reduce the extent to which they were able to provide an environment conducive to choosing HEF food.

6.6 Discussion

6.6.1 Summary of principle findings

The purpose of Study 3 was to evaluate the pilot intervention, 'Points for Our Planet', that was designed to increase the number of customers choosing healthy and environmentally friendly food choices in university food outlets. This study comprised an impact and process evaluation and had three aims; i) to assess the effect of the PFOP pilot on the purchasing behaviour of customers in the university cafes, ii) to investigate the efficacy of the PFOP programme materials, iii) to determine the feasibility of the PFOP programme activities (incentives and advocacy) and materials (posters and table talkers).

The effect of the pilot on the purchasing behaviour of customers was assessed by measuring changes in the sales of HEF choices in two university outlets compared to baseline measurements and comparison cafes. The efficacy of the programme materials and feasibility of the programme activities was ascertained from a customer feedback survey and interviews with caterers. The effect evaluation indicates that the pilot scheme did not successfully increase the number of customers purchasing healthy and environmentally friendly food choices. The process evaluation indicates the PFOP programme materials, (posters and table tents) had limited efficacy in promoting HEF choices. Furthermore, several weaknesses in the programme design and factors potentially affecting implementation were identified, which may explain the null effect of the pilot on the food purchasing behaviour of the customers in the university cafes.

6.6.2 Findings in relation to the literature

This study found that an intervention comprising information provision and a financial incentive had no significant effect on food choices of customers in a university setting. This is consistent with the findings of other worksite interventions based nutrition information provision at point-of-purchase that have reported limited to moderate effects on dietary behaviours of employees (Geaney *et al.* 2013; Maes *et al.* 2012; Ni Mhurchu *et al.* 2010) Similarly, information provision was reported to have a limited effect on dietary behaviour of adults in a range of food outlets settings, including restaurants (Seymour *et al.* 2004). As the majority of studies reviewed are not randomized control trials, it is difficult to

draw firm conclusions about the effectiveness of these strategies to improve food choice behaviours, as many are of low quality and subject to bias (Ni Mhurchu *et al.* 2010). Furthermore, these studies differ from the present study in terms of their settings, but also the majority of these studies have focused on increasing the consumption of fruit and vegetables or low fat foods which differs from the present study which aims to increase the consumption of plant-based foods. In addition, the messages conveyed to customers in these studies were based around healthy eating or weight loss, whereas the focus of this study was on the environmental impact of food. Nevertheless, the findings of the present study were consistent with Godfrey *et al.* (2017) that found presenting information around the environmental impacts of food was unsuccessful in changing customer's food choices in the university cafeteria setting.

Studies examining the effect of multi-component interventions, including a financial incentive were found to have a moderate positive effect on dietary behaviour (Allan *et al.* 2016; Geaney *et al.* 2016; Ni Mhurchu *et al.* 2010). Reductions in the price of healthier food options alongside information provision have found positive behavioural outcomes in a variety of real-world settings including the worksites and universities (Cárdenas *et al.* 2015; Deliens *et al.* 2016a; Giesen *et al.* 2011; Michels *et al.* 2008), school cafeterias (French 2003) and worksite vending machines (French *et al.* 2010). However, the present study does not reduce the price of the HEF options, it used an existing loyalty rewards scheme which does not appear to be as effective as changes to cost. The author is unaware of any studies that have examined the effect of a loyalty rewards scheme on food purchasing behaviours in university settings. However, the findings of this study are in contrast to others (Chan *et al.* 2017), who found that loyalty rewards schemes can lead to the healthier food choices in a worksite cafeteria in the US. In their study, the delivery of the rewards scheme was by a punch card that was available to all employees. This is different to the present study that required customers to already possess or obtain a GeniUS card, which required registration before points could be redeemed. This may have deterred customers from engaging with the promotion, which may explain the difference in the findings of these studies.

The findings of this study and related literature suggest that conveying information about the environmental impact of food choices and promoting healthy and environmentally friendly options using a loyalty rewards scheme is insufficient to bring about food choice behaviours, and that additional intervention elements are needed. The process evaluation of this environmentally focused intervention revealed potential weaknesses in the intervention design and materials used, which, helps to explain the null effect of this intervention.

6.6.2.1 Efficacy of intervention materials: Information provision

Most customers who completed the feedback questionnaire did not see the point-of-choice information. This suggests that a key reason why the scheme was ineffective in influencing food choices is because customers were simply unaware of it, i.e. the programme was not received. Part of the reason that customers may not have seen the posters and table talkers may be due to the installation of other promotional materials in the cafe during the intervention period. Upon visiting the cafes in week 5 of the intervention period, it was apparent that the university had launched the “*We are international*” campaign (#weareinternational) and a large promotional banner had been installed in the Medical School cafe, which hid the large PFOP posters. (See Appendix D11). This suggests that static posters may not be an ideal vehicle for the delivery of messages about the health and environment to customers in a cafe setting.

Posters and table talkers were selected as they were believed to be practically feasible to implement and did not require additional work for catering staff. However, the results of this study suggest that these materials were not effective in engaging customers with the programme, partly because they were in competition with other promotional material for the attention of customers. Caterers also expressed uncertainty in the ability of posters and table tents to reach customers and suggested the use of social media and e-mails to be more effective in raising awareness and conveying information to customers. These results are consistent with those of Mackison *et al.* (2016) who reported that caterers believed that posters were not effective for engaging customer’s attention, and that electronic messages would have been more engaging. Together these results indicate that alternative delivery channels or programme materials would be more appropriate for delivering messages about health and environmental sustainability to

customers. This conclusion is in contrast to others who found that the installation of nutritional information at point-of-choice in university cafeterias did increase the consumption of more healthful choices (Buscher *et al.* 2001; Fernandes *et al.* 2016; Peterson *et al.* 2010; Roy *et al.* 2016a). However, it should be noted that these studies are mainly based in the university dining halls, thus a slightly different context to the university cafes, which are open to the wider university community and provide different types of food options. Furthermore, other studies delivered a greater amount of information provision in a range of media, for example, (Roy *et al.* 2016a) used an exhibition banner and laminated placemats to deliver the information to students. This suggests that increasing the intensity and dose of the information provision could have a greater impact on customer behaviour. Steenhuis *et al.* (2004) concluded that educational and environmental programmes should be promoted intensively.

However, the extent to which such interventions based around providing information are cost-effective is debatable. Most participants who responded to the survey (67%) indicated that they had not seen the promotional material in the outlets, and of the 28 individuals who saw the promotion, only ten (35%) indicated that it positively influenced their food choice. The resources required to produce effective materials to raise awareness of the HEF options and the rewards promotion may outweigh the beneficial effect the intervention had on a small proportion of individuals. Furthermore, these findings suggest that awareness of the environmental impact of food choices and loyalty rewards scheme is insufficient to change behaviour, thus alternative types of interventions, particularly those higher up the ladder of intervention, such as choice editing, may be more effective. This conclusion is supported by the findings of Fitzgerald *et al.* (2017) who conducted a cost-analysis of workplace nutrition education and environmental dietary modification interventions from an employer's perspective and reported that the cost of implementing a multi-component nutrition education intervention is high compared to environmental modification strategies that added marginal additional cost, relative to the control. Whilst the analysis was conducted in a workplace setting in Ireland, it is plausible that similar costs would be incurred in other contexts.

6.6.2.2 *Message framing*

In addition to low visibility, customers reported disinterest to be a key reason for not acting upon the information provision in this study. These findings are similar to those of Godfrey and Feng, (2017), whose post-intervention interviews with students revealed they paid little attention to information provision in the university dining halls largely due to time constraints, disparate motivations and the perceived inconvenience of reading and internalising the posters. Poor understanding and lack of motivation was reported to be the cause of the null effect of nutrition labelling on students food choices in a university setting (Hoefkens *et al.* 2011, 2012). Together these findings highlight the challenge of translating dietary and environmental recommendations into understandable actions at point of purchase.

Furthermore, customer feedback indicated that the programme materials were not sufficiently engaging. Customers reported disinterest in the promotion as a key reason why it did not influence their food choices. Together this suggests that the scheme failed to attract the attention of the customers and engage them with messages about environmental protection. Catering staff also believed that customers were disinterested in messages about health and environmental protection. They believed only customers with existing knowledge and interest in health and environmental protection would engage with the scheme. Caterers were also of the opinion that the age and cultural background of the customers, specifically in the cafe of the international school, meant that they were less receptive to these messages. Whilst these views are subjective, they do highlight a potential weakness in the programme materials and the way the messages were framed. Whilst the programme materials were pre-tested with a small number of potential customers, it may have been more advantageous to trial them with a larger, more diverse sample of the student population. The importance of making environmental sustainability concerns personally relevant was highlighted by Savageau (2013), who noted that self-reflection is a key part of engaging students in sustainability efforts. Moreover, the framing of the messages is critical for engagement. Table tents included numerical measures of greenhouse gas and water footprints. Whilst images were used to simplify the messages, it is possible that these abstract concepts may have required too much processing at point of purchase, a conclusion shared by Godfrey *et al.* (2017).

6.6.2.3 Incentives

The minority of customers who reported seeing the promotion said it had influenced their food choice, largely because they liked collecting GeniUS points. This suggests that incentivising HEF choices holds promise for influencing the food choices of some customers. Whilst the author is unaware of any other study using a loyalty rewards scheme to promote HEF choices, these findings are consistent with others who have found that point-of-purchase interventions that reduce or increase the prices of healthy foods have found significant improvements in customer's choices in university (Michels *et al.* 2008; Giesen *et al.* 2011; Deliens *et al.* 2016;) and workplace settings (Mackison *et al.* 2016). Whilst caterers believed price changes were too financially risky to implement, this study suggests that a reward-based incentive may be a promising, less financially risky and acceptable alternative for improving students' food choices. However, future studies should ensure that the rewards-based incentive is applicable to all customers to be effective. In addition, future work should consider the potential compensatory effect that incentivising certain food choices can have on purchasing behaviours (Epstein *et al.* 2012). It may be that students save up the extra points to purchase more non-HEF options that would counter-act the benefits of choosing a HEF option in the first place.

6.6.2.4 Instilling positive attitudes towards the programme amongst caterers

The extent of the consultation with caterers on the background and purpose of the intervention was insufficient to promote positive attitudes towards the scheme amongst them. Whilst the interviews revealed they held positive views about the purpose of the intervention believed it valuable, there was some doubt about the extent to which the materials could influence customer food choices. This is likely to have affected the adoption of the intervention and may have caused the scheme to be less effectively implemented. Doubts in the efficacy of the scheme is also likely to have reduced their enthusiasm and verbal advocacy of the scheme, an important implementation activity and programme component.

Whilst most staff said that they had received sufficient knowledge about the scheme to be able to convey the purpose of the scheme respond to customer enquiries, two catering staff revealed that they had read around the subject prior to the intervention. Another suggested that a workshop be held in which they were

they could learn more about the healthy and environmentally friendly food choices available in the cafes. This also suggests that the meetings prior to implementation of the scheme was not sufficient to increase the self-efficacy of the catering staff, a key determinant of the performance objective to needed to implement the scheme and advocate the scheme to customers (performance objective of environmental outcome). Studies evaluating health promotion programme have reported that employee expectations about an intervention can impact on how it received and implemented (Fitzgerald *et al.* 2016).

Few studies have explored the most effective strategies for engaging caterers in workplace health promotion programmes despite their involvement being integral to the programmes success. One worksite health promotion programme, the Danish 6-a-Day Workplace Canteen Model included eight hours of canteen staff training (Lassen *et al.* 2004). Thus, to be implemented effectively it is important to ensure that caterers are knowledgeable about healthy and environmentally sustainable food choices. Workshops to equip caterers with knowledge may be a more effective strategy to instil positive attitudes towards the scheme. A review by Steyn *et al.* (2009) highlighted that workplace interventions that showed improved outcomes included dietitians providing nutrition education to participants.

The till technician expressed a high level of self-efficacy in his ability to implement the till changes. Furthermore, he was quick to draw the researcher's attention to the change in sandwich procurement during the intervention which suggests that he held positive attitudes towards the scheme and was monitoring the implementation process as planned. This suggests the involvement of the till technician from the beginning of the intervention mapping process helped to ensure the effective adoption of this programme by instilling knowledge and positive attitudes in the effectiveness of the scheme.

6.6.2.5 Feasibility of intervention implementation activities: verbal endorsement of HEF choices

The interviews revealed that catering staff did not believe that it was feasible to verbally endorse the scheme to customers. Whilst they expressed the view that verbal communication about the scheme to customers was an important way to convey the programme messages, several staff described how it was difficult to communicate such messages during the busy lunchtime service, explaining that their priority was to serve the customers quickly as possible to ensure customer

satisfaction. As a result, the catering staff did not manage to create an environment that was conducive to customers making HEF choices. Time and competing priorities have been noted to be a key barrier to participation in workplace interventions (Fitzgerald *et al.* 2016).

Further work to establish alternative ways catering staff can help to create an environment conducive to choosing HEF choices should be made. As the environmental impact of food is an emerging field, this may require a nutritionist with specialist knowledge of food-related environmental problems to be able to provide evidence and support the implementation process. However, no other studies have included verbal endorsement of HEF choices to at point of purchase as part of an intervention programme. The results of this study reveal that this is not a feasible strategy.

6.6.2.6 Implementation activity: Respond to demand for HEF choices

Another programme implementation activity of the catering staff was to monitor and respond to the increased demand for HEF choices. Insufficient time and resources to monitor and replace HEF sandwiches, meant that it was possible that the availability of HEF sandwiches was inconsistent throughout the intervention period. This would have affected how many customers were able to act upon the promotion and purchase of HEF options.

6.6.2.7 Implementation activity: Set up and monitor till system to ensure incentives in place

Another key implementation activity was programming the MCR system to provide double GeniUS points to customers who purchased HEF choices. The till technician believed this to be a practically feasible exercise and reported minor issues with the implementation process, which were resolved quickly. The supplier introduced a new selection of sandwiches which meant that the system needed updating, but this was addressed quickly. This highlights a key strength of the programme; that it is adaptable to changes in the procurement, a frequent occurrence in workplace catering. Once installed, little more effort was required to maintain the activity. (This activity was chosen during the development of the scheme by catering managers because they believed to be practically feasible.)

6.6.3 Strengths and limitations of study

A strength of this study is that it includes a process evaluation of the pilot study that was guided by the Steckler & Linnan (2002) framework. This has helped to provide an explanation as to the effective and ineffective aspects of the scheme and how it can be improved, which is often not reported in dietary intervention studies (Wierenga *et al.* 2013). Another strength of this study was that it comprised feasible and acceptable programme components, which increases the likelihood of effective wide-scale implementation. For example, it did not remove any cafe choices because it was not deemed financially feasible to caterers and was less acceptable to customers. Taste and desirability were considered in the development of the intervention in the sense that there was a range of sandwiches included in the promotion, i.e. vegan, egg no mayo and chicken no mayo. The focus groups with customers and catering staff revealed that some of the vegan options were considered less tasty and desirable, thus egg and chicken sandwiches were included, not only because they were lower impact but because they popular sandwiches choices, thus were considered appealing.

This study used a quasi-experiential design in which there was a comparison of effect of the programme on sales between test and comparison sites. This helps to measure changes with time and adjusts for confounding, extraneous variables. However, a quasi-experimental design does not use random assignment to treatment or comparison sites, which introduces selection bias. This together with the absence of blinding to treatment group, poses significant concerns about internal validity (Hoefkens *et al.* 2011). Nevertheless, quasi-experimental designs are more practical than random assignment which are highly susceptible to contamination due to student-to student contact (Roy *et al.* 2015). Another limitation of the study design was that the intervention period was of short duration. It is possible that the 3.9% increase in the proportion of HEF sandwich sold in the test site may have become significant had the intervention been implemented for longer. Had the information remained in the outlets for a longer period, a greater number of customers may have noticed the information and responded to the promotion, for example, it would have allowed more time for them to develop the habit of consuming HEF sandwiches. Since the information provision was placed on the tables, some customers may have already purchased their food before seeing the promotion, thus the promotion had no effect on their

purchases during the intervention period, but may have influenced future purchases. It is plausible that these future purchases may not have been captured within the 6-week timeframe of the study, especially since the results suggest that few customers visit the outlets more than one or twice a week. Furthermore, there was no follow up on sales purchases post intervention. The extent to which the intervention would start or continue to influence the food choices of those who had engaged with the scheme is unclear. It would be useful to explore this in future studies. However, the anecdotes from caterers suggest that customers become unresponsive to promotional materials with time, which may not have influenced the sales of HEF options.

The 'fidelity', i.e. the extent to which the programme was delivered as intended, was unable to be established, as this was not practically feasible within the timeframe of this PhD. Nevertheless, it should be noted that the researcher visited the cafes during the intervention period to ensure that the posters and tables tents were in position and to replace any that were missing or damaged. Photographs were taken periodically to demonstrate adherence to the implementation plan. Furthermore, catering staff were asked to inform the researcher about any issues with the till system relating the GeniUS points or concerns expressed by customers. The researcher contacted the till technician twice during the 6 weeks to ensure the rewards system was working correctly. The researcher also visited the control sites to ensure there were no any visible changes to the control cafes that could have affected the sales during the study period. Future studies should aim to monitor fidelity, perhaps using an observational research methods. Caterers were asked to respond to changes in demand for HEF sandwiches. Caterers did not have the time or resources to monitor and respond to changes in sales of sandwiches. This was also a shortfall in the study by (Freedman & Connors 2010) who also noted that it was possible that the healthy options had run-out during the intervention thus affecting the outcome measures. Furthermore, the availability of different types of sandwiches differs in each outlet and fluctuated week by week and suppliers discontinued some sandwiches and delivered new sandwiches during the study period. The availability of different sandwich types was not consistent therefore it was very difficult to measure changes in the proportion of HEF sandwiches sold. These findings suggest that it may be more appropriate to increase the proportion of sandwiches supplied that are HEF in the first instance.

This would remove the onus from the catering staff to monitor and respond to customer preferences.

Another key strength of this study was that the change in behaviour was measured in terms of sales data, which reflected actual behaviour. Other studies have reported the effectiveness of interventions based on self-reported behaviour that is subject to biased, or self-reported intentions that do not reflect behaviours (Vermeir & Verbeke 2006). However, the use of sales data as a measure of behaviour may lead to erroneous conclusions, as they do not accurately reflect the amount of food consumed. (Food waste was not monitored). Furthermore, sales data do not allow the measurement of individual food choices behaviours, thus it was not possible to determine the impact of the intervention at the level of the individual. It can only be assumed that changes in purchasing patterns reflect changes in individual behaviours. As we were unable to assess individual transactions on the till system, some customers may have purchased multiple sandwiches.

In addition, the sales of other cafe items were not monitored during the intervention period. It is possible that customers may have chosen to purchase a healthy, low impact sandwich but chosen to purchase a less healthy, high impact snack to accompany their sandwich which may have negated the health and environmental benefits of choosing a HEF sandwich. Furthermore, it was not possible to determine whether the number of people receiving double GeniUS cards increased during the intervention period, and therefore whether the use of the GeniUS card was an effective incentive, as the MCR system was not set up in a way to distinguish between normal reward points and double GeniUS. Knowing how many times double rewards points were collected would have helped to understand whether the incentive, (programme component) was effective in influencing food choice behaviour. Furthermore, not all customers actively use GeniUS cards. Caterers reported that it is primarily members of staff that actively collect GeniUS points. Future studies should explore other forms of incentives that are applicable to all university food outlet customers.

Background fluctuations in term time purchasing habits due to the dynamic nature of the university environment is likely to have affected the food sales between baseline and intervention. The increase in the overall sales of sandwiches and potatoes during the intervention period is likely due increased numbers of

customers visiting the cafe at the start of the new term. Baseline measurements were taken towards the end of the first semester when students began to leave for Christmas vacation. Moreover, differences in the number and rates of sandwiches and baked potatoes sales between the control and test cafes is partly due to differences in the opening times of the cafes and semester start dates. Velocity cafe was in the international college, the start date of term was 2nd January, thus these sales have been incorporated into the baseline measurements, and the vacation begins in March, which have been incorporated into the intervention period. The purchasing patterns in this test site will therefore differ considerably to the other cafes in the study.

The results indicate that at baseline in the test cafes (Velocity and Medical school) significantly more HEF sandwiches were sold compared to non-HEF sandwiches. The mix of the different types of sandwiches available in the university outlets depended on the number ordered by the team leader of that outlet. Team leaders placed their orders based on their experience and beliefs around which sandwiches sell well and ensured that the order was sufficient to cater for individuals with specific dietary requirements. It is possible that customers in Velocity preferred chicken, egg and vegan sandwiches, therefore more of these sandwiches were stocked and readily available to purchase. Customers in the control cafes may have purchased more non-HEF sandwiches in the past, thus a greater number of non-HEF sandwiches were stocked and subsequently sold.

In addition, a new cohort of students began at the start of term that may not have been familiar with GeniUS points and therefore the promotion was irrelevant to them. These differences in the procurement and fluctuations in customers with semester dates reflect the challenges of implementing health and environmental protection promotion programmes in a real-world setting. Dynamic environments such as the university cafes will reduce the amount of information received by customers, which will limit the impact it will have on their food choices. There were several pro-environmental initiatives, talks and lectures that took place during the intervention period, which may have influenced the effect of intervention. Depending on how well these messages were received, and the response taken by the cafe users, this could have affected the number of customers choosing HEF choices. Future studies should acknowledge such activities when interpreting the results of evaluation studies to ensure conclusions are accurate.

Nevertheless, a key strength of this study is that it is set in a real-world setting thus these limitations and challenges posed are realistic and common to other university and other institutional settings more broadly thus this study has strong external validity.

The customer feedback questionnaire was not piloted for readability, acceptability and clarity with customers, nor was the reliability of the questionnaire tested. On reflection, the questions do not accurately capture the information as intended. For example, the omission of a '*Not Applicable*' tick box meant that it was impossible to distinguish between a form where a question had been missed and a form where the question was not applicable. This meant that for a few of the questions the responses could not be included in the analysis, which reduced the accuracy of the results. During data collection, customers were asked if they had seen the posters and were shown table tents to aid their memory. A more useful strategy to test customer awareness of the scheme would have been to ask them to describe the information provision and what they could recall about them (Buscher *et al.* 2001). Nevertheless, survey questions were deemed to have face validity by the researcher and the supervisory team. Interviews or focus groups with customers in the university food outlets exposed to the intervention, similar to those conducted by (Godfrey & Feng 2017), would help to understand the reasons the intervention was ineffective.

The sample of customers who responded to the survey may not be representative of the customer base therefore the extent to which the results of this information can be generalised to the wider university cafe users is unclear. An alternative sampling strategy may have improved the number of responses and therefore given a better indication of the overall proportion of cafe customers exposed to the scheme. For example, using quota sampling to reflect the variety of customers in the university.

6.6.4 Implications for future research

This work has identified several changes to be made to the pilot scheme, which should be addressed prior to re-testing in other outlets, or trialled in other settings. One of the key issues raised was how best to frame the messages to make the materials more engaging and personally relevant to customers. As Godfrey & Feng (2017) noted in their study, one of the biggest challenge was the

“disconnection between scientific and personally relevant ideals regarding sustainability – rather than between actual behaviours and recommended actions”. The information provision in this study was focussed on promoting injunctive norms, what people should be doing, rather than what people are doing. The information provision may therefore be more influential if it reflected the effect on the environment of current consumption patterns in the cafe or outlets, or compared their impacts with other outlets across campus. This may have helped to motivate cafe users to achieve a specific environmental goal (Campbell-Arvai *et al.* 2012). Modelling may have also been a useful strategy for raising self-efficacy and engaging students with the intended behavioural outcomes. Establishing the best way to convey the evidence and justification for the making different food choices in a way that is meaningful to customers is an important area for future research.

Future evaluation studies should examine how customers use the information presented, and what factors influence the usefulness of the information. For example, Hoefkens *et al.* (2012) used the Consumer Information Processing model and Hierarchy of Effects model to explore how students’ objective and subjective knowledge influences their use of the information provision and what factors moderate this process e.g. attitudes. It is difficult to determine whether the information provision helped to raise awareness of environmental sustainability issues in this study. Future studies should measure changes in awareness and attitudes to such materials, using validated surveys distributed pre-and post-interventions. Godfrey & Feng (2017) noted that exposure to information about the environmental impacts of foods, created a negative attitude towards dietary change for sustainability. It is therefore important to explore student reactions to information provisions before widespread implementation of such interventions is pursued.

The results of this study imply that financial incentives to help promote HEF choices should be explored further. The incentive utilised in this study was only relevant to customers who actively collect GeniUS points. Future studies should explore alternative incentives that are more highly valued and applicable to all customers. Customers and caterers input would be needed to explore this further to identify alternative strategies are valued by customers and feasible to caterers. In future, studies may be able to track changes in purchasing patterns of individuals using GeniUS cards to measure directly the impact such programmes

have on behaviour at the level of an individual. It would be useful to understand the characteristics of those who do and do not respond to these programmes, which would help inform future intervention designs to target specific subgroups of the university community. However, this would require the MCR system to be set up for monitoring individual purchasing patterns and would also require additional ethical approval.

This study revealed that caterers work demands and time constraints reduced time available to participate in the intervention, respond to customer demands for specific sandwich types, converse with customers about promotion. Additional support would be required to implement the interventions more effectively, such as the employment of a nutritionist or health promotion practitioner may be useful to help implement and monitor changes. However, this may incur considerable additional costs, thus cost-effectiveness would need to be monitored. In future, it may be useful to simply alter the proportion of HEF sandwiches available, thus removing the onus from the caterers to monitor and respond to demand. Providing a variety of appealing option available may be acceptable and effective in enabling customers to make HEF choices on campus.

6.7 Conclusion

The results of this evaluation have revealed that PFOP scheme in its current format is only effective in influencing the food choices of a small minority of cafe users. To increase the reach of the scheme, alternative strategies are necessary to deliver messages about the promotion and to raise awareness of health and environmental issues. Whilst incentivising HEF choices was practically feasible, this may not have been the most effective way of engaging customers with the scheme. Moreover, the way the messages about health and environmental issues were framed were ineffective and need to be more culturally appropriate and engaging. Limited time and resources reduced the ability of catering staff to advocate HEF choices and respond to customer preferences thus alternative strategies to create an environment conducive to choosing HEF choices should be explored.

The results of this evaluation indicate that the strategies used to increase catering staff knowledge and awareness about healthy and environmental food choices in the cafes worked to some extent. However, these determinants alone are

insufficient to effectively implement the scheme in the cafes. Alternative change strategies are necessary to bring about the positive attitudes and self-efficacy required to adhere to and implement the scheme fully.

7 CHAPTER 7: SUMMARY AND CONCLUSIONS

7.1 Recap of research objectives

This thesis explored the research question: can a point-of-choice intervention increase healthy and environmentally friendly food consumption? To address this question an Intervention Mapping approach was used to design an intervention to increase the consumption of healthy and environmentally friendly food choices in cafes in the University of Sheffield. The intervention developed, called 'Points for Our Planet,' was piloted and evaluated as part of this thesis.

This thesis had three main research objectives, addressed by three separate studies: i) to explore the environmental impact and nutritional quality of food choices available in the university cafes (Study 1), ii) to identify a feasible and culturally acceptable intervention to encourage staff and students to make healthy and environmentally sustainable food choices (Study 2), iii) To evaluate a pilot intervention to increase the sales of healthy and environmentally friendly food choices in a university setting (Study 3)

Each study had its own study aims and objectives, which were discussed with the results at the end of each chapter, along with the methodological strengths and weakness of each study. The principle findings of this thesis in relation to the research objectives above, methodological limitations of the approach taken, recommendations for future research and policy development are discussed below.

7.2 Summary of principle findings

7.2.1 Objective 1: Identifying healthy and environmentally friendly food choices

This research has revealed that of the foods available in the university food outlets, those with the greatest environmental impact are choices containing meat and animal products, particularly beef, whilst those with the lowest impact were predominantly plant-based. Cafe options with a lower environmental impact tended to be of lower nutritional quality (contained fewer nutrients to encourage for health). However, these choices also contained fewer calories and nutrients to limit for health, thus may provide both environmental and health gains. This research has identified potential tensions between health and environmental goals

that need to be navigated effectively to develop interventions to support healthy and environmentally sustainable food consumption.

7.2.2 Objective 2: Identifying a feasible and culturally acceptable intervention

The PhD revealed that intervention implementers and beneficiaries expressed varied views over the acceptability of a cafe-based intervention to increase HEF food consumption on campus. The greatest variation in perspectives was who was responsible for the health and environmental implications of food chosen on campus. Some caterers and customers believed that this responsibility lay with the individual and therefore interventions to provide information to inform choices were deemed most acceptable. Interventions that restricted or removed choices were considered to be unacceptable to the majority of customers and therefore financially unfeasible. However, other customers and caterers believed it was the responsibility of the university to ensure that the options provided were healthy and environmentally friendly. These customers believed it was acceptable and welcomed an intervention that would 'force' them to choose HEF food. Whilst most customers were of the latter opinion when discussing HEF foods (considered to be local), when discussions focused around increasing the consumption of plant foods and restricting meat, more customers tended to change their position towards favouring interventions with higher personal responsibility. This highlights that meat attachment is an important factor influencing the cultural acceptability of interventions to support HEF food choices. This study also revealed that a perceived barrier to the selection of plant-based options was their low visual appeal and perceived lack of taste.

Practical and financial feasibility issues were important concerns expressed by caterers when discussing the intervention ideas. Those considered most feasible were ideas that utilised existing marketing strategies (posters and table tents) and promotional tools (loyalty rewards scheme). Ideas that would require changes to the business model, suppliers or food procurement were not considered financially feasible in the short term of this research. Despite emphasising that some of the greatest environmental gains could be made by reducing the size or availability of beverage and snacks, this was not considered financially feasible by caterers, as they were these items comprised the largest proportion of overall sales. It was also in immediate conflict with their promotions to increase sales of these products.

This highlights that interventions in catering establishments need to align with existing business models to be considered feasible and acceptable to implement. This study also revealed that reducing the amount of food products containing meat was not considered financially feasible by caterers, even though these changes in food procurement would likely reduce the environmental impact of the food service the most (Baldwin *et al.* 2011).

7.2.3 Objective 3: to evaluate a pilot intervention to increase the sales of environmentally friendly food choices in a university setting.

The evaluation of 'Points for Our Planet' pilot revealed that the point-of-choice intervention was unsuccessful in increasing the consumption of HEF choices in the university food outlets. The process evaluation suggests this is largely due to the limited profile and reach of the scheme. It also highlighted key limitations of the information provision and materials used to communicate the promotion.

Whilst only a minority of customers that completed the survey reported that they had been influenced by the promotion, the effect of this on a population level may be advantageous. Therefore, incentivising HEF choices may be a feasible and effective strategy that warrants further investigation. Providing information at point-of-purchase can be helpful in prompting the selection of HEF choices, however materials need to be more engaging, personally relevant and altogether more prominent if they are to be installed in cafeterias, where there is great competition for customer attention. Further involvement of the target population in the design of the programme materials would assist in ensuring the information provided is comprehensive, appealing and relevant and that the most effective channels of delivery are used. However, the costs involved in developing such materials should be carefully evaluated against the benefits considering the limited effect the posters and table-tents had on purchasing behaviours in this study. Only 3.5% of individuals who saw the information provision were motivated by the environmental concern to choose more HEF options. It may therefore follow that resources should be spent on developing promotional materials that focus on promoting HEF choices rather than on materials conveying messages around the environmental impact of food. More formal methods of education may be appropriate for conveying messages about the environmental impact of food choices, with minimal information used as part of the promotional campaign at point-of-purchase.

Whilst the pilot may not have been sufficient to influence the behaviour of most customers, information at point of purchase may have helped to increase health and environmental awareness. Glanz *et al.* (1998) have argued that providing nutrition information has benefits even if there is no change in behaviour. Whilst information is known to be insufficient to influence behaviour, awareness is important for developing positive attitudes, which, according to the RAA (Ajzen & Albarracin 2007) translate into intentions and subsequent changes in behaviour. Whilst changes in attitude were not measured in this study, others have found that information, particularly around environmental issues, can lead to greater concern, motivations and intentions to adopt more pro-environmental eating behaviours. For example, Graham & Abrahamse (2017) found that students that received information provision about the climate impacts of eating meat expressed higher rates of concern for the climate impact and lower intentions to eat meat compared to those that received no information. Pro-environmental behaviours are associated with higher levels of awareness and more pro-environmental attitudes more generally (Stern 2000). Furthermore, individuals who have environmental concerns are more likely to use sustainability labels (Grunert *et al.* 2014). Together these findings suggest that information can be useful in raising awareness and generating positive attitudes towards healthy sustainable eating behaviours, and that point-of-choice information may be most effective in bringing about changes in the behaviours of customers who already exhibit high levels of concern for health and the environment. And yet, Campbell-Arvai *et al.* (2012) others have found that concerns about environmental sustainability can be overridden by the immediate contexts in which decisions are made. Together these findings highlight the complexity of the interplay between determinants of behaviours, including knowledge, attitudes, intentions and beliefs along with the setting and other external factors. Interventions that focus on only a few of these determinants are insufficient to bring about changes in behaviour. Interventions comprising multi-components that address multiple determinants are needed to bring about changes in behaviour. Future studies should report the effects of components individually and in combination to provide an indication about the most effective strategy to alter dietary habits in a university setting (Roy *et al.* 2016). Furthermore, the findings of this study indicate that information provision in the cafeteria setting has minimal impact on food choices behaviours suggesting

other changes to the cafe environment, such as choice editing would be more effective strategy to support the consumption of healthy and environmentally friendly food options on campus.

7.3 Strength and limitations of thesis methodology

This thesis explores whether a point-of-choice intervention can be developed to increase healthy and environmentally friendly food consumption. Previous studies have focussed on healthy eating interventions or pro-environmental behaviour interventions, but not combined together. This study has helped to identify the key challenges to intervention development for implementation in a real world-setting generally, but also those that are specific to the field of food sustainability. It has used the intervention mapping approach as a conceptual framework, and has drawn upon theory and empirical evidence that is context specific.

The first step in the IM process was to conduct a needs assessment of the community and the behaviour considered to be contributing to ill-health, or in this case environmental degradation. Whilst the literature and Study 1 highlighted the consumption of high impact products to be the behaviour contributing the greatest environmental problem, the evidence in support of this notion needed strengthening as it was not holistic and did not capture the true essence of sustainability. The evidence provided was met with scepticism and uncertainty by the intervention stakeholders. This was a major challenge faced from the outset of the IM process. The second challenge was that the community upon which the intervention was focussed was largely unaware of this behavioural problem, and therefore the strategies to overcome the problem were directed by the researcher. The IM approach highlights the importance of the solutions being developed by the intervention beneficiaries themselves, and the implementation process being discussed and guided by the stakeholders. However, in this study, the problem health/environment behaviour wasn't fully recognised by the stakeholders. It was clear from the start that more information and evidence was required to proceed with the IM process successfully. Future work should examine how best to overcome this challenge, as it is important that the stakeholders fully support the intervention development process to increase the likelihood of success. As per the Diffusion of Innovation Theory of behaviour change, the first step in the adoption of an intervention is that the organisation must note the problem and bring it to

the fore, before moving onto the second step where they seek potential solutions to the problem.

Whilst involving stakeholders in the design of the intervention process is a key strength of the approach taken, the extent to which this is practically feasible was revealed by this study. The outlet managers involved in implementing the programme were unable to participate in the focus groups, thus had minimal input into the design of the intervention. Ideally, caterers at all organisational levels would be included in the design of the intervention, however, time restraints and resources limited participation. Had they been able to participate this may have helped to improve attitudes towards the scheme and knowledge of HEF foods. Some intervention ideas proposed that were considered feasible during discussions, were not considered feasible in the evaluation of the pilot. For example, caterers verbally endorsing HEF choices at point of purchase, although perceived to be an effective strategy for supporting HEF food choices, was not feasible during a busy working lunch period. This suggests that greater involvement of the catering staff during the development process may have helped to reveal more effective strategies for verbally endorsing HEF choices in the cafe setting, or may have indicated an alternative method would be most appropriate. These findings echo that of Lassen *et al.* (2004) who reported that the success of the programme was due to canteen managers and staff being allowed the freedom to be creative in achieving their goals. Future work ought to focus how best to involve stakeholders in the development process and overcoming barriers to participation.

Whilst IM provided a comprehensive overview of the intervention options available, the decision over the intervention design was ultimately determined by the budget, resources and time allowed for this PhD. Whilst it was clear from the literature that food behaviour is a highly complex process and would require a large multi-component complex intervention to be effective, this was not feasible in this study. Instead only one environmental and one behavioural outcome was targeted. Multiple determinants of behaviour, such as values and beliefs, not just knowledge of individuals and implementers need to be addressed by the intervention. Peers and colleagues have an important role in shaping the food choices of customers in the university outlets, thus interventions should aim to change the behaviours of others in various ecological levels. For example, peers and family, have been found

to strongly influence food behaviour (Contento 2011), therefore interventions which address these 'environmental agents' may be more effective than and single-component intervention. However, limited resources and time constraints are common to all health promotion programmes and future work in this area would also be limited by resource constraints. Furthermore, it could be argued that it is more effective to intervene intensively on one or two target behaviours, than to try and address multiple targets superficially.

Another challenge to arise during the intervention development process was that the literature suggested some intervention strategies would be effective, but these were not considered feasible and acceptable to the university community. For example, studies have found that customers tend to eat what food is available (Freedman & Connors 2010; Lachat *et al.* 2011) which suggests that increasing the proportions of HEF choices available and reducing the least HEF options may have been a more effective strategy to improve the food choices of university outlet customers. However, results of Study 2 indicated that altering the options available, or changing the visibility of some of the options, was considered too financially risky as it could result in a drop in the number of customers using the cafes. This highlights that communicating the evidence in support of intervention ideas may be necessary to instil confidence in the university caterers that such strategies can be effective without unintended effects. More time would be necessary to explore the intervention ideas further and to understand how best to overcome barriers to implementation highlighted by the customers and caterers. For example, it may have been considered more acceptable and feasible to edit the choices of foods available in the cafes gradually.

One of the key challenges of this study was identifying a feasible and acceptable intervention that supported food choices that were both healthy and environmentally friendly. This study found that only a small number of the low impact sandwich options available in the cafes met the WHO nutrient profiling criteria adapted for identifying 'healthier' options. Some of the options with the lowest impact score, vegan sandwiches, contained more than 1g of salt per 100g. Furthermore, it was not considered feasible to label every sandwich included in the promotion - customers needed to be able to identify promoted sandwiches based on the name of the sandwich on their packaging. From the description/names, most of the sandwiches classed as 'less healthy' contained

mayonnaise or were vegan. It was therefore decided to exclude all sandwiches that contained mayonnaise in their title from the promotion. However, vegan options were included in the promotion to be consistent with the consensus to reduce meat and dairy product consumption for environmental sustainability as confirmed by the findings of study one. Vegan sandwiches were also easy to identify from their distinct packaging, which was green and displayed the word 'Vegan' in large letters. As the intervention identified as feasible (information provision and rewards), was restricted by the options available in the cafe, some of the sandwiches included in the promotion did not completely meet the criteria for 'healthy'. This indicates that future interventions ought to focus on reformulating some of the cafe options or introducing alternative choices that meet 'healthy' nutrient profile criteria. This will enable the development of interventions that increase healthy and environmentally friendly food consumption simultaneously. It also highlights a limitation of the messaging of this study, as the information provision may have been misleading about the healthiness of some of the food options. One may have assumed, based on the information provided in this study, that all vegan options were healthy and environmentally friendly which was not necessarily the case. Future interventions should ensure that all messaging about the food options are accurate and that the options promoted meet healthy and environmentally friendly criteria.

The extent to which these findings are generalizable to other universities is a limitation of this study. It is possible that the UOS does not share the same characteristics as other university or large institutions, or have the same business models or promotional systems. For example, it may be that other universities do not have an electronic points rewards system therefore the applicability of this intervention design to other settings is restricted. Similarly, some of the caterers in this study were also students. Whilst this is useful as they provided a dual perspective about the scheme, the extent to which caterers in other settings share their views is unclear. Furthermore, it is possible that the university community in Sheffield hold disparate views to other university cities in the UK. Further studies should examine the factors influencing food choices of customers in other universities and workplace settings to confirm whether these findings are shared with the wider university population and general population. However, for any

behaviour change intervention, the specific context needs to be considered and incorporated into the design of the programme to be effective.

A key limitation of this study is that it was only considered university meals which are a small proportion of overall dietary intake of cafe customers. Most customers included in this study used the catering outlets once or twice a week. This limits the extent to which university cafes can influence students' everyday dietary choices. Nevertheless, it is important to expose customers to HEF choices and information about the environmental sustainability of food choices to help raise awareness and increase the likelihood of them choosing HEF options in other settings. Moreover, it is important to ensure that the university food environment reflects the health and environmental messages students are taught during their education and training.

Another strength of this study is that it included a process evaluation that helped to understand why the intervention was not successful. It is important to conduct careful process evaluations using a rigorous framework to ensure that interventions are evaluated more effectively. Most point of purchase interventions have not conducted a process evaluations therefore the strength of their conclusions are limited (Wierenga *et al.* 2013; Deliens *et al.* 2016).

7.4 Implications for policy development and future research

This thesis has highlighted a several of implications for policy development within the university context and on a societal level.

This thesis reaffirms that various improvements are needed to the way that the environmental impacts of food choices are measured. At present, there is limited environmental impact data comprising the full-life cycle of convenience food products or composite dishes. Much of the literature to date has been reliant on LCA data for fresh foods or commodities, which do not accurately reflect the overall impact associated with a specific food choices. Having access to supply chain information would also enable more accurate estimates of foods to be calculated as there is a large variation in environmental impacts associated foods depending on the agricultural practises and region of the world from which it originates (Poore & Nemecek 2018). Furthermore, research is needed to establish the most environmentally sustainable methods of food storage, cooking and disposal methods to provide evidence of best practise for catering establishments.

Whilst such data would improve the accuracy of the absolute values measured, it is unlikely that such improvements would alter the general consensus that livestock production and the consumption of animal products requires considerably greater natural resources and is associated with greater environmental impacts than the production and consumption of plant foods (Clune *et al.* 2015; Poore & Nemecek 2018). Clune *et al.* (2015) have argued that the clear message and generalizable findings from the growing body of LCA evidence should not be dismissed because of methodological limitations. Furthermore, the urgency by which strategies are needed to conserve natural resources and slow climate change requires immediate action based upon the present evidence.

Whilst the method used to test the environmental impacts of cafe choices in Study 1 holds promise, further research incorporating data for multiple environmental impacts parameters is needed to provide a more holistic assessment of the environmental impacts of food. The social and economic elements of sustainability should also be incorporated to this assessment to provide a more accurate indication of the sustainability of foods. At present, examination of cultural heritage and skills, equity, rights and governance are almost lacking from current literature exploring sustainable diets (Jones *et al.* 2016). Furthermore, most research studies to date have focussed on the diets of high-income countries (Jones *et al.* 2016). It is therefore important to consider the implications dietary change in high income countries will have on low income countries. They already suffer the strongest burdens of food insecurity, malnutrition and ill health and are therefore arguably the most susceptible to the effects of climate change and resource degradation (Jones *et al.* 2016).

The finding of this thesis also suggest further exploration nutrient quality of food with a lower environmental impact is needed. Studies have demonstrated that it possible to adversely affect the nutrient intakes when striving for more environmentally friendly diets. It is therefore important to consider the nutrient profile of replacement food to ensure that the alternative dishes or choices promoted are healthy and environmentally friendly. Nutrient profiling should be used or incorporated into the strategy for measuring healthy and environmentally friendly food choices. Nutrient profiling should be used or incorporated into the strategy for measuring healthy and environmentally friendly food choices. Recently, van Dooren *et al.* (2017) developed the Sustainable Nutrient Rich Food

Index that considers the nutrient quality and GHGE of food products simultaneously. In their study, van Dooren *et al.* (2017) explored the relationship between the GHGE and macronutrient content of 403 commonly consumed foods in the Netherlands. They then selected macronutrients that most strongly correlated with GHGE and have subsequently proposed a novel index to identify foods with lower GHGE and a higher Health Score that is based on (metabolic) energy density and six nutrients - three that should be encouraged (plant protein, essential fatty acids and dietary fibre) and three that should be limited (saturated fatty acids, sodium and added sugar).

In study 1 of this thesis, the relationship between the EIS (based on GHGE and WFII) of cafe options and their nutrients content was examined. Nutrients included in the correlational analysis were those of the Nutrient Rich Food index (NRF 11:3), which has been proposed to identify foods with a good nutritional quality for health. This index is based on 11 nutrients to encourage and 3 to limit (saturated fatty acids, sodium and added sugars, or in this case NMES). However, a NRFI score for each food and beverage option was not calculated therefore the overall relationship between nutrient quality and environmental impact was not examined, nor was it used to identify foods that were healthy and environmentally friendly at this stage. Nevertheless, this analysis revealed that there was a positive correlation between micronutrient content (e.g. calcium, vitamin B12, zinc) and the environmental impact of food and beverages, thus tensions between health and environmental goals exist. Van Dooren *et al.* (2017) did not include micronutrients in their SNRFI on the basis that 'an index with fewer micronutrients correlates better with GHGE measures'. Further investigation as to whether simplifying the index to include only macronutrients has implications on micronutrient intake and subsequent health is warranted. Furthermore, this index is currently limited as it is based on the relationship between nutrient quality and only one environmental impact parameter (GHGE), consideration of other sustainability parameters will be needed. Nevertheless, this index has the potential to be a useful tool for identifying healthy low impact food choices and could be a useful tool to formulate clear consumer guidance around sustainable food choices.

In study 3, the WHO nutrient profile model cut-offs were applied to foods with a lower environmental impact score to identify which of the options could be considered healthy. However, a nutrient quality score for each food option was not

calculated, thresholds were simply applied. The application of the proposed SNRF index to this study would have helped to speed up the process of identifying healthy and environmentally sustainable food choices and would in theory negate the need for GHGE calculations. However, at present the relationship between environmental impact and nutrient quality of food and beverages is still unclear and in the early stages of investigation. Such tools need to be validated against other measures of environmental sustainability and health before widespread use.

Information about dietary change for the environment needs to be robust, certain, and credible before people will accept there is a need to change and accept the evidence that supports the necessary change (Kersh & Morone 2002). According to Kerche and Monroe (2002), communities or societies will mobilise to support the necessary political solutions to societal problems provided three conditions are met: the population must perceive the problems exist, there must have been a steady build-up of evidence detailing the harmful effects of the problem, and the scientific data must have been debated and acknowledged and accepted by society. Lastly, there must be innocent victims that instil pity and outrage amongst community members to spark action (Delpuch *et al.* 2009). The results of this research suggest that many in the university community and wider population don't perceive the problem exists; they are simply unaware. Furthermore, this thesis has revealed that at present some of those who are informed express scepticism and distrust in dietary guidance, particularly with existing messages to reduce meat consumption and adopt more plant-based diets. It is therefore important to have evidence to demonstrate that plant-based diets are effective in reducing environmental impacts and improving health, without unintended social or economic consequences. This will help to reassure the university, and broader community, that such dietary changes are beneficial and help to reduce the evident scepticism amongst customers regarding the sustainability claims. According to Jones *et al.* (2016), to gain sufficient political attention and become a core priority in shaping agricultural, food and nutrition policies, empirical research must better reflect the diverse characterisation of sustainability outlined in the aspirational definition of sustainable diet.

Universities are in a strong position to run campaigns both within their institutions and local communities to help raise awareness and convey information about the environmental impacts of foods. They are also in a strong position to

formally educate future generations about the environmental impact of foods and benefits of dietary change. Even if it cannot be introduced into the curriculum design, it is still possible to use alternative educational activities to support students' learning. (Deliens *et al.* 2016b) reviewed dietary interventions among university students and found that five out of the six media-based intrapersonal interventions were effective in improving students' dietary intake. These interventions used different kinds of media, (text messages, websites, online programmes, emails) consisting of motivational dietary guidelines messages, educational lessons, stage-tailored messages and self-assessment. However, the long-term effectiveness of these interventions is unclear (Deliens *et al.* 2016b). Although most studies have focussed on healthy eating alone, a recent study by Monroe *et al.* (2015) that explored the effectiveness of a web-based intervention to promote environmentally conscious eating behaviours in US university students, The Green Eating Project, has shown promising results. In their quasi-experimental study, students in the intervention group were reported to have increased knowledge, improved attitudes and be engaged in 'green eating' behaviours, (including reducing red meat consumption), having completed four educational, interactive modules that had been incorporated into their general university education courses (Monroe *et al.* 2015).

It may therefore be concluded that intervention programmes comprising point-of-choice components in university outlets, alongside more intrapersonal education components may hold the greatest promise for increasing healthy and environmentally sustainable food consumption amongst university students. However, the costs of implementing multi-component nutritional education interventions are high. It may be more effective to explore acceptable and feasible environmental modifications, such as reformulating cafe options to lower their environmental impact of procuring a greater proportion of environmentally friendly options.

This research has revealed that interventions based on the low-to-middle rungs of the Nuffield ladder of intervention, (information provision and incentives), were considered the most acceptable and feasible by stakeholders. However, the results of study three revealed that the effectiveness of this intervention is limited. This is consistent with findings of a systematic review of the public acceptability of government interventions to change health-related behaviour, which revealed that

acceptability was greatest for the least intrusive interventions, which are often least effective (Diepeveen *et al.* 2013). Together these findings suggest that information provision at point-of-purchase has only limited success in influencing the dietary choices of individuals in a variety of real world settings. While financial incentives in terms of price reductions have been reported to have a greater effect than information alone, the magnitude of the cost has to be substantial to bring about change (Epstein *et al.* 2012). In light of the cost of producing effective information campaigns, along with the potential adverse financial implications price point incentives could have for retailers, it could be argued that interventions higher up the ladder of intervention, which would alter the availability of least healthy and sustainable options could be most cost-effective strategy food outlets could use to support the consumption of more healthy and environmentally sustainable foods.

Evidence in support of universities as settings to support HEF food consumption needs to be provided to university communities. This would help to increase the acceptability of interventions, which alter food provision for health and environmental gains. To encourage catering establishments to adopt more sustainable catering practises it would be useful to highlight the benefits to their reputation (Barling *et al.* 2016). Other interventions in the catering service may involve alteration of suppliers and reformulation of products, which may require a large shift in the food environment landscape. Legislation around the adoption of nutrient standards, such as the Nutrition Principles for Healthier and More Sustainable Catering (Public Health England 2017) in institutional food procurement may be useful to set clear guidance and expectations amongst retailers and create a level playing field upon which catering services can operate. This would help to ensure that any changes in food procurement and availability were expected by customers thus should not negatively impact on sales. This would help universities transition to more sustainable catering services.

Not only changing the access to HEF foods but also the social environment in which food is consumed may be an effective way to encourage customers to choose more HEF choices. Worksite cafeterias have been found to foster healthy eating habits (Roos *et al.* 2004) therefore it may be beneficial for universities to create food environments where all staff and students go to eat regularly. As individuals look to similar others, (those with whom they are affiliated), to provide valid

information about appropriate eating (Cruwys *et al.* 2015) this may help to normalise the habitual selection of healthy and environmentally sustainable food choices. Even if only a minority of the university community adopt more healthy and sustainable dietary choices, their behaviour may have a positive influence on others beyond the university.

Like all populations, the university community is a heterogeneous group, therefore it may be more effective to focus on a specific sub-group within this population that exhibit unhealthy and unsustainable dietary habits. Gathering information about student and staff's long-term dietary habits and choices on campus may would help to identify those in the population with unfavourable dietary choices. To date, male students have been noted to consume larger quantities of meat and lower amounts of fruits and vegetables compared to female students therefore it may be that interventions should specifically target this subgroup in the university population (El Ansari *et al.* 2011). Identifying and characterising a population unconcerned about sustainability, along with determining perceived barriers to HEF food selection would help to inform the development of targeted information campaigns to encourage the consumption of healthier and more environmentally friendly food products (Sautron *et al.* 2015).

Furthermore, long-term dietary choices have the greatest implications for health and environmental sustainability. Future studies should therefore examine the effects point-of-choice interventions have on food choices made beyond the university or workplace setting. It is possible that a point-of-choice interventions could cause unintended consequences because of a substitution effect. It may be that despite choosing a HEF choice on campus, customers may compensate by consuming more non-HEF foods in other setting, thus diminishing the beneficial effect on the environment or health.

7.5 Conclusion

This thesis has highlighted that at present there is limited data available to enable one to accurately calculate the environmental impacts of food choices available in retail outlets. This is problematic, as a clear definition of what foods are considered healthy and environmentally friendly is needed during the development of interventions to increase HEF food consumption. It is also needed to provide clear and robust guidance for customers, which will help to overcome the existing

scepticism and uncertainty that some groups currently express towards the notion of reducing meat consumption and adopting more plant-based diets. This thesis has demonstrated that a point-of-choice intervention may help to increase healthy and environmentally friendly food consumption if it forms part of a broader intervention programme that addresses multiple determinants of dietary behaviour on various ecological levels. This research provides limited support for an intervention based on education and financial incentives alone as an effective strategy to increase HEF food consumption. The results of this investigation suggest that this type of intervention would only influence a very small proportion of the population; therefore the extent to which it is cost-effective is questionable. Interventions that increase the proportion of healthy and environmentally food options and reduce the unhealthy high impact options at point-of-choice are more likely to have the greatest influence on food consumption. However, the findings of this study indicate that such changes are not considered acceptable and financially feasible to implement at present. Policies and regulations are needed to support widespread changes in catering and food procurement practices to ensure that the food available to purchase is tasty, affordable, healthy and environmentally sustainable.

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APPENDICES

A. Study 1 supplementary material

A1. Categories and sub-categories of core products by characteristics

Category: Sandwiches	
Sub-category	Core product
Beef	1079 Beef Sandwich Wedge, 50024 Beef, Red Onion & Horseradish Wedge, 7029 Corned Beef & Tomato Classic, 50050 Chilli Beef Panini, 1086 Corned Beef & Pickle Wedge, 7039 Corned Beef & Pickle Classic, 8037 Hot Chilli Beef Khobez, 7011 Cheese Classic, 5016 Cheese & Onion Toastie, 7013 Cheese & Tomato Classic, 7023 Soft Cheese & Cucumber Classic, 5017 Cheese & Tomato Toastie, 1015 Cheese Sandwich Wedge, 50046 Cheese & Red Onion Panini, 1021 Cheese Salad Wedge, , 1019 Cheese & Pickle Wedge, 50005 Savoury Cheese Wedge, 50043 Two Cheese & Tomato Panini, 14036 Brie Soft Cheese, Celery & Apple), 14041 Cheese Ploughman's (v), 7015 Cheese & Pickle Classic, 7017 Cheese & Spring Onion Classic, 1017 Cheese & Tomato Wedge, 6072 Greek Salad Wrap, 14023 Red Leicester, Spring Onion & Chive, 6023 Red Leicester, Spring Onion & Chive, 2026 Red Leicester & Spring Onion (v) Sub
Cheese	5051 Cheese & Bacon Toastie, 50040 Mozzarella & Pepperoni Panini, 50045 Brie & Bacon Panini, 50045 Brie & Bacon Panini, 5037 Ham & Cheese Toastie, 50041 Tuna Melt Panini, 50044 Ham & Mozzarella Panini, 1091 Ham & Cheesy Coleslaw Wedge, 1037 Ham, Cheese & Pickle Wedge, 14056 New York Deli, 14055 Ham, Cheese & Cranberry, 1051 Bacon, Two Cheese & Chives Wedge, 8034 Mozzarella & Pepperoni Khobez, 2036 Ham & Cheese Sub
Cheese and meat	7003 Egg & Tomato Classic, 12049 Chunky Egg Mayo Wedge, 7001 Egg Mayonnaise Classic, 1004 Egg Salad Wedge, 1002 Chunky Egg Mayonnaise Wedge, 2002 Chunky Egg Mayonnaise (v) Sub,
Egg	7005 Tuna Classic, 7007 Tuna Mayonnaise Classic, 13005 Prawn & Lettuce -300cal, 1013 Tuna Cucumber Wedge, 4073 Tuna & Onion Seeded Roll, 12009 Tuna Mayo & Cucumber Wedge, 14026 Smoked Salmon, 6061 Prawn to be Wild Wrap, 8011 Mediterranean Tuna Wedge, 12007 Tuna Mayonnaise Wedge, 13003 Tuna & Mayonnaise -300cal, 50088 Tuna Mayonnaise & Fresh Salad Ciab, 2006 Tuna Mayonnaise Sub, 1052 Prawn Mayonnaise Wedge
Fish	13002 Turkey & Ham -300cal, 14057 Chicken & Chorizo, 1074 Chicken, Mayo & Bacon Wedge, 1090 Chicken, Ham & Honey Mustard Wedge
Mixed meat	7019 Ham Classic, 12056 Bacon, Lettuce, Tomato & Mayo Wedge, 1049 Bacon & Egg Wedge, 1022 Ham Salad Wedge, 13006 Ham, Lettuce & Tomato -300cal, 1031 Ham Sandwich Wedge, 1039 Ham & Tomato Wedge, 50049 Sausage & Caramelised Onion Panini, 7021 Ham & Mustard Classic, 4045 Ham & Egg Seeded Roll, 50035 Ham & Honey Mustard Wedge, 14042 Ham Salad
Pork	7025 Chicken Classic, 1046 Turkey Sandwich Wedge, 12067 Chicken & Fresh Salad Wedge, 13004 Turkey Salad -300cal, 14043 Sweet Chilli Chicken Salad, 13001 Chicken Pesto -300cal, 8036 Fajita Chicken & Pepper Khobez, 14028 Chicken & Pesto, 12061 Chicken Mayonnaise Wedge, 50042 Chicken & BBQ Sauce Panini, 50023 Chicken & Stuffing Wedge, 6069 Chilli Chicken & Pepper Wrap, 50084 Chicken & Fresh Salad Ciabatta, 6065 Cajun Chicken Wrap, 14052 Coronation Chicken, 2064 Chicken Tikka Sub, 2062 Cajun Chicken Sub, 14040 Chicken Caesar, 6070 Chicken Caesar Wrap, 4072 Coronation Chicken Seeded Roll, 8030 Chicken Tikka Khobez, 8035 Chicken Caesar Khobez
Poultry	
Veg	12005 Plain Salad Wedge, 6062 Roast Veg & Hummus Wrap
Category: Hot food	
Baked potato with beef	Jacket Topping Chilli
Baked potato with cheese	Jacket Topping Cottage Cheese, Jacket Topping Cheese
Baked potato with fish	Jacket Topping Tuna, Jacket Topping Tuna Mayo
Baked potato with veg	Jacket Topping Coleslaw, Jacket Topping Beans
Beef soup	Knorr Beef Goulash Soup
Chicken soup	Freshfayre Cock A Leekie Soup, Knorr Chicken/Veg Soup, Knorr Cream Chicken Soup, Freshfayre Creamy Chicken Soup

Lamb soup	Freshfayre Scotch Broth Soup
Meat substitute sandwich	Vegetarian sausage sandwich
Pork sandwich	Bacon Sandwich (2rasher), sausage sandwich
Pork soup	Freshfayre Italian Tom & Pancetta Soup, Knorr Lentil/Bacon Soup, Knorr Lentil/Bacon Soup, Freshfayre Pea & Ham Soup Knorr Carrot& Coriander Soup, Freshfayre Spiced Carrot Soup, Freshfayre Leek & Potato, Knorr Minestrone Soup, Freshfayre Ministrioni Soup, Freshfayre Spiced Parsnip & Honey Soup, Freshfayre Butternut Squash Soup, Knorr Wild M/Room Soup, Knorr Highland Veg Soup, Freshfayre Country Veg Soup, Freshfayre Wild Mushroom Soup, Knorr Red Pep & Tom Soup, Freshfayre Tomato & Basil Soup, Knorr Thai Veg Soup, Knorr Cream Tomato Soup
Vegetable soup	

Category: Snacks

Biscuit	Flapjack, Eat Natural Bars (Peros) 50g bar, White Choc & Rasp Cookie, Choc Chip Cookie, Double Choc Cookie
Breakfast cereal	Porridge Pot Original, Porridge Pot Strawberry & Cream, Porridge Pot Golden Syrup
Cakes	Lemon Muffin (Brakes), Blueberry Muffin (Brakes), Chocolate Muffin (Brakes)
Chocolate confectionery	Divine Chocolate Dark, Divine Chocolate Milk, Divine Chocolate Orange, Divine Chocolate White
Fruit, general	Fruit Apple Green, Fruit Apple Red, Fruit Plum, Fruit Banana, Fruit Pear, Fruit Orange
Non-chocolate confectionery	Bagged Sweets
Nuts and seeds, general	Yoghurt Peanuts (Brakes) 100g, Fruit & Nuts (Brakes) 100g, Mixed nuts (Brakes) 100g
Pastries	Croissant Plain, Croissant Chocolate Propercorn lightly Salted, Propercorn Sour Cream, Propercorn Worcester Sauce, Propercorn Sweet & Salty, Yorkshire Crisp 40g Ham&Pickle, Yorkshire Crisps 40g Sweet Chilli, Yorkshire Crisps 40g Tom & Basil, Yorkshire Crisps Black Pepper 40g, Yorkshire Crisps Chardonnay 40g, Yorkshire Crisps Cheddar 40g, Yorkshire Crisps Henderson 40g, Yorkshire Crisps Lamb & Mint 40g, Yorkshire Crisps Sea Salt 40g
Savoury snacks	

Category: Beverages

Bottled Water	Life Water Still 500ml, Life Water Sparkling 500ml, Life Water 750ml Sport Cap
Coffee (milk-based)	Cappuccino Small, Flat white, Latte Small, Cappuccino Regular, Latte Regular, Latte Regular Iced (16oz), Cappuccino Large, Latte Large, Latte Large iced (20oz)
Coffee (water-based)	Americano Small, Espresso single, macchiato, Americano Regular, Espresso Double, Americano Large
Fruit juice	Tropicana Smooth 250ml (Freshfayre), Freshly Squeezed OJ, Fairtrade Apple Juice 500ml, Fairtrade Orange Juice 500ml Steamer Hot Milk Regular, Chi Latte Regular, Mocha Frappe latté (16oz), Regular Frappe 'latte (16oz), Regular Strawberry Crème (16oz), Vanilla Frappe latté (16oz), Steamer regular (with syrup), Chi Latte Large, Caramel Crème Regular (16oz), Regular Hazelnut Crème (16oz), Salted Caramel Frappe latté, Large Hazelnut Crème (20oz), Caramel Crème Large (20oz), Salted Caramel Frappe latté Large, Pint Milk, Hot Chocolate Regular, Mocha Regular, Hot Chocolate Large, Mocha Large
Other (milk-based)	Regular Grape Escape (16oz), Large Grape Escape (20oz), Berry Burst Regular (16oz), Regular Perfect Day (16oz), Regular Tropical Bliss (16oz), Large Berry Burst (20oz), Large Perfect Day (20oz), Large Tropical Bliss (20oz)
Smoothies	Red Bull 250ml (Brakes), Sprite Zero 500ml, Diet Coke 500ml, Fanta Zero 500ml (Coke), Cherry Coke 500ml (Coke), Coca Cola 500ml, Sprite 500ml, Glaceau Multi V 500ml, Glaceau Power C 500ml, Glaceau Triple X 500ml, Fanta Orange 500ml, Oasis Light Summer Fruit 500ml (Coke), Oasis Mango Medley 500ml (Coke), Oasis Summer Fruit 500ml
Soft drink	Yorkshire Tea Regular, Clipper Tea - Large, Clipper Tea Earl Grey Large, Clipper Tea Organic Green Large, Clipper Tea Peppermint Large, Clipper Tea Redbush Large, Clipper Tea Wild Berry Large, Yorkshire Tea Large
Tea	

A2. Greenhouse gas emission estimates-derived from Scarborough et al. (2014) for sandwich, hot food and snack composite ingredients.

Some ingredients were not listed on Scarborough et al.'s 'final' dataset therefore nearest equivalent food commodity values were used from the FAOSTAT 2007 data (published in Scarborough et al. 2014). For example, the GHGE for almonds was based on FAOSTAT 2007 value for 'treenuts'.

Food composite ingredient	Scarborough equivalent (Food code description)	2007 FAOSTAT data equivalent (food commodity)	GHGE value (gCO ₂ e/g)
Apple, green	Apples, eating, average, raw, weighed with core	Apples	0.72
Apple, red	Apples, eating, average, raw, weighed with core	Apples	0.72
Apple sauce	Chutney, apple, homemade ³	(see recipe)	1.10
Almonds	N/A	Treenuts	2.00
Bacon	Bacon rashers, back, fat trimmed, grilled	Pigmeat	7.87
Baked beans	Baked beans, canned in tomato sauce, reduced sugar ³	(see recipe)	1.08
BBQ sauce ¹	Glucose syrup	Sugar (Raw Equivalent)	0.11
Beansprouts/beans	Beansprouts, mung, raw	Beans	0.81
Beef (roast, minced)	Beef, rump steak, grilled, lean	Bovine Meat	68.83
Bistro salad	Lettuce, average, raw	Vegetables, other	2.21
Blueberries	Raspberries, raw	Fruits, Other	0.85
Brazil nuts	N/A	Treenuts	2.00
Brie	Cheese, Brie ⁴	(see adjustment)	18.58
Brown Sugar	Sugar, white	Sugar (Raw Equivalent)	0.11
Butter	Butter	Butter, Ghee	1.84
Butternut squash	Peppers, capsicum, red, raw	Vegetables, other	2.12
Cajun spices	N/A	Spices	15.80
Cannellini beans	N/A	Vegetables, other	2.21
Caramelised onions	Onions, raw	Onions	0.51
Carrot	Carrots, old, boiled in salted water	Starchy Roots	0.44
Cashew nuts	N/A	Treenuts	2.00
Ceaser dressing ¹	N/A	Rape and Mustard Oil	2.88
Celery	Celery, raw	Vegetables, other	2.21
Cheddar cheese	Cheese, Cheddar, average ⁴	(see adjustment)	18.58
Chicken	Chicken, meat, average, roasted	Poultry Meat	5.43
Chocolate	Chocolate, fancy and filled ³	(see recipe)	1.80
Chopped tomatoes	Tomatoes, raw	Tomatoes	1.48
Chorizo ¹	Bacon rashers, back, fat trimmed, grilled	Pigmeat	7.87
Ciabatta roll	White bread, average ³	(see recipe)	0.65
Cocoa powder	N/A	Cocoa Beans	3.40
Coconut milk	N/A	Coconut oil	2.10
Coleslaw	Coleslaw, with mayonnaise, retail ³	(see recipe)	1.70
Cool salsa sauce ¹	Tomatoes, raw	Tomatoes	0.15
Corn	Sweetcorn, kernels, boiled in salted water	Maize	0.74
Corned beef	Corned beef, canned	Bovine Meat	68.83

Coronation mayo	Mayonnaise ³	(see recipe)	3.42
Cranberries	Raisins ⁴	(see density adjustment)	0.82
Cranberry sauce	Jam, fruit with edible seeds	See jam	0.49
Cream	Cream, fresh, single	Cream	2.38
Crisped rice	Rice Krispies	Rice (Milled Equivalent)	3.85
Cucumber	Cucumber, raw	Vegetables, other	2.21
Egg	Eggs, chicken, whole, raw	Eggs	4.93
Emmental cheese	Cheese, Edam ⁴	(see density adjustment)	18.58
Fajita sauce ¹	Glucose syrup	Sugar (Raw Equivalent)	0.11
Farmers bread	White bread, average ³	(see recipe)	0.65
Feta cheese	Cheese, Edam ⁵	(see density adjustment)	18.58
Flour, plain	N/A	Wheat	1.04
Banana	Bananas	Bananas	1.42
Orange	Oranges, weighed with peel and pips	Oranges, Mandarins	0.60
Pear	Pears, average, raw, peeled, weighed with skin and core	Fruits, Other	0.85
Plum	Plums, average, raw	Fruits, Other	0.85
Gammon ham	Ham, canned	Pigmeat	7.87
Garlic	Garlic, raw	Onions	0.51
Gherkin	Cucumber, raw	Vegetables, other	2.21
Glucose syrup	Sugar, white	Sugar (Raw Equivalent)	0.11
Golden Syrup	Syrup, golden	Sugar (Raw Equivalent)	0.11
Ham	Ham, canned	Pigmeat	7.87
Hazelnuts	Hazelnuts	Treenuts	2.00
Honey	Sugar, white	Sugar (Raw Equivalent)	0.11
Honey mustard mayo ¹	Mayonnaise ³	(see recipe)	3.42
Horseradish	N/A	Starchy Roots	0.44
Hummus ¹	N/A	Pulses, Other	3.46
Iceberg lettuce	Lettuce, average, raw	Vegetables, other	2.21
Italian style hard cheese	Cheese, Cheddar, average ⁴	(see density adjustment)	18.58
Jalapenos	Peppers, capsicum, green, raw	Vegetables, other	2.21
Khobez	White bread, average ³	(see recipe)	0.65
Lamb	Lamb, average, trimmed fat, cooked	Mutton & Goat Meat	64.19
Leeks	Leeks, boiled in salted water	Vegetables, other	2.21
Lentils	Lentils, red, split, dried, boiled in unsalted water	Pulses, Other	3.46
Lime juice	Orange juice, unsweetened ⁴	(see density adjustment)	0.19
Malted white sub	White bread, average ³	(see recipe)	0.65
Margarine	Margarine, soft, polyunsaturated	Vegetable Oils	3.23
Mayonnaise	Mayonnaise ³	(see recipe)	3.42
Mexican mayo ¹	Mayonnaise ³	(see recipe)	3.42
Mild mustard pickle	Pickle, sweet	See sweet pickle	1.72
Milk	Milk non specific	Milk - Excluding Butter	1.84
Mixed pepper	Peppers, capsicum, red, raw	Vegetables, other	2.21
Mozzarella	Cheese, Cheddar, average ⁴	(see density adjustment)	18.58

		adjustment)	
Mushrooms	Mushrooms, common, boiled in salted water	Vegetables, other	2.21
Oatmeal bread	White bread, average ³	(see recipe)	0.65
Oats	Oat and Wheat Bran	Cereals- excluding beer	1.76
Oil	Olive oil	Olive Oil	4.48
Olives	Olive oil	Olive Oil	4.48
Onions	Onions, raw	Onions	0.51
Panini	White bread, average ³	(see recipe)	0.65
Parsnips	Parsnip, boiled in salted water	Starchy Roots	0.44
Pastrami	Beef, rump steak, grilled, lean	Bovine Meat	68.83
Peanuts	Peanuts, roasted and salted	Beans	0.81
Pearl barley	N/A	Wheat	1.03
Peas	Peas, frozen, boiled in salted water	Peas	1.24
Pecan nuts	N/A	Treenuts	2.00
Pepperoni	Bacon rashers, back, fat trimmed, grilled	Pigmeat	7.87
Peppers	Peppers, capsicum, red, raw	Vegetables, other	2.21
Pesto ¹	Basil	Vegetables, other	2.21
Pickle	Pickle, sweet	See sweet pickle	1.72
Pistachios	N/A	Treenuts	2.00
Poppy Knott	White bread, average ³	(see recipe)	0.65
Potatoes	Potatoes, roast, fat removed	Potatoes	0.40
Prawns	Prawns, boiled	Crustaceans	5.36
Pumpkin seeds	N/A	Beans	0.81
Quorn sausages	Tofu, soya bean, steamed	Soybeans (see density adjustment)	2.01
Raisins	Raisins ⁴	Rape and Mustard Oil	2.64
Rapeseed oil	Rapeseed oil	Rape and Mustard Oil	2.88
Raspberries	Raspberries, raw	Fruits, Other	0.85
Red hot chilli sauce ¹	Peppers, capsicum, green, raw	Vegetables, other	2.21
Red kidney beans	Runner beans, boiled in salted water	Beans (see density adjustment)	0.81
Red Leicester cheese	Cheese, Edam ⁴	Onions	18.58
Red onion	Onions, raw	Onions	0.51
Red pepper	Peppers, capsicum, green, raw	Vegetables, other	2.21
Reduced fat spread	Margarine, hard, vegetable fats only	Vegetable Oils	3.23
Rice	Rice Krispies	Rice (Milled Equivalent)	3.90
Rocket leaf lettuce	Lettuce, average, raw	Vegetables, other	2.21
Porridge	Porridge, made with water ³	(see recipe)	0.11
Sage and onion stuffing	Pork sausages, chilled, grilled	Pigmeat	7.87
Sausage	Pork sausages, chilled, grilled	Pigmeat	7.87
Seeded rustic bap	Wholemeal bread, average ³	(see recipe)	0.65
Shallots	Onions, raw	Onions	0.51
Sliced cheddar cheese	Cheese, Cheddar, average ³	(see density adjustment)	18.58
Slow roasted tomatoes	Tomatoes, raw	Tomatoes	0.15
Smoked salmon	Salmon, grilled	Freshwater fish (see density adjustment)	5.36
Soft cheese	Cheese, Cheddar, average ⁴	(see density adjustment)	18.58
Soft grain bread	Wholemeal bread, average ³	(see recipe)	0.65

Spaghetti	Spaghetti, white, boiled	Wheat	1.03
Spring onions	Onions, raw	Sugar (Raw Equivalent)	0.11
Stock ²	(Assumed water)	N/A	0.00
Sugar	Sugar, white	Sugar (Raw Equivalent) (see density adjustment)	0.01
Sultanas	Raisins ⁴	Sunflower seed Oil	0.26
Sunflower oil	Sunflower oil	Beans	0.33
Sunflower seeds	N/A	Onions	0.81
Sweet Thai chilli sauce ¹	Sugar, white	(see recipe)	0.51
Tikka mayo ¹	Mayonnaise ³	Tomatoes	3.42
Tomato purée	Tomatoes, raw	(see recipe)	0.15
Tomato and olive oil bread	Wholemeal bread, average ³	Tomatoes	0.65
Tomatoes/slow roasted tomatoes	Tomatoes, raw	(see recipe)	0.15
Tortilla	Wholemeal bread, average ³	Pelagic fish	0.65
Tuna	Tuna, canned in brine, drained	Poultry Meat	5.36
Turkey	Turkey, meat, average, roasted	Starchy Roots	5.43
Turnip	Swede, boiled in salted water	Vegetable Oils	0.04
Vegetable oil	Vegetable oil aggregate code	N/A	0.32
Water ²	Water	(see recipe)	0.00
White bread	White bread, average ³	(see recipe)	0.65
White semolina topped sub	White bread, average ³	(see recipe)	0.65
Wholemeal bread	Wholemeal bread, average ³	(see recipe)	0.65
Yoghurt coating	Low fat yoghurt, plain	Milk - Excluding Butter	1.84

Nb. Any sandwich composite ingredient that comprised <1g of total sandwich weight was excluded. And hot food ingredient that comprised <5% of total portion weight were excluded from the calculations and this list.

¹ Sandwich ingredients that comprised more than one component. The GHGE value selected reflected the major component of that ingredient determined from the list of ingredients on the product specification.

² GHGE for tap water derived from the report by Reffold et al. (2008). This was used as a proxy for the soup ingredient 'stock' and for the beverage calculations.

³ Value derived from recipe calculations conducted by Scarborough et al. (2014)

⁴ Value derived from density-adjusted calculations conducted by Scarborough et al. (2014)

A3. Greenhouse gas emission values for beverage ingredients and descriptions of the sources data from which they were derived/ calculated.

Beverage ingredient	Sources of data	Scarborough et al. (2014) description	Tesco description	Coca-Cola description	GHGE value (gCO ₂ e/g)
Apple Juice	Scarb	Apple Juice	N/A	N/A	0.99
Apple Juice (f/c)	Average: Tesco+ Scarb	Apple Juice	Orange JuiceX6, Orange Juice (FC) X14, Orange Juice (Value) X5		0.43
Cherry coke	Average: Tesco+ Coke	N/A	Diet cola, 6X500ml multipack X1, Diet cola, 6X500ml multipack X1	Diet coke (2l plastic bottle)	0.28
Coca cola	Average: Tesco+ Coke	N/A	Cola, 6X500ml multipack X1	Coca-Cola (2l plastic)	0.33

Coffee		Coffee infusion average	N/A	bottle) N/A	10.4
Cream	Average: Scarb +Tesco	Cream	Whipping cream X4	N/A	3.74
Diet coke	Average: Tesco+ Coke	N/A	Diet cola, 6X500ml multipack X1, Diet cola, 6X500ml multipack X1	Diet coke (2l plastic bottle)	0.28
Drinking Chocolate Powder	Scarb	Drinking chocolate powder -recipe	N/A	N/A	1.06
Fanta Orange	Tesco average	N/A	Lemonade (2l bottle) X2, (1l bottle) X1, Cola, 6X500ml multipack X1	N/A	0.36
Fanta zero	Tesco average	N/A	Diet lemonade (2l bottle) X4 (1 bottle) X1	N/A	0.31
Fresh Orange Juice	Average: Tesco +Scarb	Orange Juice	Orange Juice (freshly squeezed and not from concentrate)	N/A	0.76
Frozen fruit	Scarb	Fruit, other	N/A	N/A	0.85
Frozen fruit	Scarb	Fruit, other	N/A	N/A	0.85
Glaceau Multi V 500ml	Tesco average	N/A	Flavoured Water (X10 plastic bottles)	N/A	0.35
Glaceau Power C 500ml	Tesco average	N/A	Flavoured Water (X10 plastic bottles)	N/A	0.35
Glaceau Triple X 500ml	Tesco average	N/A	Flavoured Water (X10 plastic bottles)	N/A	0.35
Grapes	Scarb	Grapes	N/A	N/A	0.83
Milk	Scarb	Milk non-specific	N/A	N/A	1.84
Oasis Light summer medley	Coke	N/A	N/A	Oasis (375ml glass bottle)	0.91
Oasis summer fruit	Coke	N/A	N/A	Oasis (375ml glass bottle)	0.91
Orange Juice (f/c)	Average: Tesco + Scarb	Orange Juice	Orange JuiceX6, Orange Juice (FC X14, Orange Juice (Value) X5	N/A	0.43
Pint of Milk	Scarb, Tesco	Milk non-specific	Whole Milk (1,2,3,4,6pint)	N/A	1.69
Powder for hazelnut crème	Scarb	Sugar equivalent	N/A	N/A	0.11
Powder for mocha frappe latté	Scarb	Sugar equivalent	N/A	N/A	0.11
Powder for Strawberry/Caramel Crème	Scarb	Sugar equivalent	N/A	N/A	0.11
Powder for vanilla frappe latté	Scarb	Sugar equivalent	N/A	N/A	0.11
Red Bull	Average: Tesco+ Coke	Soft drinks'	Cola, 6X500ml multipack X1	Coca-Cola (2l plastic bottle)	0.33
Sparkling Water	Tesco	N/A	Sparkling water (6X500ml multipack)	N/A	0.32
Sprite	Tesco average	N/A	Lemonade (2l bottle) X2, (1l bottle) X1	N/A	0.33
Sprite Zero	Tesco average	N/A	Diet lemonade (2l bottle) X4 (1 bottle) X1	N/A	0.26

Still water	Tesco	N/A	Bottled water (6X500ml multipack)	N/A	0.28
Tea	Scarb	Tea, black, infusion, average	N/A	N/A	1.94
Tropicana Smooth (f/c)	Average: Tesco+ Coke	N/A	Orange JuiceX6, Orange Juice (FC) X14, Orange Juice (Value) X5	N/A	0.43

Scarb- Scarborough et al. (2014), Tesco- Tesco Ltd. 2012, Coke- Coca-Cola 2015. F/C- From concentrate

A4. Water footprint Impact Indicator (WFII) estimates derived from Fisher et al. (2013) for sandwich, beverage, hot food and snack composite ingredients.

Food and beverage composite ingredient	Description of WF factor used	WFII (Scarcity weighted litre/kg)	WFII (Scarcity weighted litre/g)
Apple, green	Apples, fresh	371	0.37
Apple, red	Apples, fresh	371	0.37
Almonds	Ground-nuts in shell not roasted or otherwise cooked	2187	2.19
Apple Juice (f/c)	Orange from concentrate & fresh (average)	554	0.55
Apple sauce	Apples, fresh	371	0.37
Bacon	Swine meat cured, other	3546	3.55
Baked beans	Vegetables, other & mixtures prepared or preserved	228	0.23
Banana	Bananas including plantains, fresh or dried	678	0.68
BBQ sauce ¹	Refined sugar, in solid form, containing added flavouring or colouring matter	1648	1.65
Beansprouts/beans	Vegetables, other & mixtures prepared or preserved	228	0.23
Beef (roast, minced)	Bovine cuts boneless & bone in, fresh or chilled (average)	4313	4.31
Berry burst- Frozen fruit	Fruits, fresh other	677	0.68
Bistro salad	Vegetables, fresh or chilled other	220	0.22
Blueberries	Fruits, fresh other	677	0.68
Brazil nuts	Ground-nuts in shell not roasted or otherwise cooked	2187	2.19
Brie	Cheese fresh (including whey cheese) unfermented, & curd	1322	1.32
Brown Sugar	Refined, sugar, in solid form, containing added flavouring or colouring matter	1648	1.65
Butter	Butter	1925	1.93
Butternut squash	Vegetables, fresh or chilled other	220	0.22
Cajun spices	Pepper of the genus Piper, except cubeb pepper, crushed or ground	9610	9.61
Cannellini beans	Vegetables, other & mixtures prepared or preserved	228	0.23
Caramelised onions	Onions & shallots, fresh or chilled	225	0.23
Carrot	Carrots & turnips, fresh or chilled	69	0.07
Cashew nuts	Ground-nuts in shell not roasted or otherwise cooked	2187	2.19
Ceaser dressing ¹	Olive oil, virgin	8517	8.52

Celery	Vegetables, fresh or chilled other	220	0.22
Cheddar cheese	Cheese fresh (including whey cheese) unfermented, & curd	1322	1.32
Cherry coke	Sugar containing carbonated drinks - from sugar beet	305	0.31
Chicken	Domestic fowl, duck, goose & guinea fowl meat & meat offal	1485	1.49
Chocolate	Chocolate	18951	18.95
Chopped tomatoes	Vegetables, fresh or chilled other	220	0.22
Chorizo ¹	Swine meat cured, other	3546	3.55
Ciabatta roll	Wheat bread	365	0.37
Coca-Cola	Sugar containing carbonated drinks - from sugar beet	305	0.31
Cocoa powder	Chocolate	18951	18.95
Coconut milk	Bananas including plantains, fresh or dried	678	0.68
Coffee	Coffee, roasted, not decaff - bean & instant (average)	27920	27.92
Coleslaw	CALCULATION BASED ON SCARBOROUGH'S METHOD ²	258	0.26
Cool salsa sauce ¹	Vegetables, fresh or chilled other	220	0.22
Corn	Cereals (from wheat)	419	0.42
Corned beef	Meat, meat offal or blood, prepared or preserved, other	8007	8.01
Coronation mayo	CALCULATION BASED ON SCARBOROUGH'S METHOD ²	7687	7.69
Cranberries	Grapes, fresh	538	0.54
Cranberry sauce	CALCULATION BASED ON SCARBOROUGH'S METHOD ²	1175	1.18
Cream	Cream	638	0.64
Cream	Milk and cream not concentrated and unsweetened ≥6%	638	0.64
Crisped rice	Rice, semi-milled or wholly milled	2724	2.72
Cucumber	Vegetables, fresh or chilled other	220	0.22
Diet coke	Sugar containing carbonated drinks - from sugar beet	305	0.31
Drinking Chocolate Powder	CALCULATION BASED ON SCARBOROUGH'S METHOD	2796	2.80
Egg	Eggs, bird, in shell, fresh, preserved or cooked	1116	1.12
Emmental cheese	(Including whey cheese) unfermented, & curd	1322	1.32
Fajita sauce ¹	Dolmio pasta sauce	234	0.23
Fanta Orange	Sugar containing carbonated drinks - from sugar beet	305	0.31
Fanta zero	Sugar containing carbonated drinks - from sugar beet	305	0.31
Farmers bread	Wheat bread	365	0.37
Feta cheese	Cheese fresh (including whey cheese) unfermented, & curd	1322	1.32
Flour, plain	Wheat bread	365	0.37
Fresh Orange Juice	Orange from concentrate & fresh (average)	554	0.55
Gammon ham	Swine meat cured, other	3546	3.55
Garlic	Onions	225	0.23
Gherkin	Vegetables, fresh or chilled other	220	0.22
Glaceau Multi V 500ml	Sugar containing carbonated drinks - from sugar beet	305	0.31

Glaceau Power C 500ml	Sugar containing carbonated drinks - from sugar beet	305	0.31
Glaceau Triple X 500ml	Sugar containing carbonated drinks - from sugar beet	305	0.31
Glucose syrup	Refined, sugar, in solid form, containing added flavouring or colouring matter	1648	1.65
Golden Syrup	Refined, sugar, in solid form, containing added flavouring or colouring matter	1648	1.65
Grape escape (smoothie)	Grapes, fresh	536	0.54
Ham	Swine meat cured, other	3546	3.55
Hazelnuts	Ground-nuts in shell not roasted or otherwise cooked	2187	2.19
Honey	Refined, sugar, in solid form, containing added flavouring or colouring matter	1648	1.65
Honey mustard mayo ¹	CALCULATION BASED ON SCARBOROUGH'S METHOD ²	7687	7.69
Horseradish	Vegetables, fresh or chilled other	220	0.22
Hummus ¹	Vegetables, fresh or chilled other	220	0.22
Iceberg lettuce	Vegetables, fresh or chilled other	220	0.22
Italian style hard cheese	Cheese fresh (including whey cheese) unfermented, & curd	1322	1.32
Jalapenos	Peppers of the genus Capsicum or of the genus Pimentel, fresh or chilled	283	0.28
Khobez	Wheat bread	365	0.37
Lamb	Sheep cuts, boneless, fresh or chilled	4472	4.47
Leeks	Vegetables, fresh or chilled other	220	0.22
Lentils	Vegetables, fresh or chilled other	220	0.22
Lime juice	Lemons and limes, fresh or dried	517	0.52
Malted white sub	Wheat bread	365	0.37
Margarine	Margarine	879	0.88
Mayonnaise	CALCULATION BASED ON SCARBOROUGH'S METHOD ²	7687	7.69
Mexican mayo ¹	CALCULATION BASED ON SCARBOROUGH'S METHOD ²	7687	7.69
Mild mustard pickle	Olives, provisionally preserved	1266	1.27
Milk	Liquid Milk not concentrated & unsweetened $\geq 1\%$	354	0.35
Mixed pepper	Peppers of the genus Capsicum or of the genus Pimento, fresh or chilled	283	0.28
Mozzarella	Cheese fresh (including whey cheese) unfermented, & curd	1322	1.32
Mushrooms	Vegetables, fresh or chilled other	220	0.22
Oasis Light summer medley	Sugar containing carbonated drinks - from sugar beet	305	0.31
Oasis summer fruit	Sugar containing carbonated drinks - from sugar beet	305	0.31
Oatmeal bread	Wheat bread	365	0.37
Oats	Breakfast cereals (from wheat)	419	0.42
Oil	Dressings (olive oil, virgin)	8517	8.52
Olives	Olives, provisionally preserved	1266	1.27
Onions	Onions	225	0.23
Orange	Mandarins (tangerine & Satsuma clementine, fresh/dried)	569	0.57
Orange Juice (f/c)	Orange from concentrate & fresh (average)	554	0.55
Panini	Wheat bread	365	0.37
Parsnips	Vegetables, fresh or chilled other	220	0.22

Pastrami	Bovine cuts boneless & bone in, fresh or chilled (average)	4313	4.31
Peanuts	Ground-nuts in shell not roasted or otherwise cooked	2187	2.19
Pear	Fruits, fresh other	677	0.68
Pearl barley	Breakfast cereals (from wheat)	419	0.42
Peas	Vegetables, fresh or chilled other	220	0.22
Pecan nuts	Ground-nuts in shell not roasted or otherwise cooked	2187	2.19
Pepperoni	Swine meat cured, other	3546	3.55
Peppers	Vegetables, fresh or chilled other	220	0.22
Pesto ¹	Domino pasta sauce	234	0.23
Pickle	Olives, provisionally preserved	1266	1.27
Pistachios	Ground-nuts in shell not roasted or otherwise cooked	2187	2.19
Plum	Fruits, fresh other	677	0.68
Poppy Knott	Wheat bread	365	0.37
Porridge	Breakfast cereals (from wheat)	419	0.42
Potatoes	Potatoes, fresh or chilled other	74	0.07
Powder for Caramel Crème	Refined sugar, in solid form, containing added flavouring or colouring matter	1648	1.65
Powder for hazelnut crème	Refined sugar, in solid form, containing added flavouring or colouring matter	1648	1.65
Powder for mocha frappe latté	Refined sugar, in solid form, containing added flavouring or colouring matter	1648	1.65
Powder for vanilla frappe latté	Refined sugar, in solid form, containing added flavouring or colouring matter	1648	1.65
Prawns	N/A	0	0.00
Pumpkin seeds	Ground-nuts in shell not roasted or otherwise cooked	2187	2.19
Quorn sausages	Soya beans	867	0.87
Raisins	Grapes, fresh	538	0.54
Rapeseed oil	Dressings (olive oil, virgin)	8517	8.52
Raspberries	Fruits, fresh other	677	0.68
Red Bull	Sugar containing carbonated drinks - from sugar beet	305	0.31
Red hot chilli sauce ¹	Dolmio pasta sauce	234	0.23
Red kidney beans	Vegetables, other & mixtures prepared or preserved	228	0.23
Red Leicester cheese	Cheese fresh (including whey cheese) unfermented, & curd	1322	1.32
Red onion	Onions & shallots, fresh or chilled	225	0.23
Red pepper	Vegetables, fresh or chilled other	220	0.22
Reduced fat spread	Margarine	879	0.88
Rice	Rice, semi-milled or wholly milled	2724	2.72
Rocket leaf lettuce	Vegetables, fresh or chilled other	220	0.22
Sage and onion stuffing	Swine meat cured, other	3546	3.55
Sausage	Swine meat cured, other	3546	3.55
Seeded rustic bap	Wheat bread	365	0.37
Shallots	Onions	225	0.23
Sliced cheddar cheese	Cheese fresh (including whey cheese) unfermented, & curd	1322	1.32
Slow roasted tomatoes	Vegetables, fresh or chilled other	220	0.22
Smoked salmon	N/A	0	0.00

Soft cheese	Cheese fresh (including whey cheese) unfermented, & curd		1322	1.32
Soft grain bread	Wheat bread		365	0.37
Spaghetti	Dry pasta		868	0.87
Sparkling Water	Sugar containing carbonated drinks - from sugar beet		305	0.31
Spring onions	Vegetables, fresh or chilled other		220	0.22
Sprite	Sugar containing carbonated drinks - from sugar beet		305	0.31
Sprite Zero	Sugar containing carbonated drinks - from sugar beet		305	0.31
Still water	N/A		0	0.00
Stock ²	N/A	NA	NA	
Sugar	Refined, sugar, in solid form, containing added flavouring or colouring matter		1648	1.65
Sultanas	Grapes, fresh		538	0.54
Sunflower oil	Dressings (olive oil, virgin)		8517	8.52
Sunflower seeds	Ground-nuts in shell not roasted or otherwise cooked		2187	2.19
Sweet Thai chilli sauce ¹	Dolmio pasta sauce		234	0.23
Syrup	Refined sugar, in solid form, containing added flavouring or colouring matter		1648	1.65
Tea	Black tea (fermented) & partly fermented tea in packages ≤3 kg		6958	6.96
Tikka mayo ¹	CALCULATION BASED ON SCARBOROUGH'S METHOD		7687	7.69
Tomato and olive oil bread	Wheat bread		365	0.37
Tomato purée	Vegetables, fresh or chilled other		220	0.22
Tomatoes/slow roasted tomatoes	Vegetables, fresh or chilled other		220	0.22
Tortilla	Wheat bread		365	0.37
Tropical Bliss- Frozen fruit	Fruits, fresh other		677	0.68
Tropicana Smooth (f/c)	Orange from concentrate & fresh (average)		554	0.55
Tuna	N/A	N/A	N/A	
Turkey	Domestic fowl, duck, goose & guinea fowl meat & meat offal		1485	1.49
Turnip	Vegetables, fresh or chilled other		220	0.22
Vegetable oil	Olive oil, virgin		8517	8.52
Water ²	N/A	N/A	N/A	
White bread	Wheat bread		365	0.37
White semolina topped sub	Wheat bread		365	0.37
Wholemeal bread	Wheat bread		365	0.37
Yoghurt coating	Yoghurt		430	0.43

¹ Sandwich ingredients that comprised more than one component. The WFII value selected reflected the major component of that ingredient determined from the list of ingredients on the product specification.

² WFII for 'Mayonnaise' and 'Drinking chocolate' were calculated using the same recipe and proportions as Scarborough et al. (2014) used. To calculate GHGE. GHGE were replaced with the nearest equivalent WFII values.

Nb. There was no WFII value for water or seafood used in these calculations.

A5. Greenhouse Gas Emissions and Water Footprint Impact Indicators of each cafe option ranked by EIS score

Table 1 Sandwich greenhouse gas emission, Water footprint impact indicators and Environmental impact scores

Sandwich name	Filling category	GHGE (gCO ₂ e/portion)	WFII (SWL/portion)	Environmental Impact Score
12005 Plain Salad Wedge	veg	157	42	-1.50
7005 Tuna Classic	fish	275	31	-1.48
6062 Roast Veg & Hummus Wrap	veg	285	51	-1.35
7025 Chicken Classic	poultry	309	98	-1.05
7007 Tuna Mayonnaise Classic	fish	256	107	-1.04
1046 Turkey Sandwich Wedge	poultry	332	105	-1.00
13005 Prawn & Lettuce - 300cal	fish	321	111	-0.97
1013 Tuna Cucumber Wedge	fish	360	112	-0.93
7003 Egg & Tomato Classic	egg	277	123	-0.93
4073 Tuna & Onion Seeded Roll	fish	309	123	-0.90
12067 Chicken & Fresh Salad Wedge	poultry	444	122	-0.81
12049 Chunky Egg Mayo Wedge	egg	351	134	-0.81
7001 Egg Mayonnaise Classic	egg	295	141	-0.81
5016 Cheese & Onion Toastie	cheese (only)	780	85	-0.79
7011 Cheese Classic	cheese (only)	804	83	-0.78
13004 Turkey Salad -300cal	poultry	380	138	-0.76
12009 Tuna Mayo & Cucumber Wedge	fish	373	141	-0.75
7013 Cheese & Tomato Classic	cheese (only)	834	88	-0.73
7023 Soft Cheese & Cucumber Classic	cheese (only)	848	88	-0.72
5017 Cheese & Tomato Toastie	cheese (only)	832	90	-0.72
14026 Smoked Salmon	fish	387	146	-0.71
13002 Turkey & Ham - 300cal	mixed meat	383	147	-0.71
13001 Chicken Pesto -300cal	poultry	394	148	-0.70
8011 Mediterranean Tuna Wedge	fish	331	157	-0.69
1015 Cheese Sandwich Wedge	cheese (only)	897	90	-0.67
14043 Sweet Chili Chicken Salad	poultry	500	140	-0.66

12007 Tuna Mayonnaise Wedge	fish	329	163	-0.65
8036 Fajita Chicken & Pepper Khobez	poultry	464	149	-0.64
50046 Cheese & Red Onion Panini	cheese (only)	822	105	-0.63
6061 Prawn to be Wild Wrap	fish	421	156	-0.62
12056 Bacon, Lettuce, Tomato & Mayo Wedge	pork	299	179	-0.58
12061 Chicken Mayonnaise Wedge	poultry	413	167	-0.57
7019 Ham Classic	pork	376	172	-0.56
50042 Chicken & BBQ Sauce Panini	poultry	438	170	-0.53
1004 Egg Salad Wedge	egg	426	173	-0.52
5051 Cheese & Bacon Toastie	cheese & meat	761	134	-0.51
50040 Mozzarella & Pepperoni Panini	cheese & meat	751	137	-0.50
1002 Chunky Egg Mayonnaise Wedge	egg	388	185	-0.48
50005 Savoury Cheese Wedge	cheese (only)	802	135	-0.48
13003 Tuna & Mayonnaise - 300cal	fish	388	189	-0.46
1021 Cheese Salad Wedge	cheese (only)	1075	107	-0.44
1019 Cheese & Pickle Wedge	cheese (only)	1016	116	-0.43
7015 Cheese & Pickle Classic	cheese (only)	401	191	-0.43
2006 Tuna Mayonnaise Sub	fish	440	189	-0.42
50045 Brie & Bacon Panini	cheese & meat	819	146	-0.39
7017 Cheese & Spring Onion Classic	cheese (only)	454	192	-0.39
50023 Chicken & Stuffing Wedge	poultry	488	188	-0.39
50088 Tuna Mayonnaise & Fresh Salad Ciab	fish	502	189	-0.37
14028 Chicken & Pesto	poultry	785	155	-0.37
1052 Prawn Mayonnaise Wedge	fish	336	214	-0.34
2002 Chunky Egg Mayonnaise (v) Sub	egg	425	210	-0.31
6069 Chili Chicken & Pepper Wrap	poultry	398	214	-0.30
5037 Ham & Cheese Toastie	cheese & meat	761	170	-0.30
1049 Bacon & Egg Wedge	pork	460	216	-0.24
13006 Ham, Lettuce & Tomato -300cal	pork	456	219	-0.23

1022 Ham Salad Wedge	pork	539	218	-0.17
1031 Ham Sandwich Wedge	pork	494	226	-0.16
14041 Cheese Ploughman's (v)	cheese (only)	1141	147	-0.16
50041 Tuna Melt Panini	cheese & meat	771	193	-0.15
12066 Chicken Tikka, Cucumber & Lettuce	poultry	403	239	-0.15
50043 Two Cheese & Tomato Panini	cheese (only)	1247	136	-0.15
1039 Ham & Tomato Wedge	pork	523	230	-0.11
14036 Brie Soft Cheese, Celery & Apple (cheese (only)	1482	138	0.04
14057 Chicken & Chorizo	mixed meat	508	260	0.06
50044 Ham & Mozzarella Panini	cheese & meat	807	226	0.07
50084 Chicken & Fresh Salad Ciabatta	poultry	549	260	0.08
14052 Coronation Chicken	poultry	388	281	0.09
6065 Cajun Chicken Wrap	poultry	426	277	0.10
1017 Cheese & Tomato Wedge	cheese (only)	978	210	0.10
7021 Ham & Mustard Classic	pork	427	288	0.16
2064 Chicken Tikka Sub	poultry	427	288	0.16
2062 Cajun Chicken Sub	poultry	428	291	0.18
4072 Coronation Chicken Seeded Roll	poultry	392	312	0.28
50049 Sausage & Caramelized Onion Panini	pork	871	254	0.28
6070 Chicken Caesar Wrap	poultry	439	308	0.29
1037 Ham, Cheese & Pickle Wedge	cheese & meat	1136	238	0.38
1091 Ham & Cheesy Coleslaw Wedge	cheese & meat	1180	234	0.39
14040 Chicken Caesar	poultry	763	293	0.44
6072 Greek Salad Wrap	cheese (only)	923	276	0.45
1074 Chicken, Mayo & Bacon Wedge	mixed meat	554	323	0.46
4045 Ham & Egg Seeded Roll	pork	660	322	0.53
14023 Red Leicester, Spring Onion & Chive	cheese (only)	989	285	0.55
6023 Red Leicester, Spring Onion & Chive	cheese (only)	780	318	0.60
2026 Red Leicester & Spring Onion (v) Sub	cheese (only)	786	337	0.71
1090 Chicken, Ham & Honey Mustard Wedge	mixed meat	698	362	0.80
14055 Ham, Cheese & Cranberry	cheese & meat	1244	296	0.80

8030 Chicken Tikka Khobez	poultry	553	383	0.82
1051 Bacon, Two Cheese & Chives Wedge	cheese & meat	821	362	0.88
50035 Ham & Honey Mustard Wedge	pork	667	396	0.98
14042 Ham Salad	pork	748	404	1.08
8035 Chicken Caesar Khobez	poultry	572	434	1.14
8034 Mozzarella & Pepperoni Khobez	cheese & meat	1024	464	1.64
2036 Ham & Cheese Sub	cheese & meat	1050	473	1.71
14056 New York Deli	cheese & meat	3301	246	2.00
1079 Beef Sandwich Wedge	beef	3502	246	2.15
7029 Corned Beef & Tomato Classic	beef	2844	355	2.32
1086 Corned Beef & Pickle Wedge	beef	2831	363	2.36
7039 Corned Beef & Pickle Classic	beef	2831	363	2.36
50024 Beef, Red Onion & Horseradish Wedge	beef	3568	309	2.57
50050 Chili Beef Panini	beef	3649	362	2.95
8037 Hot Chili Beef Khobez	beef	4593	442	4.11

Table 2 Greenhouse gas emission, Water footprint impact indicators and Environmental impact scores

Hot food option	Hot food sub category	GHGE (gCO ₂ e/portion)	WF (SWL/serving)	Environmental Impact score
Knorr Carrot/Carr Soup	Vegetable soup	44.9	10.7	-0.88247
Freshfayre Spiced Carrot Soup	Vegetable soup	55.9	12.8	-0.86577
Freshfayre Leek & Potato	Vegetable soup	186.4	25.3	-0.73819
Freshfayre Spiced Parsnip & Honey Soup	Vegetable soup	60.2	37.8	-0.72513
Freshfayre Ministroni Soup	Vegetable soup	157.6	35.1	-0.69675
Knorr Minestrone Soup	Vegetable soup	157.6	35.1	-0.69675
Knorr Highland Veg Soup	Vegetable soup	55.1	45.2	-0.68624
Freshfayre Country Veg Soup	Vegetable soup	73.1	45.2	-0.67814
Knorr Wild M/Room Soup	Vegetable soup	233.5	43.8	-0.61422
Jacket Topping Coleslaw	Baked potato with veg	257.1	42.1	-0.6133
Jacket Topping Tuna	Baked potato with fish	580.2	16.3	-0.61152
Freshfayre Wild Mushroom Soup	Vegetable soup	234.9	45.5	-0.60454
Freshfayre Butternut Squash Soup	Vegetable soup	338.9	38	-0.5991
Knorr Red Pep & Tom Soup	Vegetable soup	312.6	47.9	-0.55614
Freshfayre Tomato & Basil Soup	Vegetable soup	328.2	65.1	-0.45368
Freshfayre Italian Tom & Pancetta Soup	Pork soup	309.2	80.7	-0.37599

Knorr Cream Tomato Soup	Vegetable soup	328.2	84.2	-0.34811
Knorr Lentil/Bacon Soup	Pork soup	316.4	90.2	-0.32006
Knorr Thai Veg Soup	Vegetable soup	187.7	101.2	-0.31695
Jacket Topping Beans	Baked potato with veg	410.4	84.7	-0.30861
Freshfayre Cock A Leaker Soup	Chicken soup	408.9	93.1	-0.26249
Knorr Chicken/Veg Soup	Chicken soup	397.3	101.9	-0.21926
Vegetarian sausage sandwich	Meat substitute sandwich	244.3	134.1	-0.10897
Jacket Topping Tuna Mayo	Baked potato with fish	631.5	131.6	0.05032
Jacket Topping Cottage Cheese	Baked potato with cheese	1202.1	95.6	0.10653
Jacket Topping Cheese	Baked potato with cheese	1573.8	122	0.4195
Bacon Sandwich (2rasher)	Pork sandwich	445.5	227.9	0.50062
Freshfayre Creamy Chicken Soup	Chicken soup	785.1	204.8	0.52494
Knorr Cream Chicken Soup	Chicken soup	785.1	204.8	0.52494
Freshfayre Pea & Ham Soup	Pork soup	644.1	267.4	0.80834
Sausage sandwich	Pork sandwich	712.3	348.5	1.28811
Freshfayre Scotch Broth Soup	Lamb soup	3927.7	280.7	2.35279
Jacket Topping Chili	Baked potato with beef	4040.8	289.4	2.45186
Knorr Beef Goulash Soup	Beef soup	5230.5	338.1	3.25443

Table 3 Snacks greenhouse gas emission, Water footprint impact indicators and Environmental impact scores

Snack	Snack sub category	GHGE (gCO ₂ e/portion)	WF (SWL/serving)	Environmental Impact score
Bagged Sweets	Non-chocolate confectionery	11	116.4	-1.09622
Propercorn lightly Salted	Savoury snacks	27.3	63	-1.04988
Propercorn Sour Cream	Savoury snacks	27.3	63	-1.04988
Propercorn Worcester Sauce	Savoury snacks	27.3	63	-1.04988
Propercorn Sweet & Salty	Savoury snacks	42.9	87.3	-0.81661
Yorkshire Crisp 40g Ham&Pickle	Savoury snacks	44	93.2	-0.78979
Yorkshire Crisps 40g Sweet Chili	Savoury snacks	44	93.2	-0.78979
Yorkshire Crisps 40g Tom & Basil	Savoury snacks	44	93.2	-0.78979
Yorkshire Crisps Black Pepper 40g	Savoury snacks	44	93.2	-0.78979
Yorkshire Crisps Chardonnay 40g	Savoury snacks	44	93.2	-0.78979
Yorkshire Crisps Cheddar 40g	Savoury snacks	44	93.2	-0.78979
Yorkshire Crisps Henderson 40g	Savoury snacks	44	93.2	-0.78979
Yorkshire Crisps Lamb & Mint 40g	Savoury snacks	44	93.2	-0.78979
Yorkshire Crisps Sea Salt 40g	Savoury snacks	44	93.2	-0.78979

Croissant Plain	Pastries	55.9	61.1	-0.73925
Porridge Pot Golden Syrup	Breakfast cereal	64.9	35.2	-0.70468
Porridge Pot Strawberry & Cream	Breakfast cereal	65.2	34.5	-0.70294
Porridge Pot Original	Breakfast cereal	69.8	32.9	-0.65585
Buttered Toast Brown	Breads	61.1	77	-0.6411
Buttered Toast White	Breads	63.3	80.9	-0.60711
Fruit Plum	Fruit	72.3	56.9	-0.56871
Eat Natural Bars (Peros) 50g bar	Biscuit	80	90.5	-0.39822
Croissant Chocolate	Pastries	89.3	94.1	-0.28665
Flapjack	Biscuit	103.3	78.8	-0.17034
Fruit Apple Green	Fruit	110.2	56.8	-0.14984
Fruit Apple Red	Fruit	110.2	56.8	-0.14984
Fruit Orange	Fruit	126	119.5	0.18298
Yoghurt Peanuts (Brakes) 100g	Nuts and seeds	127.4	139.6	0.24855
White Choc & Rasp Cookie	Biscuit	110.6	251	0.34303
Fruit Pear	Fruit	144.5	115.1	0.37646
Fruit Banana	Fruit	170.4	81.4	0.57801
Fruit & Nuts (Brakes) 100g	Nuts and seeds	155	203.3	0.71461
Blueberry Muffin (Brakes)	Cakes	178.1	117	0.75251
Lemon Muffin (Brakes)	Cakes	201	100.8	0.96481
Choc Chip Cookie	Biscuit	119.1	474.6	0.99933
Divine Chocolate White	Chocolate confectionery	71.8	758	1.18891
Divine Chocolate Milk	Chocolate confectionery	71.8	758	1.18891
Divine Chocolate Orange	Chocolate confectionery	71.8	758	1.18891
Divine Chocolate Dark	Chocolate confectionery	71.8	758	1.18891
Mixed nuts (Brakes) 100g	Nuts and seeds	200	218.7	1.25054
Double Choc Cookie	Biscuit	132.3	548.3	1.33049
Chocolate Muffin (Brakes)	Cakes	219.3	565.6	2.33564
Chocolate Raisins (Brakes) 100g	Chocolate confectionery	214.6	895.3	3.11245

Table 4 Beverages greenhouse gas emission, Water footprint impact indicators and Environmental impact scores

Beverage name	Beverage subcategory	GHGE (gCO ₂ e/portion)	WF (SWL/serving)	Environmental Impact score
Yorkshire Tea Regular	Tea	6	22	-1.34
Clipper Tea - Large	Tea	6	22	-1.34
Clipper Tea Earl Grey Large	Tea	6	22	-1.34
Clipper Tea Organic Green Large	Tea	6	22	-1.34
Clipper Tea Peppermint Large	Tea	6	22	-1.34
Clipper Tea Redbush Large	Tea	6	22	-1.34
Clipper Tea Wild Berry Large	Tea	6	22	-1.34
Yorkshire Tea Large	Tea	6	22	-1.34
Life Water Sparkling 500ml	Bottled water	160	0	-1.13
Life Water Still 500ml	Bottled water	140	0	-1.10
Red Bull 250ml (Brakes)	Soft drink Bottled	81	76	-1.07
Life Water 750ml Sport Cap	water	210	0	-1.00
Tropicana Smooth 250ml (Freshfayre)	Fruit juice	106	139	-0.88
Sprite Zero 500ml	Soft drink	130	153	-0.80
Diet Coke 500ml	Soft drink	140	153	-0.78
Fanta Zero 500ml (Coke)	Soft drink	155	153	-0.75
Cherry Coke 500ml (Coke)	Soft drink	163	153	-0.74
Coca Cola 500ml	Soft drink	163	153	-0.74
Sprite 500ml	Soft drink	163	153	-0.74
Freshly Squeezed OJ	Fruit juice	189	139	-0.72
Glacéau Multi V 500ml	Soft drink	176	153	-0.71
Glacéau Power C 500ml	Soft drink	176	153	-0.71
Glacéau Triple X 500ml	Soft drink	176	153	-0.71
Fanta Orange 500ml	Soft drink	182	153	-0.70
Americano Small	Coffee (water-based)	91	251	-0.65
Espresso single	Coffee (water-based)	94	251	-0.64
Macchiato	Coffee (water-based)	97	252	-0.63
Fairtrade Apple Juice 500ml	Fruit juice	213	277	-0.35
Fairtrade Orange Juice 500ml	Fruit juice	213	277	-0.35
Regular Grape Escape (16oz)	Smoothie	367	214	-0.20
Large Grape Escape (20oz)	Smoothie	367	214	-0.20
Oasis Light Summer Fruit 500ml (Coke)	Soft drink	453	153	-0.17
Oasis Mango Medley 500ml (Coke)	Soft drink	453	153	-0.17
Oasis Summer Fruit 500ml	Soft drink	453	153	-0.17

Berry Burst Regular (16oz)	Smoothie	367	233	-0.15
Regular Perfect Day (16oz)	Smoothie	367	233	-0.15
Regular Tropical Bliss (16oz)	Smoothie	367	233	-0.15
Large Berry Burst (20oz)	Smoothie	367	233	-0.15
Large Perfect Day (20oz)	Smoothie	367	233	-0.15
Large Tropical Bliss (20oz)	Smoothie	367	233	-0.15
Chi Latte Regular	Other (milk-based) Coffee	594	137	0.07
Americano Regular	(water-based) Coffee	183	503	0.11
Espresso Double	(water-based)	187	503	0.12
Steamer Hot Milk Regular	Other (milk-based) Coffee (milk-based)	644	124	0.13
Cappuccino Small	Other (milk-based)	419	314	0.14
Steamer regular (with syrup)	Other (milk-based)	644	173	0.25
Large Hazelnut Crème (20oz)	Other (milk-based)	633	199	0.29
Mocha Frappe latté (16oz)	Other (milk-based)	683	160	0.29
Regular Frappe 'latte (16oz)	Other (milk-based)	683	160	0.29
Regular Strawberry Crème (16oz)	Other (milk-based)	683	160	0.29
Vanilla Frappe latté (16oz)	Other (milk-based)	683	160	0.29
Flat white	Coffee (milk-based)	485	327	0.29
Latte Small	Coffee (milk-based)	485	327	0.29
Large Frappe 'latte (20oz)	Other (milk-based)	684	167	0.31
Large Strawberry Crème (20oz)	Other (milk-based)	684	167	0.31
Mocha Frappe latté Large (20oz)	Other (milk-based)	684	167	0.31
Vanilla Frappe latté Large (20oz)	Other (milk-based)	684	167	0.31
Caramel Crème Regular (16oz)	Other (milk-based)	686	193	0.38
Regular Hazelnut Crème (16oz)	Other (milk-based)	686	193	0.38
Salted Caramel Frappe latté	Other (milk-based)	686	193	0.38
Caramel Crème Large (20oz)	Other (milk-based)	686	199	0.39
Salted Caramel Frappe latté Large	Other (milk-based)	686	199	0.39
Steamer Hot Milk Large	Other (milk-based)	837	161	0.60
Chi Latte Large	Other (milk-based)	843	190	0.68
Hot Chocolate Regular	Other (milk-based) Coffee	578	449	0.76
Americano Large	(water-based)	274	754	0.87
Pint Milk	Other (milk-based)	959	201	0.93
Cappuccino Regular	Coffee (milk-based)	655	513	1.06

Hot Chocolate Large	Other (milk-based)	824	571	1.52
Latte Regular	Coffee (milk-based)	797	621	1.58
Latte Regular Iced (16oz)	Coffee (milk-based)	802	621	1.59
Cappuccino Large	Coffee (milk-based)	872	869	2.30
Latte Large	Coffee (milk-based)	901	875	2.37
Latte Large iced (20oz)	Coffee (milk-based)	908	875	2.39
Mocha Regular	Other (milk-based)	821	962	2.42
Mocha Large	Other (milk-based)	932	1291	3.40

A6. Ranking of individual cafe options by overall environmental impact score (Lowest to highest)

	Core product	EIS		Core product	EIS
1	Knorr Carrot/Corr Soup	-1.15804	37	Freshfayre Wild Mushroom Soup	-0.87015
2	Yorkshire Tea Regular	-1.15042	38	Jacket Topping Coleslaw	-0.86349
3	Clipper Tea - Large	-1.15042	39	Flapjack	-0.86219
4	Clipper Tea Earl Grey Large	-1.15042	40	Yorkshire Crisp 40g Ham&Pickle	-0.86078
5	Clipper Tea Organic Green Large	-1.15042	41	Yorkshire Crisps 40g Sweet Chilli	-0.86078
6	Clipper Tea Peppermint Large	-1.15042	42	Yorkshire Crisps 40g Tom & Basil	-0.86078
7	Clipper Tea Redbush Large	-1.15042	43	Yorkshire Crisps Black Pepper 40g	-0.86078
8	Clipper Tea Wild Berry Large	-1.15042	44	Yorkshire Crisps Chardonnay 40g	-0.86078
9	Yorkshire Tea Large	-1.15042	45	Yorkshire Crisps Cheddar 40g	-0.86078
10	Freshfayre Spiced Carrot Soup	-1.14106	46	Yorkshire Crisps Henderson 40g	-0.86078
11	Life Water Still 500ml	-1.11552	47	Yorkshire Crisps Lamb & Mint 40g	-0.86078
12	Life Water Sparkling 500ml	-1.09845	48	Yorkshire Crisps Sea Salt 40g	-0.86078
13	Porridge Pot Original	-1.05659	49	Eat Natural Bars (Peros) 50g bar	-0.83981
14	Life Water 750ml Sport Cap	-1.05577	50	Croissant Chocolate	-0.81887
15	Porridge Pot Strawberry & Cream	-1.05474	51	Freshfayre Butternut Squash Soup	-0.80848
16	Porridge Pot Golden Syrup	-1.05246	52	6062 Roast Veg & Hummus Wrap	-0.80607
17	Freshfayre Spiced Parsnip & Honey Soup	-1.04708	53	Bagged Sweets	-0.80515
18	Knorr Highland Veg Soup	-1.0247	54	Fruit Banana	-0.79552
19	Freshfayre Country Veg Soup	-1.00934	55	Knorr Red Pep & Tom Soup	-0.79516
20	Freshfayre Leek & Potato	-0.98452	56	Freshfayre Tomato & Basil Soup	-0.71971
21	Propercorn lightly Salted	-0.98413	57	Knorr Thai Veg Soup	-0.70923
22	Propercorn Sour Cream	-0.98413	58	Lemon Muffin (Brakes)	-0.69932
23	Propercorn Worcester Sauce	-0.98413	59	Fruit Pear	-0.69589
24	Knorr Minestrone Soup	-0.9737	60	Fruit Orange	-0.69579
25	Freshfayre Minestrone Soup	-0.9737	61	Jacket Topping Tuna	-0.6809
26	Fruit Plum	-0.96776	62	Freshfayre Italian Tom & Pancetta Soup	-0.67958
27	Croissant Plain	-0.96658	63	Blueberry Muffin (Brakes)	-0.66035
28	12005 Plain Salad Wedge	-0.95118	64	Knorr Cream Tomato Soup	-0.65072
29	Fruit Apple Green	-0.93577	65	Tropicana Smooth 250ml (Freshfayre)	-0.64242
30	Fruit Apple Red	-0.93577	66	Knorr Lentil/Bacon Soup	-0.63912
31	Buttered Toast Brown	-0.90471	67	7007 Tuna Mayonnaise Classic	-0.62865
32	Red Bull 250ml (Brakes)	-0.89134	68	Yoghurt Peanuts (Brakes) 100g	-0.62199
33	7005 Tuna Classic	-0.88977	69	7025 Chicken Classic	-0.61583
34	Buttered Toast White	-0.88874	70	Jacket Topping Beans	-0.57875
35	Propercorn Sweet & Salty	-0.88304	71	1046 Turkey Sandwich Wedge	-0.57282
36	Knorr Wild M/Room Soup	-0.87749	72	Freshly Squeezed OJ	-0.57157

73	Sprite Zero 500ml	-0.57136	109	Mixed nuts (Brakes) 100g	-0.27428
74	Diet Coke 500ml	-0.56283	110	5016 Cheese & Onion Toastie	-0.26377
75	13005 Prawn & Lettuce -300cal	-0.56098	111	Americano Small	-0.25064
76	7003 Egg & Tomato Classic	-0.55258	112	Espresso single	-0.24808
77	Fanta Zero 500ml (Coke)	-0.55002	113	50042 Chicken & BBQ Sauce Panini	-0.24776
78	Freshfayre Cock A Leekie Soup	-0.54969	114	7011 Cheese Classic	-0.24739
79	Cherry Coke 500ml (Coke)	-0.54319	115	1004 Egg Salad Wedge	-0.24574
80	Coca Cola 500ml	-0.54319	116	Macchiato	-0.2419
81	Sprite 500ml	-0.54319	117	Steamer Hot Milk Regular	-0.2374
82	Vegetarian sausage sandwich	-0.54207	118	1002 Chunky Egg Mayonnaise Wedge	-0.23406
83	Glacéau Multi V 500ml	-0.5321	119	White Choc & Rasp Cookie	-0.23391
84	Glacéau Power C 500ml	-0.5321	120	Chi Latte Regular	-0.23311
85	Glacéau Triple X 500ml	-0.5321	121	13003 Tuna & Mayonnaise - 300cal	-0.2224
86	Knorr Chicken/Veg Soup	-0.5278	122	Jacket Topping Tuna Mayo	-0.22061
87	Fanta Orange 500ml	-0.52698	123	7013 Cheese & Tomato Classic	-0.20623
88	4073 Tuna & Onion Seeded Roll	-0.52655	124	7015 Cheese & Pickle Classic	-0.20108
89	1013 Tuna Cucumber Wedge	-0.52356	125	5017 Cheese & Tomato Toastie	-0.20016
90	7001 Egg Mayonnaise Classic	-0.47309	126	7023 Soft Cheese & Cucumber Classic	-0.19377
91	12049 Chunky Egg Mayo Wedge	-0.45086	127	2006 Tuna Mayonnaise Sub	-0.17592
92	12067 Chicken & Fresh Salad Wedge	-0.41465	128	1052 Prawn Mayonnaise Wedge	-0.17524
93	13004 Turkey Salad -300cal	-0.4112	129	7017 Cheese & Spring Onion Classic	-0.15534
94	12009 Tuna Mayo & Cucumber Wedge	-0.4085	130	50046 Cheese & Red Onion Panini	-0.15203
95	8011 Mediterranean Tuna Wedge	-0.38602	131	Regular Grape Escape (16oz)	-0.14872
96	13002 Turkey & Ham -300cal	-0.37689	132	Large Grape Escape (20oz)	-0.14872
97	14026 Smoked Salmon	-0.37569	133	1015 Cheese Sandwich Wedge	-0.14422
98	Fruit & Nuts (Brakes) 100g	-0.36832	134	50023 Chicken & Stuffing Wedge	-0.1381
99	13001 Chicken Pesto -300cal	-0.36552	135	50088 Tuna Mayonnaise & Fresh Salad Ciab	-0.12353
100	12007 Tuna Mayonnaise Wedge	-0.36376	136	6069 Chilli Chicken & Pepper Wrap	-0.12059
101	12056 Bacon, Lettuce, Tomato & Mayo Wedg	-0.33307	137	2002 Chunky Egg Mayonnaise (v) Sub	-0.11556
102	6061 Prawn to be Wild Wrap	-0.31073	138	50040 Mozzarella & Pepperoni Panini	-0.09976
103	14043 Sweet Chilli Chicken Salad	-0.30052	139	5051 Cheese & Bacon Toastie	-0.09974
104	8036 Fajita Chicken & Pepper Khobez	-0.29955	140	Berry Burst Regular (16oz)	-0.08008
105	Oasis Light Summer Fruit 500ml (Coke)	-0.29566	141	Regular Perfect Day (16oz)	-0.08008
106	Oasis Mango Medley 500ml (Coke)	-0.29566	142	Regular Tropical Bliss (16oz)	-0.08008
107	Oasis Summer Fruit 500ml	-0.29566	143	Large Berry Burst (20oz)	-0.08008
108	7019 Ham Classic	-0.2917	144	Large Perfect Day (20oz)	-0.08008

145	Large Tropical Bliss (20oz)	-0.08008	181	14057 Chicken & Chorizo	0.13912
146	Mocha Frappelatte (16oz)	-0.07406	182	7021 Ham & Mustard Classic	0.16859
147	Regular Frappe'latte (16oz)	-0.07406	183	Chi Latte Large	0.17088
148	Regular Strawberry Crème (16oz)	-0.07406	184	2064 Chicken Tikka Sub	0.17091
149	Vanilla Frappelatte (16oz)	-0.07406	185	50084 Chicken & Fresh Salad Ciabatta	0.17329
150	50005 Savoury Cheese Wedge	-0.06405	186	Knorr Cream Chicken Soup	0.17492
151	1049 Bacon & Egg Wedge	-0.06103	187	Freshfayre Creamy Chicken Soup	0.17492
152	Steamer regular (with syrup)	-0.06039	188	2062 Cajun Chicken Sub	0.18271
153	13006 Ham, Lettuce & Tomato -300cal	-0.0569	189	4072 Coronation Chicken Seeded Roll	0.22561
154	Fairtrade Apple Juice 500ml	-0.05258	190	6070 Chicken Caesar Wrap	0.25285
155	Fairtrade Orange Juice 500ml	-0.05258	191	Cappuccino Small	0.2569
156	Large Frappe'latte (20oz)	-0.04792	192	14041 Cheese Ploughman's (v)	0.26896
157	Large Strawberry Crème (20oz)	-0.04792	193	50044 Ham & Mozzarella Panini	0.26905
158	Mocha Frappelatte Large (20oz)	-0.04792	194	Freshfayre Pea & Ham Soup	0.2807
159	Vanilla Frappelatte Large (20oz)	-0.04792	195	Pint Milk	0.30962
160	Bacon Sandwich (2rasher)	-0.0315	196	50043 Two Cheese & Tomato Panini	0.31933
161	12066 Chicken Tikka, Cucumber & Lettuce	-0.02739	197	1017 Cheese & Tomato Wedge	0.35723
162	50045 Brie & Bacon Panini	-0.00662	198	Flat white	0.3602
163	14028 Chicken & Pesto	-0.00594	199	Latte Small	0.3602
164	1031 Ham Sandwich Wedge	0.0012	200	1074 Chicken, Mayo & Bacon Wedge	0.40335
165	1022 Ham Salad Wedge	0.01176	201	50049 Sausage & Caramelised Onion Panini	0.42712
166	Large Hazelnut Crème (20oz)	0.02414	202	14040 Chicken Caesar	0.47654
167	5037 Ham & Cheese Toastie	0.02889	203	4045 Ham & Egg Seeded Roll	0.4926
168	1039 Ham & Tomato Wedge	0.04236	204	Hot Chocolate Regular	0.52175
169	Caramel Crème Regular (16oz)	0.04771	205	14036 Brie Soft Cheese, Celery & Apple	0.52772
170	Regular Hazelnut Crème (16oz)	0.04771	206	6072 Greek Salad Wrap	0.5487
171	Salted Caramel Frappelatte	0.04771	207	Jacket Topping Cheese	0.54901
172	1019 Cheese & Pickle Wedge	0.04957	208	6023 Red Leicester, Spring Onion & Chive	0.57983
173	Steamer Hot Milk Large	0.061	209	Choc Chip Cookie	0.58107
174	1021 Cheese Salad Wedge	0.06714	210	1037 Ham, Cheese & Pickle Wedge	0.59409
175	Caramel Crème Large (20oz)	0.06938	211	1091 Ham & Cheesy Coleslaw Wedge	0.61659
176	Salted Caramel Frappelatte Large	0.06938	212	8030 Chicken Tikka Khobez	0.62068
177	14052 Coronation Chicken	0.11104	213	Sausage sandwich	0.63188

178	50041 Tuna Melt Panini	0.11905	214	14023 Red Leicester, Spring Onion & Chive	0.63891
179	6065 Cajun Chicken Wrap	0.12914	215	2026 Red Leicester & Spring Onion (v) Sub	0.65191
180	Jacket Topping Cottage Cheese	0.13638	216	1090 Chicken, Ham & Honey Mustard Wedge	0.66855
217	Americano Regular				0.7382
218	Espresso Double				0.74162
219	50035 Ham & Honey Mustard Wedge				0.76563
220	1051 Bacon, Two Cheese & Chives Wedge				0.77182
221	8035 Chicken Caesar Khobez				0.8224
222	Double Choc Cookie				0.85857
223	14042 Ham Salad				0.86258
224	14055 Ham, Cheese & Cranberry				0.89648
225	Chocolate Muffin (Brakes)				0.99532
226	Hot Chocolate Large				1.0112
227	Cappuccino Regular				1.1772
228	8034 Mozzarella & Pepperoni Khobez				1.31413
229	2036 Ham & Cheese Sub				1.37024
230	Divine Chocolate Dark				1.56444
231	Divine Chocolate Milk				1.56444
232	Divine Chocolate Orange				1.56444
233	Divine Chocolate White				1.56444
234	Latte Regular				1.68854
235	Latte Regular Iced (16oz)				1.69281
236	Americano Large				1.72258
237	Mocha Regular				1.89009
238	Chocolate Raisins (Brakes) 100g				2.1823
239	14056 New York Deli				2.47003
240	7029 Corned Beef & Tomato Classic				2.47534
241	1086 Corned Beef & Pickle Wedge				2.4946
242	7039 Corned Beef & Pickle Classic				2.4946
243	1079 Beef Sandwich Wedge				2.64372
244	Cappuccino Large				2.64842
245	Latte Large				2.69485
246	Latte Large iced (20oz)				2.70082
247	50024 Beef, Red Onion & Horseradish Wedge				2.92657
248	Mocha Large				2.9419
249	Freshfayre Scotch Broth Soup				3.13146
250	50050 Chilli Beef Panini				3.18656
251	Jacket Topping Chilli				3.25942
252	8037 Hot Chilli Beef Khobez				4.283

A7. Mean (standard deviation) energy and nutrient content, Greenhouse Gas Emission (GHGE) and Water Footprint Impact Indicator (WFII) estimates per portion of sandwiches by filling type

Estimates per portion	Sandwich categories, Mean (SD)									All sandwiches (n=101)		
	Vegetables (n=2)	Eggs (n=6)	Cheese (only) (n=20)	Fish (n=14)	Poultry (n=23)	Pork (n=12)	Beef (n=7)	Cheese meat (n=13)	& Mixed meat (n=4)	Min	Max	Mean (SD)
	Energy (kJ)	1263 (707)	1392 (470)	1759 (428)	1299 (347)	1596 (420)	1346 (429)	1477 (476)	2036 (424)	1458 (339)	763	2780
Protein (g)	9.6 (2.1)	14.1 (3)	17.7 (3.7)	16.3 (3.8)	23.4 (4.2)	16.8 (3.0)	19.0 (3.9)	22.4 (3.1)	23.8 (5.0)	8.1	30.4	19.2 (5.0)
Carbohydrate (g)	42.4 (14.4)	44.2 (23)	45.5 (18.6)	41.0 (13.9)	49.3 (18.8)	41.3 (18.8)	48.2 (19.5)	55.9 (22.1)	37.5 (4.8)	31.5	100.4	46.2 (18.4)
Total fat (g)	10.4 (9.8)	11.0 (2)	18.3 (4.6)	8.6 (2.9)	9.8 (5.4)	10.6 (4.6)	8.7 (2.5)	17.3 (6.6)	11.3 (4.5)	2.5	30.2	12.4 (6.0)
Fat of which saturated (g)	2.4(2.3)	2.6 (0)	9.0 (2.3)	1.4 (0.7)	2.0 (1.5)	2.6 (1.4)	2.7 (1.0)	7.6 (2.8)	2.3 (1.0)	0.3	12.9	4.2 (3.5)
NMES (g)	0.0 (0.0)	0.3 (0)	0.6 (1.2)	0.7 (1.1)	1.3 (3.0)	0.4 (0.2)	1.1 (1.0)	0.7 (0.8)	0.4 (0.2)	0	11.9	0.8 (1.6)
Sodium (mg)	0.8 (0.7)	0.5 (0)	0.8 (0.3)	0.7 (0.3)	0.8 (0.4)	0.8 (0.1)	1.0 (0.3)	1.0 (0.1)	0.9 (0.1)	0.3	2.5	0.8 (0.3)
Calcium (mg)	34.7 (39.0)	170.8 (90.9)	413.0 (135.0)	87.4 (60.9)	131.7 (84.0)	125.4 (78.6)	133.5 (71.6)	317.8 (110.1)	97.8 (62.8)	1.4	693.9	202.5 (155.6)
Iron (mg)	7.3(8.3)	2.4 (0.6)	4.4 (4.9)	4.2 (5.1)	6.5 (5.4)	3.5 (3.9)	4.0 (3.7)	5.9 (5.2)	7.1 (6.3)	1.3	15.4	5.0 (4.9)
Fibber (g)	5.4 (0.1)	3.1 (1.1)	3.2 (0.9)	3.5 (1.3)	3.2 (0.9)	3.2 (1.2)	2.9 (0.7)	3.2 (0.6)	3.4 (1.2)	1	5.9	3.3 (1.0)
GHGE (gCO₂e)	221 (91)	360 (64)	895 (241)	359 (66)	465 (111)	543 (164)	3403 (643)	1110 (682)	536 (130)	157	4593	823 (818)
WFII (litres)[†]	46.4 (6.9)	161.1 (33.5)	160.7 (83.1)	144.9 (46.8)	224.5 (91.4)	260.3 (77.3)	348.8 (59.8)	255.2 (114.5)	273.0 (93.8)	30.5	473.0	212.3 (100.4)
Pack weight (g)	152 (33.9)	159.3 (35.3)	162.6 (34.2)	155.9 (33.7)	178.33 (30.1)	163.0 (32.3)	158.9 (39.9)	182.0 (32.5)	160.3 (24.2)	118	250	167.3 (33)

A8. Mean (standard deviation) energy, nutrient content, Greenhouse gas emission (GHGE) and Water footprint impact indicator (WFII) estimate per portion of hot food by type

Estimates per portion	Hot food categories, Mean (SD)											All hot food (n=34)		
	Baked potato with beef (n=1)	Baked potato with cheese (n=2)	Baked potato with fish (n=2)	Baked potato with veg (n=2)	Beef soup (n=1)	Chicken soup (n=4)	Lamb soup (n=1)	Meat substitute sandwich (n=1)	Pork sandwich (n=2)	Pork soup (n=3)	Vegetable soup (n=15)	Min	Max	Mean (SD)
Energy kJ (kJ)	1599 (0)	1702 (240)	1928 (371)	2093 (176)	1446 (0)	555 (33)	1038 (0)	1320 (0)	1478 (293)	635 (234)	545 (200)	57	557	944 (587)
Protein (g)	23.5 (0.0)	19.9 (5.3)	29.8 (0.6)	14.0 (5.9)	20.7 (0.0)	11.3 (8.6)	24.9 (0.0)	18.0 (0.0)	17.3 (0.8)	8.6 (3.2)	3.1 (1.2)	1.5	30.2	10.8 (9.1)
Carbohydrate (g)	36.3 (0.0)	49.15 (31.7)	69.9 (0.28)	86.9 (18.4)	18.3 (0.0)	6.1 (3.3)	15 (0.0)	42.9 (0.0)	39.7 (5.9)	14.0 (11.9)	13.5 (5.7)	3.1	99.9	25.7 (24.5)
Total Fat (g)	16.7 (0.0)	15.6 (17.7)	8.15 (10.1)	14.2 (17.8)	21.6 (0.0)	7.2 (1.8)	10.2 (0.0)	8.9 (0.0)	14.8 (4.9)	7.1 (1.4)	7.4 (4.5)	1	28.1	9.5 (6.8)
Saturates (g)	6.4 (0.0)	9.4 (11.3)	1.3 (1.6)	2.05 (2.6)	5 (0.0)	1.32 (0.15)	4.5 (0.0)	2.1 (0.0)	5.2 (1.7)	2.4 (1.1)	2.4 (3.3)	0	17.4	3.0 (3.6)
Fibre AOAC (g)	6.6 (0.0)	4.3(1.4)	5.3 (0.0)	11.0 (6.0)	3.6 (0.0)	0.6 (0.7)	1.5 (0.0)	4.5 (0.0)	1.7 (0.0)	3.0 (1.9)	3.0 (2.2)	0	15.3	3.5 (3.0)
NMES (g)	0 (0.0)	0 (0.0)	0 (0.0)	3.8 (5.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0.6 (1.6)	0	7.7	0.5 (1.7)
Sodium (mg)	678 (0)	398 (271)	357 (51)	656 (645)	1140 (0)	1147 (112)	108 (0)	1090 (0)	1159 (134)	1117 (727)	912 (512)	41	1607	875 (486)
Calcium (mg)	55 (0)	351 (355)	33 (0.7)	88 (45)	36 (0)	46 (17)	63 (0)	188 (0)	125 (60)	31 (7)	54 (21)	25	602	77(100)
Iron (mg)	3.0 (0.0)	1.2 (0.5)	2.5 (0.0)	3.1 (1.7)	2.7 (0.0)	1.2 (0.3)	3.3 (0.0)	3.6 (0.0)	1.7 (0.3)	1.7 (1.1)	1.1 (0.3)	0.6	4.34	1.6 (0.9)
Vitamin B12 (mg)	1.3 (0.0)	1.15 (1.1)	3.7 (0.0)	0.1 (0.1)	3 (0.0)	0 (0.0)	3 (0.0)	0 (0.0)	0.65 (0.2)	0.1 (0.10)	0.00 (0.0)	0	3.7	0.556 (1.1)
GHGE (gCO₂e)	4040 (0)	1388 (263)	606 (36)	334 (108)	5231 (0)	594 (221)	3928 (0)	244 (0)	579 (189)	423 (191)	184 (110)	445	5231	755 (1209)
WFII (litres)	289.4 (0.0)	108.8 (18.7)	73.9 (81.5)	63.4 (30.1)	338.1 (0.0)	151.2 (62.0)	280.7 (0.0)	134.1 (0.0)	288.2 (85.3)	146.1 (105.1)	44.9 (23.9)	10.7	348.5	112.6 (97.8)
Portion weight (g)	440.0 (0.0)	290.0 (14.1)	319.5 (10.6)	420.0 (141.4)	300.0 (0.0)	300.0 (0.0)	300.0 (0.0)	172.0 (0.0)	155.0 (24.0)	300.0 (0.0)	300.0 (0.0)	138	520	299.4 (62.4)

A9. Mean (standard deviation) energy, nutrient content, Greenhouse Gas Emission (GHGE) and Water footprint impact indicator (WFII) estimates per portion of snack by type

Estimates per portion	Snack category, Mean (SD)										All snacks (n=43)		
	Biscuits (n=5)	Breads (n=2)	Breakfast cereal (n=3)	Cakes (n=3)	Chocolate confectionery (n=5)	Fruit, general (n=6)	Non-chocolate confectionery (n=1)	Nuts and seeds, general (n=3)	Pastries (n=2)	Savoury snacks (n=13)	Min	Max	Mean (SD)
Energy kJ (kJ)	1563 (461)	1358 (39)	1009 (42)	1982 (6)	1046 (393)	307 (112)	1534(0)	1913 (664)	1436 (151)	774 (177)	132	2563	1088(576)
Protein (g)	4.9 (0.8)	6.7 (0.1)	8.6 (0.3)	6.8 (0.8)	3.3(1.2)	1.0 (0.7)	4.4(0.0)	15.9(1.5)	7.4 (0.4)	1.9 (0.6)	0.5	17.6	4.6 (4.0)
Carbohydrate (g)	48.8 (14.8)	36.7 (2.3)	46.3 (2.2)	61.6(2.4)	31.3 (17.3)	17.7(6.4)	80.1(0.0)	15.5(9.9)	40.0 (4.5)	18.8 (5.2)	7.5	80.1	31.5 (18.4)
Total Fat (g)											0.1	57	13.7 (10.6)
Saturates (g)	5.1 (3.3)	10.7 (0.0)	0.6 (0.1)	6.4 (5.9)	7.9 (1.6)	0.0 (0.0)	0.0 (0.0)	6.4 (3.2)	9.2 (1.2)	4.1 (2.3)	0	13.2	4.6 (3.8)
NMESs (g)	17.6 (13.5)	0.0 (0.0)	10.5(1.1)	11.6 (20.2)	25.4 (4.4)	0.0 (0.0)	72.3 (0.0)	0.0 (0.0)	3.1 (4.4)	1.4 (5.1)	0	72.3	8.8 (15.0)
Sodium (mg)	271 (167)	526 (33)	73 (30)	446 (116)	38 (26)	5(3)	35 (0)	33 (13)	357 (1)	223 (151)	1	549	184 (183)
Vitamin B12 (mg)	0(0)	0 (0)	0 (0)	0 (0)	0 (0)	0(0)	0(0)	0 (0)	0 (0)	0 (0)	0	0.6	0 (0)
Calcium (mg)	56 (22)	120 (42)	162 (24)	120 (68)	89 (49)	25(37)	41(0)	112(32)	66(2)	9 (5)	2	198	60 (57)
Iron (mg)	1(0)	2 (0)	2 (0.0)	2 (0)	1 (1)	0(0)	0 (0)	3 (2)	1(0.0)	0 (0.0)	0.08	4.69	1 (1)
Fibre AOAC (g)	2.4 (0.4)	2.7 (0.9)	3.2 (0.4)	2.4 (0.2)	1.1 (1.0)	3.6 (1.1)	1.2 (0.0)	5.6 (1.7)	2.8 (0.3)	1.9 (1.3)	0	6.8	2.6 (1.5)
GHGE per portion (gCO₂e)	109.1 (19.5)	62.2 (1.5)	66.6 (2.8)	199.4 (20.6)	100.3 (63.8)	122.2 (33.5)	11 (0.0)	160.8 (36.7)	72.6 (23.6)	40.1 (7.3)	11	219	89.8 (55.7)
WFII per portion (SWI)	288.7 (216.1)	78.9 (2.7)	34.2 (1.2)	261.1 (263.8)	785.5 (61.4)	81.1 (29.7)	116.4 (0.0)	187.2 (41.9)	77.6 (23.3)	85.8 (13.1)	32.9	895.3	205.8 (244.9)
Portion weight (g)	71.4 (13.2)	82.0 (0.0)	64.0 (0.0)	123.0 (3.0)	52.0 (26.8)	148.5 (42.7)	100.0 (0.0)	100.0 (0.0)	90.0 (7.1)	34.6 (8.8)	20	210	75.9 (43.7)

A10. Mean (standard deviation) energy, nutrient content, GHGE and WF estimates per serving of beverage type.

*'Smoothies' were made using frozen fruit and fruit –juice from concentrate. **'Soft drinks' includes low calorie soft drinks, ***'Other milk-based drinks' include frappe lattés, hot chocolate, mocha and chi tea. †Scarcity-weighted

Estimates per portion	Beverage Sub Category Mean (SD)								Total (n=76)			
	Coffee (water-based) (n=6)	Coffee (milk-based) (n=9)	Tea (n=8)	Smoothie (n=8)	Soft drink (n=14)	Bottled water (n=3)	Other (milk-based) (n=24)	Fruit juice (n=4)	Mean	Min	Max	SD
Energy kJ (kJ)	17 (13)	752 (205)	33(28)	2664 (81)	403 (369)	0 (0)	1421 (207)	667 (196)	932	0	2760	829
Protein (g)	0.4 (0.4)	9.1 (2.4)	0.2 (0.2)	2.7 (0.4)	0.1 (0.3)	0.0 (0.0)	12.6 (1.8)	1.8 (1.1)	5.5	0.0	18.7	5.7
Carbohydrate (g)	0.6 (0.5)	12.5 (3.4)	0.5 (0.5)	159.6 (5.2)	27.2 (21.3)	0.0 (0.0)	38.7 (10.1)	39.0 (11.9)	37.7	0.0	165.7	46.0
Total Fat (g)	0.0 (0.0)	10.6 (2.9)	0.0 (0.0)	1.8 (0.0)	0.0 (0.0)	0.0 (0.0)	15.6 (2,1)	0.3 (0.2)	6.4	0.0	18.2	7.3
Saturates (g)	0.0 (0.0)	6.8 (1.8)	0.0 (0.0)	0.3 (0.0)	0.0 (0.0)	0.0 (0.0)	9.9 (1.3)	0.0 (0.0)	4.0	0.0	11.8	4.7
NMESs (g)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	144.0 (0.0)	23.7 (23.8)	0.0 (0.0)	21.5 (10.9)	39.0 (11.9)	28.4	0.0	144.0	43.3
Sodium (mg)	0 (1)	118 (32.0)	1 (2.0)	33 (4.0)	26 (18)	7(2.0)	191 (40.0)	24 (19)	84	0	312	84
Vitamin B12 (mg)	0 (0.0)	2 (1.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0)	3 (0.0)	0(0)	1	0	4	2
Calcium (mg)	6 (5)	324 (88)	6 (5)	107 (5)	29 (30)	32 (8.	437 (66)	43 (16)	198	0	682	195
Iron (mg)	0 (0)	0 (0)	0(0)	5 (0)	0 (1)	0 (0)	1 (0)	1 (0)	1	0	5	1
Fibre AOAC (g)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	4.8 (2.0)	0.0 (0.0)	0.0 (0.0)	0.6 (1.4)	0.5 (0.4)	0.7	0.0	8.0	1.7
GHGE (gCO₂e)	154 (74.0)	703 (196.)	6 (6.0)	367 (0.0)	219 (130)	170 (36.0)	719 (97.0)	180 (50.0)	418	6	959	293
WFII (litres)	419.0	593.5 (240.2)	21.7 (0.0)	228.4 (9.0)	147.1 (20.4)	0.0 (0.0)	227.1 (183.1)	207.8 (80.0)	239.4	0.0	936.0	215.1

B. Study 2 supplementary material

B1. Letter of ethical approval for focus groups with customer



Downloaded: 21/05/2018
Approved: 14/12/2015

Fiona Graham
Registration number: 140147575
Oncology
Programme: PhD

Dear Fiona

PROJECT TITLE: Exploring the acceptability of proposed canteen-based interventions to encourage staff and students to make environmentally friendly food choices at the University of Sheffield.

APPLICATION: Reference Number 006925

On behalf of the University ethics reviewers who reviewed your project, I am pleased to inform you that on 14/12/2015 the above-named project was **approved** on ethics grounds, on the basis that you will adhere to the following documentation that you submitted for ethics review:

- University research ethics application form 006925 (dated 30/11/2015).
- Participant information sheet 1013875 version 1 (30/11/2015).
- Participant consent form 1013876 version 1 (30/11/2015).

The following optional amendments were suggested:

take into consideration the points raised by other reviewers and consider the advertising option which was left empty. Although it is a human intervention trial but it does not carry any physical risk as not one will be forced to eat food they do not find palatable.

If during the course of the project you need to [deviate significantly from the above-approved documentation](#) please inform me since written approval will be required.

Yours sincerely

Laura Williams
Ethics Administrator
Medical School

B2. Letter of ethical approval for focus groups with caterers



Downloaded: 21/05/2018
Approved: 07/07/2015

Fiona Graham
Registration number: 140147575
Oncology
Programme: PhD

Dear Fiona

PROJECT TITLE: Exploring the feasibility of proposed canteen-based interventions to encourage staff and students to make environmentally friendly food choices at the University of Sheffield.

APPLICATION: Reference Number 003879

On behalf of the University ethics reviewers who reviewed your project, I am pleased to inform you that on 07/07/2015 the above-named project was **approved** on ethics grounds, on the basis that you will adhere to the following documentation that you submitted for ethics review:

- University research ethics application form 003879 (dated 26/06/2015).
- Participant information sheet 1008023 version 1 (13/05/2015).
- Participant information sheet 1008334 version 1 (20/05/2015).
- Participant consent form 1008332 version 1 (20/05/2015).
- Participant consent form 1008024 version 3 (04/01/2016).

If during the course of the project you need to [deviate significantly from the above-approved documentation](#) please inform me since written approval will be required.

Yours sincerely

Paula Blackwell
Ethics Administrator
Medical School

B3. Participant recruitment poster

PARTICIPANTS NEEDED!

Research project: food choices in university food outlets

- Are you a student or member of staff at the University of Sheffield?
- Do you purchase food and/or drinks in the university food outlets at least twice a week?
- Would you like to participate in a group discussion about university catering?

...GREAT!

Read on...

What does participation involve?

Taking part in a group discussion with other students/staff about food choices available in university food outlets.

What is the purpose?

This information may be used to inform food options available in university food outlets.

Where will it be held?

In the university, within working hours.

Will I be reimbursed for my time?

Yes, you will receive a £10 high street voucher for your time.

INTERESTED?

Please contact: Fiona Graham

fegraham1@sheffield.ac.uk

Thank you!

B4. Email invitation to participate (customers)

Email subject:

Research Project: food choices in university food outlets

- Are you a student or member of staff at the University of Sheffield?
- Do you purchase food and/or drinks in the university food outlets at least twice a week?
- Would you like to participate in a group discussion about university catering?

What does participation involve?

- Taking part in a group discussion with other students/staff about food choices available in university food outlets.

What is the purpose?

- This information may be used to inform food options available in university food outlets.

Where will it be held?

- In the university, within working hours.

Will I be reimbursed for my time?

- Yes, you will receive a £20 high street voucher for your time.

For more information please email Fiona Graham: fegraham1@sheffield.ac.uk

Thank you for your time.

Please note that ethical approval has been granted for this research.

If you have any queries please contact Fiona Graham or her supervisor Dr Margo Barker:
m.e.barker@sheffield.ac.uk

B5. Participant information sheet (customer)



Participant Information Sheet

Research Study: Exploring the acceptability of proposed canteen-based interventions to encourage staff and students to make environmentally friendly food choices at the University of Sheffield.

You are being invited to take part in a group discussion about ways to encourage staff and students to make environmentally friendly food choices within the university food outlets. Before you decide to participate it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Please ask if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part. Thank you for reading this.

What is the purpose of the study?

Global food production and consumption is damaging the environment. There is mounting evidence to suggest that changes in what we eat will help reduced these negative impacts. The general consensus is that a shift in dietary patterns away from meat and processed foods towards more plant based foods and fish from sustainable stocks is needed. We are trying to encourage staff and students to make environmentally friendly food choices in the University food outlets. We would like to hear your views and opinions about our ideas and whether these interventions would likely influence your own choices in the food outlets.

Why have I been chosen?

You have been chosen to participate in this discussion because you are a student/member of staff at the university and frequently use the university canteens. You will therefore have knowledge of the food and drink options available and have experience of using the food outlets. You will therefore be in a position to comment on our proposed canteen-based interventions to encourage environmentally friendly food consumption in the university and whether you think they would affect your own choices.

Do I have to take part?

Taking part in this project is entirely voluntary; it is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep (and be asked to sign a consent form). If you do decide to take part you may withdraw from the study at any time without giving a reason. If you do withdraw you can choose whether any responses you have already given for the study can be retained or destroyed by the research team.

What will happen to me if I take part?

You will be asked to participate in a group discussion with other students/staff at the University of Sheffield. If you agree to participate I will contact you to arrange a suitable time and place to take part. It is unlikely that the focus group will last any longer than 60 minutes. The agenda for discussion, along with our ideas will be supplied prior to the interview so that you have time to consider how acceptable they would be to university canteen users and any improvements that could be made. Once all the data has been collected it will be analysed and used to inform the development of interventions that may be tested in university food outlets.

Will I be recorded, and how will the recorded media be used?

A digital audio device will be used to record the focus group. The audio files will be then be transcribed to text format for analysis. The transcripts will be anonymised and pseudonyms will be used to ensure you're not identifiable in any reports. The transcripts may be used in the write up of my PhD thesis and the results may be included in papers submitted to academic journals for publications. The results may also be used to inform UK government policy development about sustainable food consumption. The audio files will not be used for any other purpose without your written permission, and they will be destroyed once they have been transcribed. The anonymised transcripts will be kept on password-protected computers for the duration of this PhD project and destroyed within five years of the thesis being completed.

What do I have to do?

If you are willing to participate I will ask you to read and sign a consent form. I will contact you to arrange a suitable time and place to hold the focus groups- they will be during working hours on university premises. Intervention ideas will be provided prior to the focus group to allow you time to consider the acceptability the proposed interventions and what possible outcomes may occur if they are to be implemented.

What are the possible disadvantages and risks of taking part?

A potential minor risk of taking part in this study is that you may feel uncomfortable if you do not wish us to test some interventions in the University food outlets. However, it must be noted that every response is valuable and there no correct answers to the questions and they are simply your views and opinions and you will not be judged. You may feel that the focus group is an inconvenience and may feel unable to complete the project, but if this is so you are free to withdraw from the study at any time without providing a reason. You may also require another member of staff to cover your work whilst you participate in the focus group.

What are the possible benefits of taking part?

Whilst there are no immediate benefits for those people participating in the project, it is hoped that this work will help to develop an effective canteen-based intervention that may be used to extend university food sustainability policy and potentially inform the development of a government policy on environmentally sustainable food consumption.

What happens if the research study stops earlier than expected?

If the study stops earlier than expected you will be informed the reasons why.

What if something goes wrong?

Should you wish to make a complaint for example regarding your treatment by the researcher you should contact the researcher's supervisor. Should you feel that your complaint has not been handled to their satisfaction you should contact the University's Registrar and Secretary.

Will my taking part in this project be kept confidential?

006925

Version 1 -Dated 30/11/15

All the information that we collect from you during the course of the research will be anonymised and you will not be able to be identified in any reports or publications. Personal information will be kept confidential and stored separately to your responses. Audio files will be deleted once they have been transcribed into text format. The anonymised transcripts will be stored on password-protected computers only accessible by members of the research team until the project is complete. (They will be destroyed within five years of the thesis being completed).

What type of information will be sought from me?

The information sought from you will be your views of the interventions we may like to test in the university canteen outlets. We will ask you to reflect upon how effective you think they would be and any unintended consequences you think they may have. This information will be used to develop and potentially test feasible and acceptable interventions in university catering food outlets.

What will happen to the results of the research project?

All data obtained from interviews will be anonymised and you will not be identified in any report. The anonymised results from the project will be written as a thesis, copies of which will be available in the University libraries. The research will also be put forward for publication in academic journals and possibly recommendations to government. The data collected during the course of the project might be used for additional or subsequent research.

Who is organising and funding the research?

The research is funded by the Grantham Foundation for the Protection of the Environment through the University's Grantham Centre for sustainable futures.

Who has ethically reviewed the project?

This project has been ethically approved via the Medical Schools/ Department of Oncology ethics review procedure. The University's Research Ethics Committee monitors the application and delivery of the University's Ethics Review Procedure across the University.

Contact for further information

If you require any further information regarding the study or wish to ask any questions please contact:

Fiona Graham (Researcher) e-mail: Fegraham1@sheffield.ac.uk

Dr Margo Barker (Supervisor) e-mail: m.e.barker@sheffield.ac.uk or Tel: 0114 2713792

Thank you very much for taking the time to read this information sheet. If you are willing to participate please could you confirm via email/telephone and I will contact you to arrange a suitable time and place to hold the focus group.

Thank you very much for your time.

B6. Participant consent form (customer)



The
University
Of
Sheffield.

Participant Consent Form

Title of Research Project: Exploring the acceptability of proposed canteen-based interventions to encourage staff and students to make environmentally friendly food choices at the University of Sheffield.

Name of Researcher: Fiona Graham

**Please initial
the box**

1. I confirm that I have read and understand the information sheet (dated 30/11/15) explaining the above research project and I have had the opportunity to ask questions about it.
2. I understand that my participation is voluntary and that I may withdraw from the study at any time without giving a reason. If I withdraw I may choose whether any responses I have already given for the study can be retained or destroyed by the research team.
3. I understand that should I not wish to answer any particular question or questions, I am free to decline without giving a reason.
4. I understand that by participating my responses will be recorded on a digital audio device for transcription by the research team. I understand that the audio files will be deleted once they have been transcribed. I understand that my name will not be linked with transcribed responses and that I will not be identified or identifiable in any reports produced from the research.
5. I understand that personal information will be kept confidential and stored on a secure password-protected PC accessible by only the research team.
6. I agree that my responses can be retained for the duration of this PhD project and that they will be destroyed within five years of the thesis being completed.
7. I agree to participate in this research project.

Name of Participant
(*or legal representative*)

Date

Signature

Lead Researcher

Date

Signature

To be signed and dated in presence of the participant

Copies:

Once this has been signed by all parties the participant should receive a copy of the signed and dated participant consent form, the information sheet and any other written information provided to the participants. A copy of the signed and dated consent form should be placed in the project's main record (e.g. a site file), which must be kept in a secure location.

006925

Exploring the feasibility of proposed canteen-based interventions

30/11/15

B7. Customer information questionnaire

Participant information: canteen food choices

The information provided through this form will enable the researcher to gain a deeper understanding of the different perspectives of those involved in the group discussion. This information will be kept confidential and stored separately to the anonymised transcript of the meeting.

Please note that if you do not wish to answer any particular question or questions you are free to decline without giving a reason.

* Required

1. Name *

2. Age (in years)

3. Gender

4. Nationality

5. Which of the following do you eat as part of your diet?

Check all that apply.

- Red meat (including beef, lamb, pork, veal, venison, goat)
- White meat (including chicken, turkey meat, duck, goose, game birds, rabbit)
- Fish
- Eggs
- Dairy products (including milk, cheese, butter, yoghurt)
- Other: _____

6. Which of the following University food outlets do you use?

Check all that apply.

- Arts Tower Cafe
- Bartolome Cafe
- The View Deli
- Uni Central
- Cafe 1828
- Courtyard Cafe
- The Diamond Kitchen
- The Edge Cafe
- The Edge Bar
- The Edge Dining Room
- Grill & Go
- The IC Cafe
- Jessop Cafe
- Krebs Cafe
- Mappin Cafe
- Oasis Cafe
- The Ridge Bar
- University Arms
- Velocity Cafe
- Inox Dine
- Other: _____

7. Which of the following student union food outlets do you use?

Check all that apply.

- New Leaf
- Coffee Revolution
- Bar One
- Interval Bar
- Proper Pasty
- Pearls
- Our shop
- Other: _____

8. How frequently do you use the food outlets?

Check all that apply.

- Everyday
- 3 - 4 times a week
- 1 -2 times a week
- Less than once a week
- Once or twice a month
- Other: _____

9. Which of the following items do you usually buy in these outlets?

Check all that apply.

- cold sandwiches
- hot sandwiches
- hot drinks
- cold drinks
- hot cooked food/meals
- snacks
- breakfast items
- Other: _____

10. Are you a member of any of the following student societies concerned with the environment?

Check all that apply.

- Carbon Neutral University Society
- Ethical and Environmental
- People and Planet
- Planet together
- No
- Other: _____

11. Do you participate in the university's Green Impact initiative?

Check all that apply.

- Yes
- No
- Other: _____

B8. Topic Guide for focus groups with customers

Topic Guide: Customer food choices & acceptability of cafe-based intervention

Topic 1: Purchasing habits

What do you generally purchase in university cafes/canteens? (cold sandwiches, hot sandwiches, snacks, hot drinks, cold drinks, cooked meals etc.)

What factors motivate you to use the university cafés/canteens? (Convenience, variety of items on offer, supporting university business etc.)

Are you satisfied with the food options available in the university canteens? Do you think they could be improved? If so, how?

Topic 2: Factors influencing food choices

What are the main factors that influence your food choices in the canteens/cafes on campus? (cost, taste, convenience, healthiness, desirability etc.)

What are the main factors that influence your drink choices in the canteens/cafes on campus?

Is the healthiness of the food/drink item important to you when it comes to making choices in the University cafes/canteens?

Topic 3: Environmental implications

Do you consider the environmental impacts associated with food and drinks when making choices in university cafes?

In comparison to the other factors mentioned earlier, how important is the environmental impact of food when it comes to purchasing food in university cafes?

Which foods or drinks do you think have the greatest impact on the environment? Which food and drinks in the canteens/cafes?

Provide participant with information about environmentally friendly choices:

- More environmentally friendly options are those which are plant-based and contain little if any meat and animal products.
- The type of meat also determines the environmental impact- beef has the most detrimental impact, followed by lamb, pork, chicken and fish.
- The portion size of the product also influences the extent of the environmental impact. (The larger the portion the greater the impact.)

Topic 4: Interventions to make more environmentally friendly food choices

Do you think the university should encourage consumers to make more environmentally friendly food choices?

How do you think the university could encourage more environmentally friendly food choices?

Do you think posters/LED screens influence your purchasing habits?

Do you think labels influence your purchasing patterns?

Would receiving extra GeniUS points for environmentally friendly purchases influence your food and drink choices?

How would you feel if all the sandwiches were the same size? (Wedge size- not baguettes, Panini etc.)
Would you have any objection if the sandwiches were the same size?

How would you feel in all the drinks were small or regular size? (no large sized drinks)

How would you feel meat items weren't available one day a week?

How do you think you would feel if meat items were unavailable altogether?

What would you think if red meat and processed meat were removed from the sandwich and soup range?

B9. Intervention ideas and information (caterers)

Information for research participants: environmentally friendly food choices

Version: 24/11/2015

Proposed cafe based interventions to encourage staff and students to make environmentally friendly food choices in the university

Information provision

- Display eye-catching posters in the cafes presenting information about food sustainability issues and general information about the principles of healthy sustainable eating patterns¹ proposed to help ameliorate these problems.
- Use LED screens in food outlets to show footage of food supply chains and the environmental impacts of food production. These films would also provide guidance as to what a healthy environmentally friendly eating patterns are.
- Use notice boards to portray general information about the eco friendliness of food and drink products.
- Labelling counters/menus with environmental impact rating high, medium, low based on an impact score² (a combination of their carbon and water footprint estimates.) This will give consumers an indication as to which items have a high or low impact scores.

Enable choice

- Increase the variety of the more eco-friendly food items on offer, (i.e vegan and vegetarian sandwiches/soups etc.) and provide a clear indication that they are environmentally friendly options.
- Reformulate/broaden the vegetarian options even further to make them more appealing.
- Provide smaller portions/servings of the high impact products.

Guide choice through changing default

- Have only most eco-friendly food items available, displayed, promoted, at the front of the counters. Least friendly food items are available but only on request, (i.e not on display).
- All drinks are one regular size (large drinks available if requested, not advertised on the menus/boards)
- All the sandwiches in the counters are smaller (larger sandwiches are available on request)

Guide choice through incentive

- Reduce the cost of the most eco-friendly items.
- Have a discounted healthy, eco-friendly meal deal (which does not include items with a high impact score.)
- Sell reduced cost vegetable soups made from supermarket cast offs/local, seasonal produce. (Needs to be significantly discounted from normal).
- Reward customers with extra points on their geniUS cards for making eco-friendly choices in the canteens.

Guide choice through disincentive

- Increase the prices of the least eco-friendly products, (by a significant amount.)
- Make the larger drinks/sandwiches considerably more than the regular/small.
- Customers do not receive points on their geniUS cards for high environmental impact purchases.

Restrict choice

- Eco-day - remove the least eco-friendly food items from the shelves/ menus for one day of the week. Customers will be provided with information as to the reasons for this.
- Meat-Free day remove the meat products from the shelves/ menus for one day of the week.

Eliminate choice

- Omit the least environmentally friendly food items from what is on offer in the canteens for the duration of the intervention.

¹ See Figure 1, page 2.

² See Table 1, page 2

Figure 1 Principles of healthy sustainable eating

Healthier diets with lower GHG and land use impacts have the following characteristics:

- Diversity – a wide variety of foods eaten
- Balance achieved between energy intake and energy needs
- Based around: minimally processed tubers and whole grains; legumes; fruits and vegetables – particularly those that are field grown, 'robust' (less prone to spoilage) and less requiring of rapid and more energy-intensive transport modes
- Meat eaten sparingly if at all – and all animal parts consumed
- Dairy products or alternatives eaten in moderation e.g. fortified milk substitutes and other foods rich in calcium and micronutrients
- Unsalted seeds and nuts
- Small quantities of fish and aquatic products sourced from certified fisheries and certified aquaculture systems
- Very limited consumption of processed foods high in fat, sugar or salt and low in micronutrients e.g. crisps, confectionery, sugary drinks
- Oils and fats with a beneficial Omega 3:6 ratio such as rapeseed and olive oil
- Tap water in preference to other beverages – particularly soft drinks

Garnett, T., (2014) *Changing what we eat*. FCRN

Table 1 Summary of core canteen products with the lowest environmental impact score (Q1) and highest impact score (Q5) in each product category. (The same products appear in each quintile when weighted by sales data from June 2014-July 2015).

Product Category	Lowest environmental impact score ('eco-friendly')		Moderate impact score		Highest environmental impact score ('least eco-friendly')
	Q1	Q2	Q3	Q4	Q5
Pre-packed sandwiches	Vegan options, low calorie (tuna, turkey), eggs	Tuna, prawn, chicken, eggs	Chicken, ham, bacon	Cheese, ham, bacon, sausage,	Ham, cheese & meat, beef
Hot food	Vegetable soups	JP with coleslaw, JP with tuna, buttered toast	Tomato soups, JP with beans	Lentil & bacon soup, chicken & veg soup, Quorn sausage sandwich, JP with cheese	Bacon sandwich, chicken soup, sausage sandwich, Scotch broth, JP with beef chilli, beef goulash soup
Hot/cold drinks	Tea, 250ml cans ³ /bottles, bottled water	500ml bottles, small coffees	Regular, large smoothies	Frappe lattes, Crème drinks	Large, hot milk-based drinks (mochas, lattes, cappuccinos)
Snacks	Savoury popcorn, crisps ³	Sweet popcorn, porridge	Apples, plums, croissants	Oranges, natural bars, white choc cookies, bananas	Fruit & nuts ³ , chocolate muffins, chocolate raisins, chocolate bars

³ Products that do not align with the principles of healthy sustainable eating. (To be discussed.)

B10. Email invitation to participate (caterers)

Version 1 dated: 4/1/16

Email invitation

003879

|
Subject: research project: environmentally friendly food choices

Dear XXX

I am a PhD student in Grantham Centre for Sustainable Futures based in the Human Nutrition Unit at the University of Sheffield. I am writing to invite you to participate in a research project exploring the feasibility of proposed canteen-based interventions to encourage staff and students to make environmentally friendly food choices at the University of Sheffield.

You have been invited to participate as you are a [team leader/ACS manager] of a University owned canteen/cafe therefore will have expert knowledge of the catering practices at the University and will be able to comment on the feasibility of our intervention ideas. Participation in the project will involve taking part in a group discussion with other [team leaders/ACS managers]. An agenda, along with our interventions ideas will be provided prior to the focus group. It is hoped that the information generated during the group discussion will be used to develop an effective intervention to encourage sustainable food consumption in the University.

Please find attached an information sheet which provides further details about the project and what participation entails. I request that you read this information and contact me or my supervisor, Dr Margo Barker, if you have any questions (see contact details on the sheet). I have also attached a consent form that I would ask you to read and complete prior to participating in the project.

Please note that participation is entirely voluntary, it is up to you whether or not you wish to participate. If you have read the information sheet and would like to participate please confirm by email/ telephone. If you do not wish to participate I'd be grateful if you could let me know. If I have not had a response from you within seven days of this email I will follow it up with a phone call.

Thank you very much for taking the time to consider participating in my project.

Yours sincerely,
Fiona Graham

B11. Participant information sheet (caterer)



Participant Information Sheet

Research Study: Exploring the feasibility of proposed canteen-based interventions to encourage staff and students to make environmentally friendly food choices at the University of Sheffield.

You are being invited to take part in a group discussion about ways to encourage staff and students to make environmentally friendly food choices within the university food outlets. Before you decide to participate it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Please ask if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part. Thank you for reading this.

What is the purpose of the study?

Global food production and consumption is damaging the environment. There is mounting evidence to suggest that changes in what we eat will help reduced these negative impacts. The general consensus is that a shift in dietary patterns away from meat and processed foods towards more plant based foods and fish from sustainable stocks is needed. We are trying to encourage staff and students to make environmentally friendly food choices in the University food outlets. We would like to hear your views and opinions about the practicalities and feasibility of our suggestions.

Why have I been chosen?

You have been chosen to participate in this discussion because as a university catering manager you will have knowledge about catering practices within university catering outlets and will be able to provide an invaluable insight into potential barriers preventing the implementation of effective interventions to encourage environmentally friendly food consumption.

Do I have to take part?

Taking part in this project is entirely voluntary; it is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep (and be asked to sign a consent form). If you do decide to take part you may withdraw from the study at any time without giving a reason. If you do withdraw you can choose whether any responses you have already given for the study can be retained or destroyed by the research team.

What will happen to me if I take part?

You will be asked to participate in a group discussion with other catering managers at the University of Sheffield. If you agree to participate I will contact you to arrange a suitable time and place to take part. It is unlikely that the focus group will last any longer than 45 minutes. The agenda for discussion, along with our ideas will be supplied prior to the interview so that you have time to consider their feasibility. Once all the data has been collected it will be analysed and used to develop a range of interventions that will be tested across university food outlets.

Will I be recorded, and how will the recorded media be used?

A digital audio device will be used to record the focus group. The audio files will be then be transcribed to text format for analysis. The transcripts will be anonymised and pseudonyms will be used to ensure you're not identifiable in any reports. The transcripts may be used in the write up of my PhD thesis and the results may be included in papers submitted to academic journals for publications. The results may also be used to inform UK government policy development about sustainable food consumption. The audio files will not be used for any other purpose without your written permission, and they will be destroyed once they have been transcribed. The anonymised transcripts will be kept on password-protected computers for the duration of this PhD project and it is possible that members of the research team will use them for further research in the future.

What do I have to do?

If you are willing to participate I will ask you to read and sign a consent form. I will contact you to arrange a suitable time and place to hold the focus groups- likely to be during working hours on the University premises. An agenda for discussion will be provided prior to the focus group to allow you time to consider the feasibility of the changes we propose and what barriers to implementation you anticipate.

What are the possible disadvantages and risks of taking part?

A potential minor risk of taking part in this study is that you may feel uncomfortable if you do not wish us to trials some changes in the University food outlets. However, it must be noted that every response is valuable and there no correct answers to the questions and they are simply your views and opinions and you will not be judged. You may feel that the focus group is an inconvenience and may feel unable to complete the project, but if this is so you are free to withdraw from the study at any time without providing a reason. You may also require another member of staff to cover your work whilst you participate in the focus group.

What are the possible benefits of taking part?

Whilst there are no immediate benefits for those people participating in the project, it is hoped that this work will help to develop an effective canteen-based intervention that may be used to extend university food sustainability policy and potentially inform the development of a government policy on environmentally sustainable food consumption.

What happens if the research study stops earlier than expected?

If the study stops earlier than expected you will be informed the reasons why.

What if something goes wrong?

Should you wish to make a complaint for example regarding your treatment by the researcher you should contact the researcher's supervisor. Should you feel that your complaint has not been handled to their satisfaction you should contact the University's Registrar and Secretary.

Will my taking part in this project be kept confidential?

All the information that we collect from you during the course of the research will be anonymised and you will not be able to be identified in any reports or publications. Personal information will be kept confidential and stored separately to your responses. Audio files will be deleted once they have been transcribed into text format. The anonymised transcripts will be stored on password-protected computers until the project is complete (and destroyed within two years of the thesis being completed) and only accessible by members of the research team.

What type of information will be sought from me?

The information sought from you will be your views of the interventions we intend to test in the university canteen outlets. We will ask you to reflect upon their feasibility, practical application and any potential barriers to implementation. This information will be used to develop and test feasible interventions in university catering food outlets.

What will happen to the results of the research project?

All data obtained from interviews will be anonymised and you will not be identified in any report. The anonymised results from the project will be written as a thesis, copies of which will be available in the University libraries. The research will also be put forward for publication in academic journals and possibly recommendations to government. The data collected during the course of the project might be used for additional or subsequent research.

Who is organising and funding the research?

The research is funded by the Grantham Foundation for the Protection of the Environment through the University's Grantham Centre for sustainable futures.

Who has ethically reviewed the project?

This project has been ethically approved via the Medical Schools/ Department of Oncology ethics review procedure. The University's Research Ethics Committee monitors the application and delivery of the University's Ethics Review Procedure across the University.

Contact for further information

If you require any further information regarding the study or wish to ask any questions please contact:

Fiona Graham (Researcher) e-mail: Fegraham1@sheffield.ac.uk or Tel: 07580048769

Dr Margo Barker (Supervisor) e-mail: m.e.barker@sheffield.ac.uk or Tel: 0114 2713792

Thank you very much for taking the time to read this information sheet. If you are willing to participate please could you confirm via email/telephone and I will contact you to arrange a suitable time and place to hold the focus group.

Thank you very much for your time.

B12. Participant consent form (caterers)



The
University
Of
Sheffield.

Participant Consent Form

Title of Research Project: Exploring the feasibility of proposed canteen-based interventions to encourage staff and students to make environmentally friendly food choices at the University of Sheffield.

Name of Researcher: Fiona Graham

**Please initial
the box**

1. I confirm that I have read and understand the information sheet (dated 04/01/16) explaining the above research project and I have had the opportunity to ask questions about it.
2. I understand that my participation is voluntary and that I may withdraw from the study at any time without giving a reason. If I withdraw I may choose whether any responses I have already given for the study can be retained or destroyed by the research team.
3. I understand that should I not wish to answer any particular question or questions, I am free to decline without giving a reason.
4. I understand that by participating my responses will be recorded on a digital audio device for transcription by the research team. I understand that the audio files will be deleted once they have been transcribed. I understand that my name will not be linked with transcribed responses and that I will not be identified or identifiable in any reports produced from the research.
5. I agree that my responses can be retained for the duration of this PhD project and that they will be destroyed within five years of the thesis being completed.
6. I agree to participate in research project.

Name of Participant
(or legal representative)

Date

Signature

Name of person taking consent
(if different from lead researcher)
To be signed and dated in presence of the participant

Date

Signature

Lead Researcher
To be signed and dated in presence of the participant

Date

Signature

Copies:

Once this has been signed by all parties the participant should receive a copy of the signed and dated participant consent form, the information sheet and any other written information provided to the participants. A copy of the signed and dated consent form should be placed in the project's main record (e.g. a site file), which must be kept in a secure location.

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Exploring the feasibility of proposed canteen-based interventions

04/01/16

B13. Topic guide for focus groups with caterers

Topic Guide/*Aide-memoire*

Focus groups with caterers

Thank you for attending today.

Check they've received participant information sheet and agreed to have had time to ask questions. Fill in the consent forms.

Request that participants refrain from discussing the opinions and views expressed in the session beyond the meeting to help to ensure confidentiality and anonymity in the write up of the report.

Reminder that they are free to withdraw from the study at any time without giving reason.

Switch on the recorder; request participants say their name in turn so that I can identify them on the recorder.

Background:

In view of the detrimental impact food production and consumption has on the earths' natural resources (including land, water, fossil fuels and climate) there is a growing need to encourage more environmentally friendly patterns of consumption. This is particularly important in the developed nations where over consumption of resource intensive products are not only draining natural resources unnecessarily, but these dietary patterns are having a negative impact on health. Strategies to encourage consumers to make choose foods that are less resource intensive and generate fewer environmental impacts are needed.

Research objective:

This study aims to explore whether an intervention in the workplace can encourage more environmentally friendly food choices. The aim of my research is to test one or two different interventions in two cafes and determine which is most effective in increasing the sales of more environmentally friendly food products,

Objective of intervention: To encourage staff and students to make food choices that are more environmentally and have a more favourable nutritional profile for health.

Work to date:

I have worked with ACS staff to identify which food products and beverages are sold in the majority of university owned food outlets. I have then calculated the approximate GHGE released and water footprint weighted for scarcity using in the ingredients of these products to give an overall indication of their environmental impact. I've also considered the nutritional profile of these choices too to determine the relationships between environmental impacts and effect on health. I've also examined the sales data to determine which products are the most popular and therefore contribute the more to the overall impact of the food choices made. Using a year's worth of sales data I was able to weight the environmental impact score of the products according to sales of the products, such that the most popular items were given a greater weighting, thus a greater impact score.

Results:

Table 1 Summary of the environmental impacts of core food and drinks products

Product Category	Least environmentally friendly products	Most environmentally friendly products
Pre-packed sandwiches	Beef sandwiches	Vegetarian sandwiches (vegan predominantly)
Hot food	Chilli beef JP, Scotch broth	Vegetable soups
Hot/cold drinks	Large, hot milk-based drinks (mochas, lattes, cappuccinos)	Tap water (tea, bottled, diet-drinks)
Snacks	Chocolate muffins, bags of chocolate raisins, chocolate bars	Popcorn, crisps

Health profile of choices

The environmental impact score given to the food products, which positively correlated with energy, pack weight. This indicates that larger sandwiches with greater amount of calories have a greater environmental impact. Sandwiches with a high environmental impact score also had a higher sodium and free sugar content. It can therefore be inferred that encouraging staff and students to select smaller sandwiches, or those with a lower environmental impact score would also help to reduce sodium and free sugars intakes.

Today's objective

- To determine how important you think it is to encourage staff and students to make environmentally friendly food choices
- How effective/ worthwhile do you think workplace interventions to encourage sustainable consumption can be.
- Determine how effective you think the interventions I have proposed would be in terms of altering purchasing patterns.
- Determine what potential barriers to implementation you foresee from experience.

Discuss each intervention in turn exploring:

- Feasibility
- Effectiveness (long-term/short-term impacts)
- Ease of implementation
- Potential barriers
- Suggestions to improve

C. Development process: supplementary material

C1. Theory-based methods and strategies to achieve the change objectives of the Points for Our Planet intervention.

Intervention objectives (individual level): cafe customers choose HEF choices in university cafes				
Determinant	Change objective	Theoretical Methods (Theory)	Intervention strategies	Applications
Awareness	Aw1. Express awareness of the benefits of choosing a HEF food choices on campus	Consciousness raising (TTM) Personalise risk	Provide information about the causes consequences of choosing non-HEF food choices. Info about the personal cost or risks of action or inaction with respect to target behaviour -Customers provided with an indication of the environmental impact score of their meal choices	Posters and table talkers
Knowledge	K1. State the benefits of choosing an HEF meal on campus	Consciousness raising (TTM)	Provide information, feedback or confrontation about the causes consequences and alternatives for a problem.	
		Persuasive communication		
	Framing (protection motivation theory)			
K2. Identify/list which food options are HEF		Chunking (Theories of information processing)	Use framed messages emphasising the advantages of choosing environmentally friendly options (prevents defensive reactions)	
		Using imagery (theories of information processing)	Use stimulus patterns that may be made up of parts but that one perceives as a whole.	

Attitudes	A1. Express positive feelings about eating a HEF food choice	<p>Persuasive communication Framing (protection motivation theory)</p> <p>Provide contingent rewards (theories of learning)</p>	<p>Images are used as an aid for memory retrieval.</p> <p>Use gain framed messages emphasising the advantages of choosing environmentally friendly options (prevents defensive reactions)</p> <p>Providing material rewards that are explicitly linked to the achievement of specified behaviours.</p>	<p>Posters and table talkers</p> <p>Rewarding HEF choices with double GeniUS points</p>
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TTM- Transtheoretical Model

C2. Theory-based methods and strategies to achieve the change objectives at the environmental level of the Points for Our Planet intervention.

Intervention objective: (organisational level): University catering outlets will create an environment conducive to purchasing HEF food

Determinant	Change objective	Theoretical Methods	Theory	Applications
Knowledge	K1. Caterers can identify HEF choices available in university cafe	Discussion	Theories of information processing	Meetings with catering staff to highlight and discuss the benefits of choosing HEF choices.
Self-efficacy	SS1. Express confidence in their ability to communicate benefits of choosing HEF options on campus.	Verbal persuasion- using messages that suggest that the participant possesses certain capabilities experience and feedback.		Meetings with catering staff to highlight and discuss the benefits of choosing HEF choices.

C3. Nutrient profile of low environmental impact sandwiches sold during the intervention that were included or excluded from the Points for Our Planet promotion.

Table C3 contains the energy and nutrient content per 100g of sandwiches with a low environmental impact score as per the results of Study 1 that were sold during the intervention period. Numbers in bold exceed WHO nutrient profile cut-offs for healthier products. The number of categories exceeded was totalled. Sandwiches that exceeded a total of three WHO cut-off categories were considered less healthy and subsequently excluded from the promotion. However, some sandwiches that were scored as less healthy were included in the promotion in order to be consistent with food environmental messages in the promotional material. Four additional sandwiches were introduced during the intervention period that were incentivized based on their description rather than their nutritional profile.

Sandwich code	Sandwich description	Energy per 100g (kcal)	of which sugars per 100g (g)	fat per 100g (g)	sat fat per 100g (g)	salt per 100g (g)	WHO cut-off categories exceeded (N)	Healthier/less healthy	Incentivised/not incentivised
CVW010	Sliced Egg & Tomato (V)	194.5	1.5	8.1	2.3	0.6	0	Healthier	Incentivised
GLB010	Crackin' Egg & Cress (V)	158.2	1.0	7.8	1.0	0.4	0	Healthier	Incentivised
HCW140	Chicken Tikka Cucumber & Mint Y	190.0	1.6	6.1	1.1	0.8	0	Healthier	Incentivised
CTT030	*NEW* Chicken & Sweetcorn	200.8	1.8	8.7	0.8	0.9	0	Healthier	Incentivised
LUW010	Egg, Mayolite & Lettuce (V)	189.1	1.1	8.3	1.5	0.5	0	Healthier	Incentivised
LUW040	Turkey Salad	187.1	1.9	7.2	0.8	0.9	0	Healthier	Incentivised
GLW020	Bombay Tandoori Chicken	195.4	3.3	7.8	0.7	0.8	0	Healthier	Incentivised
CTT020	Piri-Piri Southern Fried Chicken	183.3	1.8	5.6	2.0	1.1	1	Healthier	Incentivised
ESW080	Chicken Tikka	229.4	0.6	8.1	0.5	0.8	1	Healthier	Incentivised
HEW080	Simply Roast Chicken	186.0	0.5	13.9	1.2	0.8	1	Healthier	Incentivised
CVW050	Bhaji Crumble (Vv)	255.4	3.2	9.7	1.4	0.9	1	Healthier	Incentivised
LUW050	Chicken & Lettuce	173.6	1.1	12.9	1.2	0.7	1	Healthier	Incentivised
SIP030	Home Roast Chicken	214.6	1.0	17.9	1.7	1.0	1	Healthier	Incentivised
VCW030	Cajun Mushrooms Peppers and	207.5	2.7	6.6	1.1	1.5	1	Healthier	Incentivised

Houmous (Vv)

LXE020	Spicy Voodoo Chicken	207.1	1.2	15.0	2.9	0.9	1	Healthier	Incentivised
LXE050	Lemon Pepper Chicken	174.6	1.2	12.5	0.7	0.7	1	Healthier	Incentivised
LXE080	Turkey Delight	195.5	1.1	8.8	3.1	1.3	1	Healthier	Incentivised
HPA050	Chicken Tikka	207.4	0.3	5.3	0.2	1.2	1	Healthier	Incentivised
GLW030	VEGAN Roast Cajun Mushrooms & Veg (V)	191.5	3.7	9.1	1.1	1.5	1	Healthier	Incentivised
ESW090	Simply Turkey	246.0	1.7	6.1	1.7	1.4	2	Healthier	Incentivised
HCW020	Double Egg & Cress (V)	269.9	1.1	14.7	2.6	0.6	2	Healthier	Incentivised
HCW080	Chicken Salad	229.2	1.9	16.6	1.0	0.8	2	Healthier	Incentivised
WRA020	VEGAN Houmous, Carrot & Peppers (Vv)	255.7	3.2	9.6	2.4	0.9	2	Healthier	Incentivised
VCW040	Falafel Crumble, Salsa & Coriander (Vv)	287.2	2.7	7.4	1.3	1.2	2	Healthier	Incentivised
WRA080	BBQ Pulled Chicken Tomato & Lettuce	234.3	4.5	4.9	2.1	1.3	2	Healthier	Incentivised
WRA120	Hoi Sin Duck	253.7	8.8	5.9	2.3	1.9	2	Healthier	Incentivised
HPC080	Pesto Chicken & Mozzarella Cheese	237.1	0.7	7.3	1.6	1.1	2	Healthier	Incentivised
WRA030	Chicken Salad	264.0	2.8	11.1	2.4	1.0	3	Less healthy	Incentivised
WRA050	Chicken Tikka & Mint Yoghurt	314.9	4.0	14.3	2.7	1.2	3	Less healthy	Incentivised
CVW130	Vegetarian Sausage Breakfast (V)	374.6	2.5	20.1	2.5	1.2	3	Less healthy	Incentivised
VCW010	Chilli 'n' Lime Houmous Crunch (Vv)	294.3	2.3	12.4	1.8	1.1	3	Less healthy	Incentivised
HPC070	Cajun Chicken, Monterey Jack Cheese & Roast Tomato	233.3	1.5	10.6	2.1	1.2	3	Less healthy	Incentivised
CVW060	Eggs Florentine (V)	308.2	2.7	17.7	5.6	1.0	3	Less healthy	Incentivised
HPC010	Chilli & Jalapeño Chicken & Cheese	232.1	0.4	13.7	2.3	1.1	3	Less healthy	Incentivised
VCW020	Vegan Sausage & Onion Chutney (VV)	291.8	10.7	11.4	1.5	1.1	4	Less healthy	Incentivised

WRA090	Mexican Chilli & Lime Chicken	285.7	2.4	18.3	4.1	1.1	4	Less healthy	Incentivised
WRA100	Cajun Chicken & Soured Cream	390.3	3.8	13.8	5.5	3.4	4	Less healthy	Incentivised
WRB010	Onion & Mango Bhaji (Vv)	304.0	12.1	9.8	2.2	1.1	4	Less healthy	Incentivised
TIN030	Coronation Chicken & Coriander	288.8	5.4	14.1	4.1	1.7	4	Less healthy	Incentivised
HPA080	*NEW* The Mexicana: Jalapeño Chicken & Chilli Cheese	266.7	1.4	17.2	4.0	1.3	4	Less healthy	Incentivised
GLW010	Fajita Chicken	278.9	3.2	11.4	4.1	2.2	4	Less healthy	Incentivised
LXE010	BBQ Pinto bean and chicken stack (added 2017)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Incentivised
HPC120	Chicken vindaloo and corriander (added 2017)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Incentivised
HPC150	Fajita chicken, sour cream and roasted peppers (added 2017)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Incentivised
HPC160	Onion pakora, mango & corriander (Vv) (added 2017)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Incentivised
HEW050	Egg Mayo & Cress (V)	218.6	0.9	12.3	1.9	0.6	1	Healthier	Not incentivised
ESW010	Egg Mayonnaise (V)	277.7	1.4	14.1	2.0	0.7	2	Healthier	Not incentivised
ESW040	Chicken Mayonnaise	320.7	1.5	15.7	1.5	0.9	2	Healthier	Not incentivised
HEW110	Chicken Tikka Mayonnaise	278.5	0.6	11.2	0.6	0.9	2	Healthier	Not incentivised
GLR020	Chicken Pesto Slider	221.0	1.1	18.4	2.4	1.1	2	Healthier	Not incentivised
HCW040	Chicken Mayo Sweetcorn & Lettuce	370.5	1.9	22.2	2.0	1.3	3	Less healthy	Not incentivised
HEW090	Chicken Mayonnaise	391.7	1.2	21.8	2.0	1.0	3	Less healthy	Not incentivised
HEW100	Chicken Mayonnaise & Sweetcorn	355.9	1.4	19.7	1.9	1.0	3	Less healthy	Not incentivised
LXE100	Italian Hero	351.7	1.7	22.4	3.1	2.1	3	Less healthy	Not incentivised

C4. Creative media brief for branding manager

Communication strategy statement

Intended audience:

- Staff and students at the University of Sheffield who purchase main meals/food items in the university cafes. It is a multi-national, gender-balanced group, aged between 17 and 65 approx.

Objectives:

- To believe that making healthy, environmentally friendly (EF) choices can benefit their health and reduce the impact of food production and consumption on the environment.
- To increase the sales of HEF food products available in the cafes.

Challenges:

- Competition with other non HEF/healthy but appealing items.
- Vegan options need to be portrayed as filling and/or tasty.
- Thinking about environmental concerns related to food might be new to some customers (eg. using natural resources at a rate faster than we can replace them etc.)
- Customer may need to have a better understanding about what constitutes EF and healthy food choices. This would help customers understand why the chosen foods have been incentivised.
- Shifting customers towards choosing healthy EF food choices will need a shift in habits for some.
- Appreciating the altruistic role of the university café in promoting healthy EF food choices.

Key promise/expressions of belief

- Choosing healthy options will help me function at my best, protect my healthy and help control my weight.
- Choosing healthy and EF options in the canteen everyday will help me to develop healthy and environmentally sustainable eating habits.
- Choosing EF options will reduce the impact on the environment and the demand for natural resources.

Support statements (supported by data from a credible source- World Health Organisation/Food and Agriculture Organisation)

- Choosing healthy EF food options will help customers to feel good, look good and maintain their weight as well as help reduce the impacts food production is having on the planet (eg. reduce GHGE, land use change and fresh water consumption) thus preserving natural resources for future generations.
- Diet-related diseases such as obesity, type 2 diabetes and heart disease are highly prevalent in this country.
- Eating a healthy diet can avoid long term health issues
- Eating a healthy diet can reduce the amount of GHGE arising from the food system and reduce the pressure on fresh water availability in regions of the world where water is scarce.
- Choosing healthy food options at lunchtime can help you develop life-long healthy eating habits.

Media

- Posters
- Billboards
- Table tent/talkers

Creative considerations

- Tone: urgent action required but without fear, positive outlook
- Appealing- what matters to them (eg. 'feeling good about doing the right thing')
- Culturally appropriate- needs to be sensitive to the diverse cultures that customers come from
- Reflects local needs- estimate environmental impacts associated with food purchased in the cafes and communicate how much this would be reduced if all customers choose EF food in the cafes.** not possible.
- Reading material should match the reading age of the general public (average of 11 year olds.)

C5. Information provision pre-test evaluation form

Evaluation form for 'Points for our planet'

We would be grateful if you could answer the following questions to help us improve the information provision for the intervention: 'Points for our planet'

1. What do you think the key message is that the poster aims to convey?

2. Was the message clear?

5	4	3	2	1
Very clear				Very unclear

3. Was the poster easy to follow? (please circle)

5	4	3	2	1
Very easy				Very difficult to follow

4. Do you think this poster is asking you to do anything in particular? (please circle/highlight)

Yes

No

Don't know

- 4a. If yes, what?

5. Who do you think the poster is targeting? (please circle/highlight)

Someone like me

Other people (specify) _____

6. Do you think the poster is attractive?

5	4	3	2	1
Very attractive				Very unattractive

7. What do you think could be done to make this poster better?

Thank you for your time.

Fiona Graham, PhD student, ~~ScHARR~~ fegraham1@sheffield.ac.uk

C6. Feedback from customers and caterers on intervention materials (pre-testing)

GENERAL FEEDBACK (All three posters)

1. What do you think the key message is that the poster aims to convey?

Caterers:

- *Environmental impact of meat*
- *To remind/inform people that there is an environmental impact to their food choices & to make a considered decision about what they eat.*
- *Save the planet by reducing greenhouse gases that are released by transporting and eating and growing certain types of food sources*
- *Protect the environment as much as possible as we can when choose food*
- *As consumers and vendors, we are not conscious of what the carbon footprint of our processed food is, not the impact that carbon footprint means for our environment. Also that healthy living should be an attainable goal with a bit of extra thought*
- *The carbon footprint of food and how much energy goes into producing food*

2. Was the message clear?

Very clear- 3x caterers

Clear- 4x caterers

Unclear- 1x caterer

3. Was the poster easy to follow?

Very easy- 3x caterer

Easy- 4xcaterer

Difficult- 1x caterer

4. Do you think this poster is asking you to do anything in particular?

Yes x5 caterers

No x1 caterer

Don't know x0

4a. If yes, what?

- *Eat healthier*
- *To think about what they [customers] buy*
- *Eat more locally sourced foods and also foods that have less work involvement and less red meat because of the methane that the animals release.*
- *To reconsider our approach to what we consume- being a little bit more thoughtful and being able to actually positively impact the environment (& our health) by doing so.*
- *Be conscious of what you eat and the impact this has*

5. Who do you think the poster is targeting? (please circle/highlight)

Someone like me- 5x caterer

Other people (specify)

6. Do you think the poster is attractive?

Very attractive 1x caterer

Attractive 4x caterer

Neither attractive nor unattractive- 5x caterer

7. What do you think could be done to make this poster better?

- *Coloured background*

- *Increase size of Eatwell guide X2*
- *Offer an incentive other than GeniUS points*
- *Tell more what 1x, 8x, 35x means*
- *Bolder text on key points, more colours to attract students- 351 particularly the younger customers in velocity cafe.*
- *Nothing*

POSTER 1: Point for our planet poster- caterer and customers

1. What do you think the key message is that the poster aims to convey?

Caterer:

- *Choose better food choices*

Customers:

- *Choose to eat healthier and more eco-friendly*
- *It's encouraging 'eco-friendly' food. Visibly pushing away from non-factory meat options*
- *Get double GeniUs points if you chose a healthy, low environmental impact meal*
- *Eat better and get double points*
- *Get points by choosing specific types of healthier food*
- *A reward system for choosing more sustainable food options at the café*
- *Encouraging us to earn GeniUS points by eating food with low environmental impact*
- *Direct towards the consumption of some types of food*

2. Was the message clear?

Very clear- 2x caterers, 3x customers

Clear- 4x customers

3. Was the poster easy to follow? (please circle)

Very easy- 4 customers

Easy- 2x caterers, 2 customers

Neither easy or difficult- 1x customer

4. Do you think this poster is asking you to do anything in particular? (please circle/highlight)

Yes 2x caterers, 6x customers No- 1x customer

4a. If yes, what?

Caterer:

- *Follow each of the steps to be more environmentally friendly*
- *Choose a vegan, egg or poultry sandwich or a jacket potato to have less of an impact on the environment and receive double Genius points as an extra reward*

Customers:

- *Think about the food you're eating, both for your health and the environment*
- *Choose a particular meal*
- *Eat well, make better choices*
- *To make healthier choices*
- *Top choose products that are healthier for me and have less negative impact on the planet*
- *Choose sustainable food over other less sustainable ones*

5. Who do you think the poster is targeting? (please circle/highlight)

Someone like me

Other people (specify)

Staff and students who eat in uni buildings (geniUS cards)

people who eat at UoS outlets X2

Everyone

Anyone using the café esp. regular

6. Do you think the poster is attractive?

Very attractive- 1x customer

Attractive- 1x caterer, 5 customers

Neither attractive or unattractive- 1x customer

7. What do you think could be done to make this poster better?

Caterers:

- *As with the other poster I find the text over the globe a little difficult to read. Also I don't like the two lists for Sandwiches and Jackets. Perhaps try a version with the globe image behind the Genius card at the bottom and then rearrange the text to be a bit clearer.*
- *Customers:*
- *Layout at the bottom maybe a little better presented*
- *Is it clear which sandwiches are included? Vegan?*
- *Quite a lot of information/sections- could arrange around a planet? Or sections?*
- *I would include the image of a sandwich or would highlight some words like a 'good nutritional' or 'environmental impact'*
- *Nothing*
- *N/A*
- *Maybe more eye catching background colour*
- *Sandwiches needs a semi-colon*

POSTER 2: Eatwell for yourself and our planet -caterer

1. What do you think the key message is that the poster aims to convey?

Caterers:

- *What foods are good for you and also environmentally friendly*
- *Different steps to take to be more environmentally friendly*

Customers:

- *Eating better is good for you and the environment*
- *How to eat sustainably*
- *It is promoting healthy and environmentally friendly food choices*
- *Suggests which food we should eat to save the planet and to be healthier*
- *Informing on how to eat appropriately and simultaneously how to reduce the impact eating has*
- *Change what you eat*
- *Eat more fruit and vegetables*
- *A healthier diet will impact on the planet*

2. Was the message clear?

Very clear-1x caterer, 4x customers

Clear- 1x caterer 4x customers

Neither clear not unclear- 1x customer

Unclear

3. Was the poster easy to follow? (please circle)

Very easy to follow 1x caterer, 6x customer

Easy to follow 1x caterer, 2x customer

Neither easy nor difficult to follow 1x customer

4. Do you think this poster is asking you to do anything in particular? (please circle/highlight)

Yes x1 caterer, 9 customers

4a. If yes, what?

Caterer:

Yes, choose these food rather than others

Customers:

Eat less meat, waste less food

Change/more people to eat better?

To have more responsible diet, to be more aware of my food consumption

Eat better for the environment and my health

Yes, avoid processed/red meat, wasting food, choose fruit & veg, beans nuts and pulses, sustainably sourced fish and balanced diet.

Eat less red meat and eat more fruit, nuts, beans etc. don't waste food, drink water from a tap

eating certain types of food

Yes as above

5. Who do you think the poster is targeting? (please circle/highlight)

Someone like me- x3 Customers,

Other people (specify)

TUOS students and staff x1 customer

staff/uni staff/ locals x1 customer

adults x1customer

6. Do you think the poster is attractive?

Very attractive 2x customers

Attractive 5x customers

Unattractive x1 caterer

7. What do you think could be done to make this poster better?

Caterers:

- The 'Eatwell Guide' is difficult to read and could do with being made bigger. The bullet points are easy to read and follow so perhaps these could be made slightly smaller to allow extra room for the 'Eatwell Guide'.
- Make PLANET form more and stand out more. Work well together, especially as a table tent.
- Highlight 'Eat well for yourself' bit
- Have a green background, connotations with green and the environment (caterer)
- Make PLANET Bolder

Customer:

- Colour header
- Picture suggest poster is about fruit and veg- possibly change or add other pictures
- Picture of earth/ highlight 'P', 'L' etc. in other colour
- Either including a picture for each message (making them smaller) or distributing better the three images
- I like it as it is.
- Less words-maybe remove some, e.g. Varied diet, seasonal. It is great though
- Fizzy drinks?
- I feel that word planet is not immediately evident. I am not sure why there's only image for some but not for others. Maybe revise it.
- I do not particularly like the fact that there are worded descriptions under sandwiches, pictures should be enough?

POSTER 3: Do you know the environmental footprint of your food?

1. What do you think the key message is that the poster aims to convey?

Caterers:

- *The poster shows how much water is used and how much CO2 is created for different types of food. Carrots being the least harmful and beef being the most harmful in this example.*

Customers:

- *To raise awareness of the environmental impact of producing food*
- *What we eat affects the planet*
- *Meat has a bigger carbon footprint than carrots and uses more water in its production*
- *be aware of foods which are relatively environmentally unfriendly, and are therefore bad!*
- *To be more responsible towards what I eat, as it has an impact on the planet.*
- *The environmental impact of plant, poultry and livestock in terms of carbon footprint and fresh water*
- *The environmental footprint of common foods*
- *The poster tried to inform on the impact of production on carbon footprint and water use for different foods*

1. Was the message clear?

Very clear- 1x caterer, 2x customers

Clear- 6x customers

Neither clear not unclear- 1x caterer

Unclear- 1x customer

2. Was the poster easy to follow? (please circle)

Very easy to follow- 2x caterers, 3x customers

Easy to follow- 4x customers

Neither easy nor hard- 1x customer

Difficult to follow- 1x customer

Very difficult to follow - 0

3. Do you think this poster is asking you to do anything in particular? (please circle/highlight)

No- 1x caterer, 3x customers

Yes- 5x Customers

- 4a. If yes, what?

- *It is not asking directly but it is suggesting it would be better for the environment if you chose to eat food that has a smaller carbon footprint and less water usage. (caterer)*
- *Consider the environmental impact of food*
- *Think about what you eat*
- *Be aware of consumption/eat less meat as a consequence*
- *Think about how what I eat contributes to environmental impact*
- *Consider environmental impact in food choices*
- *Try to consume less red meat and more vegetables*

4. Who do you think the poster is targeting? (please circle/highlight)

Everyone- x3 customer

Other people who eat a lot of meat- 1x customer

Someone like me- x2 customers

5. Do you think the poster is attractive?

Very attractive- 3x customer

Attractive- 1x caterer, 3x customers

Neither attractive nor unattractive- 3x customers

6. What do you think could be done to make this poster better?

Caterers:

- *The graphics are nice and clear but the text over the globes at the bottom is not, I think just a visual change to this area would improve it*
- *The border is very 'Wordart' needs updating. Planet good, add colour to background, use capital letters? Look prettier, diagram OK*

Customers:

- *I think the poster is quite well set out and fairly good*
- *Re-arrange images- not logical to me*
- *More glossy*
- *Not sure about the cartoon style pictures*
- *Took a while to understand that water drops- what are the number in terms of quantity?*
- *Start with food pictures first*
- *Potentially make 20% and 75% of the earth shown rather than have those percentages missing*
- *Maybe linking the images, for example I got lost between the water drop and the car and planet image or the cloud with text. Maybe some arrows or some sort of different structure of the images.*
- *Make clearer what message the footprints and water droplets are conveying*
- *Put 1kg next to everything. For table size thing will writing be too small?*
- *Split the table from the explanation of what food production does to avoid confusing the three cover pictures as relates to the upper section.*

C7. Implementation plan, performance objectives for adoption and implementation outcomes (IM step 5)

	Outcomes	Performance objectives
Adoption outcomes	A01. Catering management team will implement and evaluate the programme	Review the intervention programme plan Agree to participate in intervention Agree to participate in the evaluation Support the implementation of the programme Agree to plan and execute communications Agree to remove any contradictory messages during intervention
Implementation Outcomes	IO1. Team leader will implement 'points for planet' including information provision and GeniUS reward points in test sites and participation in evaluation of programme. IO2: Till technician will agree to implement software changes necessary for financial incentive	Meet with researcher, review description of pilot. Agree to implement intervention Agree to participate in the pilot study Agree to support catering staff/team implement pilot Agree to evaluate pilot study Agree to plan and execute communications Agree to change till system set up Agree to incentivise HEF products Agree to provide weekly reports to researcher by email
	IO3: Catering staff implement and support PFOP in cafes	Agree to implement intervention Agree to participate in the pilot study Agree to evaluate pilot study Agree to plan and execute communications

C8. Example of determinants of performance objectives for adoption and implementation outcomes at each organisational level.

Performance objective	Knowledge	Attitude	Belief	Self-efficacy
Catering management group, A01: Catering management team will implement and evaluate the programme				
Agree to support the implementation of the programme	Describe the goal Point for our planet programme and explain the principles of healthy sustainable eating	Express positive attitude towards	Recognise the importance of healthy sustainable eating	Demonstrate willingness to participate with the programme planners, the PFOP programme and the catering
Caterers, IO1: Team leader will implement 'points for planet' including information provision and GeniUS reward points in test sites and participation in evaluation of programme.				
...Support the implementation of the programme	Describe the goal Point for our planet programme and explain the principles of healthy sustainable eating	Express positive attitude towards the programme	Believe the programme will bring about food choice behaviour change Recognise the importance of healthy sustainable eating	Demonstrate willingness to participate with the programme planners, the PFOP programme and the catering
Till Technician, IO2. Till technician will agree to implement software changes necessary for financial incentive				
...Support the implementation of the programme	Describe the goal Point for our planet programme and explain the principles of healthy sustainable eating	Express positive attitude towards the programme Demonstrate willingness to participate with the programme planners, the PFOP programme and the catering	Believe the programme will bring about food choice behaviour change Recognise the importance of healthy sustainable eating	Express confidence in the ability to support the implementation

C9. Methods and applications to achieve change objectives to address determinants that underpin implementation performance objectives.

Stage	Agent	Determinants/C hange objectives	Theoretical methods	Intervention applications
Adoption	Head of commercial services	Belief that it is worth conducting the study and that it might make a difference.	Persuasive communication	One-to-one meeting with researcher and supervisory team
	Retail operations manager		Evidence that it the outcome would be beneficial	
	Team leaders		Role models- what other universities are doing for this cause.	
			Organisational consultation/planning	
Implementation	Catering staff	Knowledge about the intervention and how it works in theory	Persuasive communication	Meeting with researcher
	Till Technician	Knowledge about the intervention	Persuasive communication	Meeting with researcher

C10. Evaluation Plan (Intervention Mapping Step 6)

Behavioural and environmental outcomes: Effect Evaluation Plan					
Performance objective	Measure	Sources	Data collection, Timing and Resources	Data Analysis	Reporting
(B01) Cafe users choose to purchase HEF choices in University cafes	Sales data	Till	Researcher collects data via email from till technician on a weekly basis.	Changes in sales data between baseline, during and after intervention. Compare changes with comparison sites.	Research team to provide feedback to retail operations managers
(E01) Team leaders modify purchase orders to ensure there are sufficient HEF options supplied to the university to meet increased demand		Interview			
Team leaders will modify promotional material in-line with HEF eating messages	Verbal reporting	Observation			
Catering outlets will promote HEF choices using GeniUS rewards system					
Catering staff will advocate choosing HEF choices to the cafes		Interview			
Process Evaluation Plan					
Did the catering staff have the skills, resources and access to information to deal with customer questions?	Focus groups	Team leaders	Post intervention period, during follow up period. Focus groups will be recorded using a Dictaphone and transcribed for future thematic analysis.	Thematic analysis	Report to the retail operations manager
Were HEF options available throughout the intervention period? (Did team leaders respond to changes in demand? (Pf04)			During Easter vacation when outlets are quiet?		Thesis

What was the biggest challenge/burden to implementing the intervention?

How could the intervention be improved?

Did the scheme have any adverse effects on number of customers visiting cafes/ attract particular customers?

Did the till system incentivise HEF options through GeniUS points rewards system throughout the intervention?

Interview

Technician

Post intervention period

Thematic analysis of interview transcripts

Report to the retail operations manager

Thesis

How difficult was it to set up the till system?

Were there any factors that influenced the till system during the intervention period?

Did the outlets promote HEF options?

Observation

Researcher

During programme- spot checks weeks 3, 5

Reflection

Include in thesis write up

Did the information provision remain in place during intervention?

Photographs

Were posters visible throughout the intervention period?

Did the customers exposed to the information provision and promotion in the test sites identify and select HEF food choices?

Questionnaire

Customers

Post intervention (during follow up period?) Every lunchtime between the hours of 12-2pm. Alternative sites visits each weekday.

Summarise results

Include in report to retail ops manager Thesis

Did customers exposed to information provision increase their awareness of the environmental impacts of food?

Did the information provision clearly communicate the promotions to customers?

Did the information provision appeal to the

customers as intended? (Pre-tested)

Did customers exposed to information provision
understand it?

D. Study 3 supplementary material

D1. Profile of the test cafes

a) Cafe 1828

Cafe 1828 is based in the medical school, near the main entrance. Staff and students in the medical school, and some patients and visitors. Predominantly use it. It is outside the library entrance. It is a relatively new cafe (renovated 2012).



b) Velocity cafe and comparison cafes

Velocity cafe is located in the basement of the international college. The customers are predominantly international students. The majority are aged between 16-18.



c) Krebs cafe

Krebs cafe is on the ground floor of the department for molecular and microbiology in the faculty of science. The customer base is primarily staff and students. The hot drinks are the most commonly purchased items.



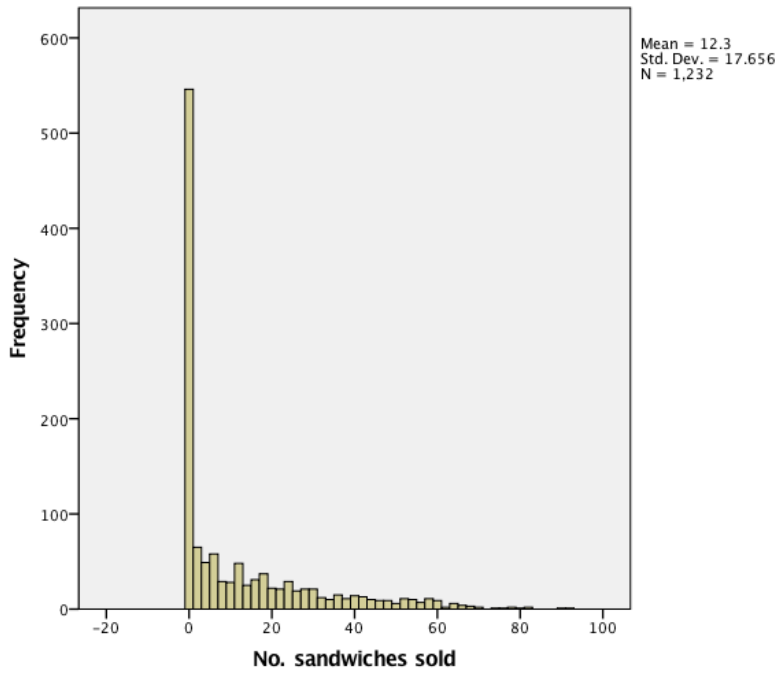
d) Art's tower cafe

The Art's Tower cafe is in the basement of a large tower block structure which lecture theatres in the basement with the department for architecture, and human resources above. Users of the cafes are student and staff, mainly from within the building.

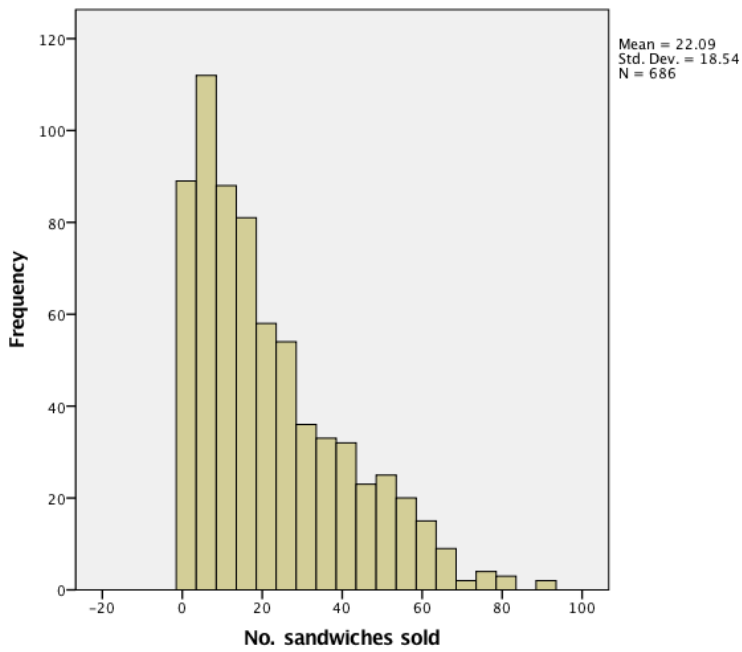


D2. Distribution of sandwiches sold during study period

Distribution of sandwiches sold during study period



Distribution of sandwiches sold after the removal of sandwiches available for 0 weeks during the 12 week study period



D3. Ethical approval for Study 3



Downloaded: 21/05/2018

Approved: 30/11/2016

Fiona Graham
Registration number: 140147575
School of Health and Related Research
Programme: PhD

Dear Fiona

PROJECT TITLE: Implementation and evaluation of a pilot intervention to encourage staff and students to make environmentally-friendly food choices at the University of Sheffield

APPLICATION: Reference Number 011549

On behalf of the University ethics reviewers who reviewed your project, I am pleased to inform you that on 30/11/2016 the above-named project was **approved** on ethics grounds, on the basis that you will adhere to the following documentation that you submitted for ethics review:

- University research ethics application form 011549 (dated 28/11/2016).
- Participant information sheet 1024536 version 6 (28/11/2016).
- Participant information sheet 1024629 version 4 (28/11/2016).
- Participant consent form 1024537 version 4 (24/11/2016).
- Participant consent form 1024682 version 2 (24/11/2016).

If during the course of the project you need to [deviate significantly from the above-approved documentation](#) please inform me since written approval will be required.

Yours sincerely

Ellen Nicolson
Ethics Administrator
School of Health and Related Research

D4. Customer feedback questionnaire

Evaluation of Points for Our Planet

Over the past 6 weeks, healthy and environmentally friendly food items in this cafe have been promoted as part of the research study 'Points for Our Planet'. Having visited the cafe during this time we would really appreciate some feedback from you about your experience. Please can you complete the following form and place it in the box labelled 'Feedback' near milk & sugar trolley.

Thank you.

In the past 6 weeks, have you purchased any of the following in this café?

(Please tick all that apply.)

- | | |
|--|---|
| <input type="checkbox"/> Vegan sandwich | <input type="checkbox"/> Poultry sandwich -no mayo (excl. handmade) |
| <input type="checkbox"/> Egg sandwich -no mayo | <input type="checkbox"/> Jacket potato with beans |

Did you notice any of the following? (Please tick all that apply)

- 'Points for our Planet' posters
- 'Points for our Planet' table tents

Did this promotion influence your food choice?

- Yes
- No

Yes because.....

(Please tick the main reason for your response above)

- I like collecting GeniUS points
- I felt I was choosing well for my health
- I felt I was choosing well for the planet
- All of the above
- Other, please specify _____
- _____
- _____
- _____

No because.....

(Please tick the main reason for your response above)

- I did not see the posters/ was unaware of the posters
- I did not understand the poster/promotion
- I would have chosen the promoted choices anyway
- I don't have a GeniUS card
- I was not interested in the promotion
- Other, please specify _____
- _____
- _____
- _____

Please tick those that apply about you...

- | | | |
|---------------------------------|----------------------------------|----------------------------------|
| <input type="checkbox"/> Male | <input type="checkbox"/> Staff | <input type="checkbox"/> Visitor |
| <input type="checkbox"/> Female | <input type="checkbox"/> Student | |

Any queries please contact fegraham1@sheffield.ac.uk.

D5. Participant information sheet for catering staff



The
University
Of
Sheffield.

Catering staff information sheet

Research Study: Implementation and evaluation of the intervention: 'Points for our planet'

You are being invited to take part in a group discussion about the intervention 'Points for our planet.' Before you decide to participate it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Please ask if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part. Thank you for reading this.

What is the purpose of the study?

Global food production and consumption is damaging the environment. There is mounting evidence to suggest that changes in what we eat will help reduced these negative impacts. The general consensus is that a shift in dietary patterns away from meat and processed foods towards more plant based foods and fish from sustainable stocks is needed. We have tested an intervention to encourage staff and students to make environmentally friendly food choices in the University food outlets, called 'Points for our planet'. We would now like to evaluate this intervention to determine how successful it was and how it can be improved.

Why have I been chosen?

You have been chosen to participate in the evaluation of this intervention because you are a member of staff in one of the cafés that piloted this intervention. You will therefore have first-hand experience of the running this intervention and will therefore be able to provide an invaluable insight into the effectiveness of the pilot, any challenges you faced and how it could be improved.

Do I have to take part?

Taking part in this evaluation process is entirely voluntary; it is up to you to decide whether or not to take part. If you do decide to take part you will be given this information sheet to keep (and be asked to sign a consent form). If you do decide to take part you may withdraw from the study at any time without giving a reason. If you do withdraw you can choose whether any responses you have already given for the study can be retained or destroyed by the research team.

What will happen to me if I take part?

You will be asked to participate in a group discussion with other catering staff at the University of Sheffield who implemented the intervention. During the meeting the researcher will ask you to answer questions relating to your experiences of the intervention. If you agree to participate I will contact you to arrange a suitable time and place hold the meeting. It is unlikely that the meeting will last any longer than 45 minutes.

Will I be recorded, and how will the recorded media be used?

A digital audio device will be used to record the meeting. The audio files will be transferred to an encrypted password protected computer immediately after the meeting and subsequently deleted from the device. The audio files will be then be transcribed to text format for analysis. The transcripts will be anonymised to ensure you're not identifiable in any reports. The audio files will not be used for any other purpose and will be deleted once they have been transcribed. The anonymised transcripts will be kept on an encrypted password-protected computers for the duration of this PhD project and will be deleted within three years of completing my thesis.

What do I have to do?

If you are willing to participate I will ask you to read and sign a consent form to indicate you are happy to participate and for me to record the meeting using a digital audio device. I will contact you to arrange a suitable time and place to hold the focus groups- likely to be during working hours on University premises. If it is more convenient to hold the focus groups outside working hours then you will be reimbursed for your time with a £20 high street voucher. You will receive your voucher when you attend the meeting. An agenda for discussion will be provided prior to the focus group to allow you time to consider your experience of the intervention and challenges you faced.

What are the possible disadvantages and risks of taking part?

A potential minor risk of taking part in this study is that you may feel uncomfortable if you did not want to implement the intervention in your café. However, it must be noted that every response is valuable and there no correct answers to the questions and they are simply your views and opinions and you will not be judged. You may feel that the focus group is an inconvenience and may feel unable to complete the project, but if this is so you are free to withdraw from the study at any time without providing a reason. (If you attend a focus group outside working hours and decide to withdraw from the study after the meeting you will still keep the £20 high street voucher for your time.)

What are the possible benefits of taking part?

Whilst there are no immediate benefits for those people participating in the project, it is hoped that this work will help to identify effective workplace interventions that may be used to extend university food sustainability policy and potentially inform the development of a government policy about environmentally sustainable food consumption.

What happens if the research study stops earlier than expected?

If the study stops earlier than expected you will be informed the reasons why.

What if something goes wrong?

Should you wish to make a complaint for example regarding your treatment by the researcher you should contact the researcher's supervisor: Michelle Holdsworth, michelle.holdsworth@sheffield.ac.uk. Should you feel that your complaint has not been handled to your satisfaction you should contact the Dean of The School of Health and Related Research: Jon Nicholl, j.nicholl@sheffield.ac.uk or telephone 0114 222 5453.

Will my taking part in this project be kept confidential?

011549

Version 2- 23/11/16

All the information that we collect from you during the course of the research will be anonymised and you will not be able to be identified in any reports or publications. You will be asked to agree on the consent form not to share the views of other participants outside the focus group- this will help ensure that your responses remain anonymous. Personal information will be kept confidential and stored separately to your responses. The personal information and responses will be deleted within three years of the thesis being completed.

What type of information will be sought from me?

The information sought from you will be your views of the intervention. I will ask you to reflect upon your experience of implementation, any challenges you faced and how effective you thought the intervention was in increasing sales of healthy environmentally friendly food choices.

What will happen to the results of the research project?

Your anonymised responses will form part of the evaluation of the intervention and will be included in the write up of my thesis (copies of which will be available in the University libraries.) Your anonymous feedback will also be shared with the retail manager at the university to inform their decision about the future feasibility of the intervention. The results of this research will also be put forward for publication in academic journals and possibly recommendations to government. The data collected and published during the course of the project might be used for additional or subsequent research.

Who is organising and funding the research?

The research is funded by the Grantham Foundation for the Protection of the Environment through the University's Grantham Centre for Sustainable Futures.

Who has ethically reviewed the project?

This project has been ethically approved via the School of Health and Related Research ethics review process. The University's Research Ethics Committee monitors the application and delivery of the University's Ethics Review Procedure across the University.

Contact for further information

If you require any further information regarding the study or wish to ask any questions please contact:

Fiona Graham (Researcher) e-mail: Fegraham1@sheffield.ac.uk
Professor Michelle Holdsworth (Supervisor) e-mail: michelle.holdsworth@sheffield.ac.uk

Thank you very much for taking the time to read this information sheet. Please can you let me know via email whether or not you are willing to participate.

Thank you very much for your time.

D6. Participant consent form for catering staff



The University
Of Sheffield.

Catering staff consent form

Title of research project: Implementation and evaluation of the intervention: 'Points for our planet'

Name of Researcher: Fiona Graham

**Please tick
the box**

1. I confirm that I have read and understand the information sheet (dated 23/11/16) explaining the above research project and I have had the opportunity to ask questions about it.
2. I understand that my participation is voluntary and that I may withdraw from the study at any time without giving a reason. If I withdraw I may choose whether any responses I have already given for the study can be retained or destroyed by the research team.
3. I understand that should I not wish to answer any particular question or questions, I am free to decline without giving a reason.
4. I understand that the research team will use a digital audio device to record my responses during the meeting and that these audio files will be deleted once they have been transcribed into text format.
5. I understand that my name will not be linked with any responses and that I will not be identified or identifiable in any reports produced from the research.
6. I understand that my personal information will be kept confidential and stored on an encrypted password-protected computer accessible by only the research team.
7. I agree that my responses and personal information can be retained for the duration of this PhD project and that they will be destroyed within three years of the thesis being completed.
8. I agree I will not discuss the views of other participants outside the group.
9. I agree to participate in this research project.

Name of Participant
(or legal representative)

Date

Signature

Lead Researcher

Date

Signature

To be signed and dated in presence of the participant

Copies:

Once this has been signed by all parties the participant should receive a copy of the signed and dated participant consent form, the information sheet and any other written information provided to the participants. A copy of the signed and dated consent form should be placed in the project's main record (e.g. a site file), which must be kept in a secure location.

D7. Interview schedule for implementers of pilot (catering staff, team leader and till technician)

Questions for catering staff

1. What do you think about the 'Points for Our Planet' scheme implemented in your cafe? (How did you find the implementation of...)?
2. What do you think of the information provision used in promoting healthy and environmentally friendly food choices?
3. What do you think of the GeniUS rewards system used in promoting healthy and environmentally friendly food choices?
4. What do you think about the food choices included in the promotion? (Would increasing them/the variety have helped? Was there too many?)
5. What do you think about the length of the scheme? (Should it have been longer/shorter?)
6. What comments did you get from customers about the scheme?
7. How successful do you think the scheme was in influencing food choices? (Are there any noticeable differences in customer groups- students/staff? males/females?)
8. Did the scheme affect the number of customers visiting the cafe? Or did the proportions of staff/students/visitors changed?
9. How do you think the scheme could be improved?
10. Do you feel the 'Points for Our Planet' scheme is valuable and why?

Additional questions for team leaders...

What, if any, comments did you get from your team about the scheme?

Additional questions for the till technician...

How did you find the implementation of Points for Our Planet scheme implemented in cafe 1828 and velocity?

What aspects of the scheme were easiest to implement?

What aspects for the scheme were the hardest to implement? What were the main obstacles or factors affecting the implementation process?

D8. Sales of sandwiches and baked potato in each cafe each week of the study period

Sales of sandwiches during study period

Week	Cafe 1828			Velocity			Art's Tower			Krebs		
	TOTAL	HEF	NOT HEF	TOTAL	HEF	NOT HEF	TOTAL	HEF	NOT HEF	TOTAL	HEF	NOT HEF
(Week commencing)												
Baseline Week1	419	136	283	202	105	97	507	149	358	243	78	165
Baseline Week2	491	158	333	116	59	57	459	127	332	243	75	168
Baseline Week3	360	105	255	78	29	49	419	116	303	229	69	160
Baseline Week4	374	125	249	251	146	105	173	37	136	203	57	146
Baseline Week5	356	122	234	271	158	113	280	58	222	195	60	135
Baseline Week6	377	123	254	284	175	109	409	98	311	212	69	143
Intervention Week1	482	167	315	292	169	123	348	90	258	234	72	162
Intervention Week2	457	159	298	252	163	89	408	107	301	240	72	168
Intervention Week3	462	162	300	244	162	82	493	128	365	242	69	173
Intervention Week4	466	161	305	252	148	104	453	144	309	251	67	184
Intervention Week5	424	148	276	248	150	98	368	98	270	316	81	235
Intervention Week6	386	149	237	87	50	37	357	96	261	238	61	177
BASELINE TOTAL	2377	769	1608	1202	672	530	2247	585	1662	1325	408	917
INTERVENTION TOTAL	2677	946	1731	1375	842	533	2427	663	1764	1521	422	1099
GRAND TOTAL	5054	1715	3339	2577	1514	1063	4674	1248	3426	2846	830	2016

Baseline dates: 29/11/16-03/02/17, Intervention dates: 06/02/17-17/03/17. No data collected 23/12/16-20/01/17 due to Christmas vacation.

Sales of baked potatoes during the study period

	Cafe 1828			Velocity			Art's Tower			Krebs		
	Total	HEF	Not HEF	Total	HEF	Not HEF	Total	HEF	Not HEF	Total	HEF	Not HEF
Baseline Week1	15	4	11	2	0	2	45	30	15	33	24	9
Baseline Week2	20	3	17	4	4	0	69	29	40	44	24	20
Baseline Week3	20	4	16	3	0	3	71	33	38	41	22	19
Baseline Week4	20	13	7	2	1	1	45	25	20	39	15	24
Baseline Week5	26	15	11	7	5	2	47	35	12	36	16	20
Baseline Week6	21	6	15	1	1	0	37	21	16	29	24	5
Intervention week 1	27	7	20	1	1	0	43	18	25	41	16	25
Intervention week 2	25	15	10	0	0	0	56	27	29	46	15	31
Intervention week 3	25	8	17	1	1	0	59	35	24	43	16	27
Intervention week 4	23	9	14	6	4	2	69	44	25	51	23	28
Intervention week 5	16	3	13	2	2	0	67	39	28	41	23	18
Intervention week 6	21	7	14	4	4	0	60	32	28	47	15	32
Baseline Total	122	45	77	19	11	8	314	173	141	222	125	97
Intervention Total	137	49	88	14	12	2	354	195	159	269	108	161
Grand Total	259	94	165	33	23	10	668	368	300	491	233	258

D9. Customer survey evaluation of Points for Our Planet (qualitative responses)

“Other” reasons given as to why Points For our Planet did not influence meal choice included:

‘The promotion did not include food I usually purchase’

‘I wouldn’t have chosen the promoted items anyway’.

‘I eat in the cafe but don’t usually purchase food from the cafe’

‘I am limited by what I can eat so most promotions don’t affect me’

‘Soups were not included in the promotion’

‘I saw the poster but didn’t read it’

‘Not a regular visitor so probably just haven’t noticed it’.

D10. Additional responses provided by customers about Points for our Planet in the open text field of the survey.

General comments given about the scheme

Other comments noted on the forms included:

“I don’t often eat at the cafe, but I’m interested in saving the planet and would be more likely to make purchases based on the ‘points for planet’ poster”.

“I think this is a really great idea- I deliberately would base my food choices on these things and hopefully the more aware people are and the more interesting low carbon options they have, the more they might be inclined to choose “greener” food too

D11. Observation of cafes during study period

When visiting the outlets in week 3 it was apparent that there was a new information campaign being held which obscured the Points for Our Planet information in the test outlets.

