How can we encourage more sustainable food consumption choices?

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Declaration of ownership

I, Arianna Buratto, confirm that the work presented in my thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Abstract

More than a quarter of total greenhouse gas emissions come from the food system. Meanwhile, climate change has a negative impact on agricultural productivity, threatening food security. Food security is already under threat due to sub-optimal allocation of food, whereby a third of the world's food goes to waste every year. To achieve a more sustainable food system, it is necessary to change our dietary choices towards foods with a lower environmental impact, and to reduce food waste. This thesis uses behavioural economics and behaviour change theories and methods to investigate ways to encourage individuals to make these changes. Three empirical studies are presented, each addressing a different stage of food consumption. The first study examines how well individuals can rate food products in terms of their environmental impact, and how labels can affect their sustainability judgments. The second study investigates how labels can encourage individuals to choose vegetarian and plant-based dishes. The third study tests a behaviour change intervention aimed at helping individuals reduce their food waste at home. Results suggest that labels can have an impact both on consumers' perceptions of food products sustainability, and on their consumption choices. When many food alternatives are available, a green label signalling low environmental impact will be relied on whether the product is sustainable or not. Vegetarian and plant-based labels on menus can actually discourage some consumers from selecting those dishes, which become more popular when those labels are removed. A low-emission label added to a menu as a transparent nudge can also encourage diners to eat more sustainably. A letter and a leaflet can encourage the creation of pro-environmental habitual behaviour at home, leading to a reduction in household food waste. These results show how low-cost behavioural interventions can deliver an impact and help us transition towards more sustainable food consumption.

Impact Statement

Theories and methodologies from behavioural science have been applied to food consumption before. However, most studies so far were aimed at promoting healthy eating. Although some recommendations on how to eat more healthily, such as reducing red meat consumption, can also apply to eating more sustainably, it is becoming increasingly important to recognise the impact of current food consumption trends on the environment, and consider sustainable eating practices alongside healthy eating practices. This thesis illustrates how behavioural interventions can promote sustainable food consumption choices.

This work shows how labels can have a big impact on consumers' judgments and choices, and forms the basis for future research to investigate how different marketing strategies can be used to encourage sustainable eating. Additionally, this thesis considers the debate surrounding the paternalistic aspect of nudging interventions, and argues that transparent nudges can provide a solution which is both ethical and effective. This thesis also investigates how habit creation can be exploited to help achieve long-lasting effects through interventions.

The first study shows the importance of labels in shaping consumers' judgments of food product sustainability. As of 2016, EU pre-packed food products are required to bear a nutrition declaration. These front-of-pack nutrition labels were developed to encourage healthy eating. As the first study illustrates how, in the face of many alternatives, consumers tend to rely on green labels, whether they are truthful or untruthful, an argument for a front-of-pack label bearing information on the environmental impact of products can be made. This highlights the importance of government action in promoting and regulating sustainability labelling schemes.

The second study is the first real world trial that shows how removing vegetarian and plant-based labels can make those dishes more appealing. As these labels are widespread, this result suggests that businesses could apply small changes to the way they market their products and play a big role in shifting consumption choices towards more sustainable ones. A conflict of interest may arise where businesses which rely on selling meat and fish-based products may not be willing to change their offer and marketing strategy. Although demand for meat-alternative products has been increasing, this might not be enough to act as an incentive. Because the introduction of taxes and subsidies on the production side from a single country may backfire, international agreements should be sought to reduce production of those foods with highest environmental impact.

The third study shows how a simple behaviour change intervention can be instrumental in helping households cut down on food waste. Although methods for food waste recycling, such as anaerobic digestion, can provide effective ways of transforming food waste into clean energy, the benefits of food waste reduction outweigh those of recycling. This is why many initiatives and legislations, such as the EU Waste Framework Directive, are in place to encourage prevention over recycling. This study was conducted in partnership with Westminster City Council, and it shows how local government authorities can employ similar strategies to tackle the issue of excessive food waste in their communities.

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List of abbreviations

ABP: animal-based protein

CEOT: Chinese and European organic labels together

CH_4: methane

CO_2: carbon dioxide

CO_2eq: carbon dioxide equivalents

COM-B: capability, opportunity, motivation – behaviour

COT: Chinese organic label

EAST: easy, attractive, social, timely

EOT: European organic label

EU: European Union

EU27: European Union (including Belgium, Bulgaria, Czech Republic, Denmark, Germany, Estonia, Ireland, Greece, Spain, France, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden, United Kingdom)

EU28: European Union (including Belgium, Bulgaria, Czech Republic, Denmark, Germany, Estonia, Ireland, Greece, Spain, France, Croatia, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden, United Kingdom)

FOP: front-of-pack

GDP: gross domestic product

GHG: greenhouse gas emissions

GPs: general practitioners

HMSAM: hedonic-motivation system adoption model

NLS: Nutrition for a Lifetime System

OECD: Organisation for Economic Co-operation and Development

PB-APAs: plant-based animal product alternatives

SDGs: Sustainable Development Goals

SDT: self-determination theory

SIT: social identity theory

SRHI: Self-Report Index of Habit Strength

TPB: theory of planned behaviour

TRA: theory of reasoned action

UK: United Kingdom

UN: United Nations

US: United States

USD: United States Dollar

VABH: value-attitude-behaviour hierarchy

WHO: World Health Organization

WIC: Special Supplemental Nutrition Program for Women, Infants, and Children

WRAP: Waste and Resources Action Programme

WTP: willingness to pay

Chapter 1

Introduction

1.1 Sustainability

Sustainability can be defined in various ways. For example, the United Nations (UN) give a definition of sustainability focused on development, whereas the World Health Organization (WHO) gives a definition focused on health. According to the UN, sustainable development can be thought of as having three dimensions: economic, environmental, and social (United Nations, n.d.a). The WHO's definition, known as the One Health approach, on the other hand, focuses on the health of people, animals and ecosystems, with the aim of balancing and optimising them (World Health Organization, n.d.).

The 2030 Agenda for Sustainable Development, as defined by the UN, outlines 17 Sustainable Development Goals (SDGs) to be achieved through collaborative actions taken by all member countries. These include: no poverty; zero hunger; good health and well-being; quality education; gender equality; clean water and sanitation; affordable and clean energy; decent work and economic growth; industry, innovation and infrastructure; reduced inequalities; sustainable cities and communities; responsible consumption and production; climate action; life below water; life on land; peace, justice and strong institutions; and partnerships for the goals (United Nations, n.d.b).

Promoting SDGs means seeking a balance between driving economic growth, providing good health and education, supporting equality, fighting climate change, and preserving the planet (United Nations, n.d.b). Synergies and trade-offs between SDGs need to be evaluated, considering that working towards a goal in one location might create spillover effects that will hinder the achievement of sustainable development in another (Zhao et al., 2021). Trade-offs in sustainability implementation can be found, not only among economic, social, and environmental goals, but also spatially, temporally, and contextually

(Haffar & Searcy, 2017). Transboundary SDG interactions can take place in many forms (e.g. trade and nature-caused flows), and high-income countries (14.18% of the global population) contribute to more than half of the total SDG interactions worldwide (60.60%) (Xiao et al., 2024). Therefore, SDGs can only be achieved through a united effort and communication between countries (Xiao et al., 2024).

Sustainability can also be approached in two different ways: with a weak sustainability perspective and a strong perspective. The weak perspective gives equal importance to each pillar as defined by the UN (economic, social and environmental), whereas the strong perspective gives priority to the environmental pillar (Nasrollahi et al., 2020; Xiao et al., 2024). This research focuses on the goal of responsible consumption and production, targeting food consumption and production with a strong sustainability perspective.

1.2 Sustainable food production and consumption

Oosterveer and Spaargaren (2007) give a sustainability definition centred on food, which is based on four criteria: naturalness, food safety, animal welfare, and environment preservation. Naturalness implies that food should have not been altered, and that the production process should have made use of natural processes only. Examples of natural food include organic food and whole foods. Food safety refers to products which may not negatively affect human health through diseases such as the Bovine Spongiform Encephalopathy (known as “mad cow disease”) or pesticide contamination. Animal welfare refers to the fight against to the bio-industrialized production of animal or animal products, such as chicken and eggs, which started after World War II. Environmentally friendly or eco-friendly food refers to food with low greenhouse gasses emissions (GHG), and the production of which is based on raw materials which can be produced without undue environmental harm (Oosterveer & Spaargaren, 2007; Tiwari et al., 2014).

Sustainable food production and consumption entail many challenges. Food security is already under threat and the global population is

expected to rise, hence agricultural productivity will need to increase, and allocation of food will need to be optimised (Food and Agriculture Organization, 2011; Food and Agriculture Organization, 2018a; Lipper et al., 2014). However, agricultural productivity has been falling because of climate change (Lipper et al., 2014), which is partly caused by food production and consumption themselves (Poore & Nemecek, 2018).

The Food and Agriculture Organization (2006) defines food security as being based on 4 pillars: Availability, access, utilization, and stability. Availability refers to the supply of food; access refers to having the means to acquire food; utilization refers to people's ability to absorb the nutrition the body needs; and stability refers to having sufficient food over time. Current food allocation is already sub-optimal: A third of the world's food goes to waste or is lost every year (Food and Agriculture Organization, 2011), while 811.7 million people are undernourished and more than 672 million are obese (Food and Agriculture Organization, 2018a). Global population is also predicted to grow by 2.4 billion people by 2050, with most of this growth happening in developing countries (Lipper et al., 2014). Meanwhile, food availability and stability are already being affected by increasing temperatures, changing precipitations patterns, and more frequent extreme natural events (Mbow et al. 2019). For example, it is estimated that climate change has already reduced global yields of maize by 3.8%, and of wheat by 5.5% (Lipper et al., 2014).

Around 13.7 billion metric tons of carbon dioxide equivalents (CO_2eq), more than a quarter of total greenhouse gas emissions, are produced by the food supply chain (Poore & Nemecek, 2018). Additionally, 70% of freshwater is used for agriculture and 78% of freshwater and ocean eutrophication[1] is estimated to be produced by agriculture (Ritchie et

[1] Eutrophication: "the gradual increase in the concentration of phosphorus, nitrogen, and other plant nutrients in an aging aquatic ecosystem such as a lake. […] Cultural eutrophication occurs when human water pollution speeds up the aging process by introducing sewage, detergents, fertilizers, and other nutrient sources into the ecosystem. Cultural eutrophication has had dramatic consequences on freshwater resources, fisheries, and recreational bodies of water and is one of the leading causes of aquatic ecosystem degradation" (Britannica, 2023).

al., 2022). Half of our habitable land, which means excluding glaciers and barren land, is used for agriculture (Ritchie et al., 2022). Agricultural practices should be changed as part of an effective adaptation strategy: Farmers should be encouraged to adopt mixed crop-livestock production systems and water-efficient irrigation practices (Intergovernmental Panel on Climate Change, 2018). The productivity of our agricultural systems should be improved to reduce emissions from agriculture and pressure on land (Intergovernmental Panel on Climate Change, 2018).

According to the Intergovernmental Panel on Climate Change (2018), we should also reduce emissions and increase climate change adaptation options by changing our dietary choices towards foods with lower emissions and requirements for land, and by reducing food loss and waste. This thesis focuses on what could be done on the consumer side, and tries to answer the question "How can we encourage more sustainable food consumption choices?" by addressing the following challenges:

1. Can consumers rate products in terms of sustainability? And what cognitive biases can affect consumers' judgments?
2. Can different labels help to increase the sales of sustainable dishes?
3. Can behavioural interventions be delivered to help people reduce their food waste and create pro-environmental habitual behaviours?

1.3 The environmental impact of food consumption

A great measure of the food carbon footprint can be associated with livestock and fisheries, used to produce meat, dairy, eggs, and seafood, which cause 31% of food emissions[2] (Ritchie, 2019). On the other hand, crop production accounts for 27% of food emissions, land use for 24%, and supply chains for 18% (Ritchie, 2019). The

[2] This figure only accounts for fuel use in fisheries, pasture management, manure management, and methane from cattle. It does not account for land use and for the production of crops for animal feed.

environmental impact of food items can be evaluated across different metrics (carbon footprint, water use or scarcity-weighted water use, eutrophication, and land use) and with reference to either 1 kg, 100 g of protein, or 1000 kcal (Ritchie et al., 2022).

As an example, I will be using 1000 kcal as reference, and I will make comparisons between some of the foods with greater impact, and some of those with smaller impact. In terms of greenhouse gas emissions, beef (beef herd) has the highest impact, followed by prawns. Farmed prawns require the most amount of freshwater, followed by cheese. Prawns also have the greatest impact on water eutrophication, followed by beef (dairy herd). Beef (beef herd) requires the greatest amount of land, followed by lamb and mutton. Eggs, on the other hand, have the least impact when assessed against these criteria and compared to beef (beef and dairy herds), lamb and mutton, farmed prawns and cheese (see Table 1) (Ritchie et al., 2022).

Eating less meat, fish and cheese can help reduce one's diet's environmental footprint. These foods may be replaced with vegetables-based meals, together with legumes and whole grains (Behavioural Insights Team, 2020), as growing vegetables produces much lower greenhouse gas emissions, requires less water and land, and has a much smaller impact on water eutrophication (see Table 1) (Ritchie et al., 2022). Fruits can also be consumed more: For example, apples, bananas, berries and grapes account for much lower greenhouse gas emissions per 1000kcal than meat and fish (see Table 1) (Ritchie et al., 2022). There can be big differences, however, even within the categories of fruits and vegetables. For example, berries and grapes require more freshwater than apples and bananas, and even more than beef and lamb, although their production has a lower impact on water eutrophication compared to beef and lamb, and requires much less land compared to beef and lamb (see Table 1) (Ritchie et al., 2022).

Reducing consumption of red and processed meat, together with sugar-sweetened beverages, refined grains and oils high in saturated fat, and eating more fruits, vegetables, legumes, nuts and seeds,

whole grains and oils high in unsaturated fats, is also important from a health perspective. Unbalanced diets have been associated with more than 12 million avoidable deaths in 2018 (26% of deaths among adults), leading to medical issues such as coronary hearth disease, strokes, type-2 diabetes, and cancers (Springmann et al., 2021).

Table 1. Environmental impact of different foods assessed against greenhouse gas emissions, water usage, water eutrophication, and land usage. The highest figures relative to each environmental criteria are bolded. CO_2eq: carbon dioxide equivalent. PO_4eq: phosphate equivalent. Data from Poore & Nemecek (2018) and Ritchie et al. (2022).

Food (per 1000 kcal)	**GHG emissions ($kgCO_2eq$)**	**Freshwater usage (L)**	**Water eutrophication (gPO_4eq)**	**Land usage (m^2)**
Beef (beef herd)	**36.44**	532	110.4	**119.49**
Beef (dairy herd)	12.20	994	133.8	15.84
Lamb & mutton	12.53	569	30.6	116.66
Prawns (farmed)	26.09	**3,413**	**220.6**	2.88
Cheese	6.17	1,448	25.4	22.68
Eggs	3.24	401	15.1	4.35
Root vegetables	1.16	77	4.4	0.89
Apples	0.90	375	3.0	1.31
Bananas	1.43	191	5.5	3.22
Berries & grapes	2.68	736	10.7	4.23

Chai et al. (2019) conducted a systematic review of vegan, vegetarian and omnivorous diets, analysing their impact on the environment in terms of greenhouse gas emissions, land use, and water footprint. They came to the general result that the more plant-based a diet is, the lower these three impacts are. Takacs et al. (2022) assessed the environmental impact (global warming, freshwater eutrophication, terrestrial acidification, and water depletion potential) of 13 meals belonging to different cuisines. They found that the plant-based version of these meals was more environmentally friendly in terms of all the criteria compared to the vegetarian and meat-based versions of the dishes. In particular, the meat-based meal had 14 times higher environmental impact than the plant-based meal, whereas the vegetarian version had 3 times higher environmental impact. Similarly, the Planetary Health Diet by the EAT-Lancet Commission

recommends a “plant-forward diet” that is healthy for both people and the planet, and where meat and dairy make up a smaller proportion of what we should eat than whole grains, fruits, vegetables, nuts and legumes (EAT, n.d.). Plant-based animal product alternatives (PB-APAs) are also a good way for meat eaters to switch to a more sustainable diet. PA-APAs are products that try to recreate the appearance, smell, test and functionality of animal products: for example, Beyond Meat burgers are a substitute for beef burgers (Heller & Keoleian, 2018). A review of 43 studies found PB-APAs to be more sustainable and present several health benefits compared to animal products (Bryant, 2022). A comparison between Beyond Meat burgers and beef burgers found the former to be more environmentally friendly in terms of greenhouse gas emissions, energy use, land use, and water use (Heller & Keoleian, 2018).

“Eat vegan” is therefore a truthful general rule of thumb for eating sustainably. On the other hand, “eat local” is not. First, only 6% of food system emissions come from transportation (Ritchie, 2019). Second, differences in emissions between foods are large (Ritchie et al., 2022). Therefore, what we eat is more important than where it comes from. For example, the shipment of 1kg of avocados from Mexico to the UK generates only 0.21kgCO_2eq, only 8% of avocados’ total footprint (2.625kgCO_2eq) (Ritchie et al., 2022). There are also cases where producing something locally would create more emissions than importing it: For example, importing lettuce from Spain during winter creates 3-8 times lower emissions than producing it in the UK (Hospido et al., 2009).

“Eat organic because it is better for the environment” is also a misconception. Organic and conventional agriculture affect or cause land use, energy use, acidification and eutrophication, greenhouse gas emissions, and biodiversity in different ways (Clark & Tilman, 2017; Ritchie, 2017). Conventional agriculture performs better in terms of land use because in the same space it can achieve a higher yield than organic farming thanks to fertilizers and pesticides. On the other hand, because the production of fertilizers and pesticides is energy-

intensive, organic agriculture generally requires less energy. Results on acidification and eutrophication are mixed: The impact of organic agriculture is higher on average, but this is context dependent. Nitrogen is supplied by synthetic fertilizers, crop residues and manure in conventional agriculture, and through crop residues and manure application only in organic farming. Fertilizers release nitrogen based on the crop's demand, whereas manure releases nitrogen depending on external conditions (weather, soil moisture and temperature). Therefore, nitrogen release in organic farming does not always match what the crop needs, and an excessive release can find its way to rivers and lakes. As for greenhouse gas emissions, results are also mixed: Pulses and fruits create less emissions when produced organically, whereas cereals, vegetables and animal products create less emissions when produced conventionally. Overall, both methods create greenhouse gas emissions, although in different ways: conventional agriculture through production and application of synthetic fertilizer, and organic agriculture through manure application which creates nitrous oxide. Biodiversity is affected by pesticide application, soil erosion, land tillage methods, and habitat destruction. For example, pesticides are thought to be at least partially responsible for a great decline in insect populations (Hallmann et al., 2017). Organic farming may affect biodiversity less per unit of cultivated area but requires more land than conventional agriculture to produce the same amount of food. This creates a debate as to whether a smaller area should be farmed intensively even though this means greatly affecting its biodiversity, or whether a larger area should be farmed organically therefore affecting its biodiversity less but over a greater surface (Ritchie, 2017). An additional consideration that needs to be made is whether organic farming can benefit soil health. Soil health can be defined as the "capacity of a soil to function within ecosystem boundaries to sustain biological productivity, maintain environmental quality, and promote plant and animal health" (Doran & Parkin, 1994). Despite what was discussed regarding the possible benefits of organic farming for biodiversity, inconsistent results have been found regarding the impact of organic farming systems on soil health

(Hathaway-Jenkins et al., 2011; Tuomisto et al., 2012). This might be due to the diversity of farming practices both within conventional and organic agriculture (Reeve et al., 2016). In conclusion, no farming method can be said to be overall better for the environment than the other.

Many consumers believe that organic food is more nutritious than its conventionally grown alternative, however, no significant differences in carbohydrate or vitamin and mineral content has been found between the two (Williams, 2002). Moreover, because those who regularly consume organic food also tend to eat more fruit and vegetables, and less meat, and tend to exercise more and are less likely to smoke, it has been hard to isolate the impact of organic food consumption on health from other confounding factors (Mie et al., 2017). Chronic exposure to pesticides among farmers has been associated with health problems including respiratory problems, neurologic deficits like Parkinson disease, and cancer (Forman & Silverstein, 2012). Similarly, exposure to organophosphate insecticides during pregnancy likely has a negative impact on children's neurodevelopment (Gonzalez-Alzaga et al., 2014). However, it is not clear if similar side effects may arise from exposure to pesticide residues in food (Mie et al., 2017). There are concerns regarding possible gaps in the risk assessments which are carried out on chemical pesticides before market release, and their impact on health through food consumption, but more research is needed (Mie et al., 2017). Therefore, it is not possible yet to conclude that consuming organic produce should be favoured over regular produce.

1.4 Current consumption trends

Current global consumption trends are neither sustainable nor healthy. In the world in 2018, the intake of fruits and vegetables was 59% lower than what it should be, that of legumes was 74% lower, and that of whole grains was 55% lower (Springmann et al., 2021). Consumption of dairy was also below recommendations (by 20%), whereas that of red meat was higher by 257% (Springmann et al., 2021). In Europe in 2018, the intake of fruits and vegetables was 41% lower than what it

should be, that of legumes was 86% lower, and that of whole grains was 58% lower (Springmann et al., 2021). On the other hand, consumption of dairy was 141% higher than what it should be, and that of red meat was 486% higher (Springmann et al., 2021).

Animal-based protein (ABP) consumption has risen from 1961 to 2011 by 19 g per person per day (from 61 g to 80 g) (Sans & Combris, 2015). Over that period, the proportion of plant protein in the total calorie intake fell from 6.9% to 6.3% and was replaced by ABP intake from 3.8% to 4.9% (Sans & Combris, 2015). Great differences can be seen between income groups: 21.9% of protein intake in the poorest countries are made up by ABPs, compared to 59.5% in the richest countries (Sans & Combris, 2015). Both calorie and protein intake on average follow GDP and urbanisation rate. A big rise in meat consumption has taken place in emerging countries like Brazil (from 18 to 49 g / person / day) and China (from 4.2 to 37.2 g / person / day). Nevertheless, some OECD countries have equally seen an increase in ABP consumption: Spain (from 28.1 to 65.8 g / person / day), Italy, and the Netherlands (Sans & Combris, 2015). At a global level, in 2020, 224 million tons of global meat were sold, of which 48 million were of beef and veal, and 66 million tons were of pork (Euromonitor, 2021, as cited in Bryant, 2022). Therefore, meat consumption has been rising and is at a very high level, despite the numerous reports which advocate for its reduction (Dasgupta, 2021; Intergovernmental Panel on Climate Change, 2018; Willet et al., 2019).

According to the EAT-Lancet Commission, consumption of red meat should decrease globally by more than 50% for a sustainable and healthy food system to be achieved (Willett et al., 2019). The EAT-Lancet Commission diet estimates a CO_2eq production of 740kg/person/year; as a comparison, the current Italian diet is responsible for a CO_2eq production of 1465kg/person/year (Willett et al., 2019). The consumption of beef and pork meat, animal fat and sugar should be reduced by 60-90%, and of dairy products and eggs by 50% (Vitale et al., 2021). However, in Italy in 2020, sales of beef increased by 8.2%, and sales of cheese and milk increased by 9.7%

and 3.9% respectively (ISMEA, 2021). On the other hand, between 2008/9 and 2018/9, the UK average daily meat consumption fell by 17.4g/day per capita, with a 30% reduction in beef consumption. This is significant, but still far from the necessary reduction of 89% (Stewart et al., 2021).

Consumers have different reasons for choosing to buy different products. Italians mostly choose what food products to purchase based on whether they originate from Italy (26%) and whether high quality ingredients make up the product (20%); 6% choose products based on whether they are organic, and 2% on whether they are preserved in eco-friendly packaging (Agrifood Monitor, n.d.). In the UK, prices are often reported to be the main reason for purchase, with 90% of the shoppers listing it as one of the top five reasons, and 36% reporting is as the main reason (Department for the Environment, Food and Rural Affairs, 2017). Other reasons are considered as follows (Department for the Environment, Food and Rural Affairs, 2017). Quality and performance, and special offers and promotions, are listed respectively by 62% and 60% of the people within their main five reasons for purchase. Use by or sell by dates are reported to be quite important in purchasing choice as well, with 51% of the people taking them into account. Finally, ethical and eco-friendly product characteristics are taken into account only by 18% of the shoppers, making them the least important reason behind purchase (Department for the Environment, Food and Rural Affairs, 2017). Nevertheless, sales of “ethical” food and drink, including organic food and vegetarian meat alternatives, has risen since 2007, reaching £8.5 billion in 2014, which is equivalent to 9.2% of all household food sale (Department for the Environment, Food and Rural Affairs, 2017).

Socio-demographic characteristics such as age, income, education level, marital status and household size also have an impact on individuals’ diets. The data collected from the Agrifood Monitor Consumer Survey (n.d.) suggest that there are four types of consumers in Italy. 38% of Italians may be considered “traditionalists”, as they gravitate towards traditional Italian food and trusted products.

Traditionalists mainly live in the Centre and South of Italy, are older than 55, earn between 1800 and 2400 Euros a month, have medium level of education and are mostly families without children. 35% of Italians may be considered “aware”, as they have tried to shift their consumption towards natural, organic, vegetarian or vegan products. Aware consumers are around 30-44 years old, mostly live in the North of Italy, earn between 2400-3500 Euros, have medium or high level of education, and are mostly families with children. 12% of Italians may be considered “luxury” consumers, as they prefer high quality products and/or foreign products, are between 18 and 44 years old, they mainly live in the North-East, earn between 1800-3500 Euros, have medium or high level of education, and are either single or living with parents. Finally, 15% of consumers have a “less is more” attitude towards food consumption, as they aim to save what they can in food shopping. They are mostly between 30-44 years old, live in the North, earn 1200-1800 Euros, have medium level of education, and are mostly single (Agrifood Monitor, n.d.).

In the UK, according to data collected by the Office for National Statistics (2020), the richest ten per cent of the population spend per week £3.50 on beef, £5.40 on fish, £3.50 on cheese, £6.70 on fruits and £7.80 on vegetables, calculated as average weekly household expenditure. On the other hand, the poorest 10% of the population spend weekly £0.90 on beef, £1.50 on fish, £1 on cheese, £2.20 on fruits and £2.30 on vegetables. This means that the richest ten per cent spend 288% more on beef, 260% more on fish, 250% more on cheese, 204% more on fruits and 239% more on vegetables than the poorest ten per cent (Office for National Statistics, 2020).

1.5 Food waste

It is not only what we eat that we should care about to live a more sustainable lifestyle, but it is also what we buy and do not eat. Food waste generation is a widespread issue. According to the Food and Agriculture Organization estimates (2013), the total amount of food thrown away at a global level in 2007 was around 1.6 gigatons, with 1.3 gigatons representing the edible component. In 2012, 53% of all

food waste produced in the EU28, which is equal to 88 million tonnes, was wasted by households during the final consumption stage (Stenmarck et al., 2016). In China, 56.6 million tons of food went to waste in 2015, and 72% was landfilled (Li et al., 2018; MEE, 2017, as cited in Liang et al., 2021). In the US, 133 billion pounds of food, that is 30% of available food, are wasted every year, and 20% of this wastage occurs at consumer level (United States Department of Agriculture, 2014). In the UK, in 2018, 9.5 million tonnes of food waste were produced, of which 6.4 million tonnes was avoidable (96kg/person) (Waste and Resources Action Programme, 2021). It is estimated that 85% of this food waste was produced by households and food manufacture (Waste and Resources Action Programme, 2021). Because 43 million tonnes of food are purchased in the UK, the wasted amount represents around 22% of this amount (Waste and Resources Action Programme, 2021).

Food waste has various negative effects (Ananno et al., 2021). It affects energy consumption, water and land usage, our health, the economy, and the environment. It was estimated that 344 million tons of consumer avoidable food waste is responsible for 4 EJ of waste energy, which is equal to the energy consumption of Germany and France together (Coudard et al., 2021). 550 billion cubic meters of water is wasted every year globally because of food waste (Ananno et al., 2021), while 663 million people do not have access to fresh drinking water (United Nations International Children's Emergency Fund & World Health Organization, 2015). 1.53 billion hectares, 12% of Earth’s ice-free land mass, is used for cultivating crops (Foley et al., 2011), while synthetic fertilizers, often used in food production, rely on finite natural resources like phosphorous, and adversely affect water quality and biodiversity (Dawson & Hilton, 2011; Kummu et al., 2012). Food waste also means lost nutrients: 1520 kcal per person per day are wasted in North America and Oceania because of food waste; 748 calories per person per day are wasted in Europe (Lipinski et al., 2016). Moreover, fruits and vegetables are often a big proportion of food thrown away by households (Vanham et al., 2015), therefore food

waste also means losing the opportunity to eat more healthily (Wharton et al., 2021). In low- and middle-income countries, waste prevention could result in a nationally sufficient supply of fruit and vegetables (Mason-D'Croz et al., 2019; Rolker et al., 2022). Food waste costs 310 billion USD in the developing countries and 680 billion USD in developed countries (United Nations, 2019, as cited in Ananno et al., 2021). Only in the US do food losses equal to around 161 billion USD (United States Department of Agriculture, 2014) and in Europe to 143 billion USD (Stenmarck et al., 2016). If food waste ends up in landfill, carbon dioxide, methane and other greenhouse gases are produced (Chen et al., 2017; Han & Shin, 2004). In the US, landfills are the third largest source of anthropogenic methane emissions (United States Department of Agriculture, 2014), and eliminating avoidable food waste would prevent 113 million metric tons of CO_2eq from being produced every year (Venkat, 2012).

The United Nations set the goal 12.3, the aim of which is to: "By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses" (United Nations, n.d.b). Many countries have started adopting policies and initiatives to tackle this issue (Ananno et al., 2021). In the EU, the Waste Framework Directive (2008/98/EC, Article 4) encourages waste prevention over reuse, followed by recycling, energy recovery and disposal (European Commission, 2008, as cited in De Sadeleer et al., 2020). Moreover, the Circular Economy package advocates for all material to be recovered, reused and redesigned, or used for energy recovery, rather than being landfilled (European Commission, 2015). In 2014, the European Commission proposed the year 2030 as a deadline for the municipal waste recycling rate to reach 70% (Secondi et al., 2015). In Norway, the government reached an agreement with the food industry with the aim of reducing food waste by 50% by 2030 (The Norwegian Government, 2017, as cited in Ananno et al., 2021). This requires the industry to provide reports, implement reductive measures, and donate surplus food (De Sadeleer et al., 2020). In South Korea, stricter measures

have been implemented (Ananno et al., 2021). The country first made it illegal for food to be landfilled and mandatory for it to be recycled in 2005 (Nguyen et al., 2017). Subsequently, a pay-as-you-throw mandate was introduced, by which households are charged based on how much food waste they produce. As a result, 95% of food waste is now recycled (Broom, 2019; Sheldon, 2020; as cited in Ananno et al., 2021). In France, supermarkets with a large carbon footprint must donate surplus food to charities. Moreover, a campaign was launched in 2017 in Paris, where a recycle bin and a recycling guide was provided to residents, so that waste could be then recycled to produce fertilizers or heat and electricity (The Connexion, 2017, as cited in Ananno et al., 2021; De Sadeleer et al., 2020). In the US, the Food Recovery Act establishes requirements and provides funding to reduce food waste (De Sadeleer et al., 2020). The UK has adopted the Champions 12.3 Guidance and recommended the following actions: measure and report food waste amounts; report progress compared to the SDG12.3; and apply the “50% target reduction from ‘farm to fork’” (Waste and Resources Action Programme, 2021). These are only some of the countries which have been adopting measures to fight the issue of food waste.

Research in this field has also focused on understanding which method of disposal for organic waste is most beneficial. Options such as composting, aerobic digestion, anaerobic digestion, incineration, and landfill are considered. Through composting, both businesses and households can use certain leftovers to create an organic material which can be used as a conditioner and fertilizers in gardens and farms (Lai, 2022). Aerobic digestion is a process which allows food waste to be broken down into water by creating an oxygenated environment with microorganisms, and then be discharged via an existing drainage system. Anaerobic digestion is a different procedure through which food waste is broken down by microorganisms in the absence of oxygen, with the goal of producing renewable energy from the captured biogas, and fertilizer from the nutrient rich digestate (Stones, 2019). Incineration means destroying waste by burning it into ash;

landfill means burying waste between layers of earth (Owen, 2018). When comparing between these methods of disposal, the consensus is that anaerobic digestion is more environmentally friendly than composting, incineration and landfilling, assuming that the generated biogas will be used, for example, as a substitute for fossil car fuel (Bernstad, 2011; De Sadeleer et al., 2020; Martinez-Sanchez et al., 2016). Incineration and landfilling are regarded as particularly detrimental for the environment, as they produce greenhouse gases such as carbon dioxide (CO_2) and methane (CH_4). They also remove the opportunity to convert food waste into renewable energy or nutrients for soil. Home composting can be an efficient way for households to recycle their waste, but not everyone has a garden or the opportunity to do so (Allison et al., 2022). Even though anaerobic digestion seems to be a promising solution to the issue, even small reductions in food waste can result in large amounts of avoided emissions and can outweigh the benefits of recycling (Bernstad & Andersson, 2015; De Sadeleer et al., 2020).

1.6 The contribution of this thesis

Changes in food consumption patterns can be attributed not only to population growth, but also to economic growth and globalization. Between 2003 and 2013, animal protein consumption grew by 69%, while population grew only by 29% (Sharma et al., 2018). Consuming a meat-based diet is seen by many as a status symbol, and in some developing countries, such as Vietnam and Thailand, a big part of people's now higher income is being spent on purchasing meat (Sharma et al., 2018). Moreover, in some countries, such as Argentina, Uruguay and Chile, it is also part of the local culture (Navarro, 2016, as cited in Giacoman et al., 2021). As previously illustrated (1.4), developed countries have also seen an increase in meat consumption (Sans & Combris, 2015). Overall, global red meat consumption is higher than what recommended by the EAT-Lancet Commission (Willett et al., 2019). Meanwhile, consumption of vegetables and fruits, legumes and whole grains is below recommendations (Springmann et

al., 2021). To summarise, current eating choices are unsustainable both for the environment and for the global population's health.

Similarly, as explained in chapter 1.5, most of the food waste that we produce is edible (Food and Agriculture Organization, 2013) and avoidable (Waste and Resources Action Programme, 2021), and a great proportion of it is created at the consumer stage (Stenmarck et al., 2016). Although new methods of food waste recycling, such as anaerobic digestion, have emerged and have shown to be effective, the consensus is that food waste prevention should be favoured over recycling (De Sadeleer et al., 2020). Reasons behind wastage of edible food include behaviours such as "not used in time" or "served too much" (Waste and Resources Action Programme, 2013).

Because behaviours are a core part of the issue of unsustainable food consumption, this thesis will investigate how consumers evaluate food products in terms of sustainability, what can influence eating choices, and how individuals can be encouraged to waste less food. To do so, theories and methodologies from behavioural economics and, more generally, behavioural science, will be discussed.

Behavioural economics is a field of research that challenges classical economic theory and its assumptions regarding human behaviour, its institutional underpinnings, its poor prediction power, and its intrinsic non-falsifiability (Kao & Velupillai, 2013). Behavioural economics allows for a better understanding of decision-making processes and behaviours by integrating behavioural science with economic principles (Camerer, Loewenstein, & Rabin, 2004; Reed, Niileksela & Kaplan, 2013). Behavioural science encompasses multiple disciplines, such as psychology, neuroscience, and sociology, with the aim of investigating human behaviour of individuals and groups (Kappes, 2016). This thesis builds on previous research from behavioural science to better understand behaviours that lead to unsustainable food consumption patterns. Specifically, theories and previous studies from not only behavioural economics, but also other disciplines within behavioural science, are reviewed for a more holistic understanding of food consumption patterns, which are determined by a variety of

factors: individual beliefs and choices, but also social norms and habits (e.g. Lally et al., 2008; Nezlek & Forestell, 2020; Vassallo et al., 2016; as discussed in chapters 2 and 5).

This thesis is organised as follows. Chapter 2 illustrates theories and findings which try to explain eating behaviour, and previous interventions which tackled eating behaviour. Chapter 3 discusses an online behavioural experiment which tested whether consumers can evaluate food products in terms of their environmental impact, and how different labels on packaging can affect people's perception of food sustainability. Chapter 4 discusses a study which investigated how nudges can influence diners' eating choices in a real-world restaurant setting. Chapter 5 illustrates theories and findings which try to explain waste behaviour. Chapter 6 is focused on a behaviour change intervention which aimed at helping individuals reduce their household food waste through the creation of habitual pro-environmental behaviours. Chapter 7 provides a summary of my results and discusses what they mean both for policies and interventions aimed at tackling unsustainable food consumption, and for consumers.

Chapters 3, 4 and 6 discuss the three experimental studies which are the foundation of this work. The Three-Stage Model of Service Consumption describes three main stages which consumers go through when they make use of services: the pre-purchase stage, the service encounter stage, and the post-encounter stage (Tsiotsou & Wirtz, 2015). By adapting this model to describe food consumption behaviour, the following stages can be defined: forming opinions about a food product or a dish; purchasing or consuming a product or a dish; and discarding what is unwanted. The three main studies of this research are presented in this thesis following the order of these consumption stages, although they were not strictly conducted in this same order due to external circumstances. The first study investigates how consumers form sustainability judgments on food products, and whether the presence of labels or the number of available choices can influence these judgments. The second study investigates the role of

labels on a restaurant menu in determining food consumption choices. In particular, this study answers the questions of whether signposting a dish as vegetarian or plant-based affects its popularity, whether we can encourage the consumption of vegetarian and plant-based dishes through a low-emission label, and whether disclosing the purpose of a label will change its effect on consumer choices. Finally, the third study investigates whether positive behaviours aimed at food waste reduction can be encouraged and made habitual, and if so, whether these behaviours will actually lead to a reduction in households' food waste.

Chapter 2

Decision-making

2.1 Individual decision-making

Why do consumers not eat sustainably? There may be two general reasons: They might not be interested in or concerned about eating sustainably; They might want to eat sustainably but may not be able to. Previous research suggests that both reasons apply.

When consumers are looking to make a choice between products, they seem to care mostly about taste, cost, variety, convenience, and health (see chapter 1.4). Whether the product is environmentally friendly or not seems not to be a primary concern. Awareness of the environmental impact of some products is still quite low, together with motivation to eat more sustainably: Even vegetarians often mention reasons other than the environment for not eating meat, such as disgust, being concerned about animals and health (Behavioural Insights Team, 2020).

Nevertheless, some consumers may be sincerely concerned about the planet. However, people's actions do not always match their values, and this is referred to as the "value-action gap". This value-action gap seems to be frequent across environmentally friendly attitudes and behaviours (Kollmuss & Agyeman, 2002, as cited in Behavioural Insights Team, 2020). A linked hypothesis, the "low-cost hypothesis", argues that we are prone to act environmentally friendly only when it is not hard for us to do so (Diekmann & Preisendörfer, 2003, as cited in Behavioural Insights Team, 2020). However, there are many barriers to acting sustainably, often psychological, such as lack of willpower, and economic, such as costs, which make sustainable food less affordable for poorer households (De Haen & Réquillart, 2014). Knowledge barriers may also be a problem: Consuming more

vegetarian meals requires learning new recipes (Behavioural Insights Team, 2020).

A major barrier to acting sustainably is imperfect decision-making. Theories and experiments in the fields of behavioural economics and psychology try to explain and test for the reasons why people's decision-making is often imperfect.

According to Goldstein and Hogarth (1997, as cited in Newell, Lagnado & Shanks, 2015), the research on decision-making can be divided into research on decisions and research on judgments. Research on decisions saw Neumann and Morgenstern's theory of games and economic behaviour (1947) on maximising expected utility being challenged by Savage's concept of subjectivity (1954), Simon's concept of bounded rationality (1956), Edwards' probabilistic judgments (1968), Kahneman and Tversky's heuristics, biases, and prospect theory (Kahneman & Tversky, 1979; Kahneman, 2011). An example of a bias that may affect food purchasing decisions is projection bias. People tend to believe that their preferences will not change over time (Loewenstein et al., 2003), when in fact variations in circumstances and needs are likely to affect their decisions. For example, Read and van Leeuwen (1998) showed workers were more likely to pick an unhealthy snack when hungry than when satisfied.

Research on judgments was inspired by the model of visual perception, Brunswik's Lens Model (Hammond & Stewart, 2001, as cited in Newell, Lagnado & Shanks, 2015), by which an object in the environment produces multiple cues through the stimulation of the perceiver's organs. These cues reveal the true state of the world only imperfectly and perception involves making inferences. The process with which judgments are created is similar and is characterised by the following steps: Discovering new information, acquiring and searching through information, combining information, and receiving feedback (Newell, Lagnado & Shanks, 2015). For the scope of this research, it is particularly interesting to consider the way we acquire information, especially how shoppers acquire information about products before deciding which one to purchase: How much information do they look

for and in what order, and when do they settle for something? (Newell, Lagnado & Shanks, 2015). This problem is often described as a trade-off between exploration and exploitation (Cohen, McClure & Yu, 2007, as cited in Newell, Lagnado & Shanks, 2015). Exploitation means staying with the usual option, like the customary product, whereas exploration means looking for something new. Simon (1956) suggested that people are “satisfiers”: Rather than looking for the optimal solution, they look for good enough solutions by searching through the alternatives in an unordered manner and settling for the first option which satisfies a set of characteristics.

In the context of purchasing food, this means that the order in which items are considered is important, as it can have an impact on the final consumption decision (Payne, Bettman & Luce, 1998). People’s decisions tend to be sensitive to contextual factors and to how choices are presented to them, that is to the choice architecture (Behavioural Insights Team, 2020). In particular, there are six factors relating to the choice architecture which research has suggested to be particularly impactful on decisions (Behavioural Insights Team, 2020):

- If an option is marked as the “default”, people rarely switch away from it.
- The way choices are displayed makes a difference: People tend to choose the first option available in canteens, and the top and bottom options listed on menus.
- More available products are more likely to be chosen.
- Products at eye-height, at checkout and at the end of the aisles in supermarkets tend to sell more.
- More eye-catching products tend to sell more.

Having too much choice can also be a problem: People perceive the choice as more difficult to make, their motivation to choose is lower, they have lower confidence in their final choice and are less satisfied with it (Fasolo et al., 2005; Iyengar & Lepper, 2000). Behavioural economics research suggests that having too much choice can create what are called “menu effects”. An example would be choice

avoidance, whereby too many alternatives to choose from discourage the buyer from choosing altogether (Iyengar & Lepper, 2000). Alternatively, consumers may choose to diversify too much. For example, in an experiment conducted by Simonson (1990), most of the students who were asked to choose snacks in advance for the subsequent meetings decided to pick different ones, whereas most students who picked their snacks one by one did not diversify their choices as much. Another way to go around the problem of too much choice is to stick with the familiar or the salient: Investors may prefer picking domestic equities (French & Poterba, 1991), or companies that have been in the news (Barber & Odean, 2008). Finally, choice overload can also cause confusion, which can lead mistakes in choices, such as voting for the wrong candidate (Shue & Luttmer, 2009).

2.2 Social decision-making

People who consume sustainable food are often classified into one specific segment of the population, and this is justified with the argument that similar actions should correspond to similar beliefs and attitudes (Oosterveer and Spaargaren, 2007). However, research has shown how people behave differently during studies and in real life (Richter, 2002, as cited in Oosterveer and Spaargaren, 2007) and how individuals do not stop to evaluate every single consumption decision that they make, but rather their choices depend on a mix of in-the-moment decisions and routines (Warde, 1997, as cited in Oosterveer and Spaargaren, 2007).

A similar idea is proposed by Evans et al. (2012) who argue that an environmentally damaging consumption behaviour is not only dependent on the individual's decisions, but also and most importantly on social practices. Social practices are routinized behaviours (Reckwitz, 2002, as cited in Evans et al., 2012), such as going to the supermarket. Theories of practice include insights from social and cultural theory and think about the individual as not an autonomous decision-maker, but rather as someone who acts in accordance to what is perceived as socially normal (Evans et al., 2012). Evans et al.

(2012) suggest that, according to the theories of practice, habits, routines, social relations, socio-technical systems and cultural conventions should be taken into account and/or tackled when aiming for behaviour change.

An example of a policy which aimed at changing behaviour through the modification of socio-technical systems is the Cool Biz initiative in Japan in 2005. Throughout this initiative, conditioners had to be set at a temperature not lower than 28° during the summer months in order to reduce energy consumption. To enable workers to better deal with the higher temperature in the offices, a new dress code with summer clothing was introduced. By changing the social convention behind the workplace dress code, offices were able to save energy and reduce CO_2 emissions by about 1.14 million ton (Evans et al., 2012).

As far as eating behaviour is concerned, Evans et al. (2012) suggest that policies should focus on practices such as food acquisition, food storage and cooking, and the ways in which discarded food is disposed of. These policies include the promotion of particular foods, product substitutions, and informational campaigns on how to reduce food waste.

There are also other social factors which can influence consumer choice, such as associations and stereotypes. For example, vegetarianism is often associated with being weak or feminine (Behavioural Insights Team, 2020). The food that we eat also reflects our culture and what we identify with, and meat is considered an important part of our meals in Northern Europe and America (Behavioural Insights Team, 2020). Eating meat therefore becomes the status quo or default option, and we are inherently biased towards consuming it.

2.3 Explaining eating behaviour through psychological theories

2.3.1 Subjective relevance

Food consumption can be seen as part of our human experience and consequently consumption behaviour may depend on our “subjective

relevance", that is the symbolic and emotional value that food has for us (González Rey, 2017; Hicks & King, 2009; as cited in Castellini et al., 2020). Castellini et al. (2020) tested two hypotheses: 1. That organic food choice motivation positively influences our subjective relevance of food, and 2. That our subjective relevance of food has a positive impact on the frequency of organic food consumption. In other words, the researchers were interested in the effect of subjective relevance of food as a mediator between organic food choice motivation and frequency of organic food consumption (see Figure 1).

Figure 14. Subjective relevance model (Castellini et al., 2020).

Both hypotheses were supported by the data, which suggested that subjective relevance of food both positively influenced frequency of organic food consumption ($B = 0.28$, $p < 0.001$) and was positively impacted by organic food choice motivation ($B = 0.64$, $p < 0.001$).

2.3.2 Value-attitude-behaviour hierarchy

The value-attitude-behaviour hierarchy (VABH) suggests that our values influence our attitude towards a particular behaviour, which in turn influences the behaviour itself (Homer & Kahle, 1988). This hierarchy has been often applied to describe and understand pro-environmental behaviours (Kim et al., 2020). For example, VABH can adequately describe sustainable clothing purchases by explaining 31.1% of the variance in behaviour (Jacobs et al., 2018). In the context of environmentally friendly eating, Kim et al. (2020) found a significant relationship between perceived value on sustainability and three attitude measures (attitude on waste reduction, personal norm on waste reduction, and social norm on waste reduction), which were in turn significantly related to behaviours for environmentally friendly eating. In this case, VABH could explain 56.7% of the variance in behaviour (Kim et al., 2020). Interestingly, being vegetarian moderated

the relationship within the hierarchy: the explained variances were higher for attitude on waste reduction and personal norm on waste reduction, but lower for social norms on waste reduction and environmentally friendly eating behaviours.

2.3.3 The theory of reasoned action and the theory of planned behaviour

The theory of reasoned action (TRA) (Fishbein & Ajzen, 1975) argues that attitudes and subjective norms influence behaviour intention, which in turn influences behaviour. The theory of planned behaviour (TPB) (Ajzen, 1991) is an extension of the TRA, whereby perceived behavioural control also influences behaviour intention. Attitudes refer to how someone feels towards that behaviour. Subjective norms refer to the expectations held by the people surrounding the individual and how the individual perceives these. Perceived behavioural control refers to whether the individual believes they can carry out a specific behaviour, and the opportunities they have.

2.3.4 The theory of planned behaviour – extended

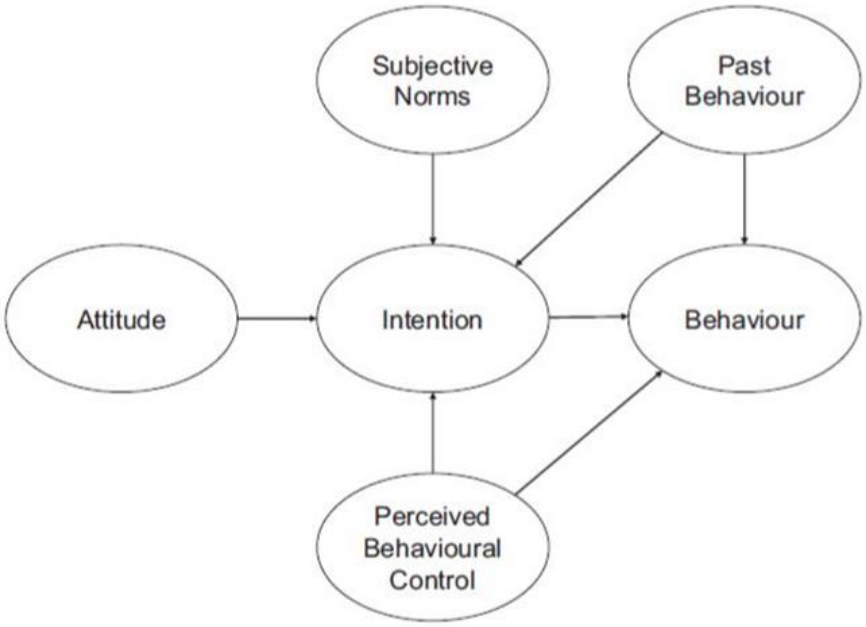
Vassallo et al. (2016) investigated whether the theory of planned behaviour can be used to explain food consumption behaviour in Italy. Past behaviour was also added to the original model (see Figure 2). The study sampled 3025 Italians that were over the age of 18 and were solely, or jointly, responsible for their household's food shopping. Amongst their sample, 31.2% of consumers "hardly ever" bought sustainable food products, whereas 69% did "sometimes" and more.

The data suggested that the theory of planned behaviour can explain consumption behaviour satisfactorily, with past behaviour being the strongest predictor for behaviour, followed by behavioural intention and perceived behavioural control, at the national level. At the regional level, past behaviour was also the strongest determinant, but the role of behavioural intention and perceived behavioural control was different depending on the macro-region. Behavioural intention was the second most important predictor in the northwest, northeast and centre of Italy, whereas perceived behavioural control was the second

most important predictor in the south and on the islands. Past experiences seemed to be the most important factor to be able to overcome perceived barriers.

The impact of social pressure was also heterogeneous (Vassallo et al., 2016). Pressure from “society” did not have an impact. Pressure from “friends” was not significant in the northeast and centre of Italy, but it was at the national level and in the northwest, south and on the islands. Pressure from “family” was the biggest predictor of behavioural intention towards buying at the national level and in every macro-region, except for the islands. The impact of “important people” was significant at the national level, in the south and on the islands.

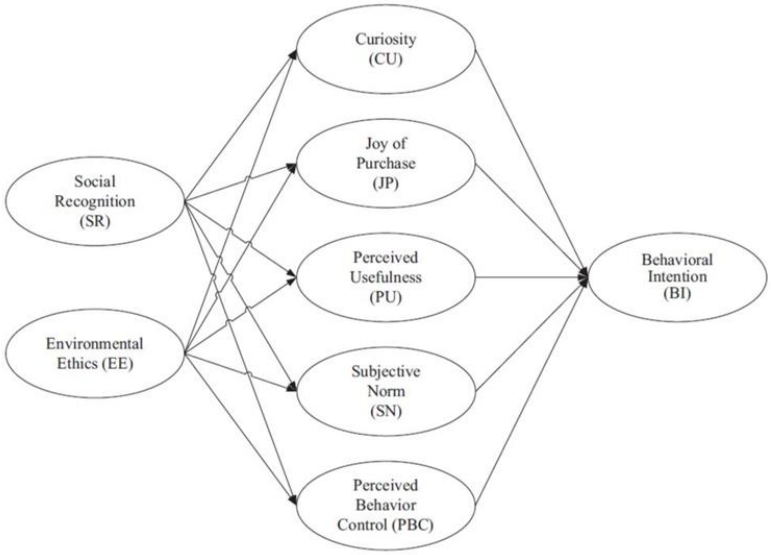
Figure 15. Model of the extended theory of planned behaviour (Vassallo et al., 2016).



Chen et al. (2021) tested an extended version of the TPB by incorporating the hedonic-motivation system adoption model (HMSAM) (in particular: curiosity, joy of purchase, and perceived usefulness), and intrinsic constructs (social recognition and environmental ethics) into it (see Figure 3). They found that social recognition and environmental ethics are positively correlated with curiosity, joy of purchase, and perceived usefulness (HMSAM), and with subjective norm and perceived behavioural control (original TPB).

Therefore, a positive response from society to the individual's behaviour, and a commitment to environmental protection initiatives for ethical reasons, are related to higher curiosity in understanding green eating and its usefulness in ecological protection, and greater pleasure associated with eating green.

Figure 16. Model of the extended theory of planned behaviour (Chen et al., 2021).



2.3.5 Social identity

Individuals tend to "define themselves in terms of the groups to which they think or feel they belong" (Nezlek & Forestell, 2020, p. 45). We can have multiple identities, and these do not need to be formally recognised by a group. Each of our identities can be more or less salient over time and depending on the circumstances. Moreover, social identities "include normative expectations for attitudes and behaviours" (Nezlek & Forestell, 2020, p. 45).

Social identity theory (SIT) states that we categorise ourselves and others into groups, and we therefore think of people in terms of these groups which represent different social identities (Tajfel & Turner, 2001). This has two functions: It allows us to navigate our material and social worlds, and to understand core beliefs and practices which are fundamental for communication (Moscovici, 1973).

By choosing what we eat, we express our ideals and identities. For example, vegetarians share beliefs about eating animal-based

products, and behaviours like not eating meat. Moreover, eating is a social activity, and therefore these beliefs and behaviours are shared publicly. Non-vegetarians see vegetarians in a certain way, and vice versa. Vegetarianism can therefore be considered a social identity (Nezlek & Forestell, 2020).

Research also suggests that there is a spillover effect whereby what we eat influences our philosophical and political views (Chuck et al., 2016). Romo and Donovan-Kicken (2012) found that 70% of the vegetarians they interviewed thought that being vegetarian was a “core part of their identity and value system”, which also had an impact on other parts of their lives, like wanting to recycle or having service-oriented careers. Similarly, those who adopt a vegan lifestyle report to feel psychologically better, being able to protect both nature and others (Ghaffari et al., 2021).

It is important to note, however, that not everyone who eats a vegetarian diet identifies as a vegetarian. The number of people who identify as vegetarians has remained constant over the last 20 years in the UK and in the US (Šimčikas, 2018), but sales of plant-based meat substitutes have increased, and this could simply mean that some people have reduced the quantity of meat they consume, following a “flexitarian” diet (Nezlek & Forestell, 2020).

2.4 Interventions

Given the negative impact that eating meat and animal-derived products can have on the environment, it is important to understand how diets may be changed. Various behaviour change interventions, defined as “coordinated sets of activities designed to change specific behaviour patterns” (Michie et al., 2011, p. 1), may be considered for this purpose.

The introduction of taxes and subsidies to tackle unsustainable food consumption could present both benefits and drawbacks. If a single country was to impose a tax on emissions on the production side, it may put local producers at a competitive disadvantage, with production increasing in exporting countries, thus obtaining the

opposite result: an increase in greenhouse gas emissions (Abadie et al., 2016). Introducing a tax on the consumption side of €60 per ton of CO_2e, for example, could reduce greenhouse gas emissions by 7% in the EU27 (Wirsenius et al., 2011). A target of a 10% reduction in emissions could be achieved through a set of taxes and subsidies in Norway, such as 40% tax on ruminants and a 40% subsidy on fish (Abadie et al., 2016).

On the other hand, there is a chance that a tax on red meat may lead to a suboptimal use of land resources and a foregone opportunity to occupy non-fertile soils and produce essential nutrients (Lee et al., 2021), therefore affecting food security (Golub et al., 2013). In fact, the livestock industry provides livelihoods for 1.3 billion people (FAO, n.d.). However, some argue that the health benefits from reductions in obesity that would come from these taxes would outweigh the health losses from increased people being underweight (Springmann et al., 2017). A fine balance between optimal levels of nutrition, rural economy and climate change mitigation should be sought (Lee et al., 2021).

Alternatively, nudge interventions have often been successful at steering people's choices towards the greener alternative. A nudge is "any aspect of the choice architecture that alters people's behaviour in a predictable way without forbidding any options or significantly changing their economic incentives" (Thaler & Sunstein, 2008, p. 8). For an intervention to be considered a nudge, it "must be easy and cheap to avoid. Nudges are not mandates. Putting fruit at eye level counts as a nudge. Banning junk food does not" (Thaler & Sunstein, 2008, p. 8).

Nudges have been used successfully in various contexts, such as to increase vaccination rates (Milkman et al., 2011). In the context of food consumption, healthier food choices were successfully encouraged by increasing their visibility and accessibility (Wansink & Hanks, 2013). In the context of sustainable food consumption, nudges may provide a useful tool to achieve a reduction in meat consumption, and lead to an increase in consumption of vegetarian and plant-based dishes.

As argued by Ammann et al. (2023), although market-based and regulatory interventions are more effective, they are also more intrusive instruments. On the other hand, information-based interventions and nudges are less intrusive, more widespread, more likely to be well-received by the public, and can be combined with each other. Mertens et al. (2022) found that choice architecture interventions, on average, promote behaviour change with a small to medium effect. Additionally, such interventions seem to be particularly effective on impacting food choices, delivering effects up to 2.5 times larger than in other contexts (Mertens et al., 2022).

Although most studies will deliver the desired outcomes, about 15% of nudging interventions are likely to backfire, meaning the desired behaviour is either reduced or reversed (Mertens et al., 2022). For example, text message reminders to encourage people to save actually discouraged those who set high saving goals (Andrieş & Walker, 2023).

2.5 The argument for transparent nudges

Despite their effectiveness, nudges are sometimes criticised for being unethical: Some see them as manipulative, threatening people's freedom of choice, and paternalistic, pushing others to choose the option preferred by the nudger (Michaelsen et al., 2021).

Lemken (2021) defines six characteristics which can be used to make an ethical assessment of an intervention: the initial state of the choice architecture; the invasiveness of the nudge, the psychological mechanism it relies on; the visibility of the decision; whether it is the same for everyone or is individually customized; and the disclosure of the intent behind the intervention.

Some argue that nudges could be made more transparent through the disclosure of the intent, but there are two factors to consider. First, their covert nature may be what makes nudges effective (Bovens, 2009). Second, letting people know that they are being "nudged" may lead to psychological reactance (Bruns et al., 2018). Psychological reactance refers to a state of distress, anxiety and resistance that follows the loss

of or perceived threat of loss of behavioural freedom, whereby the individual will try to regain that freedom (Brehm, 1966). Psychological reactance may make the nudge ineffective, or even produce the opposite effect whereby people refuse to make the recommended choice even though they would have been happy to do that had there not been a behavioural intervention in place (Arad & Rubinstein, 2018).

However, no evidence has been found that making a nudge transparent has a negative impact on the effect of the nudge (Kroese et al., 2016; Loewenstein et al., 2015; Steffel et al., 2016, Bruns et al., 2018). For example, Bruns et al. (2018) found that neither disclosing the possible influence of a default nudge on decision-making nor its purpose negatively affected contributions to climate protection. Moreover, transparency was neither found to create psychological reactance (Bruns et al., 2018) or affect the experiences of autonomy and choice satisfaction (Wachner et al., 2020).

2.6 Previous interventions

2.6.1 Types of interventions

So far, real-world interventions aimed at tackling food purchasing behaviour have mostly focused on finding ways to increase the consumption of healthy items. Some of these interventions specifically targeted low-income population groups or families with special needs, such as with new-born children. Despite not always addressing food sustainability issues, these studies form a base to understand consumption behaviour and to create similar interventions to encourage the consumption of more sustainable products. Moreover, interventions which aimed at increasing consumption of certain items, like fruits and vegetables, could also be considered as having a sustainability-oriented goal, despite being originally advertised as health-oriented.

Interventions aimed at changing purchasing behaviour can be classified into four categories: economic interventions, changes to the microenvironment, swap interventions, labelling and/or educational interventions (Hartmann-Boyce et al., 2018). Economic interventions

usually include price increases or decreases, financial rewards and/or vouchers. Interventions that rely on changes to the microenvironment test whether changing the store environment and altering the choice architecture produce changes in consumer behaviour. Swap interventions rely on suggesting to the consumers to switch their product with an alternative one, generally with a healthier one. Labelling and/or educational interventions give consumers more information about the products: For example, an educational intervention aimed at increasing the consumption of fruit and vegetable will spread information about the importance of eating “five a day”.

2.6.2 Economic interventions

Economic interventions are often effective, with most studies conducted in physical stores reporting a statistically significant increase in purchasing behaviour of the targeted item(s) (Hartmann & Boyce, 2018). Especially interesting to consider are the studies conducted by Anderson et al. (1997) and Waterlander et al. (2013), who tested the usefulness of economic interventions, together with educational interventions, when aimed at increasing consumption of healthier products. Anderson et al. (1997)’s intervention, Nutrition for a Lifetime System (NLS), aimed at increasing the amount of fibre and fruit and vegetable, whilst reducing the amount of fat, purchased by shoppers through educational sessions and coupons. The study found that the NLS educational sessions and the coupons contributed to an increase in the intake of fibre, as well as fruits and vegetables, and to a reduction in fat amounts in the food purchased. The coupons contributed to a greater decrease in fats and a greater increase in fruit and vegetable consumption.

The study was conducted in Virginia, US, and through stratified randomization, investigating whether individuals with different ages, family size and socio-economic status would respond differently to the intervention. The interactions between age and the treatment, and family socio-economic status and the treatment, were not significant, but the interaction between family composition and treatment was.

Both families with and without children increased fibre consumption as a result of the study, but the treatment had the biggest impact on families without children (Anderson et al., 1997).

Waterlander et al. (2013), who conducted a similar study with a randomized controlled trial, found similar results. The authors tested the impact of education alone, discounts alone, and education and discounts together, on fruit and vegetable sales in a Dutch supermarket throughout a period of 9 months. Participants were randomly assigned to four different groups (control, education, discounts, education plus discounts), and their purchases were measured through supermarket receipts at different points in time: baseline, 1 month after the start of the intervention, 3 months after, 6 months after (which was also the end of the intervention), and 9 months after (that is, 3 months after the end). Price discounts (50% off), and discounts together with education, showed positive results after 6 months, as they increased fruit and vegetable purchases respectively by 3.9 kg and 5.6 kg per household per week. Additionally, the percentage of participants who consumed the recommended amount of fruit and vegetable increased from 42.5% (measured at baseline) to 61.3% (measured at the end of the intervention). However, education alone did not produce a statistically significant change in purchases, and no significant results were detected 3 months after the intervention ended (Waterlander et al., 2013). This may suggest that economic and education interventions tend to produce more results in the short-term. Long-term effects therefore seem to require further investigation.

2.6.3 Changes to the microenvironment

Thorndike et al. (2016) also searched for ways to increase the sales of fruit and vegetables in supermarkets. They relied on changes to the microenvironment, such as improving the visibility of fresh produce in supermarkets. Their study was conducted in the context of the Special Supplemental Program for Women, Infants and Children (WIC) in Massachusetts, US, which provides food assistance through vouchers and education for pregnant and postpartum women, and infants and

children under 5 years old, in order to promote healthy eating. Two thirds of participants in this program lived at or below the federal poverty level.

In this study, six small corner stores were randomly assigned to the intervention and control groups, and results were measured through voucher and non-voucher sales, and self-reported purchases at baseline and at the end of the intervention. During the baseline period, voucher sales of fruit and vegetable reportedly decreased in both control and intervention stores by about $16 a month. During the intervention period, voucher fruit and vegetable sales increased in treatment stores by $40 per month and decreased in control stores by $23 per month. On the other hand, non-fruit and vegetable vouchers sales were similar in control and intervention stores. It therefore seems like the tested changes in the microenvironment (placement of fruits and vegetables near the front of the store) produced an increase in the target items by customers using the program vouchers. The authors argue that this strategy seems to be particularly effective when combined with economic incentives for families with lower income and small kids (Thorndike et al., 2016).

Foster et al. (2014) tested the impact of in-store marketing strategies such as placement, signage, and product availability, on sales. The aim was to increase the purchase of healthy items belonging to these food types: milk, cereals, frozen meals and beverages. This study was conducted in Pennsylvania and Delaware, US, where eight urban supermarkets in low-income, high-minority neighbourhoods were selected. The authors conducted a cluster-randomized controlled trial, where stores were matched based on store size and sales from government food-assistance programs, and were randomly assigned to either control or intervention. A six-month marketing intervention was conducted in the intervention stores. Sales data showed mixed results, as sales of skimmed and 1% milk, water and healthier frozen meals increased compared to control, whereas there were no differences in the sale of cereals, whole or 2% milk, and diet beverages

(Foster et al., 2014). Hence, the intervention seemed to work for only certain types of food.

A similar but sustainability-oriented intervention found that moving vegetarian products to meat aisles in supermarkets can increase sales of those products, whilst not reducing sales of meat (Piernas et al., 2021). Vegetarian dishes are also chosen more when they compose most of the menu (75%) compared to when there are fewer vegetarian choices available (25%) (Parkin & Attwood, 2021).

Overall, interventions aimed at changing the microenvironment seem to yield mixed results (Hartmann-Boyce et al., 2018). In store marketing interventions appear promising, especially when combined with economic incentives and education (Thorndike et al., 2016), although not effective for all foods (Foster et al., 2014). Placement and availability can effectively increase consumption of vegetarian products (Parkin & Attwood, 2021; Piernas et al., 2021).

2.6.4 Swap interventions

Swap interventions seem to be effective in real shopping situations (Huang et al., 2006; Winett et al., 1991, as cited in Hartmann-Boyce et al., 2018), despite not being effected in simulated studies (Forwood et al., 2015, as cited in Hartmann-Boyce et al., 2018).

Huang et al. (2006), for example, conducted a study where they targeted consumers' online purchases. The aim of the intervention was to promote the sales of products lower in saturated fats. A randomized controlled trial was implemented, where consumers were randomly assigned to a control or treatment group. The control group only received general advice on how to make their diet healthier by reducing saturated fats (education). The treatment group received specific advice on possible switches, i.e., they were recommended alternative products lower in saturated fats to switch their selected one with (swaps). The study was conducted in Sydney, Australia, and the outcomes were measured through amounts of saturated fats in shopping baskets. The intervention (swaps) reduced the amount of saturated fats by 0.66% compared to the control (general education

only), and the effects seemed to continue over consecutive shops, suggesting a long-term effect (Huang et al., 2006). Because there are not many studies which have investigated swap interventions, these require further attention.

2.6.5 Educational interventions and labelling

Different labels and graphics have been tested in the context of influencing pro-environmental eating behaviour. For example, traffic light labelling was instrumental in changing students' eating decisions at a university restaurant: Sales of green labelled meat dishes (indicating low greenhouse gas emissions) increased by 11.5%, whereas sales of red labelled meat dishes decreased by 4.8% (Brunner et al., 2018). In a workplace lunch restaurant in Finland, nudging reduced meat consumption of those people who were already looking to switch to more plant-based and fish-based eating. Moreover, customers appreciated vegetarian dishes which were familiar to the Finnish culinary culture, and the use of sustainably sourced fish. Meanwhile, the climate label was seen as a restriction to the menu by some (Kaljonen et al., 2020).

The use of the label "vegetarian", or "v" for short, next to dish names in menus is a controversial issue. It could be argued that labelling dishes as "vegetarian", or segregating vegetarian dishes from the rest, reinforces the idea that they are different (Behavioural Insights Team, 2020). In fact, vegetarians are a minority group, and their behaviour may be seen as "deviant" from the norm (Romo & Donovan-Kicken, 2012). In practice, previous research found that it either had a negative impact on sales of vegetarian dishes (Bacon & Krpan, 2018) or had no significant effect on consumer choice (Parkin & Attwood, 2022). Some argue that any alternative framing to "vegetarian" is better than "vegetarian" itself: Krpan and Houtsma (2020) found that a pro-environmental label ("Environmentally friendly main course for a happy planet"), a social label ("Refreshing main courses for relaxing conversations"), and a neutral frame (no distinction between vegetarian and non-vegetarian dishes) all led to the vegetarian choice being selected more compared to when it was described as vegetarian.

However, these last three studies were conducted online, with participants being asked to make hypothetical choices from a mock menu. One real-life study found that promoting vegetable-rich dishes as “dish of the day” can make them more popular compared to the neutral frame without affecting consumer satisfaction (Saulais et al., 2019). However, this research did not test the dishes’ popularity when signposted as vegetarian.

The way a dish is described or offered can also have an impact on consumers’ choices. When meat-related labels were used to describe vegetarian dishes (e.g., “cauliflower steak” instead of “cauliflower slice”) in an online study, consumers reported higher willingness to eat those dishes, and reported to perceive them as more filling and containing more protein (Marshall, 2022). In another study, the likelihood of picking a vegetarian dish increased when participants were given the option of adding meat to the dish (De Vaan et al., 2019). This could be seen as an example of a default nudge being successful. A real-world restaurant study investigated what could influence customers to pick either the richest or the lightest version of the same dessert. It was found that a dessert would get chosen more frequently when it was presented as the default option, irrespectively of whether it was the richest or lightest version (Bergeron et al., 2019). This result suggests a strong status quo bias, and the efficacy of default framing as a nudge.

Other visual nudges such as signs and posters have also been shown to be effective. Signs placed in grocery carts successfully increased the sales of fruits and vegetables in supermarkets in New Mexico, US, and Denmark (Payne et al., 2015; Bauer et al., 2022). These studies relied on the concepts of salience, social norms, and simplification. The posters were attention-grabbing and strategically placed so that they would be easily visible; they informed customers of other clients’ consumption of fruits and vegetables; and they simplified customers’ decision-making by suggesting recipes to make with fruits and vegetables. Similarly, letting customers know that asking for a doggy bag to take their leftovers home is common, and therefore socially

acceptable, led to a significant increase in the number of diners who did so (Giaccherini et al., 2021).

As discussed previously, educational interventions may also be useful when paired up with other interventions, especially with economic interventions, changes to the microenvironment and swap interventions. The results discussed by Anderson et al. (1997) and Waterlander et al. (2013) suggest that providing vouchers together with educational sessions can encourage the consumption of healthy items, such as fruits and vegetables. Similarly, in Thorndike et al. (2016), vouchers, education, and changes to the microenvironment increased purchase of fruits and vegetables. Finally, the study by Huang et al. (2006) suggests that educating on healthy diets alone is not as effective as sharing advice on possible product swaps.

2.7 The impact of labels on consumers' judgments and willingness-to-pay

Labels reduce the asymmetry of information between the consumers and the producers by providing additional information about the product (Golan et al., 2001). They can do more than simply nudging consumers towards buying certain foods: They can also shape the way products are perceived and increase willingness-to-pay (WTP), as shown, for example, by organic labels.

Massey et al. (2018) conducted a meta-analysis of 150 studies and 124,353 consumers, and found that health, safety, quality, respect for the environment and for animals are the main features attributed by buyers to organic food products.

Parker et al. (2020) suggest that organic labelling may have a different impact on preferability of products depending on whether they are vice or virtue foods[3]. The researchers found that organic labels benefit virtue foods, but not vice foods. The way the information is conveyed in the label also determines how consumers evaluate vice foods:

[3] "Vice foods are those that provide immediate pleasure (e.g., tastiness) but have long-term negative consequences (e.g., weight gain), whereas virtue foods are less immediately pleasurable but have greater long-term benefits" (Parker et al., 2020, p. 420).

Product-level organic labels (such as “organic burrito”) leads to a lower evaluation of the product, whereas ingredient-level organic labels (“burrito with all organic ingredients”) do not. However, this distinction does not seem to apply to virtue foods. The authors explain the negative impact of product-level labels on vice foods with two hypotheses: feature-based categorical typicality (Hampton, 2007) and fluency (Alter & Oppenheimer, 2009). First, organic vice foods are thought of as atypical. Second, because they are considered atypical, the concept of organic vice foods is more difficult to understand. The researchers found that this led to the likelihood of consumers ordering a burger being higher in the ingredient-level condition (where an ingredient-level label was placed), compared to the product-level condition.

Ellison et al. (2016) also argued that labelling effects should be evaluated while keeping into account product type, but the context in which the purchase takes place as well, i.e., in which kind of store. First, it was found that the organic label creates an “halo” effect, as organic products were rated better in terms of nutrition, safety, brand attitude, and brand trust, than their corresponding standard products. However, this effect did not apply to expected taste and likelihood of purchase. Second, as Parker et al. (2020) also argued, they found that the organic label has a different effect on organic vice and virtue products: Higher expected nutrition and better expected taste were respectively associated with the products. Third, Ellison et al. (2016) argued that Target, which is associated with style and aspiration, may be better suited for selling organic vice products, whereas Walmart, known as a more utilitarian kind of shop, may be better suited for selling organic virtue products.

Previous research also finds that consumers are willing to pay more for organic products than for their standard corresponding products. For example, Tranter et al. (2009) found that consumers in Europe had a willingness to pay (WTP) for organic products that ranged from 110% to 150%. Liu (2013) found that consumers in the Henan province in China would be willing to pay a premium of 150-180% for organic grain.

Zanoli et al. (2012) also found that consumers value organic meat more and are willing to pay a premium of 26.25 Euros/kg for organic beef compared to conventional beef.

Chen et al. (2015) compared how much Chinese consumers would be willing to pay for products that had either the Chinese organic label (COT), or the European organic label (EOT), or both (CEOT), and found that the price premium for COT, EOT and CEOT were 132%, 174% and 180% respectively. A significant difference was found between the WTP for COT and EOT, and between COT and CEOT, but not between EOT and CEOT. What this suggests is that consumers may also respond differently to organic labelling depending on what organic certification the product presents. The authors argued that, in this case, the phenomenon could be traced back to food safety incidents in China which may have negatively affected consumers' confidence in food with Chinese certifications. It was also found that demographics affect people's WTP: Females had higher WTP; consumers under 40 years old had significantly higher WTP for EOT than COT, whereas the older age group preferred the Chinese organic certification; people with higher education tended to prefer the Chinese organic label; and having minor children also led to preferring CEOT, followed by EOT, and then by COT. Being environmentally aware led to higher WTP for organic products, but did not produce different WTP depending on the labelling – possibly indicating that consumers believed the three types of organic foods had similar environmental impact. Organic knowledge also had a positive effect on WTP for organic food, and led to consumers preferring EOT to COT, but no difference was found between EOT and CEOT (Chen et al., 2015).

Other research seems to find an interaction effect between organic labelling and origin, whereby consumers value domestic organic products more than imported organic products (Xie et al., 2016). The authors suggest this may be to the fact that Americans may believe that domestic products that qualify for the organic label may have had to meet stricter requirements than products labelled as organic coming from abroad, when in fact all organic products sold in the US need to

meet the same requirements set by the United States Department of Agriculture. This finding is different to what was found by Chen et al. (2015), who observed that EU labelling was preferred to Chinese organic labelling by Chinese consumers.

2.8 Constructing interventions to target unsustainable food consumption

This chapter discussed some relevant theories and interventions that may be used to tackle unsustainable food consumption behaviours. In particular, section 2.6 presented four types of interventions: economic interventions, changes to the microenvironment, swap interventions, and educational/labelling interventions. Section 2.7 then focused on the impact of labels on consumers' judgments and willingness-to-pay. While some of the presented studies were indeed concerned with the issue of unsustainable food consumption, this area of research is still emerging, and the following gaps in the literature were identified.

Firstly, no study specifically investigated the impact that a green label may have on consumers' sustainability judgments of food products. Previous research mainly focused on the effectiveness of organic labels on influencing consumers. In the context of addressing unsustainable food consumption, this raises the question as to whether a green symbol placed on product packaging could similarly impact consumers' perceptions of food products by highlighting their low environmental impact. The first experimental study of this research, described in Chapter 3, addresses this question.

Secondly, no real-life intervention tested the impact of vegetarian and plant-based symbols, commonly found in restaurant menus, on consumers' dining choices. The second experimental study of this research, presented in Chapter 4, investigates whether removing the symbols which sign-post vegetarian and plant-based options, and subsequently adding a label indicating sustainability (both as a hidden and transparent nudge), can increase the sales of those dishes.

Chapter 3

The impact of salient labels and choice overload on sustainability judgments

3.1 Introduction

3.1.1 Overview

Previous research suggests that contextual factors can affect the perception of food products (2.7), however, we still know little about how consumers evaluate these items in terms of sustainability. This chapter (Buratto & Lotti, 2023) investigates how well shoppers can rate food items in the matter of their environmental impact, whether they are overconfident in their knowledge of food sustainability, and whether labels on packaging and great availability of choice can affect their judgment. Through an online behavioural experiment, I tested the impact of salient truthful and untruthful green labels, and of choice overload on people's perceptions of the environmental quality of food products. I found that choice overload is detrimental to consumers' judgment, but that truthful labels can help shoppers correctly identify sustainable items. However, untruthful labels can negatively impact consumers' judgments with choice overload, even if shoppers have greater prior knowledge of sustainability. These findings suggest that truthful and untruthful salient labels and choice overload can have an impact on shoppers' perceptions of food products. Moreover, overconfidence in one's sustainability judgment is negatively correlated to judgment accuracy. Hence, great care should be taken in presenting food products to consumers to make the most environmentally friendly items stand out.

3.1.2 Research theme, questions and hypotheses

The following study explores how well consumers can rate food products in terms of sustainability, defined with the criteria of greenhouse gas emissions, freshwater and scarcity-weighted water

usage, and land usage (see 3.2.2). I use the term “judgment accuracy” thereafter to indicate how well respondents can answer the experiment questions. The aim of this experiment is to test what can influence participants’ judgment accuracy, answering the following research questions.

Salience of labels

Do labels affect people’s judgment accuracy? And can consumers recognise when labels accurately describe a product as sustainable and when they do not? I investigate the impact of salience of labels on judgment accuracy. Salience, defined as novel, relevant and attention-drawing information, can affect our thinking and actions (Kahneman & Thaler, 2006; Dolan et al., 2012). For example, brand name may be used as a proxy for quality when motivation to form an accurate judgment is low (Maheswaran et al., 1992), and calorie posting on menus can reduce the average calories per transaction (Bollinger et al., 2011). In this case, I am testing whether adding a green label on the product affects people’s perception of it in terms of sustainability. I am differentiating between those labels that accurately indicate the most sustainable item out of the available ones and those that do not. I refer to the former case as “salience” and to the latter case as “distractor” when describing the treatments. I predict that respondents will rely on the label in both cases, hence:

H1. Salience will lead to greater judgment accuracy.

H2. Distractor will lead to lower judgment accuracy.

Choice overload

Does the number of available products affect consumers’ judgment accuracy? This question tests the impact of choice overload, defined as a wider range of available options, on judgment accuracy. Because previous research suggests that accuracy does not necessarily change with more information (Castellan, 1977), and it may in fact decrease (Arkes, 1981), I predict that:

H3. Choice overload will lead to lower judgment accuracy.

Interactions between treatments

The treatments of salience and choice overload will produce opposite effects on judgment accuracy. No prediction is made on which effect will prevail, leaving this as an exploratory question. On the other hand, the treatment of distractor and choice overload are both predicted to have a negative effect on judgment accuracy, hence:

H4. The treatments of distractor and choice overload together will diminish judgment accuracy.

Overconfidence

Are consumers overconfident in their knowledge of product sustainability? Is there a relationship between their overconfidence and their judgment accuracy? Is there a link between their overconfidence and the impact of external factors such as salience, distractor, and choice overload? Griffin and Varey (1996) define being overconfident as either overestimating the likelihood that one's preferred outcome will occur or overestimating the validity of one's judgment. In this research, I use the second definition for overconfidence. Being overconfident may limit information search (Cooper et al., 1995; Harvey, 1994; Mahajan, 1992), and may reduce decision accuracy (Zacharakis & Shepherd, 2001). I therefore predict that:

H5. Overconfidence in one's food sustainability knowledge will be correlated to lower judgment accuracy.

H6. Overconfidence in one's performance when determining food sustainability in the experiment will be correlated to lower judgment accuracy.

Interactions between treatments and overconfidence

As the amount of relevant information increases, confidence tends to increase as well (Oskamp, 1982), but not as much as judgment accuracy (Tsai et al., 2008). Therefore:

H7. Overconfidence will be higher when the treatments of salience and distractor are activated.

The effects of overconfidence and salience will compete against each other, with overconfidence being associated with lower judgment accuracy and salience with higher judgment accuracy. The effect of overconfidence will be greater, hence:

H8. Judgment accuracy will be lower when both salience and overconfidence are present.

The effects of overconfidence and distractor will both be negative on judgment accuracy, hence:

H9. The treatment of distractor and the presence of overconfidence together will be related to a lower judgment accuracy.

Because choice overload may result in lower motivation to choose and lower satisfaction with the chosen option (Iyengar & Lepper, 2000), or in the consumer avoiding choosing altogether (Samuelson & Zeckhauser, 1988), I expect that:

H10. Overconfidence will be lower when the treatment of choice overload is activated.

H11. The treatment of choice overload and the presence of overconfidence together will be related to a lower judgment accuracy.

Demographics and other background information

It is predicted that being vegetarian (H12), vegan (H13), the primary shopper in one's household (H14), and buying organic food (H15) will be associated with higher judgment accuracy. Information on respondents' age, gender, education, income, employment status, household size, country of residence (Italy or UK) and preferred place for grocery shopping is also collected to explore their relationship with judgment accuracy.

3.2 Method

3.2.1 Study design

The current experiment had a within-subject design with 6 experimental sections: control; salience; distractor; choice overload; salience plus choice overload; and distractor plus choice overload. In the control section participants were asked to select the most sustainable item out of 4 shown products. In the treatment of choice overload participants had to judge between 8 products (see Figure 4). The treatment of salience consisted in adding a green symbol on the most sustainable item amongst the shown products (see Figure 5). The treatment of distractor similarly consisted in adding a green symbol but on a product that was not the most sustainable one in the group (see Figure 6).

Figure 17. Choice overload treatment.

Figure 18. Salience treatment.

Figure 19. Distractor treatment.

3.2.2 Materials

The experiment was conducted in the form of a quiz. The quiz was made up of 5 parts: self-assessment; experiment; symbol; consumers' preferences; and demographics. The self-assessment part contained two questions to determine participants' overconfidence about their general knowledge of food sustainability. The experiment comprised of 6 sections: Each of these contained 4 questions about food products and their sustainability characteristics, plus 2 questions that asked participants to estimate how well they answered each section. Every respondent completed all 6 experimental sections:

- Section 1: control
- Section 2: choice overload
- Section 3: salience
- Section 4: salience and choice overload
- Section 5: distractor
- Section 6: distractor and choice overload

The sustainability questions of the experiment and their relative correct answers were defined using data from Ritchie et al. (2022). As the environmental sustainability of a product can be described in different ways depending on what is being assessed, such as greenhouse gas emissions or water usage during production, the questions specified

the criteria the respondent should use when selecting the most sustainable product. Different questions made use of different criteria including the following: greenhouse gas emissions across the supply chain; greenhouse gas emissions per 100g of protein or per 1000 kilocalories; freshwater or scarcity-weighted water usage per kg of product or 1000 kilocalories; land usage per kg or 1000 kilocalories. To allow respondents to focus on the food products only, information on type of product packaging and country of origin is defined as irrelevant in the survey.

The symbol used in the salience and distractor treatments depicted a hand holding a plant with two leaves (see Figure 7). This symbol can be found in Microsoft Office packages, and was used in the following colour schemes so that it could be visible on different coloured packaging. Participants were not given an explanation regarding the meaning of this label.

Figure 20. Green symbols used in the salience and distractor treatments.

Because the respondents were either from Italy or the UK, it was decided to use a neutral symbol that is not found on packaging in either country but could be recognised by both as related to sustainability. The symbol part of the quiz included a manipulation check question that asked participants to indicate whether they could see the green symbol on some of the products in the experimental sections.

The part on consumers' preferences contained 5 questions investigating the following: whether participants are vegetarian, or vegan; if they oversee grocery shopping for their household; where they generally go grocery shopping; what percentage of their groceries is organic. Finally, the last section of the experiment, demographics, contained questions about the participants' age, gender, education, income, employment status, household size, and country of residence (Italy/UK).

3.2.3 Measures

Judgment accuracy

Each experimental section of the quiz was either worth 16 or 32 points, depending on whether the treatment of choice overload was present: If participants had to choose between 4 products (no choice overload), getting the correct answer would give them 4 points; If they had to choose between 8 products (with choice overload), getting the correct answer would give them 8 points. If the respondents picked the second-best alternative, they would score either 3 (no choice overload) or 7 points (with choice overload), and suchlike. Following this logic, sections 1, 3, and 5 were worth 16 points in total, and sections 2, 4, and 6 were worth 32 points in total. The maximum score a participant could get in the quiz was 144 points. I computed the dependent variable, *judgment accuracy*, as the ratio of correct answers in points per each section.

Overconfidence

I differentiated between two forms of overconfidence: overconfidence in one's sustainability knowledge and overconfidence in one's performance. Thereafter I will refer to overconfidence in one's sustainability knowledge as self-assessment, and to overconfidence in one's performance as overprecision.

Self-assessment

Self-assessment was measured through two questions in the quiz, the answers to which were coded as the variables *selfassessment1* and *selfassessment2*. Both variables are continuous and were recorded through a slider ranging from 0 to 100. *Selfassessment1* represents how much participants think they know about sustainability, where 0 corresponds to "I don't know anything about sustainability", 50 to "I know about half of what there is to know", and 100 to "I know everything about sustainability". *Selfassessment2* represents how much participants believe to know about sustainability in comparison to other people in their country, where 0 means "I know nothing

compared to other people", 50 means "I know more or less the same as other people", and 100 means "I know everything compared to other people. A correlation between these two measures is suspected and will be checked during data analysis; if that is the case, a combined measure of the two, *selfassessment*, will be used thereafter.

Overprecision

Overprecision was measured in two ways, *overprecision1* and *overprecision2*, as described below. The computations that follow are my own adaptation of the Reported Error Method described in Ahrens et al. (2021).

Overprecision1 was calculated as the difference between a participant's actual error and their estimated error, which is derived from the participants' estimations of their own scores for each section of the experiment.

Overprecision2 was calculated as the difference between a participant's actual error and their predicted error. Participants' answers to the question "How many questions do you think you got wrong in this section?" were recorded and then converted into participants' predicted errors calculated in points.

A high correlation between *overprecision1* and *overprecision2* is expected and will be checked during data analysis.

An individual will be described as overconfident if their overprecision measures are greater than 0; the further away from 0, the more overconfident. On the other hand, if their overprecision is smaller than 0, then the individual is underconfident.

3.2.4 Model of judgment accuracy

The following model of judgment accuracy is tested:

$$
\begin{aligned}
&accuracy\ ratios_i \\
&\quad = b0 + b1 * selfassessment_i + b2 * organic_i + b3 \\
&\quad * age_i + b4 * vegetarian_i + b5 * vegan_i + b6 \\
&\quad * primary\ shopper_i + b7 * country_i + b8 * education_i \\
&\quad + b9 * earnings_i + b10 * household\ size_i + b11 \\
&\quad * overconfidence\ in\ sections_i + b12 * salience + b13 \\
&\quad * choice\ overload + b14 * distractor + b15 * salience \\
&\quad * choice\ overload + b16 * distractor * choice\ overload \\
&\quad + b17 * salience * overconfidence\ in\ sections_i + b18 \\
&\quad * choice\ overload * overconfidence\ in\ sections_i + b19 \\
&\quad * distractor * overconfidence\ in\ sections_i + C * X_i + D \\
&\quad * Y_i + E * Z_i
\end{aligned}
$$

Where *salience*, *choice overload*, and *distractor* are dummy variables indicating the experimental treatments. *Overconfidence in sections* is a measure of overconfidence derived from overprecision (see 3.3.3). X_i, Y_i, and Z_i are vectors: X_i represents the individual's preferences for food stores or markets; Y_i is their gender; Z_i represents their employment status. The variables *vegetarian*, *vegan*, *primary shopper*, and *country* are dummies; *education*, *earnings* and *household size* are ordinal.

3.2.5 Participants

Participants were recruited through Amazon Mechanical Turk. They were asked to read an information sheet and then to tick a box to give their consent before taking part in the study. Anyone registered on the platform and located in either Italy or the UK could take part in this study. Participants had a maximum of 1 hour to submit their answers and were compensated with $0.50 for their time spent on the experiment. They were given a code during the study which they had to provide on Amazon M. Turk after submitting their answers to validate their participation; 5 participants were excluded from recruitment for not providing the code.

336 participants completed the study, with 166 people from the UK (49.4%) and 165 from Italy (49.1%), and the remaining preferring not

to say or not answering. Participants were, on average, 32 years old (*M* = 32.88, *SD* = 11.244), with the minimum reported age being 18 and the maximum being 76. 60.1% were male and 37.2% were female. 1 person preferred to self-describe as non-binary, and 1 as gender-fluid. 5 people preferred not to disclose their gender.

3.2.6 Ethics

This research was registered with the UCL Data Protection Office (Z6364106) and received ethical approval from The Bartlett School of Environment, Energy and Resources Ethics Committee.

3.2.7 Data analysis

The following data analysis, planned before data collection, is performed. Descriptive statistics are calculated first. A model-testing analysis follows, with a focus on answering the research questions described in 3.1.2. First, a linear regression is computed. Second, a Tobit regression is performed to check if the same results hold. Third, a quantile regression is performed to assess whether our variables have a different impact on judgment accuracy depending on how low or high participants' scores are. Adjustments to the variables used in our model are made where appropriate to avoid issues such as that of multicollinearity.

3.3 Results

3.3.1 Consumers' preferences and household size

Participants reported, on average, that less than half of their food shopping is organic (organic: *M* = 42.8, *SD* = 23.3). 14.9% (*N* = 50) of the participants said to be vegetarian, and 5.7% (*N* = 19) to be vegan. 81% (*N* = 272) of the participants reported to be the primary food shopper in their household. When asked to indicate where they do their grocery shopping, the majority (46.1%, *N* = 155) reported to go to their local supermarket, followed by a big chain store (38.1%, *N* = 128). Only 11.1% of the participants (*N* = 37) said they shop at their local market, and 3.3% (*N* = 11) at specialty food stores.

25.6% (*N* = 86) of the participants had a household of 4, and 25.0% (*N* = 84) a household of 3. 24.1% had a household of 2, and 12.2% of 1. 7.1% had a household of 5, 2.4% of 6, 1.2% of 7, and 0.3% of 8.

3.3.2 Participants' information

38.7% of the participants (*N* = 130) had a Bachelor's degree or an Italian Laurea Triennale. 22.6% completed up to the final exam of secondary school in Italy, and 19.3% had a Master's degree or the equivalent Specializzazione in Italy. 10.1% completed A-levels in the UK, and 2.7% completed GCSE. 1.2% achieved a PhD or the equivalent Dottorato. 1.2% completed middle school in Italy, and 0.3% only primary school in Italy. Both the Italian and British sub-samples reported higher levels of education compared to their respective country's populations (see Table 2).

43% of the participants (*N* = 147) reported to be employed full-time and 18.5% (*N* = 62) to be employed part-time. 7.1% were unemployed but looking for work, and 1.5% unemployed and not looking for work. 3% reported to be unemployed and not looking for work for personal reasons, and 19.9% were students. 2.1% were retired.

12.5% of the participants reported to be earning £37,000 or more (€42,977 or more), 17.6% to be earning £24,000 to £36,999 (€27,877 – 42,976), 13.7% to be earning £17,000 to £23,999 (€19,746 – 27,876), 11.3% to be earning £12,000 to £16,999 (€13,938 – 19,745), 8.9% to be earning £8,000 to £11,999 (€9,292 – 13,937), 5.7% £4000 to £7,999 (€4,646 – 9,291), and 9.8% £1-3,999 (€1 to 4,645). 3.9% reported not to be earning.

Table 2. Employment status and education level of the sample compared to national averages. Population data from Istat (2021, 2023) and ONS (2022, 2023).

Country	**Italy**		**UK**	
Group	**Sample**	**Population**	**Sample**	**Population**
Employment: full-time and part-time	46.7% (from 18yo)	60.3% (from 15yo)	78.3% (from 18yo)	75.6% (from 16yo)

Education: Secondary school **(At least. For Italy: at least a Diploma. For UK: level 3 and level 4 qualifications.)**	91.5%	62.9%	90.4%	50.7% (England and Wales)
Education: Bachelor's degree **(At least. For Italy: Laurea. For UK: level 4 qualification.)**	49.7%	20.1%	69.3%	33.8% (England and Wales)

3.3.3 Overconfidence

Self-assessment

Participants reported, on average, that they know more than half of what there is to know about sustainability (*selfassessment1*: *M* = 56.5, *SD* = 19.7), and that they know more than others (*selfassessment2*: *M* = 60.9, *SD* = 17.6). The two measures were found to be statistically correlated ($r(334) = 0.67$, $p < .001$), but a paired samples t-test suggested their means to be statistically different ($t(335) = -5.25$, $p < .001$). Hence, a new combined measure (*selfassessment*) was created by computing their average and is used thereafter for model testing.

Overprecision

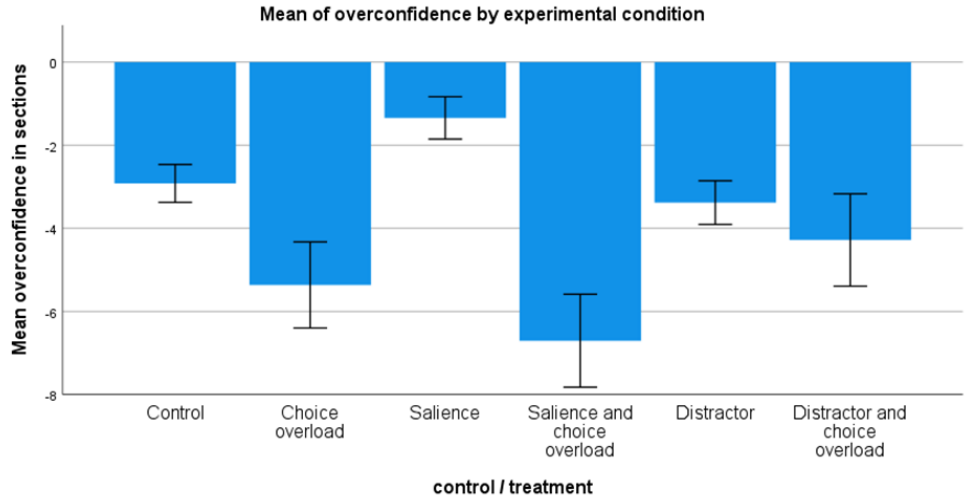
It was found that participants were, on average, underconfident: The average scores of overprecision were negative in each experimental section (see Figure 8). Therefore, participants estimated on average to have performed worse than they did across the experiment.

Overprecision1 was the lowest, on average, in section 4 (*M* = - 6.7, *SD* = 10.2), and the highest in section 3 (*M* = - 1.3, *SD* = 4.6). The highest measure of *overprecision1* was found in section 4 (with a value of 26), and the lowest in sections 4 and 6 (with a value of - 30). Similar results were found for *overprecision2*, being the lowest in section 4 (*M* = - 6.7, *SD* = 10.1), and the highest in section 3 (*M* = - 2.2, *SD* = 4.8). These findings show that, despite participants being underconfident on

average, there was great variation in overconfidence levels, with some participants being very overconfident and others very underconfident.

The two measures of overprecision were found to be statistically correlated in each section. Moreover, the two measures had non-statistically different means in sections 4, 5, and 6 of the experiment. Therefore, only *overprecision1* is used thereafter for the purpose of model testing to avoid the issue of multicollinearity, and is recoded as *overconfidence in sections*.

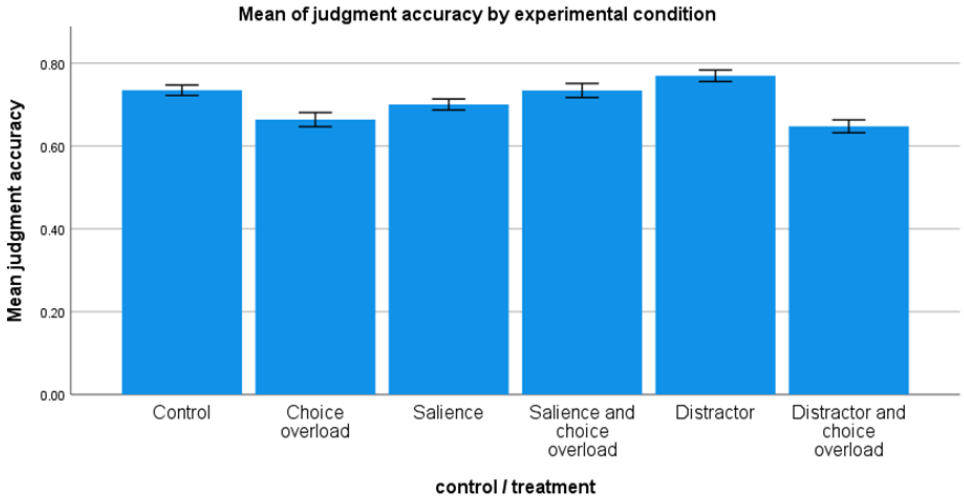
Figure 21. Mean overconfidence in sections by treatment. Error bars: +/- 2 SE. Tested with 336 participants, 32 years old on average.



3.3.4 Judgment accuracy

Participants' judgment accuracy was, on average, at least 64%, with the highest average accuracy rate being 76.97% in section 5 (distractor), and the lowest average accuracy rate being 64.76% in section 6 (distractor, choice overload) (see Figure 9).

Figure 22. Mean judgment accuracy by treatment. Error bars: +/- 2 SE. Tested with 336 participants, 32 years old on average.



3.3.5 Symbol and manipulation check

When answering the question “Could you easily see or spot the symbols below on the packaging in some of the photos?”, most participants (*N* = 51) selected “Sometimes could be seen, sometimes could not be seen”, which corresponded to a value of 50 on the slider ranging from 0 (“Could not be seen at all”) to 100 (“Could very easily be seen”). The average response was *symbol* (*M* = 46.3, *SD* = 29.8), which suggests great variation amongst participants. It may have been harder for some to spot the symbols on the packaging than for others, and this is considered in the discussion.

3.3.6 Model testing

The model can explain 30.1% (R^2 = .30) of the variance in accuracy ratios ($F(32, 1491) = 20.10$, $p < .001$). The variables of self-assessment, age, vegan, primary shopper, local market in *X*, overconfidence in sections, choice overload, distractor, and the interactions of salience and choice overload, distractor and choice overload, and choice overload and overconfidence in sections, were found to be significantly related to accuracy ratios (see Table 3).

Table 3. The effects of treatments and overconfidence on judgment accuracy. Significance: *** for P ≤ 0.001. Coefficients are unstandardized.

Model	B	Std. Error
Salience	-.008	.011
Choice Overload	-.060***	.011
Distractor	.035***	.011
Salience X Choice Overload	.064***	.016
Distractor X Choice Overload	-.053***	.015
Overconfidence-In-Sections	-.013***	.001
Salience X Overconfidence-In-Sec.	-.001	.001
Choice Overload X Overconfidence-In-Sec.	.006***	.001
Distractor X Overconfidence-In-Sec.	.000	.001

A post-hoc power analysis was conducted using the software G-Power 3.1 (Faul et al., 2007). Considering a sample size of 336 and 28 predictors, α set at 0.05, and a large effect size (f^2 = 0.43) (two tails), a Power equal to 1 was obtained.

3.3.7 Hypotheses testing

The treatment of salience (H1) did not have a significant impact on judgment accuracy (t(1491) = - 0.69, p = .489). The treatment of distractor had a significant impact on judgment accuracy, with accuracy increasing by 0.035, contrary to expectations, when the distractor was present (t(1491) = 3.18, p = .001) (H2).

As predicted, the treatment of choice overload (H3) had a significant impact on accuracy, as when a high amount of information was present, the accuracy declined by 0.060 (t(1491) = - 5.27, p < .001). Moreover, the interaction of distractor and choice overload was also significant: When both treatments were present this led to a decline in accuracy of - 0.053 (t(1491) = - 3.46, p = .001), as hypothesised (H4).

The variable self-assessment was positively linked to accuracy ratios (*b1* = 0.001, *t*(1491) = 5.74, *p* < .001), contrary to what was hypothesised (H5). On the other hand, overconfidence in sections was negatively linked to accuracy as hypothesised (*b11* = - 0.013, *t*(1491) = - 10.65, *p* < .001) (H6).

Using paired-samples t-tests, I checked whether participants' overprecision1 in sections 3 (salience) and 5 (distractor) were significantly different than their overprecision1 in section 1 (control) of the experiment. It was found that, on average, respondents' overprecision1 in the salience treatment (*M* = - 1.3, *SD* = 4.6) was statistically different than the control measure (*M* = - 2.9, *SD* = 4.1); [*t*(335) = – 6.70, *p* < .001]. On the other hand, the measures of overprecision1 relative to section 1 and 5 (*M* = - 3.3, *SD* = 4.8) were not found to be, on average, statistically different (*t*(335) = 1.84, *p* = .065). Hence, H(7) was only partially supported.

The interaction between salience and overconfidence in sections (H8) was not significant (*t*(1491) = -0.59, *p* = .554), and neither was the interaction between distractor and overconfidence in sections (H9) (*t*(1491) = 0.46, *p* = .641).

By comparing participants' overprecision1 in the control section (*M* = - 2.9, *SD* = 4.1) and in the choice overload treatment section (*M* = -5.3, *SD* = 9.4) with a paired-samples t-test, it was found that the two are statistically different (t(335) = 5.53, p < .001). Hence, H(10) was supported.

Unexpectedly, the interaction between choice overload and overconfidence (H11) was found significant and positively related to accuracy (*b18* = 0.006, *t*(1491) = 5.25, *p* < .001).

Being vegetarian was not significantly related to judgment accuracy (H12) (*t*(1491) = - 0.53, *p* = .593), however, being vegan was linked to a decrease in judgment accuracy of - 0.033 (*t*(1491) = - 2.16, *p* = .031), in opposition to the hypothesis that being vegan would lead to greater knowledge of sustainability characteristics of products which would in turn mean higher judgment accuracy (H13).

Being the primary shopper of a household was related with an increase in judgment accuracy of 0.026 (t(1491) = 2.76, p = .006), which is consistent with hypothesis (H14).

No significant relationship was found between buying organic food and judgment accuracy (H15) (t(1491) = - 1.24, p = .214).

3.3.8 Exploratory analysis

The interaction of salience and choice overload was significant: When both treatments were present this led to an increase in accuracy of 0.064 compared to when neither treatment was present (t(1491) = 4.10, p < .001).

The variable age was also positively linked with accuracy ratios (t(1491) = 2.34, p = .019) suggesting that an increase in age of 1 years old was linked to an increase of 0.001 in accuracy.

The variable for local market (in X) was also significant (t(1491)=1.97, p = .048), with shopping at the local market being linked with a 0.022 increase in accuracy.

Overconfidence was not significantly different between countries (t(1953) = - .930, p = .352).

No significant relationship was found between gender, education, income, employment status, household size, and country of residence, and judgment accuracy.

3.3.9 Further analysis

Tobit regression

A Tobit regression was performed to check if considering the scores as having a minimum and a maximum value would change the results of the hypotheses testing analysis. No changes in the overall significance or signs of the coefficients of the treatment variables and overconfidence variable were found (see Table 4).

Table 4. The effects of treatments and overconfidence on judgment accuracy (tobit regression). Significance: *** for P ≤ 0.001. Coefficients are unstandardized.

Model	B	Std. Error
Salience	-.007	.011
Choice Overload	-.060***	.011
Distractor	.037***	.011
Salience X Choice Overload	.064***	.015
Distractor X Choice Overload	-.055***	.015
Overconfidence-In-Sections	-.013***	.001
Salience X Overconfidence-In-Sec.	-.000	.001
Choice Overload X Overconfidence-In-Sec.	.006***	.001
Distractor X Overconfidence-In-Sec.	.000	.001

Quantile regression

Finally, a quantile regression was performed to test whether the impact of our treatments, of the interactions between treatment variables, and of the interactions between treatment variables and overconfidence, on accuracy was different depending on participants' scores. These were divided using the quantile points 0.25, 0.50, and 0.75. It was found that this model best predicts lower scores (q = 0.25, R^2 = 0.181) compared to higher scores (q = 0.5 and q = 0.75, R^2 = 0.179).

Overconfidence in sections had an impact of - 0.012, - 0.014, and - 0.015 respectively on judgment accuracy, with higher scores being affected the most. Choice overload and overconfidence in sections had an impact of 0.004, 0.007 and 0.007 respectively, again affecting the highest scores the most. Choice overload was the most detrimental on the lower scores, with an impact of - 0.086 on lower scores, and of - 0.048 and of - 0.040 on middle and higher scores. Distractor had an impact of 0.014 on lower scores, and of 0.046 and 0.048 on higher scores. The interaction of distractor and choice

overload only affected the middle and high scores. The interaction of salience and choice overload had an impact of 0.074 and 0.073 on low and middle scores, and of 0.080 on high scores. The interaction of distractor and choice overload had an impact of - 0.032 on low scores, and of - 0.065 and - 0.074 on middle and high scores.

Age was not a significant factor in affecting the lower scores but was significantly related to the middle and higher scores of judgment accuracy. Vegan was only a determining factor for the lower scores. Being the primary shopper, and employment status, were determining factors for the lowest and highest scores. Education was a factor in all quartiles, but at different levels: The highest level of education that was found to be significantly correlated with low accuracy scores was completion of high school; whereas for middle and high scores it was completion of a bachelor's degree. Country only significantly affected high scores, however, there was not a significant difference between the countries' mean scores ($t(1984) = -.250$, $p = .803$). The directions and possible interpretations of these correlations are considered in the discussion section.

3.4 Discussion

3.4.1 Labels

The analysis suggests that salience did not have an impact on consumers' judgment accuracy. However, when the label was used as a distractor, it had an unexpected positive relationship with participants' scores (in middle and high-score groups). This is a surprising finding as previous research suggests that greater knowledge is correlated with higher involvement with labels (Karakaya & Saracli, 2018). However, the context of that finding is different: Karakaya and Saracli (2018) were investigating how consumers interact with nutrition labels, and found that when consumers were aware of the negative impact of certain nutrients, they would pay more attention to labels. On the other hand, I found that consumers with greater sustainability knowledge may ignore those labels which are untruthful. This finding could be interpreted in multiple ways. It is possible that participants rely on their

own knowledge more than on labels, thereby ignoring additional information placed on packaging. Alternatively, participants who scored well in the quiz may know enough about food sustainability to be able to identify a misleading label on packaging.

3.4.2 Choice overload

As expected, choice overload decreased sustainability judgment accuracy. This means that when presented with multiple options, consumers may find it harder to pick the sustainable one (even if they want to). This effect was greater on lower scores, suggesting that the judgment accuracy of those who do not know much about product sustainability is affected the most.

The interaction between choice overload and distractor also had a negative effect on accuracy, suggesting that assessing many options whilst evaluating label information into the judgment can be challenging for consumers. Importantly, the effect of the interaction was found to affect middle and high scores, but not low scores. This means that, independently of someone's knowledge of sustainability, the combination of choice overload and a label acting as a distractor is detrimental for judgment formation.

Salience did not have a significant effect on judgment accuracy on its own, however the interaction between salience and choice overload positively affected judgment accuracy. The effect of this was greater on higher scores. Overall, this finding suggests that consumers may rely more on labels when more options are available, therefore improving their judgment when labels are truthful.

Choice overload was detrimental for sustainability judgment accuracy, and brought consumers to take into account both truthful and untruthful labels more. The negative impact of choice overload on consumers' choice was already suggested by Iyengar and Lepper (2000), who found that customers would choose to buy a jam more frequently when they only had to choose between six rather than twenty-four alternatives. The authors suggested that too much choice

can decrease motivation to make a choice. Similarly, my finding suggests that too much choice can be bad for consumer judgment.

3.4.3 Overconfidence

Respondents believed to know more than half of what there is to know about sustainability, and to know more than others. However, higher self-assessment ratings were positively correlated to judgment accuracy, possibly suggesting that a greater level of knowledge corresponded to a higher level of confidence.

When overconfidence was measured as overprecision, participants were, on average, underconfident: They believed they had scored worse than they did. However, this measure showed great variation, with some participants being overconfident and some underconfident. When analysing the relationship between their overconfidence-in-sections and judgment accuracy, a negative relationship was found. This is in line with previous literature that suggests that being overconfident about one's knowledge or ability relates to a lower performance (Zacharakis & Shepherd, 2001). Moreover, the effect of overconfidence-in-sections was found to be negative and bigger in absolute terms as judgment accuracy increases.

When comparing overconfidence-in-sections measures across treatments, it was found that participants' overprecision was higher in the salience treatment than in control, despite both measures showing underconfidence on average. This may suggest that labels increase participants' confidence, however, no significant relationship was found between salience and scores. On the other hand, participants' overprecision in the distractor treatment was not found to be statistically different to the control measure.

No significant interaction was found between salience and overconfidence-in-sections or distractor and overconfidence-in-sections. This suggests that there is no combined effect of overconfidence and interpreting new information such as labels on accuracy. This is different to the previous finding that being

overconfident would lead people to consider less information and therefore be less accurate (Zacharakis & Shepherd, 2001).

Participants' overconfidence-in-sections with choice overload was statistically lower than the control measure, despite both being on average smaller than 0 (indicating underconfidence). This finding shows that a high amount of information reduces consumers' confidence in their product sustainability knowledge. However, the interaction between overconfidence-in-sections and choice overload was found to have a positive and statistically significant impact on judgment accuracy, possibly suggesting that higher overconfidence can help in the decision-making process when it is hindered by many options. The effect of this interaction was found to be bigger on middle and high scores.

3.4.4 Demographics and consumers' preferences

Age was positively linked to accuracy (mostly with higher scores), indicating that more experience with grocery shopping leads to greater knowledge of food product sustainability.

Employment status seemed not to have an effect when the general model was tested. However, the quantile regression analysis showed it affected low and high scores. Looking for work was negatively related to low scores but positively related to high scores. Education was not significantly correlated to scores in the general model but was surprisingly a negative factor in the quantile analysis at different levels across quantile groups. Completion of high school was the highest level of education significantly related to low scores, whilst completion of a bachelor's degree was the highest level related to middle and high scores. Therefore, the overrepresentation of highly educated people in my sample compared to the general population has likely not led the judgment accuracy scores of the sample to be higher than those of the population.

Being vegetarian did not seem to be related to judgment accuracy. However, being vegan was negatively related to participants' accuracy. This finding is contrary to my prediction that being vegan would lead

to greater knowledge of food sustainability and therefore higher scores. This suggests that consumers may choose to be vegan for other reasons (ethical, rather than environmental). Alternatively, vegan consumers may not be informed about the environmental impact of food products such as meat and fish simply because they do not consume them. Because this negative effect was only present in the lower scores group, the first explanation seems more plausible. Participants may be vegan for reasons other than being environmentally friendly, and may not be interested in sustainability. However, being vegan per-se does not imply a lack of food sustainability knowledge. Similarly, no relationship was found between buying organic food and judgment accuracy, suggesting that consumers may buy organic products for reasons other than the environment, such as beliefs about their health benefits.

Being responsible for the household's food shopping was positively related to judgment accuracy. Further analysis suggests that this effect applies to low and high scores, but not middle scores. Those who shop more often may have a greater knowledge of food products. Shopping at the local market was positively linked to accuracy, which may be an indicator of caring for the environment and looking for more environmentally conscious produce.

Participants were recruited from the UK and Italy. These two countries were chosen for having similarly developed economies but different food cultures. By testing our general model, we found no correlation between country of residence and participants' judgment accuracy scores. The quantile regression found country to only be significantly related to high scores, with UK scores being 0.018 higher than Italian scores. Overall, no significant difference in scores was found between the two countries, suggesting that consumers' decision-making varies little across these two cultures.

3.4.5 Implications for retailers and policymakers

The findings from this study suggest that labels do have an impact on consumers' perception of food products, especially when there are

many goods to choose from. If labels truthfully describe a sustainable product as such, the consumers will then be able to identify the most environmentally friendly items, and buy them, if they wish. However, if labels are untruthful, shoppers will be misled. It is therefore important for retailers and policymakers to recognise the value of salient labels to help consumers eat more sustainably. Retailers should take great care in making sure that sustainable food products stand out.

As research shows that mandatory calorie posting can be effectful in reducing the average calorie consumption per purchase (Bollinger et al., 2011), the introduction of a mandatory environmental label on food products may be considered. However, the issue of "greenwashing", i.e. misleading consumers with false information regarding a product's environmental performance of benefits (Markham, Khare & Beckman, 2014), should also be considered. Companies have three main reasons to be ecologically responsible: competitiveness, legitimacy and responsibility (Bansal & Roth, 2000; Markham, Khare & Beckman, 2014). Greenwashing may lead consumers to become sceptical, reducing demand for environmentally friendly products and therefore also discouraging responsible investment practices (Markham, Khare & Beckman, 2014). Policymakers should therefore make certain that quality checks are performed to ensure that companies do not mislead their customers by placing their own green label on a product that is not actually environmentally friendly. This might prove challenging. For example, the Competition Bureau of Canada has made an effort to address the issue of greenwashing by issuing the "Environmental Claims: A Guide for Industry and Advertisers" (Competition Bureau of Canada, 2008), however, there is little evidence that the institution has confronted firms engaged in greenwashing (Markham, Khare & Beckman, 2014).

3.4.6 Limitations

Participants were recruited on Amazon Mechanical Turk. There is a debate as to whether responses collected through this platform are reliable enough (Buhrmester et al., 2011; Rouse, 2015), which could represent a limitation of the current sample. However, a code was used

as a method for screening candidates (see 3.2.5). Moreover, Amazon Mechanical Turk allowed for recruitment of participants from two different countries at the same time, which would have not been possible had the study been conducted in a laboratory setting, therefore positively contributing to the diversity of the sample.

Participants were paid $0.50 to take part in this piece of research. This can be considered a low compensation given the length of the questionnaire, and may have also been evaluated as unethical by participants. Therefore, it may have not provided a good incentive for participants to put in effort when completing the study.

The study was advertised as a questionnaire on food consumption and sustainability. Those who decided to participate and completed the study may not be representative of the general population as they may have an interest in the topic, and hence their average accuracy score may be higher.

The green symbol that was used in the salience and distractor treatments may not have been identified by all participants (see 3.3.5). However, as not all the experimental sections had products with a symbol on their packaging, it is not clear whether participants could not identify the symbol because it was not present or because they could not see it when it was present. Further research could test the impact and recognisability of different symbols on product packaging to identify which logos are more easily seen and associated with environmental sustainability.

Other symbols and logos were present on the packaging of the products shown in the experiment (e.g. country of origin, brand names, “fairtrade” labels, etc.). Although participants were asked to ignore the country of origin and the type of packaging (recyclable vs. non-recyclable) when assessing the products, the extra information in the pictures may have influenced their answers. Therefore, future research may investigate the impact of different pieces of information, both singularly and collectively, on consumers’ sustainability judgments.

Participants were explicitly asked to identify the most sustainable item amongst the ones presented to them. Therefore, this experiment gives insights into how well consumers can distinguish between the most and least environmentally friendly food products when they wish to do so. However, being able to identify sustainable food products does not necessarily translate into willingness to purchase them. Therefore, the results from this experiment should be used in conjunction with findings from behavioural studies aimed at encouraging consumption of sustainable products to inform retailers.

This experiment had a within-subjects design. As is common with within-subjects designs, treatments may have become progressively less effective as participants got used to them. However, participants never saw the same combinations of products. Because sustainability, in this piece of research, was evaluated in comparative terms, not in absolute terms, each question was therefore unique, despite certain items being shown to participants multiple times in the experiments. Therefore, participants had to answer each question individually, and could not rely on their previous answers.

As this study was conducted online, respondents could only see photos of the food products. This design may be more representative of online shopping than an in-person grocery shopping scenario. Moreover, participants were presented with images of different food products, such as meat and vegetables, next to each other. This is not generally the case when shopping online or in-person, as products tend to be grouped in categories. Further research may test possible differences between online and in-person shopping scenarios, and between different food products layouts.

Finally, only 8 products were shown to the participants in the choice overload treatment. However, in a real-life shopping scenario, there are generally many more alternatives consumers can choose from. Further research may investigate whether increasing the number of available products linearly worsens judgment, or whether the effect of choice overload eventually plateaus.

3.4.7 Alternative research methods for this question

The research question of this chapter could have been investigated with other strategies. Another experiment could have been performed before the present study to test how participants react to different symbols indicating sustainability. For example, would different sustainability symbols create different judgments of the same product? The results could have then informed this study and help determine what symbol to use as the “green symbol”. Alternatively, qualitative interviews could have been conducted, asking participants how they interpret labels on packaging, what symbols they would associate with environmental sustainability, and whether they rely on other information on packaging to make sustainability assessments.

3.5 Summary

This study shows the impact that salient labels and choice overload can have on consumers’ judgments of food products and sustainability. We learn that choice overload can negatively affect judgment accuracy. Truthful labels may counteract this effect by helping consumers pick the most environmentally friendly option available. However, labels, if untruthful, can also be misleading. For these reasons, great attention should be given to the way food is displayed and labelled in grocery stores and online shops to encourage consumption of environmentally friendly products.

Chapter 4

Encouraging sustainable food consumption through nudges

4.1 Introduction

4.1.1 Overview

Finding ways to steer consumers' food choices towards vegetarian and plant-based meals is important to reduce our diets' environmental impact. This chapter investigates how nudges in restaurants can be effectively used to increase sales of vegetarian and plant-based dishes. As the previous study suggests that labels can indeed change consumers' judgments of food products, this next study investigates whether they can also determine purchase choices.

I partnered with two restaurants, which can host up to 130 guests in total and are located in the same building, and I tested the effect of three nudge-based interventions on the sales of vegetarian and plant-based dishes. First, I found that removing the symbols for vegetarian and plant-based dishes increased the sales of those starters by 10.2pp, and of those mains by 6.2pp. This result supports what had been found by previous online studies. Second, when a low emissions symbol was added to the menu to replace the symbols for vegetarian and plant-based dishes, it did not affect sales. However, when the same nudge was made transparent through a statement explaining its purpose on the menu, the sales of those starters increased by 14.1pp. This result suggests that nudges can be used ethically and still be effective. Overall, these findings support the use of nudges as low-cost interventions to tackle the issue of unsustainable food consumption in the hospitality sector.

4.1.2 Hypotheses

This study aims at testing whether making use of decision information nudges in the form of different labels on selected dishes in a restaurant

menu can have an impact on customers' choices. This intervention examines:

1. Whether removing the symbols "v" and "pb", respectively indicating a vegetarian and a plant-based dish, will make those dishes more or less popular;

2. Whether adding a low-emission label ("LE") to make consumers aware that some dishes are responsible for creating less emissions than others will make those dishes more or less popular;

3. Whether being transparent about the intentions behind the low-emission nudge above described will make it more effective.

Based on past experimental findings, it is hypothesised that:

H1. Removing the symbols "v" and "pb" associated with those dishes will increase the sales of those products compared to control.

H2. Introducing the symbol "LE" (standing for Low Emissions) next to the vegetarian or plant-based options will increase their sales compared to control.

H3. Making the "LE" nudge transparent will increase the sales of those products compared to control.

It is left as an exploratory question to investigate which treatment would be the most effective.

4.2 Method

4.2.1 Restaurants and diners

The two partner restaurants will thereafter be called Restaurant A and Restaurant B. The nudges were implemented at Restaurant A, whereas Restaurant B acted as control for the experiment.

The restaurants are both part of a five-star hotel in central London, and are in the same building but on different floors. Both restaurants offer dishes from British and European cuisines. Restaurant A can host up to 70 guests, whereas Restaurant B up to 60 guests. Restaurant A's prices range from £6 to £20 for starters, from £25 to £45 for mains,

and from £6.50 to £28 for desserts. Restaurant B's prices range from £4.50 to £16 for starters, from £12 to £45 for mains, and from £6.50 to £22 for desserts. Although the restaurants are associated with a hotel, the majority of their clients are not hotel guests. The clients are mostly in the 30-50 age range, with around 65% of them being male and 35% being female. Clients are often couples, or bigger groups visiting the restaurants for a work meal.

Diners were not asked for their consent to participate in the study as no personal information was collected, and the sales data used for this experiment is normally recorded by the partner restaurants for their own profit and loss records.

4.2.2 Ethics

This research was registered with the UCL Data Protection Office (Z6364106) and received ethical approval from The Bartlett School of Environment, Energy and Resources Ethics Committee.

4.2.3 Materials

The menus from Restaurant A and Restaurant B were used. The former restaurant had an à la carte menu which did not differ between lunch and dinner. The latter restaurant had two menus, one for lunch and one for dinner. The vegetarian and plant-based dishes were those selected for treatment. This choice was made considering the literature supporting the claim that, the more plant-based a diet is, the more environmentally friendly it is (see section 1.3). The ratios of vegetarian and plant-based dishes in each category in each restaurant are reported in Table 5. Examples of the restaurants' dishes from the study period and from a different period of the year can be found in Appendix A.

Table 5. Ratios of vegetarian (v) and plant-based (pb) dishes over total number of dishes in each category in each menu.

Menu	**Starters**		**Mains**		**Desserts**	
	$\frac{v}{total}$	$\frac{pb}{total}$	$\frac{v}{total}$	$\frac{pb}{total}$	$\frac{v}{total}$	$\frac{pb}{total}$
Restaurant A	$\frac{1}{6}$	$\frac{0}{6}$	$\frac{1}{5}$	$\frac{0}{5}$	$\frac{4}{6}$	$\frac{2}{6}$
Restaurant B lunch	$\frac{1}{6}$	$\frac{5}{6}$	$\frac{0}{13}$	$\frac{4}{13}$	$\frac{4}{4}$	$\frac{0}{4}$
Restaurant B dinner	$\frac{3}{12}$	$\frac{6}{12}$	$\frac{3}{17}$	$\frac{2}{17}$	$\frac{4}{4}$	$\frac{0}{4}$

4.2.4 Study design

Variations of Restaurant A's menu were presented to the restaurant's clients during the period from June 21st to September 20th, 2022 (see Table 6). A control menu, with no variations, was used from the 21st of June to the 7th of July. During the baseline period, the symbols "v" and "pb" appeared as plain text and looked the same on both menus. The first treated menu, on which the symbols "v" and "pb" were not present, was used between the 8th of July and the 8th of August. The second treated menu, with the symbol "LE" written as plain text next to the vegetarian and plant-based dishes, was used between the 9th of August and the 6th of September. The third treated menu, where the intentions behind the symbol "LE" were explained to make the nudge transparent, was used between the 7th and the 20th of September.

The second and third treated menus differed in the following way. The second menu only explained the meaning of the symbol "LE" as "Low Emissions". The third menu included the following statement: "A selection of dishes we would like you not only to taste for the amazing flavour but also for the environment". It therefore disclosed the purpose of the nudge, making it transparent.

Table 6. Treatments and timeline.

	Baseline	Treatment 1	Treatment 2	Treatment 3
Menu	Original menu	Symbols "v" and "pb" removed	"LE" symbol added	"LE" symbol plus transparency statement
Timeline	June 21st – July 7th	July 8th – August 8th	August 9th – September 6th	September 7th – September 20th

The label "LE" was chosen after discussing various possibilities with the restaurants' head chef. This logo was considered more acceptable than alternatives such as "environmentally friendly" symbols by the partner, who wanted to make sure that no information added to the menu would give the impression that some dishes were superior to others. Additionally, it was agreed that the transparency statement should be framed positively to avoid the risk of triggering negative emotions. This statement was meant to encourage customers to try the vegetarian and plant-based dishes for good reasons: their flavour and the environment. It is important to note, however, that the use of the expression "we would like you to" might have created a mechanism of social pressure. This will be kept into consideration in the discussion (see section 4.4).

As previously illustrated, the vegetarian and plant-based dishes in the menu were chosen as the sustainable dishes to be treated during this study. However, because all dishes in the dessert category of Restaurant A's menu were at least vegetarian, and plant-based can be often considered more environmentally-friend than vegetarian, only the plant-based desserts from that category were treated with the addition of the "LE" symbol.

4.2.5 Measures

Both restaurants collected their sales data as per usual and shared them with me at the end of the study. The following pieces of information were also used for the purpose of this study: the location of sale (Restaurant A or Restaurant B); the category of the dish (starters, mains, desserts); the time of day (lunch or dinner); whether it was during the weekend (Saturday and Sunday) or not; and which menu was used (original, treatment 1, treatment 2, treatment 3).

Two dependent variables were used. The first dependent variable was "sustainable sales ratios". *SustainableSalesRatios* (*M* = 0.18, *SD* = 0.18) was calculated as the ratio of sales of the sustainable items over total sales. This was computed separately for starters, mains, and desserts, and separately for lunch and dinner, each day for each restaurant. This was considered a more appropriate measure than the absolute number of sales because ratios illustrate how much of the customer's choice is sustainable in comparative terms. Additionally, analysing ratios means that fluctuations in absolute number of sales have no impact on the trends of interest. It is important to note, however, that *SustainableSalesRatios* was obtained by transforming the original data, and is bounded between 0 and 1. The second dependent variable, *binarySales*, was calculated by recoding *SustainableSalesRatios* as a dummy variable with values 0 for any $SustainableSalesRatios = 0$, and 1 for any other value.

The other following variables were used in the model: *restaurantA* is a dummy variable which takes value of 1 if the restaurant is Restaurant A (treated), and 0 if the restaurant is Restaurant B (control); the variable *days* indicate which day the sale is from (days were numbered from 1, indicating June 21st, to 92, indicating September 20th); *dinner* is a dummy variable which indicated whether it was lunch (0) or dinner (1); *weekend* is a dummy variable which took the value 1 if the sale happened either on a Saturday or Sunday; *mains* is a dummy variable which took the value 1 if the dish was a main; the variables *experimentalPeriod1*, *experimentalPeriod2*, and *experimentalPeriod3*

were dummy variables indicating respectively which, if any, of the treatments was present at the time of sale.

4.2.6 Models

Three linear models with *SustainableSalesRatios* as dependent variable were created. Because the dataset provided information on each restaurant's sales for both lunch and dinner for each day, and because I was interested in understanding how much of those sales came from vegetarian and plant-based dishes rather than other dishes depending on the treatment, the following models seemed fit to conduct the relevant analyses.

The first model, *Model 1*, concerns only Restaurant A:

$$SustainableSalesRatios = b0 + b1 * dinner + b2 * weekend + b3 * experimentalPeriod1 + b4 * experimentalPeriod2 + b5 * experimentalPeriod3$$

The second and third models, *Model 2* and *Model 3*, look at the comparison between the treated restaurant and the control restaurant. *Model 2* gives an overall picture by looking at all the experimental periods and categories of dishes together.

Model 2:

$$SustainableSalesRatios = b0 + b1 * restaurantA + b2 * days + b3 * dinner + b4 * weekend + b5 * mains + b6 * experimentalPeriod1 + b7 * experimentalPeriod2 + b8 * experimentalPeriod3 + b9 * restaurantA * experimentalPeriod1 + b10 * restaurantA * experimentalPeriod2 + b11 * restaurantA * experimentalPeriod3$$

On the other hand, *Model 3* is used whilst isolating treatment periods and categories of dishes.

Model 3:

$$SustainableSalesRatios = b0 + b1 * days + b2 * dinner + b3 * weekend + b4 * restaurantA + b5 * restaurantA * experimentalPeriod + b6 * experimentalPeriod$$

In both models, the interactions between restaurant and experimental period represent the relevant treatment.

Finally, a robustness check analysis was performed by using *binarySales* as a dependent variable, and by conducting a logistic regression with the same predictors used in *Model 2*.

I decided to use both linear and logit models because both present their advantages and disadvantages. The linear models presented above allow for a more intuitive interpretation of the results, facilitating a discussion on their magnitudes and implications. However, the first dependent variable, *SustainableSalesRatios*, is bounded between 0 and 1, making the use of linear models debateable. On the other hand, using a logit model with *binarySales* as a dependent variable can be considered more statistically sound, and it therefore provides useful information to be able to support the results of the linear models. However, conducting an analysis with *binarySales* implies losing important information about the magnitude of sustainable sales over total sales. I therefore present the results from both approaches in section 4.3.2.

4.2.7 Data analysis

First, the sustainable sales at Restaurant A were analysed through *Model 1*. Second, a comparison between Restaurant A and Restaurant B is made, and the results from the analyses of *Model 2* and *Model 3* are reported. A robustness check was then performed by conducting a binary logistic regression with *binarySales* as dependent variable. Finally, graphs were created to show the sales of starters and mains for each treatment period in comparison to the baseline period.

The period between July 18th and July 26th was excluded from the analysis of comparison between Restaurant A and Restaurant B, as the latter restaurant was closed for refurbishment during that period of time. As Restaurant B did not offer any plant-based desserts, therefore not providing a counterfactual, this category of dishes was also excluded from the analysis which compared the two restaurants. Thus, the effects of the interventions on Restaurant A's plant-based desserts were only evaluated in comparison to that restaurant's sales during the baseline period (*Model 1*).

4.3 Results

4.3.1 Restaurant A only

Model 1

When analysing the sales of Restaurant A through *Model 1*, it was found that the sales of starters were only influenced by the first treatment ($t(178) = 2.02$, $p = .045$), which was correlated to an 8pp increase in *SustainableSalesRatios*. On the other hand, no significant correlation was found between the treatments and the *SustainableSalesRatios* of mains and desserts.

4.3.2 Restaurant A vs. Restaurant B

Model 2

Model 2 can explain 31.6% of the variance in ratios of sales ($F(11, 652) = 27.38$, $p < .001$). The variables *restaurantA*, *dinner*, *mains*, *restaurant*experimentalPeriod1* were found to be significantly related to *SustainableSalesRatios* (see Table 7). In particular: Treatment 1 brought an increase of 8.2pp in *SustainableSalesRatios* at Restaurant A ($t(652) = 2.54$, $p = .011$); vegetarian and plant-based options were more popular at dinner time by 3pp ($t(652) = 2.74$, $p = .006$); vegetarian and plant-based mains were less popular compared to starters by 15.5pp ($t(652) = -14.04$, $p < .001$).

Table 7. Model 2 results. Significance levels: ****p < .001, ***p < .01, **p < .05, *p < .1.

Model 2		**B**	**S.E.**
Control variables	*constant*	.297****	.020
	restaurantA	.067***	.024
	days	-.001	.001
	dinner	.030***	.011
	weekend	.016	.012
	mains	-.155****	.011
Periods	*experimentalPeriod1*	-.020	.029
	experimentalPeriod2	.026	.044
	experimentalPeriod3	.007	.059
Treatments (Difference-in-Difference)	*restaurantAXexperimentalPeriod1*	.082**	.032
	restaurantAXexperiemntalPeriod2	-.001	.031
	restaurantAXexperimentalPeriod3	.047	.036

Model 3

Model 3 was then tested by analysing the sales of starters and mains separately, and by isolating treatment periods, comparing each of them to the baseline period (see Table 8). As far as starters are concerned, treatment 1 ($t(153) = 1.97$, $p = .050$) and treatment 3 ($t(117) = 2.41$, $p = .017$) were found to be effective; on the other hand, treatment 1 ($t(153) = 2.68$, $p = .008$) was the only treatment to significantly affect sales of mains at Restaurant A. Treatment 1 increased the ratio of sustainable sales by 10.2pp for starters and by 6.2pp for mains. Treatment 3 increased the ratio of sustainable sales by 14.1pp for starters.

Table 8. Model 3 results. Significance levels: ****p < .001, ***p < .01, **p < .05, *p < .1. Other variables in the model: days, time, weekend, restaurant, treatment.

Model 3		**B**	**S.E.**
Treatment 1	Starters	.102*	.052
	Mains	.062**	.023
Treatment 2	Starters	-.009	.056
	Mains	.006	.024
Treatment 3	Starters	.141**	.058
	Mains	-.048	.031

Robustness check

A binary logistic regression was conducted by using *binarySales* as dependent variable (see Table 9). Treatments 1 and 3 were again found to be effective as they both increased the probability of vegetarian and plant-based dishes being picked. The odds of a vegetarian or plant-based dish being ordered were 45.735, 95% CI [2.007, 1042.048] when treatment 1 was in place, and 18.904, 95% CI [1.113, 321.183] when treatment 3 was in place. These results therefore support what we previously found through our linear models.

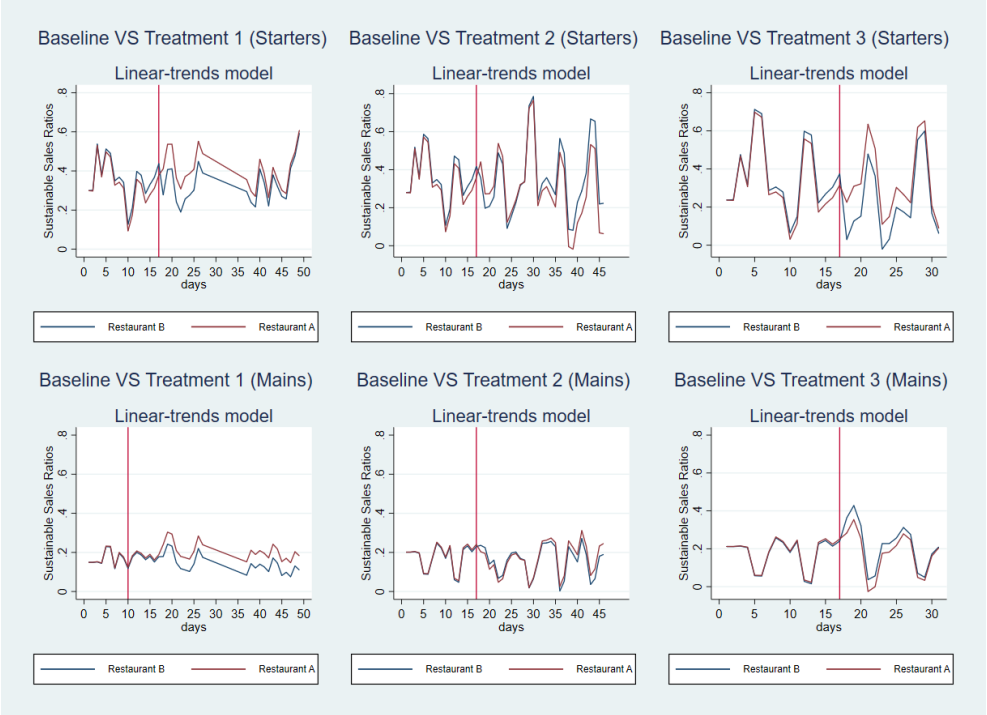
Table 9. Robustness check results. Significance levels: ****p < .001, ***p < .01, **p < .05, *p < .1.

Robustness check		**Odds Ratio**
	constant	3.320
Control variables	*restaurantA*	3.193
	days	.958*
	dinner	5.168****
	weekend	2.014*
	mains	3.338***
Periods	*experimentalPeriod1*	.280
	experimentalPeriod2	2.753
	experimentalPeriod3	1.670
Treatments (Difference-in-Difference)	*restaurantAXexperimentalPeriod1*	45.735**
	restaurantAXexperiemntalPeriod2	2.006
	restaurantAXexperimentalPeriod3	18.904**

Parallel trends

Figure 10 illustrates 6 parallel trends, each showing a comparison between Restaurant A's sales (maroon line) and Restaurant B's sales (blue line), and between the baseline period and each treatment period (separated by a red vertical line). As shown in the trends, treatment 1, the removal of the symbols "v" and "pb" from the menu, had a positive impact on the sales of both sustainable starters and sustainable mains at Restaurant A. Treatment 2, the inclusion of the symbol "LE" next to the treated dishes on the menu, did not have an impact on the sales of those. Treatment 3, the inclusion of the symbol "LE" together with a message to make the nudge transparent, successfully increased sales of the starters at Restaurant A.

Figure 23. Parallel trends. Each of them illustrates a comparison between baseline and a treatment period which are separated by the red vertical line.



4.4 Discussion

4.4.1 The efficacy of labels

This study tested whether removing the “vegetarian” and “plant-based” labels from restaurant menus, and subsequently adding a decision information nudge in the form of a “low emissions label”, could increase the sales of those dishes. It was found that both removing the “v” and “pb” labels and adding a “LE” label plus a transparency disclaimer were successful strategies. When the vegetarian and plant-based labels were taken off the menu, the sales of sustainable starters increased by 10.2pp, and those of sustainable mains increased by 6.2pp. When the “LE” label was added next to the sustainable dishes on the menu, together with the statement “LE means Low Emissions. A selection of dishes we would like you not only to taste for the amazing flavour but also for the environment” at the bottom of the menu, the sales of sustainable starters increased by 14.1pp. Therefore, these interventions can be effective instruments to decrease the environmental impact of our diets.

Although there are currently not many published studies that have tested the impact of different labels on menus, the magnitudes of my results can be compared to previous research as follows. I found that removing the vegetarian and plant-based labels increased the sales of the sustainable dishes by 10.2pp for starters and by 6.2pp for mains; adding a transparent low-emissions label increased sales of sustainable starters by 14.1pp. In their online study, Krpan and Houtsma (2020) had found that a pro-environmental label increased the percentage of participants who selected the dish by 9.3pp compared to the vegetarian label, and that a social label was more effective than the vegetarian label by 5.9pp. Saulais et al. (2019) reported that, in their study set in a living laboratory, labelling the vegetarian dish as “dish of the day” increased the percentage of customers who chose it by 25.2pp when only one alternative dish was available, and by 30pp when two alternatives were available. In an online research, Marshall et al. (2022) found that labelling a cauliflower slice as “steak” increased participants’ willingness to consume by 5.4pp. Considering that the current study was conducted in a real-life setting and that most of the dishes on the treated menu were not vegetarian, the present results can be considered significant.

4.4.2 The contribution of this study

The first experimental treatment, removing the symbols indicating a vegetarian or plant-based option (“v” and “pb”), was conceptually built on what had been suggested by Bacon and Krpan (2018), and Krpan and Houtsma (2020), which is that signposting vegetarian and plant-based options as such is detrimental for sales, and a neutral frame is better. My results indeed show that removing the symbols indicating a vegetarian or plant-based option (“v” and “pb”) successfully increased the sales of both starters and main dishes at Restaurant A. The current study brings a significant novel contribution to this field of research as it is the first piece of research that finds this result in a real-world setting. Given how common it is for restaurants and cafes to include symbols such as “v” and “pb” on their menus, this study’s result gives an important insight: Those symbols may conveniently suggest suitable

dishes for those who identify as vegetarian but may not be helpful to encourage the majority to go for the vegetarian and plant-based option.

Including a “Low Emissions” logo (“LE”) next to the sustainable alternatives on the menu was not successful at increasing sales of those items. Making the addition of the logo “LE” a transparent nudge was successful at increasing the sales of the starters, but not of the main dishes. These two results together give us important insights into how nudges can be used to create interventions that are both transparent and effective. Previous literature argued that transparent nudges may dissuade consumers to act in the desired way, which would have otherwise happened had the nudge been hidden (Arad & Rubinstein, 2018). However, I found the opposite: The hidden nudge was not effective, but its transparent alternative was. Including only the symbol “LE” may have not been enough to prompt behaviour change due to the value-action gap (Behavioural Insights Team, 2020): Consumers may be concerned about the planet but may still not act on this worry for economic reasons, such as cost, and psychological reasons, such as lack of willpower (De Haen & Réquillart, 2014). Making the nudge transparent may have prompted behaviour change possibly by creating social pressure, signalling that eating vegetarian or plant-based was the socially desirable or normal thing to do (Evans et al, 2012). Moreover, as people tend to prefer “conscious decisional enhancements” (Felsen et al., 2013), customers may have appreciated the nudge’s purpose being transparent, and may have therefore felt more willing to pick the suggested dishes.

As for how the current study was run at a practical level, this is also the first piece of research to test the impact of such nudges whilst also providing a control: Restaurant B provided a useful counterfactual for my analysis. The two restaurants are quite similar as they are situated in the same building and are part of the same hotel, whilst being also highly frequented by visitors other than the hotel guests. This meant that I was able to compare sales data from the two, isolating the impact of our treatments on the choice of sustainable dishes whilst accounting for possible external shocks to their business.

4.4.3 Future research and implications for businesses

The low emissions label that was used in this research was simply added to the menu as “LE” written in plain text. Previous research had trialled different graphics for similar interventions, such as a traffic light coloured label (Brunner et al., 2018), and colourful posters (Bauer et al., 2022). Although the simple labels from this study and these colourful nudges (Brunner et al., 2018; Bauer et al., 2022) were all found to be effective, it is reasonable to assume that choosing the right type of nudge and the right type of graphics for the specific place of interest is essential. For example, it sounds sensible to assume that a small label written in plain text would be more difficult to spot if it was placed somewhere in a supermarket aisle compared to a restaurant menu. On the other hand, very colourful and/or big labels may not be considered appropriate for a restaurant menu for being too invasive. Different wording and graphics may be tested by businesses and future research to find out how to best market vegetarian and plant-based products depending on the context.

This experiment made use of labels to induce a change in diners’ choices. Other studies which aimed at changing consumption choices within bars, restaurants and cafeterias, and adopted different behaviour change strategies, may be considered for comparison. For example, a trial conducted in partnership with five bars and restaurants in England was aimed at estimating the effect of wine glass size on the volume of wine sold in these establishments (Pilling et al., 2020). It was found that more wine might be sold when 370-ml glasses are used compared to when 300-ml glasses are used in restaurants (the volume was 7.3% higher), but not in bars (Pilling et al., 2020). Another experiment conducted in England showed promising results for increasing the proportion of healthier options available to reduce the amount of kcal in customers’ orders: An average of 6.9% reduction was found, although the impact varied across sites (Pechey et al., 2019). Future research may test various combinations of the above-mentioned behaviour change strategies to encourage sustainable dining. For example, a restaurant might choose to both increase the

proportion of vegetarian and plant-based dishes available, and add sustainability labels on the menu.

Adding or removing labels on a menu may or may not be seen as helpful strategies by restaurant managers. One of the concerns the research partners expressed during the preparation of this research was that changing the menu may result in the non-sustainable dishes being perceived as less appealing. Another possible concern is that the consumer may become overwhelmed while reading the labels and decide not to purchase at all. However, if a business was interested in reducing its emissions, removing the vegetarian and plant-based labels, and possibly adding simple symbols signalling that a product is low-emission, would be low-cost strategies to implement. These suggestions imply that businesses would need to be prepared to reduce their sales of meat-base dishes, which might or might be acceptable depending on the nature of the store/restaurant, and on how big the portion of profits coming from those sales is.

4.4.4 Limitations

Restaurant B was used as a control for this experiment. This study could not be solely conducted in partnership with Restaurant A, as it was not possible to split the one restaurant into different sections. Furthermore, the dataset did not provide enough information to differentiate between orders coming from different tables. This constitutes a limitation of this study because, although the two restaurants and their menus were similar, they were not identical. Characteristics which are inherent to the restaurants themselves may have influenced the results of this study. Future research may therefore replicate this trial by collaborating with a single restaurant and allocating different tables to different experimental groups.

Restaurant B did not offer any plant-based desserts; hence it was not possible to make a comparison between the two restaurants and test the effect of the treatments on the sales of Restaurant A's desserts using Restaurant B as a counterfactual.

This study did not test the impact of the low-emission symbol when added to the menu alongside the vegetarian and plant-based symbols due to the limited amount of time in which this experiment could be conducted. Given that restaurants might be reluctant to permanently remove the symbols “v” and “pb”, future research may investigate how keeping those whilst adding additional information regarding the sustainability of their dishes could affect diners’ choices.

I could not collect detailed information on the socio-demographic characteristics of the restaurants’ clientele. Therefore, it was not possible to keep this into account in the models and analysis. Nonetheless, considering the nature of the partner restaurants and the attached five-star hotel, it could be argued that their average guest might be affluent and not representative of the general population. Therefore, future research might replicate this study in various cafes and restaurants to test whether these findings hold in different types of dining settings and with different types of clienteles.

This study was conducted in London, and it is therefore likely that those who participated in this research (i.e., the restaurants’ clients) had various cultural backgrounds and attitudes towards eating vegetarian and plant-based dishes. Nevertheless, the UK is a country where the average daily consumption of meat is still too high and needs to decrease both for health and environmental sustainability reasons (Stewart et al., 2021). Further research may replicate this study in different locations, whilst accounting for the customers’ socio-economic status and attitudes towards eating meat-based dishes. Similar nudges may be tested in other countries, either with higher or lower average meat consumption, and in different cities, either bigger or smaller than London, and with different cultural backgrounds.

Party sizes could also not be collected. Because of the impact that social pressure can have on eating behaviours, it is possible that diners could influence each other whilst choosing what to order. It would therefore be interesting to run a similar study and collect this piece of information to test whether the number of people sitting

together moderates the effect of the nudges on sales of the recommended dishes.

It was not feasible to check whether the same guests went to both restaurants or dined there multiple times during the trial. In particular, if a guest had eaten at Restaurant A first, and subsequently at Restaurant B, a spillover effect may have been created: The nudges in the first restaurant may have had an impact on the selection of dishes at the second restaurant. However, this would have made the difference between the sales of Restaurant A and Restaurant B smaller, therefore reducing the chances of finding significant effects through a difference-in-difference analysis. Similarly, if the same guests dined at Restaurant A multiple times, the labels might have influenced their choices the first time round, but not subsequently. This would have also reduced the chances of finding significant effects. Because significant effects were found nevertheless, it is likely that spillover or learning effects either did not present themselves or were small enough not to cancel out the differences in sales between the two restaurants.

This study was conducted mostly during the summer period, and this determined what dishes were available on the menu (see Appendix A). Dishes can be considered inherently more or less appealing depending on one's personal taste and preferences. For example, it could be that the non-vegetarian and non-plant-based dishes in the mains category were seen as more appealing by the customers, hence treatment 3 only worked for the starters. Additionally, one's dining choices may vary depending on the season. Had the winter menu been used during the study (see Appendix A), customers' preferences may have changed. Therefore, future research may replicate this study in different seasons to keep into account the impact of seasonality and diners' preferences on final consumption choices.

Finally, vegetarian and plant-based dishes were the minority in our treated restaurant's menu. To provide further support to this study's results, future research may replicate this study with different menus containing more or less sustainable dishes.

4.5 Summary

This study was innovative in its application of behavioural interventions, including a transparent nudge, in a real-world dining setting with the use of a counterfactual. My aim was to find ways to encourage the consumption of more sustainable dishes, which would in turn reduce the carbon footprint of our diets. I found that two strategies may be effective in encouraging the consumption of vegetarian and plant-based dishes: removing any symbols or labels that define a dish as “vegetarian” or “plant-based”; and including a symbol such as “LE” (Low Emission) to signpost which dishes are most sustainable on the menu, whilst being transparent about the reasons behind the intervention. These results contribute to the so far limited but emerging literature on interventions designed to reduce the environmental impact of our diets through nudges. I showed how adding labels to menus is an easy yet low-cost strategy to encourage individuals to eat vegetarian and plant-based meals. Meat consumption needs to decrease both for health and environmental sustainability reasons. For this to happen, restaurants and food shops may need to be prepared to rely less on sales coming from foods such as beef. Nudges like the ones used in this research can be useful tools to tackle unsustainable food consumption in the hospitality sector whilst leaving the consumer free to make the final choice.

Chapter 5

Food waste

5.1 Introduction

As illustrated in Chapter 1, making unsustainable food choices is only half of the problem of unsustainable food consumption: The creation of excessive food waste is the other half of this problem that needs to be tackled. This chapter illustrates some theories which might explain food waste behaviour, and summarizes the methods and findings of previous research that focused on this issue. A discussion of behaviour change theories and models which might be helpful in tackling this issue then follows. Chapter 6 illustrates a study which learns from what described in this chapter, and aims at helping individuals reduce their food waste at home.

5.2 Theories of food waste

Situational variables and psychological factors can explain waste behaviour and attitudes towards food waste (Barr, 2007). Situational variables refer to the behavioural context, such as the level of recycling service provision: People with better access to recycling and greater knowledge of the environment tend to recycle more, waste less and be more prone to reduce their waste (Ball & Lawson, 1990; Schahn & Holzer, 1990). As for psychological factors, extrinsic motivation is less likely than intrinsic motivation to lead to a long-term increase in recycling behaviour (De Young, 1986). Hopper and Nielsen (1991) suggest that altruistic feelings, intrinsic motivation to act, and the degree to which wasting is perceived as a threat to well-being, all have a positive impact on waste behaviour (De Young, 1986; Baldassare & Katz, 1992). Similarly, perceived behavioural control is positively related to waste management (Ajzen, 1991; Hopper & Nielsen, 1991; Chan, 1998). Finally, social norms are very important in encouraging people to reduce their food waste (Fishbein & Ajzen, 1975; Chan, 1998), and to reuse materials: Those who are members of community,

political and environmental groups reuse more than those who are not (Barr, 2007).

More recent research has focused on showing the importance of psychological factors as predictors of waste behaviour (Visschers et al., 2016). Russell et al. (2017) tested how well the theory of planned behaviour by Ajzen (1991) (see Chapter 2) and the model of the environmental behaviour by Klöckner (2013) can be applied to explain people's food waste behaviour. Klöckner (2013) argues that many studies on pro-environmental behaviours, such as on water conservation, support the theory of planned behaviour (Tonglet et al., 2004).

However, the theory of planned behaviour has been criticized for not considering non-cognitive factors like habits and emotions (Bamberg & Moser, 2007; Klöckner, 2013; Steg & Vleg, 2009). Russell et al. (2017) argue that food waste behaviour highly depends on habits. Emotions are both a feeling and a cognitive component, and they can signal how important something is to us, and can therefore ignite a reaction (Forgas, 1994; Lazarus, 1991). For example, guilt is important in determining transport behaviour (Bamberg et al., 2007), and positive emotions have an impact on willingness to engage in energy saving behaviour (Webb et al., 2013).

Barr (2007) suggests there may be another problem with the theory of planned behaviour: The value-action gap (Burgess, Harrison & Filius, 1998). Our actions may not always match our values, and our intentions may not necessarily translate into actions.

5.3 Measurement methods

Three main methods have been used to assess the amount of food waste produced by individual households (Visschers et al., 2016). The first one is collecting all the waste that is produced by each household and measuring its amount (Waste and Resources Action Programme, 2013a). This is probably the most valid assessment of all three but, being quite costly, it is rarely performed (Visschers et al., 2016). The second one is asking households to collect and separate their food

waste in specific containers and report its amount. The third one is using surveys which ask households to estimate their food waste amounts.

5.4 Previous findings

Russell et al. (2017) conducted an online questionnaire through the supermarket Asda. They found that the higher the intention to reduce food waste, the lower the food waste. Subjective norms, perceived behavioural control and negative emotions were positively related to intentions to reduce food waste. Attitudes were, contrary to predictions, not related to intentions. Past behaviour was found to be a positive predictor of behaviour. Negative emotions were associated with higher intentions to reduce food waste, but also with higher actual waste.

Visschers et al. (2016) suggest that bakery products, fruits and vegetables seem to be wasted more often compared to ready-to-eat products. Respondents seemed to have high intentions to avoid food waste, to have negative emotions towards food waste, and their subjective norms were also against food waste. Stronger personal norms and perceived behavioural control were related to higher intention to avoid food waste. The authors argue that intention may be the mediator between attitudes and behaviour (Ajzen, 1991), but that subjective norms and knowledge did not appear to be related to consumers' intention to reduce food waste, contrary to what was found by Russell et al. (2017). Household planning habits were not related to self-reported food waste, but only to consumers' intentions. So, the theory of planned behaviour may not explain waste behaviour completely.

Zhang et al. (2018) used a questionnaire in Shenzhen City, China. The proportion of avoidable food waste was around 56% of total food waste, and that this avoidable food waste was comprised mostly of cereal products, fruits, vegetables, animal-derived wastes, and packaging. Income level was positively correlated with food waste and avoidable food waste, as well as the number of people in each household. Possible motivations behind household food waste were thought to be

cultural attitudes, which put pressure on people to over-cater when they have guests, rising incomes, the abundance of fruits and vegetables available and preference for meat-based meals, and consumer behaviour, such as not planning for shopping.

5.5 Tackling food waste through behaviour change

To address the issue of excessive food waste, opportunities for behaviour change need to be created (van Trijp, 2014). The next few sections illustrate some relevant theories and models which have been applied to issues of healthy and sustainable consumption, addressing both eating behaviours and waste behaviours. These include the theory of self-determination, the COM-B model, and the concept of habitual behaviours. These are then used to inform the study presented in Chapter 6.

5.5.1 Self-determination theory

Yardley et al. (2015) argue that the self-determination theory (SDT) should be considered when thinking about how people will respond to interventions. SDT suggests that there are three basic psychological needs that are necessary for psychological growth, integrity, and well-being: autonomy, competence, and relatedness (Deci & Ryan, 2000). The theory predicts that if people feel autonomous in directing their own behaviour, if they feel competent enough to control the outcome of their actions and be successful, and if they feel related to others in such a way that they feel supported and connected to others, then their self-motivation and well-being will increase. Yardley et al. (2015) argue that if these three psychological needs are satisfied, then positive health behaviour change is more likely to occur. For this reason, they suggest that interventions should do the following: promote individuals' autonomy in how they engage with the trial; cause minimal disruption to their lifestyle and promote habits; and promote a positive experience by using language that invites rather than instructs them to do something a certain way. Heiskanen et al. (2010) suggest that a greater focus should be placed on individuals as community members

and their role of citizens, rather than their role of consumers, when trying to change their energy consumption behaviour.

5.5.2 COM-B

Michie et al. (2014) created the behaviour change framework COM-B, where C stands for capability, O for opportunity, M for motivation, and B for behaviour. This framework identifies the main determinants of behaviour and can be used as a tool to address behaviour change. The term capability refers to whether someone is psychologically and physically able to perform the behaviour. The term opportunity refers to everything outside the individual that can make the behaviour possible or not. Physical opportunity refers to the environment (time, resources, location, cues); social opportunity refers to interpersonal relationships, culture, and social cues. Motivation refers to both the intrinsic and extrinsic motivation that the individual may have to perform the behaviour or not. Following this behaviour change approach, it is necessary to identify the wished outcomes and the behavioural determinants of behaviour(s) of interest, understand current behaviour through COM-B, design and deliver an intervention which targets at least one of the three behavioural determinants, and evaluate its impact.

5.5.3 Motivation

Motivation is what energizes us to do something, stems from both conscious and unconscious processes, and can be extrinsic and/or intrinsic (West & West, 2019). Extrinsic motivation stems from rewards and punishments that are not related to the behaviour in question. Intrinsic motivation stems from wants and needs related to the behaviour in question.

Intrinsic and extrinsic motivation can both be useful to elicit when addressing behaviour change, however, introducing an external reward to motivate people to do something can sometimes crowd out the individual's internal motivation. External rewards, such as money, change the relationship between the person and the activity (West & West, 2019). When a financial incentive was introduced to increase

the number of general practitioners (GPs) recommending their patients to stop smoking in the UK, it was found that despite GPs reporting to have done it, there was no significant change in their behaviour, and they did no longer feel that it was an important part of their job (West & West, 2019). The same negative consequence can happen with incentives that act as punishments. Gneezy and Rustichini (2000) found that introducing a fine for late collection of children at day-care centres actually increased the number of late arrivals.

5.5.4 SDT and COM-B applied to issues of healthy and sustainable consumption

Previous research has investigated healthy and sustainable consumption behaviours through the lens of SDT. Schösler and colleagues (2014) argued that SDT can provide useful insights to explain motivations that might lead consumers to either make more sustainable food choices or not. Maillet and Grouzet (2021) conducted a review of articles which investigated changes in eating behaviour when new students transitioned to university, and made use of SDT to interpret relevant findings. In particular, they found that moving into a university residence or off-campus housing often meant that students ate less food, less healthy and less regularly (Maillet & Grouzet, 2021). Changes in habits, self-regulation and motivation were observed (Maillet & Grouzet, 2021). Lin and colleagues (2023) investigated the determinants of local food consumption, including cultural competence, eudaimonia (welfare), and behavioural intention. Khan and colleagues (2023) researched organic food consumption, especially studying motivational factors behind this behaviour. They found that extrinsic motivational factors have a significant positive impact on consumers' attitude (Khan et al., 2023).

Multiple studies have also used COM-B to identify both barriers and enablers to reduce meat consumption and switch to a more plant-based diet. Graça and colleagues (2019), for example, mapped them as follows. Barriers in the capability domain included difficulty to get reliable information and acquire new skills, and sensitivity to bitter

tastes. Enablers included building knowledge and skills. Barriers in the opportunity domain included the social belief of meat as main protein, social prejudice towards following a plant-based diet, reactions of family members and friends, and lack of support. Enablers were support from friends and family, increased prices of meat, changes of social norms, and changes in availability of meat dishes in places such as canteens. Barriers in the motivation domain included eating meat frequently and holding positive beliefs about meat consumption, perceived convenience, familiarity, and positive taste experience. Enablers included creating positive beliefs regarding plant-based meals or a feeling of reward (Graça et al., 2019). Similarly, van den Berg and colleagues (2022) found taste, perceived high prices of meat alternatives, and habits to be relevant barriers; on the other hand, care for the environment and animal welfare, enjoyment of smaller portions of meat, and saving money were identified as enablers.

Furthermore, COM-B has been applied to better understand behaviours concerning packaging, such as biodegradable and compostable plastic packaging purchase and disposal. Allison and colleagues (2021) identified the following barriers and enablers related to purchase behaviour. Capability barriers included not understanding terminology used on labels, not paying attention to packaging, and preferring other types of packaging. Motivation barriers included negative beliefs about this kind of plastic's environmental impact and being sceptical regarding its decomposition claims. Opportunity barriers included not having access to appropriate waste management. Motivation enablers included creating positive beliefs about its environmental impact. Opportunity enablers included creating access to waste management. When disposal behaviour was assessed, the following were identified: attention and knowledge (capability), beliefs around the environmental impact of compostable plastic (motivation), and access to waste management (opportunity) (Allison et al., 2022). Following the recognition of these barriers and enablers, the researchers recommended interventions based on education and environmental restructuring. Recommended behaviour change

techniques comprised of instructions on how to perform the desired behaviour, and cues in the environment (Allison et al., 2022).

5.5.5 Habits

Gardner (2012) defines habits as automatic responses to everyday contexts learnt through repeated performance. Because habitual behaviours are triggered by the environmental and situational context, they can and tend to override deliberative intensions (Gardner et al., 2011). Therefore, only boosting motivation may not be enough to break the cue-response link that is at the heart of habitual behaviours. Once this cue-response link has been created, habitual behaviours may persist even when they are not performed frequently, hence the concept of habit as automaticity and not frequency (Gardner, 2012). Because habits happen on an impulsive pathway, habits could be used in intervention in a way that if good habitual behaviours are formed this may lead to long-term behaviour change (Rothman et al., 2009).

It is also important to distinguish between past behaviour and habitual behaviour. Despite it was found that frequency of past behaviour may predict future behaviour (Ouellette & Wood, 1998), it was also argued that the statistical relationship between frequency of past and future behaviour is not meaningful because frequency of past behaviour is a construct that has no explanatory value (Verplanken & Orbell, 2003). Repeated behaviour can become habitual. However, a habit is not only a frequent behaviour, but is instead a psychological construct by which we respond automatically to a certain cue with a certain learnt behaviour. Therefore, measuring a habitual behaviour just as past behaviour frequency is inappropriate (Verplanken & Orbell, 2003). The Self-Report Index of Habit Strength (SRHI) was therefore developed (Verplanken & Orbell, 2003), and is based on the following features of habitual behaviours: the history of repetition of behaviour; the difficulty of controlling behaviour; the lack of awareness; efficiency; and the identity element.

A successful intervention which used the concept of habitual behaviours is that by Lally, Chipperfield and Wardle (2008). This

weight loss intervention aimed at helping people lose weight through tips that were based on everyday eating behaviours and activities that were associated with weight loss. The authors made use of the SRHI to assess perceived automaticity of these suggested behaviours at the baseline, 12 weeks in, and 32 weeks in for the intervention groups. The authors found that people in the control group lost 0.4 kg, whereas the two intervention groups lost respectively on average 2.4 kg (monthly weighing) and 1.6 kg (weekly weighing). The difference between treatment groups and control was statistically significant, but the difference between the two treatment groups was not, suggesting that difference in frequency of weighing was not a determining factor. It was also found that weight loss continued after the intervention. The participants' mean automaticity scores increased, and the average change in automaticity score across behaviours was significantly correlated with participants' weight loss. Participants felt it took them on average three months for the suggested behaviours to become habitual. The significant correlation between weight loss and automaticity scores suggests that habit-formation was instrumental in helping people lose weight.

Chapter 6

Managing food waste through a behaviour change intervention

6.1 Introduction

6.1.1 Overview

In the UK, a large amount of avoidable food waste is produced every year, and this has a negative impact both on the environment and on the economy. This present research trialled a communication-based intervention aimed at tackling this problem by helping households reduce their avoidable food waste. All participants were asked to weigh their waste weekly for four months. The first intervention group received tips on reducing waste, and the second intervention group received the same tips together with a letter which highlighted the importance of wasting less. All groups saw an overall decline in their avoidable food waste. The behaviours recommended through the tips remained more habitual than they were at baseline even after the end of the intervention for the second intervention group. This suggests that sending the tips and the letter together was the most effective way to create long-term behaviour change. Interventions based on communication like these are low-cost, and could be implemented by policymakers and local authorities to help households manage their food waste.

This study addresses the issue of excessive avoidable food waste, which concerns the last stage of the food consumption cycle described in section 1.6. Although the three experiments discussed in this thesis are linked conceptually through said cycle, the method used in this study was developed separately from the methods of the other two.

6.1.2 Objectives and background

The objective of this intervention was to find out whether people can be encouraged to reduce their food waste at home through regular

measurement, the provision of tips on how to reduce it, and a letter informing them on why food waste should be reduced.

This research innovatively brings together COM-B and SDT to target food waste behaviour. Despite the former being often used as a framework of reference for behavioural interventions, and the latter being recognized as helpful in understanding how people may react to interventions, they have not been used to address the issue of food waste before. Additionally, the role of habits is considered as potentially instrumental in reducing food waste.

By using the COM-B framework when evaluating the problem of excessive food waste, the behaviour of interest can be defined as follows: Households throw away food that could have been eaten. The goal is a reduction in the amount of edible food that gets thrown away by households in the UK. Some assumptions then need to be made about the determinants of the behaviour in question. Whilst designing the current intervention it was assumed that households have the physical capability to reduce their home food waste, but they may lack the psychological capability to do so: They may not know how to reduce their food waste and/or they may not know why it is important to cut down on food waste. It was also assumed that households may lack the opportunity to reduce their food waste: They may not have a lot of time to think about their food waste; they may lack support from others in engaging with the behaviour; and they may not have triggers around them that remind them to think about the behaviour. Finally, it was assumed that households may lack the motivation to reduce their food waste and they may not have positive habitual behaviours in place.

Participants were asked to fill in the survey on a regular basis, and this acted as a trigger to make them think about their food waste, thus challenging their opportunity to engage with the problem. Some participants (20/69) were given a leaflet with 10 tips on how to reduce their food waste. This leaflet addressed the following: the lack of psychological capability by educating participants on how to reduce their food waste; the lack of opportunity by working as a cue; and the

lack of motivation by encouraging the creation of healthy habits. Participants had autonomy, as these tips were given to them as a resource, not with the instruction to necessarily use them. The leaflet was also meant to increase participants' competence and relatedness. Finally, some participants (23/69) received a letter which informed them of why cutting down food waste would be beneficial to them and the environment. This letter addressed the lack of psychological capability by providing additional information, it provided a social cue, and it encouraged participants to reflect on why changing their behaviour was important, boosting motivation. As the letter contained information about how residents in London view food waste recycling and encouraged participants to find out how their local council disposes of their food waste, it also highlighted their role of and responsibilities as citizens.

Habits are also considered in this study. People think they make, on average, about 15 drinking and eating decisions in a day. However, we make about 219. Hence, most of these decisions are unconsciously made (Wansink & Sobal, 2006), and could be made from habit. The current study aims at conducting a similar trial to that by Lally, Chipperfield & Wardle (2008) to test whether, after suggesting 10 food management tips, these can become habitual and help participants reduce their food waste.

6.1.3 Hypotheses and exploratory questions

This study tests whether:

1. Intervention elements such as a leaflet and a letter can be instrumental in helping households reduce their food waste;

2. Certain behaviours (such as planning grocery shopping to avoid overbuying) can become habitual and, if so, whether this is linked with a reduction in food waste.

Participants were randomly assigned to one of three groups: Control, Intervention A, and Intervention B. Control did not receive any extra material during the study. Intervention A received the leaflet.

Intervention B received the leaflet together with the letter. It was hypothesized that:

H1. There will be a reduction in food waste across all groups.

H2. The treatment that will see the greatest reduction in food waste will be Intervention B, followed by Intervention A, followed by Control.

H3. After three months since the beginning of the intervention the suggested behaviours (tips) will have become more habitual for participants in the intervention groups.

H4. After one month since the end of the intervention habitual behaviours will have persisted.

H5. At the end of the intervention period, Intervention B's change in automaticity scores will be higher than Intervention A's, which will be higher than Control's.

H6. At the end of the study (after one month since the end of the intervention), Intervention B's change in automaticity scores will be higher than Intervention A's, which will be higher than Control's.

H7. There will be a correlation between the increase in automaticity of suggested behaviours and food waste reduction.

Information on which types of items were waste was also collected to explore whether certain food products are wasted more than others.

6.2 Method

6.2.1 Participants

This study was conducted both in partnership with Westminster City Council (WCC) and within the University College London (UCL) community. Participants were recruited from the WCC members of staff through the Council internal communication channels, such as their newsletter. Similarly, UCL participants were recruited through the university's internal mailing lists and ads on the university's social media accounts (LinkedIn, Twitter, and Instagram). All participants were asked to read an information sheet and give their consent when signing up to the study online.

69 participants took part in the study, 31 from WCC and 38 from UCL. 26 were assigned to Control, 20 to Intervention A, and 23 to Intervention B. Participants were randomly assigned to a group. Final group numbers are not homogenous due to subjects dropping out after registering for the study and before completing any weekly questionnaires.

Westminster City Council

During recruitment, some buckets were made available for participants to collect from the council and use during the study. After signing up, WCC participants had to choose an ID number to insert when filling in the following surveys, and were reminded to complete their surveys by two WCC officers who acted as the intermediary between the authors and the participants.

University College London

The methodology was the same when the study was conducted with UCL participants, the only differences being that participants were not provided with the option of collecting a bucket but were asked to use what they already owned, and that participants had to sign up with their email address. The latter change allowed for automatic reminders to be sent to participants when it was time for them to complete the next part of the study, and for the treatment groups to receive their leaflets and posters via email.

6.2.2 Ethics

This research was registered with the UCL Data Protection Office (Z6364106) and received ethical approval from The Bartlett School of Environment, Energy and Resources Ethics Committee.

6.2.3 Materials

A leaflet and a letter were developed as intervention materials for this experiment. The leaflet (see Appendix B) contained 10 tips for participants on how to reduce their food waste. Each of these tips was accompanied by a QR code linked to a page where participants could find out more about that specific recommendation. For example, the

first tip recommends planning your shopping, and the QR code takes you to a page where you can find more information on how to do so. The letter (see Appendix B) explained to participants how reducing food waste would benefit both them and the environment, and encouraged them to find out more about food waste disposal practices in their local area. Both the theory of self-determination (Deci & Ryan, 2000) and the COM-B model (Michie et al., 2014) informed the development of these materials. Table 10 below illustrates the links between the intervention materials, SDT and COM-B.

Table 10. Intervention materials, SDT and COM-B.

Material	Description	Link to SDT	Link to COM-B
Leaflet	• List of 10 tips to cut down on food waste. • Easy-to-retrieve additional information thanks to QR codes.	• Autonomy: the leaflet was given to participants who could then choose to make use of it or not. • Competence: the leaflet gives practical and easy-to-adopt tips.	• Capability: the leaflet increases capability through education. • Opportunity: the leaflet acts as a cue. • Motivation: the leaflet encourages the creation of plans (reflective processes).
Letter	• Information on food waste. • Explanation of the benefits of reducing food waste to the planet and people. • Prompt to find out more	• Relatedness: the leaflet increased relatedness by highlighting both participants' role as citizens, and	• Capability: the letter provides insightful information. • Opportunity: the letter acts as a social cue.

	about the participants' local council and its food waste recycling practices.	the positive impact that reducing food waste would have on people and the planet.	• Motivation: the letter encourages participants to reflect on why cutting down waste is important.

6.2.4 Experimental design

The experiment was conducted through the platform REDCap. When first opening the experiment link, participants were taken to the information sheet and consent page. After reading about the study and accepting its terms, the platform would take them to the baseline survey, which collected information about how participants generally dispose of their food waste, their household size, whether they oversee their household's food shopping, their age, gender, education, and income. After completing the sign-up process, they were asked to start weighting their food waste from a selected date. From this moment onwards, participants had to complete 16 weekly food waste questionnaires (see Appendix B). These weekly questionnaires asked them to report the following: how much food waste they have produced during the previous week in grams; which items went to waste during that week out of certain categories (meat, fish, fresh fruit and veg, cheese and milk, pre-packaged meals); how much food in grams went into the compost bin (optional). When completing a weekly questionnaire, participants were not allowed to go back and review their answers from the previous week. The survey instructions indicated to only report avoidable food waste, that is food that could have been eaten but was not, and to disregard non-edible parts such as bones, seeds, and skin. After completing the fourth questionnaire, participants in Intervention A were given the leaflet with tips (see Appendix B), and those in Intervention B were given the leaflet together with the letter (see Appendix B). After a month since the last

questionnaire was filled in, participants received a feedback survey with questions about their experience of participating in the study.

During week 1 (starting from the baseline), week 16, and week 20, participants had to fill in an extra survey together with their weekly food waste questionnaire: The habit survey. The habit survey asked the participants to answer some questions about the ten behaviours that were also used as recommendations in the treatment groups. These behaviours were: planning food shopping; freezing food to make it last longer; using leftover recipes; storing food according to the Love Food Hate Waste guide (https://www.lovefoodhatewaste.com/); checking the use-by and best-before dates; planning meal portions; planning meal portions for kids; keeping track of what food has been wasted; making the most out of meat and fish, following the Love Food Hate Waste guide; and making the most out of the fridge, following the Love Food Hate Waste guide. The habit survey asked participants to rate whether these behaviours are something: they do frequently; they do automatically; they do without having to consciously remember; that makes them feel weird if they do not do it; they do without thinking; that would require effort not to do it; that belongs to their routine; that they start doing it before they realizing they are doing it; that they would find hard not to do; that they have no need to think about doing; that is typically “them”; that they have been doing for a long time. Participants had to state how much they agreed with the above statements on the following scale: strongly disagree, disagree, neither agree nor disagree, agree, strongly agree. These 12 statements are part of the SRHI (Verplanken & Orbell, 2003). Because Lally, Chipperfield and Wardle (2008) estimated that it takes 66 days to form a new habit, it was possible to check whether those behaviours had become habitual by the end of the intervention, and whether this effect had continued to persist even after the end of the intervention.

The timeline of the study and a list of the items provided to the participants are summarized in Table 11 and Table 12.

Table 11. Timeline.

Period	Duration	Ordered Tasks
Recruitment	2 months	Participants can sign up to the study by clicking on the provided link in the advertisement.
Baseline	1 month	Baseline survey; weekly questionnaires (x4); habit survey.
Intervention	3 months	Participants from the intervention groups receive assigned resources (leaflet, letter); weekly questionnaires (x12); habit survey.
Cooling-off	1 month	No surveys or questionnaires need to be completed.
Wrap-up	1 week	Habit survey; feedback survey.

Table 12. Material provided to the participants.

Item	Group
Food waste recycling bucket (optional)	All groups (WCC only)
Leaflet (10 tips)	Intervention A and B
Letter	Intervention B
Baseline survey	All groups
Weekly questionnaires to report food waste (x16)	All groups
Habit surveys (x3)	All groups
Feedback survey	All groups

6.2.5 Data analysis

First, the average food waste amounts for the first month, second month, third month, and fourth month were computed and analysed. Whenever a participant was not able to fill in a weekly questionnaire, the average food waste of their group of that week was computed and inserted to replace that missing data point. This allowed for all

participants to always be included in the analysis without altering the monthly average food waste amounts of each group. Second, the monthly amounts were compared across time, independently of groups, to verify whether all groups saw a decline in their food waste over time or not. Third, the monthly amounts were compared between groups. Fourth, the monthly amounts were compared within groups across time.

Participants' answers to the SRHI-based questionnaires were summed up to compute automaticity scores. Three automaticity scores were calculated, respectively representing the baseline automaticity score, the automaticity score at the end of the intervention, and the automaticity score measured one month after the end of the intervention. Whenever a participant did not fill in their habit survey, the average automaticity score of that experimental group at that point in time was used instead. Automaticity scores were first analysed over time. Second, a correlation between the change in automaticity over time and the respective change in average food waste was computed, both for all participants, and for individual groups. Third, the changes in automaticity over time were compared across experimental groups.

6.3 Results

6.3.1 Demographics and other background information

Most participants were primary shoppers, between the age of 25 and 34, female, had a master's degree, and had an income of £37,000 or more in all groups. The sample was therefore mostly composed of younger and highly educated people, which is in line with expectations given that recruitment took place within WCC and UCL.

Group B had the highest percentage of primary shoppers (91.3%). Control had both the highest percentage of younger participants (23.1%) and older participants (11.5%). Most participants in Intervention A were female (80%), whereas Intervention B had a more balanced group (52.2% female and 43.5% male). Intervention A had the highest percentage of highly educated people (25%), compared to only 3.9% in Control. All groups were mostly comprised of high earners.

Most households in Control were made up of 2 people (57.7%); Intervention A was made up mostly of households of 2 people (35%) or 4 people (30%); Intervention B was made up mostly of households of 1 (21.7%) or 3 people (21.7%).

The general demographics of the sample are described in Table 13.

Table 13. Demographics of sample. (Note: Percentages may not add up as not all participants answered all questions).

Category	**Value**	**All groups (%)**	**Control (%)**	**Group A (%)**	**Group B (%)**
Primary shoppers	Yes	79	69.2	84.2	91.3
	No	17.4	30.8	15.8	4.3
Age	18-24	14.5	23.1	5	13
	25-34	31.9	34.6	25	34.8
	35-44	18.8	15.4	25	17.4
	45-54	20.3	15.4	25	21.7
	55-64	8.7	11.5	5	8.7
	65 or older	0	0	0	0
Gender	Female	66.7	69.2	80	52.2
	Male	27.5	30.8	5	43.5
	Non-binary	1.4	0	0	4.3
Education	Secondary school	13	19.2	10	8.7
	Bachelor's	26.1	34.6	15	26.1
	Master's	36.2	34.6	30	43.5
	PhD	14.5	3.9	25	17.4
	Other further education	5.8	7.7	5	4.3
	£0	10.1	15.4	5	8.7

Yearly income	£1-3,999	7.2	7.7	5	8.7
	£4,000-7,999	1.4	0	5	0
	£8,000-11,999	0	0	0	0
	£12,000-16,999	2.9	0	5	4.3
	£17,000-23,999	4.3	3.8	5	4.3
	£24,000-36,999	21.7	19.2	20	26.1
	£37,000 or more	47.8	53.8	40	47.8
Household size	1 person	21.7	26.9	15	21.7
	2 people	37.7	57.7	35	17.4
	3 people	11.6	3.8	10	21.7
	4 people	17.4	7.7	30	17.4
	5 people or more	5.7	3.8	5	12.9

Participants also provided information on their usual methods of food waste disposal in the baseline survey. From Control: 46.2% make use of the food waste collection by their local council; 7% do food composting at home; 42.3% do not separate food waste by other waste. From Intervention A: 60% make use of the food waste collection by their local council; 6% do food composting; 5% do not separate food waste. From Intervention B: 56.5% make use of food waste collection; 21.7% do food waste composting; 43.5% do not separate food waste.

6.3.2 Food waste

Food waste over time

The average (weekly) food waste during the first month was 771.1 g; the average food waste during the second month was 534.8 g; the average food waste during the third month was 565.4 g; the average food waste during the fourth month was 519.1 g (see Table 14). Paired samples t-tests showed the means of the second, third and fourth month to be different from the mean of the first month ($t(68) = 6.12$, p

< 0.001; $t(68) = 4.27$, $p < 0.001$; $t(68) = 5.16$, $p < 0.001$). There was no significant difference between the average food waste of the second month and of the third month ($t(68) = -1.21$, $p = 0.227$); but there was a significant difference between the average food waste of the third month and of the fourth month ($t(68) = 2.60$, $p = 0.011$). This data therefore supports hypothesis 1 (H1).

Table 14. Average food waste over time.

	Mean (g)	***SD (g)***
Average food waste (Month 1)	771.1	526.2
Average food waste (Month 2)	534.8	393.2
Average food waste (Month 3)	565.4	459.4
Average food waste (Month 4)	519.1	391.0

Comparisons between groups

Differences between food waste amounts can be seen even during the first month of the trial, i.e. when the intervention period had not yet begun (see Table 15). Although it is not possible to know the exact reason behind these differences, it could be argued that they might be due to characteristics inherent to each group. For example, Control's amount of average food waste was higher than the intervention groups. Out of the three groups, control also had the biggest share of younger people. Previous research suggested that age might be negatively correlated with food waste (Visschers et al., 2016).

When comparing Control and Intervention A, it was found that there was a significant difference in average food waste measured during the second month ($t(44) = -2.98$, $p = 0.005$), with Intervention A reporting higher food waste ($M = 810.9$, $SD = 378.0$) than Control ($M = 490.2$, $SD = 348.4$), but not at other time points (month 1: $t(44) = 0.37$, $p = 0.713$); month 3: $t(44) = -0.76$, $p = 0.450$; month 4: $t(44) = 0.40$, $p = 0.692$).

When Control and Intervention B are compared, it is found that their respective average monthly food waste amounts are always different (month 1: $t(47) = 2.66$, $p = 0.011$; month 3: $t(47) = 2.51$, $p = 0.016$; month 4: $t(47) = 3.04$, $p = 0.004$), expect for month 2 ($t(47) = 1.49$, $p = 0.142$).

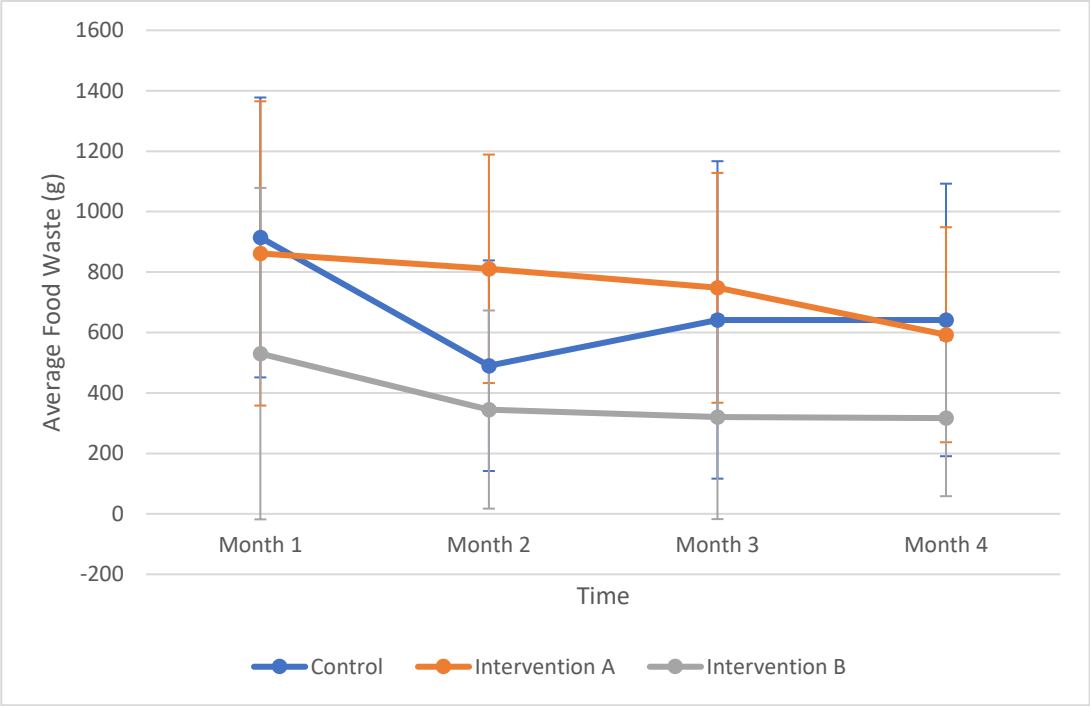
When Intervention A and B are compared, it is found that their respective average monthly food waste amounts are always different (month 1: $t(41) = 2.05$, $p = 0.046$; month 2: $t(41) = 4.32$, $p < 0.001$; month 3: $t(41) = 3.90$, $p < 0.001$; month 4: $t(41) = 2.93$, $p = 0.003$).

A summary of each group's average food waste amounts over time is presented in Table 15. Figure 11 illustrates a comparison between groups.

Table 15. Average food waste over time by group.

	Group	***Mean (g)***	***SD (g)***	***Mean per capita (g)***
Month 1	Control	914.6	463.1	457.3
	Intervention A	861.7	503.4	307.7
	Intervention B	530.2	548.4	139.5
Month 2	Control	490.2	348.4	245.1
	Intervention A	810.9	378.0	289.6
	Intervention B	345.2	327.8	90.8
Month 3	Control	641.7	525.2	320.8
	Intervention A	747.9	380.3	267.1
	Intervention B	320.4	337.7	84.3
Month 4	Control	641.6	450.9	320.8
	Intervention A	592.7	355.7	211.7
	Intervention B	316.8	258.4	83.4

Figure 24. Average food waste over time by group. Error bars: +/- SD. Tested with 69 participants, with most of them being 25-34 years old.



Comparisons within groups

When looking at the monthly average food waste produced by Control, it was found that these amounts are statistically different each month (months 1 and 2: $t(25) = 7.54$, $p < 0.001$; months 1 and 3: $t(25) = 2.84$, $p = 0.009$; months 1 and 4: $t(25) = 3.10$, $p = 0.005$; months 2 and 3: $t(25) = -2.86$, $p = 0.008$), except for months 3 and 4 which are not statistically different ($t(25) = 0.01$, $p = 0.994$).

When looking at the monthly average food waste produced by Intervention A, it was found that the averages of months 1 and 4 ($t(19) = 2.77$, $p = 0.012$), and of months 3 and 4 were different ($t(19) = 6.72$, $p < 0.001$), but not those of the other months (months 1 and 2: $t(19) = 0.69$, $p = 0.498$; months 1 and 3: $t(19) = 1.19$, $p = 0.247$; months 2 and 3: $t(19) = 2.03$, $p = 0.057$).

When looking at the monthly average food waste produced by Intervention B, it was found that the averages of months 2 ($t(22) = 3.80$, $p = 0.001$), 3 ($t(22) = 4.41$, $p < 0.001$) and 4 ($t(22) = 3.01$, $p = 0.006$) were different from that of month 1, but were not different between

each other (months 2 and 3: $t(22) = 1.47$, $p = 0.156$; months 3 and 4: $t(22) = 0.11$, $p = 0.910$).

Change in average food waste

Control saw a decline in the average food waste amount of 273.0 g between the baseline and the end of the intervention, that is a 29.85% reduction. Intervention A's average food waste diminished by 268.98g, which equals to a 31.22% reduction. Intervention B's average food waste diminished by 213.4 g, which equals to a 40.25% reduction. The differences in average food waste between the beginning and the end of the intervention were not, however, statistically different between groups ($F(2, 66) = .15$, $p = 0.859$). Therefore hypothesis 2 (H2) was not supported. This might indicate that the act of weighing one's food waste accounted for most of the observed changes in food waste amounts over the intervention period. This possibility will be considered in the discussion section (6.4).

Wasted items

When participants filled in their food waste weekly surveys, they were also asked to tick which types of food had gone to waste that week. The food categories of interest were meat, fish, fruit and vegetables, milk and cheese, and pre-packaged meals. Out of these categories, the most wasted items were fruit and vegetables, wasted 191 times during the study period. The second most wasted item was meat (53 times), followed closely by milk and cheese (48 times). The least waste items were pre-packaged meals (24 times) and fish (12 times).

6.3.3 Automaticity

Automaticity scores over time

Participants' average automaticity scores increased between the baseline ($M = 389.9$, $SD = 44.9$) and the end of the intervention ($M = 410.8$, $SD = 40.9$), but reverted to lower scores when reassessed after a month since the end of the intervention ($M = 383.5$, $SD = 53.9$) (Table 16). Scores 1 and 2 were found to be statistically different ($t(68) = -4.27$, $p < 0.001$), and so were scores 2 and 3 ($t(68) = 6.99$, $p < 0.001$);

but scores 1 and 3 were not ($t(68) = 0.93$, $p = 0.353$). Therefore, hypothesis 3 (H3) is supported, but hypothesis 4 (H4) is not.

Table 16. Automaticity scores.

	Mean	***SD***
Automaticity score 1	389.9	44.9
Automaticity score 2	410.8	40.9
Automaticity score 3	383.5	53.9

Automaticity scores by group

Control's automaticity scores 1 and 2 were not statistically different ($t(25) = -1.31$, $p = 0.203$), but scores 1 and 3 ($t(25) = 3.11$, $p = 0.005$) and 2 and 3 ($t(25) = 9.51$, $p < 0.001$) were.

Similarly, Intervention A's automaticity scores 1 and 2 were not statistically different ($t(19) = -0.82$, $p = 0.424$), but scores 1 and 3 ($t(19) = 4.28$, $p < 0.001$) and 2 and 3 ($t(19) = 15.06$, $p < 0.001$) were.

On the other hand, Intervention B's automaticity scores 1 and 2 ($t(22) = -6.89$, $p < 0.001$) and 1 and 3 ($t(22) = -4.32$, $p < 0.001$) were different, but scores 2 and 3 were not ($t(22) = .21$, $p = 0.839$).

Control and Intervention A have similar baseline automaticity scores (automaticity score 1: $t(44) = -1.38$, $p = 0.175$) and similar final automaticity scores (automaticity score 3: $t(44) = -0.34$, $p = 0.734$), but different automaticity scores at the end of the intervention (automaticity score 2) ($t(44) = -2.10$, $p = 0.042$).

Control and Intervention B have different automaticity scores at all time points ($t(47) = -2.34$, $p = 0.023$) ($t(47) = -8.22$, $p < 0.001$) ($t(47) = -13.80$, $p < 0.001$).

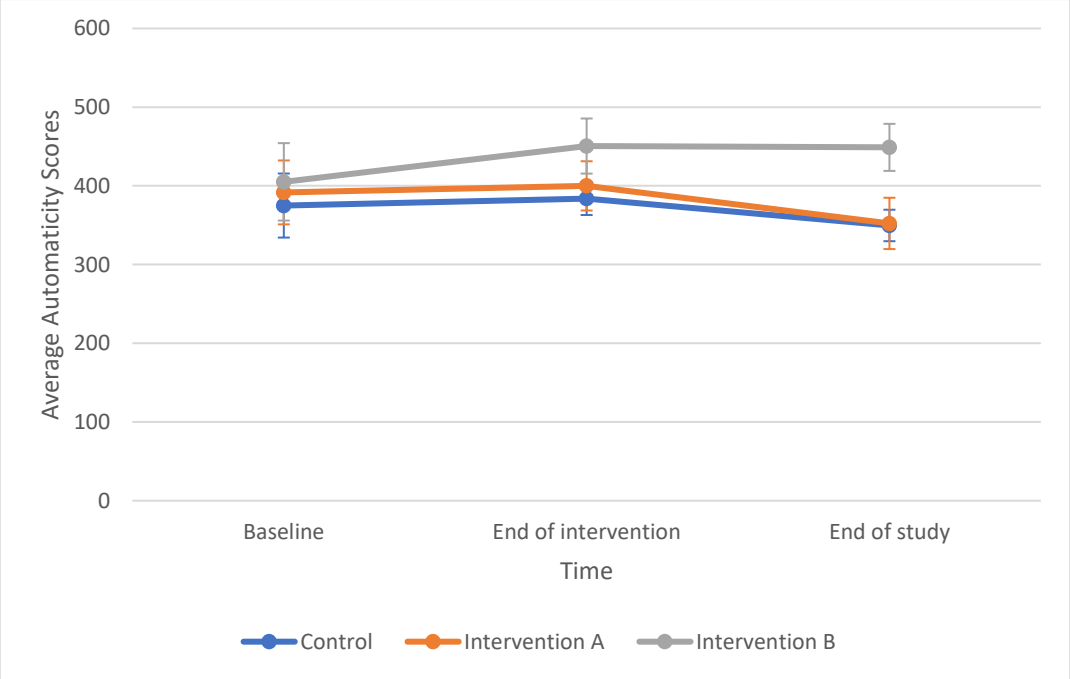
Intervention A and B have similar baseline automaticity scores ($t(41) = -0.96$, $p = 0.339$), but different automaticity scores thereafter ($t(41) = -4.96$, $p < 0.001$) ($t(41) = -10.13$, $p < 0.001$).

A summary of each group's average automaticity scores over time is presented in Table 17. Figure 12 illustrates a comparison between groups.

Table 17. Automaticity scores over time by group.

	group	*Mean*	*SD*
Automaticity score 1	Control	375.0	40.7
	Intervention A	391.7	40.6
	Intervention B	405.1	49.2
Automaticity score 2	Control	383.8	20.8
	Intervention A	400.0	31.3
	Intervention B	450.6	35.0
Automaticity score 3	Control	349.7	20.0
	Intervention A	352.3	32.6
	Intervention B	448.9	29.9

Figure 25. Automaticity scores over time by group. Error bars: +/- SD. Tested with 69 participants, with most of them being 25-34 years old.



Are changes in automaticity over time different between experimental groups?

The changes in automaticity between the baseline and the end of the intervention, and the baseline and the end of the study, of Control and Intervention A were not significantly different ($t(44) = 0.04$, $p = 0.966$; $t(44) = 1.14$, $p = 0.261$).

However, the changes in automaticity between the Control and Intervention B were statistically different ($t(47) = -3.86$, $p < 0.001$; $t(47) = -5.37$, $p < 0.001$): Intervention B saw an increase in automaticity, both between the baseline and at the end of the intervention, and between the baseline and a month after the end of the intervention; On the other hand, Control saw a small increase in automaticity between time points one and two, but a decrease in automaticity between time points one and three.

Changes in automaticity were also statistically different between the Intervention A and Intervention B ($t(41) = -3.14$, $p = 0.003$; $t(41) = -6.01$, $p < 0.001$): Intervention A saw, similarly to Control, a small increase in automaticity between the baseline and the end of the intervention, but an overall decline between the baseline and at time point of a month after the end of the intervention.

Hypotheses 5 and 6 (H5, H6) were partially supported: Intervention B saw the biggest change in their automaticity scores, and this change was overall positive both between the baseline and the end of the intervention, and the baseline and the end of the study; Control's and Intervention A's changes in automaticity scores were non-statistically different, and even negative when calculated between the baseline and the end of the study (see Table 18).

Table 18. Changes in automaticity over time.

	group	*Mean*	*SD*
Change in automaticity (2-1)	Control	8.8	34.4
	Intervention A	8.3	45.6
	Intervention B	45.5	31.7
Change in automaticity (3-1)	Control	-25.3	41.6
	Intervention A	-39.3	41.1
	Intervention B	43.8	48.6

Changes in automaticity and average food waste

Although a negative correlation between the change in average food waste between the baseline and the end of the intervention, and the change in automaticity during that period of time, was computed, it was not found to be significant ($r(67) = -0.10$, $p = 0.377$).

When groups were analysed individually, similarly no statistically significant correlations were found. However, it was found that the correlation between change in automaticity and food waste was negative for Control ($r(24) = -0.37$, $p = 0.064$) and Intervention A ($r(18) = -0.04$, $p = 0.860$), but positive for Intervention B ($r(21) = 0.02$, $p = 0.931$).

Hypothesis 7 was therefore not supported.

6.4 Discussion

6.4.1 The findings

Overall, the amount of food waste produced by all participants declined over time. This suggests that measuring your own food waste may act as an intervention. It is possible that participants, once more aware of the actual food waste amounts they produced, tried to reduce it, as also suggested by Wenlock et al. (1980). As expected, regular weighing may have created the opportunity for participants to engage

with the problem, one of the three key elements for behaviour change (Michie et al., 2014).

Differences in the fluctuations of food waste amounts can be seen between different groups. Control's food waste declined between the first and the second month, then increased between the second and the third month, and was stable thereafter. Measuring food waste may act as an intervention but may not sustain motivation to reduce waste in the long run. On the other hand, Intervention A saw an overall decline in their food waste between month 1 and 4, mainly due to a decline between month 3 and 4. This suggests that the leaflet may have increased psychological capability and motivation, together with competence and autonomy (Michie et al., 2014; Deci & Ryan, 2000). Previous research had found a negative correlation between perceived behavioural control and avoidable food waste (Van der Werf et al., 2021), and the positive impact of the poster supports this result. Intervention B's waste amounts saw a decline which was significant between the first and second month, and thereafter stable. The letter may have also been successful at increasing psychological capability and motivation, whilst highlighting the participants' role as citizens and increasing their relatedness (Deci & Ryan, 2000; Heiskanen et al., 2010). This finding suggests that norms can affect not only intentions to manage food waste (Ariyani & Ririh, 2020), but also the behaviour itself.

Participants' automaticity scores increased between the baseline and the end of the intervention, but then decreased between the end of the intervention and the check-in conducted a month after. Behaviours linked to food waste reduction can become more habitual over time, but this change may not last after the intervention finishes, possibly because the opportunity to engage with the problem goes away (Michie et al., 2014). However, the three groups' automaticity scores changed in different ways. Control's and Intervention A's average automaticity scores overall decreased over time: Their final automaticity score was lower than at the baseline. On the other hand, Intervention B's automaticity score saw an overall increase, despite

dropping slightly between the end of the intervention and the last check-in survey. This suggests that sending both a poster and a letter may have been effective in sustaining habit creation (Verplanken & Orbell, 2003; Lally et al., 2008).

A review of food waste reduction studies (Reynolds et al., 2019) found that information-based interventions tested with small samples of households were effective with a reduction of up to 28% in food waste (Devaney & Davies, 2017). Another study aimed at reducing households' food waste through education delivered a 27.85% reduction in waste (Wharton et al., 2021). A prevention campaign conducted by the Waste and Resources Action Programme (WRAP) and, similar to this study, targeting London households, delivered a 15% reduction in waste (Waste and Resources Action Programme, 2013). An information-based intervention using the Theory of Planned Behaviour, sharing a similar theoretical background to the current study, reported a reduction in avoidable food waste of 30% (Azjen, 1991; van der Werf et al., 2021). As this study found that Intervention A helped residents reduce their waste by 31.22%, and Intervention B by 40.25%, it can be considered an advancement in this field of research. When comparing our intervention to other studies which targeted food waste but made use of different mechanisms, it can be argued that information-based interventions are not always the most effective. Other experiments have adopted technological solutions which make use of changes to objects, such as plates. For example, switching to smaller plate sizes can reduce waste by up to 57% (Reynolds et al., 2019; Wansink & van Ittersum, 2013). Policy or practice changes can also be effective: Changing school dietary guidelines produced a 28% waste reduction in vegetables (Cohen et al., 2014; Reynolds et al., 2019). Although this review suggests that technological solutions may be the most effective, conducting similar interventions in households is impractical. What can be done instead is educating residents about the effects of reduced plate and portion sizes.

Overall, our results indicate that the trial created food waste reduction. Local government authorities could design low-cost campaigns that make use of printed or digital materials to share waste management tips and emphasize both individual and social potential gains from waste reduction. Additionally, “decisional enhancement” interventions which preserve people’s autonomy, such as in the current study, are more likely to be received well by the public (Felsen et al., 2013).

6.4.2 Limitations of this study and recommendations for future research

Some considerations need to be made regarding the sample. First, participants were recruited through Westminster City Council and University College London, and were on average young and highly educated. For these reasons, the results of this study may not be generalized to the entire population. It is difficult to predict how these things would have been different had the sample been older and/or less educated. Because previous research found that people who left school earlier wasted less food (Secondi et al., 2015), and that age is negatively correlated to food waste (Visschers et al., 2016), the interventions may have worked even better with a less educated and/or older sample. Second, the average household size was higher for Intervention B. Hence, it was difficult to make comparisons between the groups and their relative food waste amounts, as it is assumed that household size is a determinant of food waste. Third, the sample size of this study was small compared to Lally, Chipperfield and Wardle’s sample (2008), possibly not allowing for a correlation between habit formation and behaviour change to be found. A post-hoc power analysis for this correlation, considering the effect size as small, gives a power of just 0.13 (Faul et al., 2007). Hence, an interaction between the formation of habitual behaviours and food waste reduction should not be ruled out but investigated further. Fourth, it is important to recognise that this sample might have suffered from self-selection, as those who took part might have been interested in environmental causes and in reducing their households’ food waste to begin with. For example, the average weekly food waste reported during the first

month was 771.1g. This would roughly add up to 3084.4g per month. As previously discussed (see 1.5), 6.4 million tonnes of edible food are thrown away in the UK each year (Waste and Resources Action Programme, 2021); this amount corresponds to 8kg of food waste per capita per month. Therefore, the food waste amounts reported in this study were lower than expected, which might be an indication of self-selection. Future research may replicate this intervention by recruiting a sample as big and diverse as possible, and by selecting participants based on their demographic information, creating three intervention groups that are as similar as possible.

Although Control, Intervention A and Intervention B respectively saw a decline of 29.85%, 31.22% and 40.25% in their average food waste amounts between the beginning and the end of the intervention, these differences were not found to be statistically significant. This raises the question of whether the intervention materials had a relevant impact on behaviours, or whether the simple act of weighing one's food waste accounted for most of this decline in food waste. Additionally, this study did not measure participants' capability, opportunity and motivation before and after the study. It is therefore not possible to claim with certainty that the intervention materials influenced them. Future research should further investigate the impact of intervention materials such as letters and posters on food waste management behaviours and on participants' capability, opportunity, and motivation. Qualitative interviews and/or surveys may be conducted with participants before and after the intervention. For example, a survey containing questions on capability, opportunity and motivation relevant to the behaviour(s) of interest might be administered before and after the trial, and participants' answers might be assessed on a Likert scale (Baumann et al., 2022). The presence of statistically significant differences between pre-intervention and post-intervention scores would support the hypothesis that the intervention materials have affected capability, opportunity and motivation.

Although the design of the leaflet and the letter was informed by the COM-B model, the Behaviour Change Wheel and the Behaviour

Change Technique Taxonomy, which this model is mapped to (Michie et al., 2014), were not directly used to create these intervention components. Additionally, this study made assumptions regarding the possible barriers and enablers that could affect food waste behaviour, rather than testing them before constructing the intervention. Future research may conduct surveys and qualitative interviews to better understand what might be causing excessive food waste amounts, and what households might find useful to reduce them, and use this information to build more effective intervention instruments. This strategy, together with the use of the Behaviour Change Wheel and the Behaviour Change Technique Taxonomy (Michie et al., 2014), would allow for a more systematic approach to creating further behaviour change trials in this field.

Both the food waste questionnaires and the SRHI surveys relied on self-reports. When answering self-reports, people may want to appear consistent with their answers or may answer according to what they think is expected or socially desirable (Verplanken & Orbell, 2003). However, using an external source of food waste collection and measurement is costly, difficult to implement, and may disrupt participants' lifestyles more; habits would be practically impossible to study without self-reports.

This trial was conducted between the months of January and of May, with participants filling in their last weekly food waste questionnaire at the end of April. It is possible that participants' food preferences changed with the change of seasons, and that lighter meals were preferred in Spring compared to Winter. This may have contributed to a drop in food waste over the trial period, which was observed in all groups (Control as well). This study may be replicated for a longer period to test whether seasonality does in fact have an impact on households' food waste amounts.

Future research may also investigate additional means to help residents prevent food waste creation. For example, the provision of free compost bins and tips on how to use them may be considered: This could allow households to reuse their food scraps for gardening

purposes. Additionally, ways for residents to exchange unwanted food items before their expiry date may be promoted.

6.5 Summary

This study was successful at helping individuals reduce their food waste by increasing the following: their opportunity to engage with the issue through regular weighing; their psychological capability, motivation, competence, and autonomy through a leaflet with tips; and their psychological capability, motivation, relatedness, and awareness of their role as citizens through a letter. Between the baseline and the end of the intervention, all groups saw a reduction in their average monthly food waste amounts. The second intervention group also showed an increase in automaticity of the recommended behaviours which lasted past the end of the intervention. These results should encourage policymakers and local authorities to conduct similar interventions to help their residents improve their food waste management, thus reducing the negative environmental and economic impact of waste.

Chapter 7

Final discussion

7.1 The results of this thesis

The goal of this thesis was to enrich the research literature around sustainable food consumption by finding ways to encourage pro-environmental consumption behaviours.

The first study assessed what can influence consumers' judgments on food products and sustainability. I found that choice overload, that is having more options to choose from, makes individuals rely on labels more, with the result of their judgments improving in accuracy thanks to salient truthful labels, and decreasing in accuracy due to salient untruthful labels (also called distractors). Moreover, being overconfident about one's food sustainability knowledge was negatively linked to judgment accuracy. Being vegan was also negatively correlated with judgment accuracy.

The second study tested how making small changes to a restaurant menu can influence diners' choices. I found that removing the commonly seen "v" (for "vegetarian") and "pb" (for plant-based) symbols from the menu increased the sales of those dishes (both starters and mains). Replacing those symbols with "LE" (for "low emissions") and keeping the nudge hidden did not affect sales. However, making the nudge transparent by disclosing its purpose successfully increased sales of those starters.

The third study aimed at helping individuals reduce their food waste through regular measuring, a leaflet, and a letter, with the goal of fostering good habitual behaviours which can help maintain positive results over time. I found that regular measuring was related to a reduction in food waste. The treatment group which received both the leaflet and the letter showed a long-lasting increase in automaticity of

those recommended behaviours, suggesting that habit creation was successfully achieved during the tested period.

7.2 The importance of simple and direct communication

The positive results achieved through the illustrated studies suggest the importance of communication in shifting consumers' food choices towards more environmentally friendly ones. Previous findings suggest that providing general education may not be as effective at changing behaviours as delivering specific tips to the consumer: For example, suggesting product swaps to customers is more effective at reducing saturated fats in their diets compared to only educating consumers on what a healthy diet low in saturated fats looks like (Huang et al., 2006). Communication in the form of simple nudges which suggest to the consumers what food options to pick, such as a graphic green symbol or a low-emission label, are more likely to be effective than simply providing general education.

The EAST framework developed by the Behavioural Insights Team (Behavioural Insights Team, n.d.) suggests that when a behaviour wants to be encouraged, it should be made easy, attractive, social and timely. Examples of ways to make a behaviour easy are making it the default option, reducing the effort required to pursue it, and simplifying communication around it. It can be made attractive with images and colours, and by using rewards and sanctions correctly. The desired behaviour should be made seen as social by illustrating how most people perform it, by promoting collective action, and by encouraging individuals to make a commitment to each other. It can be made timely by prompting people when they are most likely to be receptive, considering the immediate costs and benefits, and helping people addressing the barriers preventing them from acting as desired. What simple nudges like labels do is they make the behaviour easy by making a certain food product or dish the default option through simple communication, therefore simplifying what it takes for the consumer to buy sustainably. Labels can be designed in a way that makes them attractive through images and colours. They prompt behaviour at the right time: Contrary to an educational session on environmentally

friendly diets which consumers may not remember of when they find themselves grocery shopping or dining in a restaurant, labels can inform or remind consumers then and there of how and why it is important to eat sustainably.

7.3 What do these results mean for policymakers and local authorities?

7.3.1 Labelling schemes

Front-of-pack (FOP) nutrition labels started being developed in 1980s as part of strategies to prevent obesity and other dietary diseases. In the EU, as of 2016, pre-packed food products are required to bear a nutrition declaration: This is generally found on the back of the item, and is formatted as a simple legible table. FOP labels may be added as well, but it is up to each Member State of the EU to develop their own nutritional schemes. FOP labels have become popular because they provide additional information to the consumer, helping them make healthier food choices, and they encourage food companies to reformulate products to get a better label. Two types of FOP labels exist: nutrient-specific labels and summary labels. Nutrient-specific labels generally give numerical information in the form of a table, and can be colour-coded. Summary labels are often either endorsement logos or graded indicators, and are mostly designed as symbols (include image examples). In the UK, a traffic light label (colour-coded nutrient-specific) can be found on many food products. This traffic light scheme was introduced in 2013, and it is meant to provide information on the content of fat, saturated fat, sugars and salt, and on the energy value per portion. The colours on the table indicate whether the food is low (green), medium (amber), or high (red) in the specific nutrient (European Commission, 2020).

FOP labels are meant to help consumers make healthier food choices, but whether they are effective in changing people's purchasing behaviour depends on multiple factors (European Commission, 2020; Kanter et al., 2018). For labels to work they need to attract the consumer's attention, be accepted (liked and trusted) by the buyer,

and be understood by the buyer (Grunert & Wills, 2007). According to the Joint Research Centre (2020), FOP labels can increase consumers' willingness-to-pay for healthy products, and can improve the nutritional quality of people's shopping baskets, but there are few real-life studies investigating their impact on actual purchasing behaviour. Some argue that FOP labels support health-conscious consumers (Finkelstein et al., 2018), and that different labels may work better with different types of consumers (Hamlin, 2015; Sanjari et al., 2017). The food category can also interact with the label's effectiveness: Consumers may ignore labels on unhealthy foods on purpose because they want to indulge (Talati et al., 2016).

FOP labels can also act as incentive for food companies to reformulate their products to be able to sell them with a healthy or healthier logo on them. However, a reformulation may backfire for the company if the consumer no longer enjoys the product and demand for it therefore declines. Fees and certification procedures can also discourage businesses from applying FOP labels, which is why some schemes are free. Even though these labelling schemes are required by the Food Information to Consumers Regulation to not create obstacles to the free movement of these goods in the EU, some manufacturers still argue that schemes used in a certain Member State may negatively affect the sales of these products in a different Member State. In the case of the UK traffic light scheme, some sectors are opposed to it because they believe the way the information is provided to the consumer is too judgmental and negatively affects the sales of products which cannot be reformulated much or at all, such as meat products (European Commission, 2020).

Another commonly seen label on food products is an organic label. As of now (2023), packages of UK products may present an organic logo, such as the organic logo of the Soil Association, if they meet the requirements imposed by that particular UK organic control body. UK products may also present the EU organic logo, however, this is not compulsory, and not necessarily possible if the product does not meet the EU requirements (UK Government, 2023). As previously discussed

(see Chapter 2.6), organic labels can increase WTP and create a halo effect by which the product is evaluated better in terms of nutrition, safety, brand attitude, and brand trust, compared to its standard alternative. However, as discussed in Chapter 1, even if a product is organic, it cannot be considered strictly more environmentally friendly than its standard alternative.

A FOP sustainability-related scheme could be created to achieve similar results to FOP health labels and organic labels: increase the likability of sustainable products; inform consumers on which products are more environmentally friendly and encourage them to purchase them; incentivise producers to improve their products, creating more sustainable alternatives. Study 1 suggested how consumers may find it harder to distinguish between accurate and non-accurate information when faced with many options. Therefore, policymakers should consider creating a sustainability-related labelling scheme which is based on clearly defined and science-informed criteria to guarantee trustworthiness. Study 2 showed how a transparent nudge can not only be effective, but can even be more effective than its non-transparent alternative. Because previous research suggests that consumers prefer to be left autonomous in their decision-making, and nudges are often criticised for being paternalistic (see 2.5), policymakers may consider making a transparent sustainability-related label, whereby a small message may be added to the product packaging explaining either the possible influence of the label or its purpose (Bruns et al., 2018).

Nonetheless, it should be noted that a sustainability label will not exist in isolation but would be placed alongside other labels and texts on product packaging. More research should therefore be conducted on how consumers integrate different sets of information, and how this has an impact on their purchase decisions. Additionally, this calls for an integrated approach where health considerations and sustainability considerations should be made together. As previously discussed, reducing consumption of red meat, and increasing consumption of fruits, vegetables, and legumes, might be encouraged for both health

and sustainability reasons (Ritchie et al., 2022; Springmann et al., 2021; see 1.3). However, great care should be taken when placing both health and sustainability logos on packaging as to avoid confusing consumers with labels that might discourage consumption of a certain product for one reason, but encourage it for another.

7.3.2 Taxes and international agreements

The results from study 2 also show how the way businesses market their dishes and food products can have a big impact on consumers' consumption choices. Marketing strategies like adding or removing labels are low-cost and effective. Businesses could therefore have a pivotal role in steering food consumption choices towards more sustainable ones. However, the question is whether they would be willing to change their offer and marketing strategy. Although demand for plant-based substitutes has increased (Šimčikas, 2018) (see 2.3.5), meat consumption has also increased (see 1.3). If a business' profits rely mostly on meat-based and fish-based products, they may not be willing to prioritise sales of vegetarian and plant-based dishes.

Governments could consider taxing emissions on the production side but, if this was implemented only at a local level, it may backfire (see 2.4). It would therefore be necessary for international agreements to be made to regulate production of foods with high environmental impact. Taxing consumers, to reduce demand directly, could also be considered (see 2.4). Taxation of sugary foods and drinks, for example, has been shown to improve consumers' health, and reduce healthcare costs associated with excess sugar consumption (Liu et al., 2022). Nevertheless, the introduction of a tax on consumers might only bring moderate benefits, and should be combined with other strategies such as labelling interventions (Fichera et al., 2021).

7.3.3 Waste initiatives

In the UK, various organisations and local authorities have been promoting waste initiatives. WRAP, for example, works with both the government and business to reduce the amount of food waste produced. The Courtauld Commitment 2030 is WRAP's initiative to

achieve a 50% per capita reduction in food waste by 2030 (Waste and Resources Action Programme, n.d.a), compared to the UK 2007 baseline; achieve a 50% absolute reduction in greenhouse gas emissions coming from food consumption compared to 2015 baseline; and source 50% of fresh food from areas where water is sustainably managed. In order to achieve the desired food waste reduction, WRAP encourages businesses to incorporate regular measuring into their practices, and to take action by collaborating with supply chain partners and supporting citizens to reduce food waste (WRAP, n.d.b).

Local councils which were previously not providing a food waste collection service have been trialling food waste recycling schemes. For example, Westminster City Council conducted a pilot study where they trialled their food waste recycling service with a few residents first. Focus-group sessions were also conducted to find out more about how residents felt in regard to this new recycling service. Some of the residents who were interviewed admitted the following: They were sceptical towards the council (for example, they were not sure the council would dispose of their food waste and recycling properly); they wanted to receive feedback on how their food waste and recycling can make a difference after being collected; and they maybe felt even less guilty about producing food waste after the food waste collection service was introduced. In addition to this, the report highlighted the following problem: Some residents had misconceptions about the food waste service that led them to dispose of their food waste in the wrong way (e.g., some people believed that food waste would be used to feed livestock, hence avoided putting any meat components in the food waste bin) (Westminster City Council, 2020).

Study 3 showed how simple and inexpensive interventions can make a big difference in people's waste behaviour. The results from WCC's trial show how clear communication is essential: The impact of food waste on the environment is a complex issue, and so are the disposal and recycling methods used. Helping residents understand why it is important to reduce food waste and how their local council disposes of food waste is key. Simple interventions such as the ones adopted in

study 3, like sharing food waste reduction tips and sending messages to residents, can make a difference. Local authorities can replicate study 3, and should consider the EAST framework, making food waste reduction and recycling behaviour: easy, for example by sharing tips; attractive, for example by highlighting not only the positive impact on the environment but the chance to save money; social, for example by highlighting individuals' responsibility as citizens (as in study 3) and by encouraging residents to take part in collective initiatives; timely, for example by sending reminders around food recycling collection dates.

7.4 What do these results mean for consumers?

Consumers who are interested in eating more sustainably may create their own prompts and reminders to start incorporating positive behaviours in their daily routines. For example, measuring your own food waste on a regular basis for a period may make you more aware of how much you are buying and then throwing away. You may wish to take note of what items you are throwing away the most of, and adjust your grocery shopping accordingly, which would then allow you to both save money and waste less. Writing down some notes, such as ways to use leftovers, and making them visible in your kitchen may help you remember what to do at the right time.

The letter in the waste study also played a part in encouraging households to reduce their food waste. Because the letter encourages households to recognize their role as citizens in addressing the food waste problem, a way to act on this without the need for an intervention would be to sign up to a collective initiative or create one with friends, where everyone makes a commitment to try reduce their food waste, and individuals within the group can share tips with each other, and make each other accountable.

Although FOP sustainability labels are not currently used on food packaging, if an individual was interested in reducing the environmental footprint of their diet, a good rule of thumb would be to try and incorporate some vegetarian and vegan meals into their diets, and cut their beef consumption. Vegan products can be easily

identified thanks to the Vegan Trademark (see Figure 13) (Vegetarian Society, n.d.). Taking part in initiatives such as Veganuary may also be helpful for consumers to learn more about eating meat-free whilst feeling part of a community.

Figure 26. Vegan trademark (Vegetarian Society, n.d.).

7.5 General discussion

7.5.1 Strengths of behavioural science and this thesis

Behavioural science has, so far, shown promising results in various fields of research, including health, sustainability, education, and criminal justice (Cadario & Chandon, 2020; Damgaard & Nielsen, 2018; Ferrari et al., 2019; Fishbane et al., 2020; Hallsworth, 2023). Behavioural science can, in fact, not only be adopted as a tool, but also as a lens to better look at both public and private sector issues: It can be used to enhance policies; it can be used to create new interventions, but also help reassess existing efforts; and it can be integrated into an organization's core activities (Hallsworth, 2023). Behavioural science has indeed caught the attention of governments and international organizations, which are now promoting its use. For example, in 2010, the UK government set up the Behavioural Insights Team, now an independent organization which has run more than 1000 projects so far (Behavioural Insights Team, n.d.). At a global level, the World Health Organization now supports and encourages the use of behavioural science to address various issues of public health, including prevention and management of alcohol and drug use, as well as tropical diseases and HIV (World Health Organization, 2022).

This thesis investigated how behavioural science can help us switch towards more sustainable food consumption choices. Three studies

were conducted, aiming to address the following: how consumers evaluate food products in terms of sustainability, and whether symbols on product packaging can affect their judgments; how different labels on a restaurant menu can influence diners' choices; and how an intervention can help residents reduce their households' avoidable food waste. This research provided support to the use of behavioural science interventions to encourage more environmentally friendly food consumption practices. The first study showed the relevance of symbols on product packaging, and how these can have a big impact on consumers' perceptions of food products. These results hint to the potential role that a sustainability front-of-pack label, designed similarly to a nutrition declaration, could have in addressing the issue of unsustainable food consumption. This therefore suggests the role of governments in promoting the use of green labels, whilst regulating sustainability schemes and fighting greenwashing. The second study showed how simple changes to a menu can influence customers' food choices. It was also the first real world trial that suggests that vegetarian and plant-based symbols on menus may have a negative impact on the popularity of those dishes. These results indicate the important role of businesses such as restaurants and cafes in influencing food consumption choices. Finally, the third study shows how simple behaviour change interventions can help households cut down on food waste. For example, the simple act of weighing one's food waste might be enough to create behaviour change. This piece of research was conducted in partnership with Westminster City Council, and these results show how local government authorities could take simple actions to tackle excessive food waste in their areas.

7.5.2 Limitations of behavioural science and this thesis

According to Mangal and Mangal (2013), behavioural science research suffers from a few limitations. One of them relates to the nature of what it is investigating: human behaviour. Human behaviour is dynamic, unpredictable, and complex. Additionally, constructs such as personality, intelligence and emotions do not have material existence, and for this reason cannot be investigated with the same

rigor as physical scientists would research the properties and functions of materials such as copper. Two issues follow: the difficulty with which studies and research are replicated, and the difficulty to generalize results. Another limitation concerns the difficulty in selecting and creating appropriate techniques and tools to conduct the research. For example, relying on answers from a questionnaire creates doubts regarding the reliability of the research. Similarly, it is difficult for researchers in this field to keep their studies objective: From the design of the research to the analysis and interpretation of the data, behavioural science research is inherently objective. Finally, selecting participants for the research and seeking their cooperation is challenging. For example, it is difficult to be sure that your sample is representative of the general population (Mangal & Mangal, 2013).

Similar limitations can be found in the research presented in this thesis. It is difficulty to say with certainty if all the results of this work can be replicated and generalised. For example, the positive impact of the labels applied to the restaurant menu on the sales of vegetarian and plant-based dishes (Chapter 4) might change if this study were to be conducted in a different setting (different type of restaurant, different type of clientele, different city, different country). The online experiment created for the first study of this thesis (Chapter 3), and the intervention materials created for the third study of this thesis (Chapter 6), were created in a way that was considered appropriate to investigate the research questions of interest. However, the content and design of these can be considered subjective; had other researchers conducted similar studies, they might have created different types of questionnaires and/or intervention materials. The second and third study (Chapter 4 and Chapter 6) especially suffered from the difficulty of either finding research partners or recruiting participants, and of seeking cooperation from them. Before establishing a partnership with the two restaurants which made the second study possible, multiple enquiries were sent to other shops and restaurants, which were either not interested in collaborating or could not cooperate. As far as the third study is concerned, not only it is possible that the recruited

sample suffered from self-section (as discussed in 6.4.2), but some participants also dropped out during the study. The experiment, in fact, required the participants to commit to this research for five months.

This thesis also focused on nudges as both a concept and effective tool in behavioural science. However, despite nudges having the potential to be both effective and low cost, as suggested by the results of this thesis, their use has been questioned mainly due to two reasons (Sunstein, 2017). Firstly, they are meant to "make people better off, as judged by themselves" (Thaler & Sunstein, 2008, p. 5). How can you be sure that the outcome you are trying to achieve with a nudge would have been sought by the decision-maker to begin with? Secondly, do people really want to be nudged? These two criticisms have been answered by Sunstein (2017) as follows. Nudges generally aim to induce positive outcomes, such as healthy lifestyles, which people in numerous nations, including the UK, would endorse. There are also cases where choosers suffer from self-control problems and, despite them having had a different preference to begin with, they will be possibly grateful that their preference then changed thanks to a nudge (Sunstein, 2017). This thesis also explored the issue of whether a nudge can be considered ethically acceptable or not, and a transparent nudge was tested as an alternative to a hidden nudge in study 2. As discussed in Chapter 5, the hidden nudge, which disclosed the purpose of the new label "LE", was found to be effective. However, literature on transparent nudges is still emerging, and more research will be needed to reach a conclusion as to whether transparent nudges are always successful in achieving the desired outcome.

7.5.3 Alternative research focus and methods

This thesis aimed to explore the question "How can we encourage more sustainable food consumption choices?" by conducting three studies, each focusing on a different stage of consumption (pre-purchase, purchase, and post-purchase) (Tsiotsou & Wirtz, 2015). An alternative method to explore this field of research could have been to select one of the three stages of consumption, and conduct three studies investigating behaviours relevant to that specific stage. For

example, had the first stage (pre-purchase) been selected, other research methods, such as qualitative interviews and/or surveys, could have been conducted to explore consumers' opinions and reactions towards different kinds of sustainability labels. Had the second stage (purchase) been selected, multiple trials could have been conducted in different locations and settings, that is not only in restaurants, but also in shops, bars and canteens. However, it is important to recognise that conducting this kind of research in shops and restaurants proved difficult. Firstly, it was difficult to strike a collaboration with a business that would be willing to run a behavioural trial on their premises. Secondly, there might be specific reasons why shops cannot contribute to this kind of research. For example, the manager of a supermarket in London, which is part of a big chain of stores in the country, explained that it would be difficult for them to partner on this research as brands pay for their products to be displayed in a certain way in the shop. Hence, conducting a piece of research testing the impact of choice architecture on consumers' choices would have not been possible. Additionally, a partnership with a smaller and independent shop was indeed formed, but the data provided by this store was not enough to conduct an in-depth and sound statistical analysis, and was therefore not discussed in this thesis. Finally, had the third stage (post-purchase) been selected, qualitative interviews and surveys could have been conducted to better understand what might be causing excessive food waste in people's homes, and what could help households cut down on their food waste. However, recruiting big and diverse samples of people to participate in food waste trials is challenging, as shown by the limitations related to the sample of study 3. Therefore, this field of research could have been explored differently, however, alternative approaches might have suffered from other limitations as well.

7.5.4 Future research

Notwithstanding the challenges that conducting behavioural science research in the field of sustainable food consumption entails, future research could build on the results from this thesis and investigate the

question “How can we encourage more sustainable food consumption choices?” further. Firstly, more research should be conducted on the impact of labels on product packaging and on menus. Similar studies to the ones presented in this thesis should be run in a variety of different settings. This would allow for more generalizable conclusions to be drawn. More research should also be conducted on the challenges faced, not only by households, but by businesses as well, with regards to the production of excessive food waste. The results from these studies could then inform policies and strategies of governments and international organizations working towards making food consumption more sustainable. A front-of-pack sustainability label may be developed to help and encourage consumers to shop and eat more sustainably. Local government offices may directly either collaborate on food waste research projects or take the results of these studies to inform their climate emergency strategies.

Future research should also investigate the issue of unsustainable food production. Research on food sustainability should, in fact, not only be focused on what can be done on the consumer side, but what can also be done on the production side. Furthermore, this thesis focused on sustainability with an environmental lens. However, there are other issues concerning food sustainability that should be considered: naturalness, food safety, and animal welfare (Oosterveer & Spaargaren, 2007). Additionally, we should also be working towards achieving a food system that can guarantee food security, defined as availability, access, utilization, and stability (FAO, 2006).

Finally, the issues of unsustainable food production and consumption are complex and multi-faceted, and should therefore be investigated with an interdisciplinary and varied approach. Different theories and methodologies, and approaches other than one grounded in behavioural science as this body of work, should be considered.

7.5.5 Conclusion

This research aimed to contribute to the emerging body of work on food consumption and sustainability. Theories and methodologies

from behavioural science were used to address the question “How can we encourage more sustainable food consumption choices?”. Three experiments were conducted in a variety of settings. The first one took place online, and investigated the impact of a green label on consumers’ sustainability judgments in Italy and the UK. The second one took place in two restaurants in London, and investigated the impact of different labels on diners’ food choices in a restaurant. The third one was conducted in partnership with Westminster City Council, and tested ways of helping households reduce their avoidable food waste. The results of this thesis highlight the role of communication in shaping consumers’ choices, and of behavioural science as a potential instrument to tackle unsustainable food consumption practices. Future research may conduct further studies in the fields of sustainability and food consumption, possibly targeting unsustainable food production practices as well.

References

Abadie, L. M., Galarraga, I., Milford, A. B., & Gustavsen, G. W. (2016). Using food taxes and subsidies to achieve emission reduction targets in Norway. *Journal of Cleaner Production*, *134*, 280-297. https://doi.org/10.1016/j.jclepro.2015.09.054

Agrifood Monitor. (n.d.). *Food consumption.* https://www.agrifoodmonitor.it/en/food-consumption/

Ahrens, S., Bosch-Rosa, C., & Kassner, B. (2021). *Overconfidence and the political and financial behaviour of a representative sample.* (Discussion Paper No. 283). https://www.econstor.eu/handle/10419/244323

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes, 50,* 179-211. https://doi.org/10.1016/0749-5978(91)90020-T

Allison, A. L., Lorencatto, F., Michie, S., & Miodownik, M. (2021). Barriers and Enablers to Buying Biodegradable and Compostable *Plastic Packaging. Sustainability*, *13*, 1463. https://doi.org/10.3390/su13031463

Allison, A. L., Lorencatto, F., Michie, S., & Miodownik, M. (2022). Barriers and enablers to food waste recycling: A mixed methods study amongst UK citizens. *International Journal of Environmental Research and Public Health*, *19*, 2729. https://doi.org/10.3390/ijerph19052729

Allison, A. L., Purkiss, D., Lorencatto, F., Miodownik, M., & Michie, S. (2022). Improving compostable plastic disposal: An application of the Behaviour Change Wheel intervention development method. *Frontiers in Sustainability*, *3*, 968152. https://doi.org/10.3389/frsus.2022.968152

Alter, A. L., & Oppenheimer, D. M. (2009). Uniting the Tribes of Fluency to Form a Metacognitive Nation. *Personality and Social Psychology Review, 13*(3), 219–35. https://doi.org/10.1177/1088868309341564

Ammann, J., Arbenz, A., Mack, G., Nemecek, T., & Benni, N. E. (2023). A review on policy instruments for sustainable food consumption. *Sustainable Production and Consumption*, *36*, 338-353. https://doi.org/10.1016/j.spc.2023.01.012

Ananno, A. A., Masud, M. H., Chowdhury, S. A., Dabnichki, P., Ahmed, N., & Arefinm A. Md. E. (2021). Sustainable food waste management model for Bangladesh. *Sustainable Production and Consumption*, *17*, 35-51. https://doi.org/10.1016/j.spc.2020.10.022

Anderson, E. S., Winett, R. A., Bickley, P. G., Walberg-Rankin, J., Moore, J. F., Leahy, M., Harris, C. E., Gerkin, R. E. (1997). The effects of a multimedia system in supermarkets to alter shoppers' food purchases. *Journal of Health Psychology, 2*(2), 209-223. https://doi.org/10.1177/135910539700200217

Andrieş, A. M., & Walker, S. (2023). When the message hurts: The unintended impacts of nudges on saving. *Journal of Comparative Economics*, *51*(2), 439-456. https://doi.org/10.1016/j.jce.2023.01.002

Arad, A., & Rubinstein, A. (2018). The people's perspective on libertarian-paternalistic policies. *Journal of Law and Economics*, *61*(2), 311-333. https://doi.org/10.1086/698608

Ariyani, L., & Ririh, K. R. (2020). Understanding behavior of household food waste management: Food waste hierarchy context. *Jurnal Ilmiah Teknik Industri*, ISSN: 2460-4038. https://doi.org/10.23917/jiti.v19i2.11994

Arkes, H. R. (1981). Impediments to accurate clinical judgment and possible ways to minimize their impact. *Journal of Consulting and Clinical Psychology*, *49*, 323–330. https://doi.org/10.1037/0022-006X.49.3.323

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

Baldassare, M., & Katz, C. (1992). The personal threat of environmental problems as predictor of environmental practices.

Environment and Behavior, 24, 602-616. https://doi.org/10.1177/0013916592245002

Ball, R., & Lawson, S. M. (1990). Public attitudes towards glass recycling in Scotland. *Waste Management and Research, 8,* 177-182. https://doi.org/10.1177/0734242X9000800135

Bamberg, S., & Möser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behavior. *Journal of Environmental Psychology, 27*(1), 14-25. https://doi.org/10.1016/j.jenvp.2006.12.002

Bamberg, S., Hunecke, M., & Blöbaum, A. (2007). Social context, personal norms and the use of public transportation: Two field studies. *Journal of Environmental Psychology, 27*(3), 190-203. https://doi.org/10.1016/j.jenvp.2007.04.001

Bansal, P. & Roth, K. (2000). Why companies go green: A model of ecological responsiveness. *Academy of Management Journal*, *43*(4), 717–736. https://doi.org/10.2307/1556363

Barber, B. M. & Odean, T. (2008) All that Glitters: The Effect of Attention and News on the Buying Behavior of Individual and Institutional Investors. *The Review of Financial Studies*, *21*, 785-818. https://doi.org/10.1093/rfs/hhm079

Barr, S. (2007). Factors influencing environmental attitudes and behaviors. A U.K. case study of household waste management. *Environment and Behavior, 39*(4), 435-473. https://doi.org/10.1177/0013916505283421

Bauer, J. M., Aarestrup, S. C., Hansen, P. G., & Reisch, L. A. (2022). Nudging more sustainable grocery purchases: Behavioural innovations in a supermarket setting. *Technological Forecasting & Social Change*, *179*, 121605. https://doi.org/10.1016/j.techfore.2022.121605

Baumann, A. A., Woodward, E. N., Singh, R. S., Adsul, P., & Shelton, R. C. (2022). Assessing researchers' capabilities, opportunities, and motivation to conduct equity-oriented dissemination and

implementation research, an exploratory cross-sectional study. *BMC Health Services Research*, *22*, 731. https://doi.org/10.1186%2Fs12913-022-07882-x

Behavioural Insights Team. (n.d.). *Who we are*. https://www.bi.team/about-us-2/who-we-are/

Behavioural Insights Team. (2014). *EAST. Four simple ways to apply behavioural insights.* https://www.bi.team/wp-content/uploads/2015/07/BIT-Publication-EAST_FA_WEB.pdf

Behavioural Insights Team. (2020). *A menu for change.* https://www.bi.team/publications/a-menu-for-change/

Bergeron, S., Doyon, M., Saulais, L., & Labrecque, J. (2019). Using insights from behavioral economics to nudge individuals towards healthier choices when eating out: A restaurant experiment. *Food Quality and Preference*, *73*, 56-64. https://doi.org/10.1016/j.foodqual.2018.12.001

Bernstad, A., & Andersson, T. (2015). Food waste minimization from a life-cycle perspective. *Journal of Environmental Management*, *147*, 219–226. https://doi.org/10.1016/j.jenvman.2014.07.048

Bernstad, A., & la Cour Jansen, J. (2011). A life cycle approach to the management of household food waste – A Swedish full-scale study. *Waste Management*, *31*, 1879-1896. https://doi.org/10.1016/j.wasman.2011.02.026

Bollinger, B., Leslie, P., & Sorensen, A. (2011). Calorie Posting in Chain Restaurants. *American Economic Journal: Economic Policy*, *3*, 91-128. https://doi.org/10.1257/pol.3.1.91

Bonaccorsi, G. (2015). Food and human behaviour: consumption, waste and sustainability. *Journal of Public Health Research, 4*(606), 133-134. https://doi.org/10.4081/jphr.2015.606

Bovens, L. (2009). The Ethics of Nudge. In T. Grüne-Yanoff, & S. O. Hansson (Eds.), *Preference Change. Theory and Decision Library* (Vol.

42, pp. 207–219). Springer. https://doi.org/10.1007/978-90-481-2593-7_10

Brehm, J. W. (1966). *A theory of psychological reactance*. Academic Press.

Britannica. (2023). *Eutrophication*. https://www.britannica.com/science/eutrophication

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

Bruns, H., & Kantorowicz-Reznichenko, E. (2018). Can nudges be transparent and yet effective? *Journal of Economic Psychology*, *65*, 41-59. https://doi.org/10.1016/j.joep.2018.02.002

Bryant, C. J. (2022). Plant-based animal product alternatives are healthier and more environmentally sustainable than animal products. *Future Foods*, *6*, 100174. https://doi.org/10.1016/j.fufo.2022.100174

Buhrmester, M., Kwang, T., & Gosling, S. D. (2011). Amazon's Mechanical Turk: A New Source of Inexpensive, Yet High-Quality, Data? *Perspectives on Psychological Sciences*, *6*(1), 3–5. https://doi.org/10.1177/1745691610393980

Buratto, A., & Lotti, L. (2023). The impact of salient labels and choice overload on sustainability judgments: An online experiment investigating consumers' knowledge and overconfidence. *Food Quality and Preference*, *107*, 104846. https://doi.org/10.1016/j.foodqual.2023.104846

Burgess, J., Harrison, C. M., & Filius, P. (1998). Environmental communication and the cultural politics of environmental citizenship. *Environment and Planning A: Economy and Space, 30,* 1445-1460. https://doi.org/10.1068/a301445

Cadario, R. & Chandon, P. (2020). Which healthy eating nudges work best? A meta-analysis of field experiments. *Marketing Science*, *39*, 465–486. https://doi.org/10.1287/mksc.2018.1128

Camerer C. F., Loewensein G., & Rabin M. (2004). *Advances in behavioral economics.* Princeton University Press & Russell Sage Foundation.

Castellan, N. J. (1977). Decision-making with multiple probabilistic cues. In N. Castellan, J. Pisoni, & M. Potts (Eds.), *Cognitive Theory* (Vol. 2, pp. 117-146). Erlbaum.

Castellini, G., Savarese, M., Castiglioni, C., & Graffigna, G. (2020). Organic food consumption in Italy: The role of subjective relevance of food as mediator between organic food choice motivation and frequency of organic food consumption. *Sustainability, 12*, 5367. https://doi.org/10.3390/su12135367

Chai, B. C., van der Voort, J. R., Grofelnik, K., Eliasdottir, H. G., Klöss, I., & Perez-Cueto, F. J. A. (2019). Which Diet Has the Least Environmental Impact on Our Planet? A Systematic Review of Vegan, Vegetarian and Omnivorous Diets. *Sustainability*, *11*(15), 4110. https://doi.org/10.3390/su11154110

Champions 12.3. (n.d.). *Target 12.3.* https://champions123.org/target-123

Chan, K. (1998). Mass communication and pro-environmental behavior: Waste recycling in Hong Kong. *Journal of Environmental Management, 52,* 317-325. https://doi.org/10.1006/jema.1998.0189

Chen, H., Jiang, W., Yang, Y., Yang, Y., & Man, X. (2017). State of the art on food waste research: a bibliometrics study from 1997 to 2014. *Journal of Cleaner Production*, *140*, 840–846. https://doi.org/10.1016/j.jclepro.2015.11.085

Chen, M., Yin, S., Xu, Y., & Wang, Z. (2015). Consumers' willingness to pay for tomatoes carrying different organic labels: Evidence from auction experiments. *British Food Journal, 117*(11), 2814-2830. https://doi.org/10.1108/BFJ-12-2014-0415

Chen, Y., Lee, B-F., & Lu, Y-C. (2021). Fitnesser's Intrinsic Motivations of Green Eating: An Integration of Theory of Planned Behavior and Hedonic-Motivation System Adoption Model. *Frontiers in Psychology*, *12*, 670243. https://doi.org/10.3389/fpsyg.2021.670243

Chuck, C., Fernandes, S. A., & Hyers, L. L. (2016). Awakening to the politics of food: politicized diet as social identity. *Appetite*, *107*, 425-436. https://doi.org/10.1016/j.appet.2016.08.106

Clark, M., & Tilman, D. (2017). Comparative analysis of environmental impacts of agricultural production systems, agricultural input efficiency, and food choice. *Environmental Research Letters*, *12*(6), 064016. https://doi.org/10.1088/1748-9326/aa6cd5

Cohen, J. F. W., Richardson, S., Parker, E., Catalano, P. J., & Rimm, E. B. (2014). Impact of the new U.S. department of agriculture school meal standards on food selection, consumption, and waste. *American Journal of Preventive Medicine*, *46*, 388–394. https://doi.org/10.1016/j.amepre.2013.11.013

Cooper, A. C., Folta, T. B., & Woo, C. (1995). Entrepreneurial information search. *Journal of Business Venturing*, *10*, 107–120. https://doi.org/10.1016/0883-9026(94)00022-M

Competition Bureau of Canada. (2008). *Environmental Claims: A Guide for Industry and Advertisers.* Government of Canada Queen's Printer.

Coudard, A., Corbin, E., de Koning, J., Tukker, A., & Mogollón, J. M. (2021). Global water and energy losses from consumer avoidable food waste. *Journal of Cleaner Production*, *326*, 129342. https://doi.org/10.1016/j.jclepro.2021.129342

Crippa, M., Solazzo, E., Guizzardi, D., Monforti-Ferrario, F., Tubiello, F. N., & Leip, A. (2021). Food systems are responsible for a third of global anthropogenic GHG emissions. *Nature Food*, *2*, 198–209. https://doi.org/10.1038/s43016-021-00225-9

Damgaard, M. T. & Nielsen, H. S. (2018). Nudging in education. *Economics of Education Review*, *64*, 313–342. https://doi.org/10.1016/j.econedurev.2018.03.008

Dasgupta, P. (2021). *The Economics of Biodiversity: the Dasgupta Review.* HM Treasury. https://bibliotecadigital.ciren.cl/handle/20.500.13082/32687

Dawson, C. J., & Hilton, J. (2011). Fertilizer availability in a resource-limited world: Production and recycling of nitrogen and phosphorus. *Food Policy*, *36*, S14–S22. https://doi.org/10.1016/j.foodpol.2010.11.012

De Haen, H., & Réquillart, V. (2014). Linkages between sustainable consumption and sustainable production: Some suggestions for foresight work. *Food Security,* *6*(1), 87-100. https://doi.org/10.1007/s12571-013-0323-3

de Sadeleer, I., Brattebø, H., & Callewaert, P. (2020). Waste prevention, energy recovery or recycling – Directions for household food waste management in light of circular economy policy. *Resources, Conservation & Recycling*, *160*, 104908. https://doi.org/10.1016/j.resconrec.2020.104908

De Vaan, J. M., van Steen, T., & Müller, B.C. N. (2019). Meat on the menu? How the menu structure can stimulate vegetarian choices in restaurants. *Journal of Applied Social Psychology*, *49*(12), 755-766. https://doi.org/10.1111/jasp.12632

De Young, R. (1986). Some psychological aspects of recycling: the structure of conservation satisfactions. *Environment and Behavior, 18,* 435-449. https://doi.org/10.1177/0013916586184001

Deci, E. L., & Ryan, R. M. (2000). The “What” and “Why” of Goal Pursuits: Human Needs and the Self-Determination of Behavior. *Psychological Inquiry,* *11*(4), 227-268. https://doi.org/10.1207/S15327965PLI1104_01

Department for the Environment, Food & Rural Affairs. (2019). *Organic farming statistics 2018.*

https://www.gov.uk/government/statistics/organic-farming-statistics-2018

Department for the Environment, Food and Rural Affairs. (2017). *Food statistics pocketbook 2016.* https://www.gov.uk/government/statistics/food-statistics-pocketbook-2016

Department for the Environment, Food and Rural Affairs. (2020). *UK statistics on waste.* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/874265/UK_Statistics_on_Waste_statistical_notice_March_2020_accessible_FINAL_rev_v0.5.pdf

Devaney, L., & Davies, A. R. (2017). Disrupting household food consumption through experimental HomeLabs: outcomes, connections, contexts. *Journal of Consumer Culture, 17,* 823–844. https://doi.org/10.1177/1469540516631153

Dolan, P., Hallsworth, M., Halpern, D., King, D., Metcalfe, R., & Vlaev, I. (2012). Influencing behaviour: The mindspace way. *Journal of Economic Psychology*, *33*, 264-277. https://doi.org/10.1016/j.joep.2011.10.009

Doran, J. W., & Parkin, T. B. (1994). Defining and assessing soil quality. In J. W. Doran, D. C. Coleman, D. F. Bezdicek, & B. A. Stewart (Eds.), *Defining Soil Quality for a Sustainable Environment* (pp. 3-21). Soil Science Society of America. https://doi.org/10.2136/sssaspecpub35

EAT. (n.d.). *The Planetary Health Diet.* EAT. https://eatforum.org/eat-lancet-commission/the-planetary-health-diet-and-you/

Edwards, W. (1968). Conservatism in human information processing. In B. Kleinmuntz (Ed.), *Formal representation of human judgment* (pp. 17– 52). Wiley.

Ellison, B., Duff, B. R. L., Wang, Z., & White, T. B. (2016). Putting the organic label in context: Examining the interactions between the organic label, product type, and retail outlet. *Food Quality and*

Preference, 49, 140-150. https://doi.org/10.1016/j.foodqual.2015.11.013

European Commission. (2015, December 2). *Closing the loop: commission adopts ambitious new Circular Economy Package to boost competitiveness, create jobs and generate sustainable growth* [Press release]. https://ec.europa.eu/commission/presscorner/detail/en/IP_15_6203

European Commission. (2020). *Report from the Commission to the European Parliament and the Council regarding the use of additional forms of expression and presentation of the nutrition declaration.* https://food.ec.europa.eu/system/files/2020-05/labelling-nutrition_fop-report-2020-207_en.pdf

Evans, D., McMeekin, A., & Southerton, D. (2012). Sustainable Consumption, Behaviour Change Policies and Theories of Practice. *COLLeGIUM, 12,* 113-129.

Fasolo, B., McClelland, G. H., & Lange, K. A. (2005). The effect of site design and interattribute correlations on interactive web-based decisions. In C. P. Haugtvedt, K. Machleit, & R. Yalch (Eds.), *Online consumer psychology: underdstanding and influencing behavior in the virtual world* (pp. 325-344). Lawrence Erlbaum Associates.

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39,* 175-191. https://doi.org/10.3758/BF03193146

FederDistribuzione & PWC. (2021). *Osservatorio Federdistribuzione. Consumi, nuove abitudini d'acquisto e stili di vita.* https://www.federdistribuzione.it/app/uploads/2021/07/Osservatorio-Federdistribuzione_Consumi_v.3.0.pdf

Felsen, G., Castelo, N., & Reiner, P. B. (2013). Decisional enhancement and autonomy: Public attitudes towards overt and covert nudges. *Judgment and Decision Making, 8*(3), 202-213. https://doi.org/10.1017/S1930297500005933

Ferrari, L., Cavaliere, A., De Marchi, E. & Banterle, A. (2019). Can nudging improve the environmental impact of food supply chain? A systematic review. *Trends in Food Science and Technology*, *91*, 184–192. https://doi.org/10.1016/j.tifs.2019.07.004

Fichera, E., Mora, T., Lopez-Valcarcel, B. G., & Roche, D. (2021). How do consumers respond to “sin taxes”? New evidence from a tax on sugary drinks. *Social Science & Medicine*, *274*, 113799. https://doi.org/10.1016/j.socscimed.2021.113799

Finkelstein, E. A. A., Li, W. Y., Melo, G., Strombotne, K., & Zhen, C. (2018). Identifying the effect of shelf nutrition labels on consumer purchases: results of a natural experiment and consumer survey. *American Journal of Clinical Nutrition*, *107*(4), 647–651. https://doi.org/10.1093/ajcn/nqy014

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behavior: An introduction to theory and research.* Addison-Wesley.

Fishbane, A., Ouss, A. & Shah, A. K. (2020). Behavioral nudges reduce failure to appear for court. *Science*, *370*, eabb6591. https://doi.org/10.1126/science.abb6591

Foley, J. A., Ramankutty, N., Brauman, K. A., Cassidy, E. S., Gerber, J. S., Johnston, M., Mueller, N. D., O’Connell, C., Ray, D.K., & West, P.C. (2011). Solutions for a cultivated planet. *Nature*, *478*, 337-342. https://doi.org/10.1038/nature10452

Food and Agriculture Organization of the United Nations (FAO). (2006). *Policy Brief. Food Security.* Retrieved from http://www.fao.org/fileadmin/templates/faoitaly/documents/pdf/pdf_Food_Security_Cocept_Note.pdf

Food and Agriculture Organization of the United Nations (FAO). (2011). *Global food losses and food waste.* http://www.fao.org/3/a-i2697e.pdf

Food and Agriculture Organization of the United Nations (FAO). (2013). *Food wastage footprint. Impact on natural resources. Summary Report.* http://www.fao.org/3/i3347e/i3347e.pdf

Food and Agriculture Organization of the United Nations (FAO). (2017). *Water for Sustainable Food and Agriculture.* http://www.fao.org/3/a-i7959e.pdf

Food and Agriculture Organization of the United Nations (FAO). (2018a) *The state of food security and nutrition in the world*. http://www.fao.org/3/I9553EN/i9553en.pdf

Food and Agriculture Organization of the United Nations (FAO). (2018b). *Soil pollution: A hidden reality.* http://www.fao.org/3/I9183EN/i9183en.pdf

Food and Agriculture Organization of the United Nations (FAO). (2019). *The state of food security and nutrition in the world.* http://www.fao.org/3/ca5162en/ca5162en.pdf

Food and Agriculture Organization of the United Nations (FAO). (2020). Emissions due to agriculture. *Global, regional and country trends 2000-2018.* FAOSTAT Analytical Brief Series No 18. https://www.fao.org/3/cb3808en/cb3808en.pdf

Food and Agriculture Organization of the United Nations (FAO). (n.d.). *Animal production*. https://www.fao.org/animal-production/en/

Food and Agriculture Organization of the United Nations (FAO). (n.d.). *Sustainable Development Goals.* https://www.fao.org/sustainable-development-goals/indicators/1231/en/

Forgas, J. P. (1994). The role of emotion in social judgments: An introductory review and an Affect Infusion Model (AIM). *European Journal of Social Psychology, 24,* 1-24. https://doi.org/10.1002/ejsp.2420240102

Forman, J., & Silverstein, J. (2012). Organic Foods: Health and Environmental Advantages and Disadvantages. *Pediatrics*, *130*(5): e1406-e1415. https://doi.org/10.1542/peds.2012-2579

Foster, G. D., Karpyn, A., Wojtanowski, A. C., Davis, E., Weiss, S., Brensinger, C., Tierney, A., Guo, W., Brown, J., Spross, C., Leuchten, D., Burns, P. J., Glanz, K. (2014). Placement and promotion strategies

to increase sales of healthier products in supermarkets in low-income, ethnically diverse neighbourhoods: a randomized controlled trial. *American Journal of Clinical Nutrition, 99,* 1359-1368. https://doi.org/10.3945/ajcn.113.075572

Freed, S. A., & Freed, R. S. (2002). *Green Revolution: Agricultural and Social change in a North Indian Village.* Anthropological Papers of The American Museum of Natural History.

French, K. R., & Poterba, J. M. (1991). Investor Diversification and International Equity Markets. *The American Economic Review*, *81*(2), 222–226. http://www.jstor.org/stable/2006858

Galvao, D., Gaspar, P. D., Da Silva, P. D., & Pires, L. (2017). Thermal performance, usage behaviour and food waste of domestic refrigerators in a university student community: Findings towards cities sustainability. *WIT Transactions on Ecology and the Environment, 223,* 539-550. https://doi.org/10.2495/SC170471

Gardner, B. (2012). Habit as automaticity, not frequency. *The European health psychologist, 14,* 32-36. https://doi.org/10.1037/e544772013-003

Gardner, B., de Bruijn, G. J., & Lally, P. (2011). A systematic review and meta-analysis of applications of the Self-Report Habit Index to nutrition and physical activity behaviors. *Annals of Behavioral Medicine, 42*(2), 174–187. https://doi.org/10.1007/s12160-011-9282-0

Ghaffari, M., Rodrigo, P. G. K., Ekinci, Y., & Pino, G. (2021). Consumers' motivations for adopting a vegan diet: A mixed-methods approach. *International Journal of Consumer Studies*, *46*, 1193-1208.

Giaccherini, M., Gilli, M., Mancinelli, S., & Zoli, M. (2021). Nudging food waste decisions at restaurants. *European Economic Review*, *135*, 103722. https://doi.org/10.1111/ijcs.12752

Giacoman, C., Pamela, A. A., & Alfaro, J. (2021). Choosing to stop consuming meat for environmental reasons: Exploring the influence of gender and social status variables in Chile. *British Food*

Journal, 123(9), 2996-3013. https://doi.org/10.1108/BFJ-03-2021-0239

Gneezy, U., & Rustichini, A. (2000). A Fine is a Price. *The Journal of Legal Studies, 29,* 1 - 17. https://doi.org/10.1086/468061

Golan, E., Kuchler, F., & Mitchell, L. (2001). Economics of food labelling. *Journal of Consumer Policy, 24*(2), pp. 117-184. https://doi.org/10.1023/A:1012272504846

Golub, A. A., Henderson, B. B., Hertel, T. W., Gerber, P. J., Rose, S. K., & Sohngen, B. (2013). Global climate policy impacts on livestock, land use, livelihoods, and food security. *PNAS*, *110*(52), 20894–20899. https://doi.org/10.1073/pnas.1108772109

González Rey, F. (2017). The topic of subjectivity in psychology: Contradictions, paths and new alternatives. *Journal for the Theory of Social Behaviour, 47*, 502–521. https://doi.org/10.1111/jtsb.12144

Gonzalez-Alzaga, B., Lacasana, M., Aguilar-Garduno, C., Rodriguez-Barranco, M., Ballester, F., Rebagliato, M., & Hernandez, A. F. (2014). A systematic review of neurodevelopmental effects of prenatal and postnatal organophosphate pesticide exposure. *Toxicology Letters*, *230*(2), 104–21. https://doi.org/10.1016/j.toxlet.2013.11.019

Graça, J., Godinho, C. A., & Truninger, M. (2019). Reducing meat consumption and following plant-based diets: Current evidence and future directions to inform integrated transitions. *Trends in Food Science & Technology*, *91*, 380-390. https://doi.org/10.1016/j.tifs.2019.07.046.

Griffin, D. W., & Varey, C. A. (1996). Towards a consensus on overconfidence. *Organ Behav Hum Decis Process*, *65*(3), 227–231. https://doi.org/10.1006/obhd.1996.0023

Grunert, K. G. and Wills, J. M. (2007). A review of European research on consumer response to nutrition information on food labels. *Journal of Public Health*, *15*(5), 385–399. https://doi.org/10.1007/s10389-007-0101-9

Haffar, M., & Searcy, C. (2017). Classification of tradeoffs encountered in the practice of corporate sustainability. *Journal of Business Ethics*, 140(3), 495–522. https://doi.org/10.1007/s10551-015-2678-1

Hallmann, C. Sorg, M., Jongejans, E., Siepel, H., Hofland, N., Schwan, H., Stenmans, W., Müller, A., Sumser, H., Hörren, T., Goulson, D. & de Kroon, H. (2017). More than 75 percent decline over 27 years in total flying insect biomass in protected areas. *PLoS One*, *12*(10), e0185809. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0185809

Hallsworth, M. (2023). A manifesto for applying behavioural science. *Nature Human Behaviour*, 7, 310–322. https://doi.org/10.1038/s41562-023-01555-3

Hamlin, R. (2015). Front of Pack Nutrition Labelling, Nutrition, Quality and Consumer Choices. *Current Nutrition Reports*, *4*, 323–329. https://doi.org/10.1007/s13668-015-0147-1

Hampton, J. A. (2007). Typicality, Graded Membership, and Vagueness. *Cognitive Science, 31*(3), 355–384. https://doi.org/10.1080/15326900701326402

Han, S.-K., & Shin, H.-S. (2004). Biohydrogen production by anaerobic fermentation of food waste. *International Journal of Hydrogen Energy*, *29*, 569–577. https://doi.org/10.1016/j.ijhydene.2003.09.001

Hartmann-Boyce, J., Bianchi, F., Piernas, C., Riches, S. P., Frie, K., Nourse, R., Jebb, S. A. (2018). Grocery store interventions to change food purchasing behaviours: A systematic review of randomized controlled trials. *American Journal of Clinical Nutrition, 107,* 1004-1016. https://doi.org/10.1093/ajcn/nqy045

Harvey, N. (1994). Relations between confidence and skilled performance. In G. Wright, & R. Ayton (Eds.), *Subjective Probability* (pp. 321-351). Wiley.

Hathaway-Jenkins, L. J., Sakrabani, R., Pearce, B., Whitmore, A. P., & Godwin, R. J. (2011). A comparison of soil and water properties in organic and conventional farming systems in England. *Soil Use*

Manage, *27*, 133–142. https://doi.org/10.1111/j.1475-2743.2011.00335.x

Heiskanen, E., Johnson, M., Robinson, S., Vadovics, E., & Saastamoinen, M. (2010). Low-carbon communities as a context for individual behavior change. *Energy Policy, 38,* 7586-7595. https://doi.org/10.1016/j.enpol.2009.07.002

Heller, M. C., & Keoleian, G. A. (2018). *Beyond Meat's Beyond Burger Life Cycle Assessment: A detailed comparison between a plant-based and an animal-based protein source.* Center for Sustainable Systems. https://gastronomiaycia.republica.com/wp-content/uploads/2018/09/diferencias_hamburguesa_vegetal_carne_impacto_medioambiental.pdf

Hicks, J.A., & King, L.A. (2009). Meaning in Life as a Subjective Judgment and a Lived Experience. *Social and Personality Psychology Compass, 3,* 638–653. https://doi.org/10.1111/j.1751-9004.2009.00193.x

Homer, P. M., & Kahle, L. R. (1988). A structural equation test of the value-attitude-behavior hierarchy. *Journal of Personality and Social Psychology*, *54*(4), 638–646. doi:10.1037//0022-3514.54.4.638

Hopper, J. R., & Nielsen, J. M. (1991). Recycling as altruistic behavior: Normative and behavioral strategies to explain participation in a community recycling program. *Environment and Behavior, 23*, 195-220. https://doi.org/10.1177/0013916591232004

Hospido, A., i Canals, L. M., McLaren, S., Truninger, M., Edwards-Jones, G., & Clift, R. (2009). The role of seasonality in lettuce consumption: a case study of environmental and social aspects. *The International Journal of Life Cycle Assessment*, *14*(5), 381-391. https://doi.org/10.1007/s11367-009-0091-7

Huang, A., Barzi, F., Huxley, R., Denyer, G., Rohrlach, B., Jayne, K., Neal, B. (2006). The effects on saturated fat purchases of providing internet shoppers with purchase-specific dietary advice: A randomized

trial. *PLoS Clinical Trials, 1*(5), e22. https://doi.org/10.1371/journal.pctr.0010022

INRAN-SCAI. (2005-06). *L'indagine nazionale sui consumi alimentari in Italia.* https://www.crea.gov.it/web/alimenti-e-nutrizione/-/indagine-sui-consumi-alimentari

Intergovernmental Panel on Climate Change (IPCC). (2018). *Global Warming of 1.5 °C: An IPCC Special Report On the Impacts of Global Warming of 1.5 °C Above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty.* Intergovernmental Panel on Climate Change.

ISMEA. (2021). *Consumi alimentari. I consumi domestici delle famiglie italiane. Gennaio-Dicembre 2020.* Numero 1/2021. https://www.ismeamercati.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/11321

Istat. (2019). *Condizione economica, vita quotidiana e consumi delle famiglie.* https://www.istat.it/it/files//2019/12/C09.pdf

Istat. (2021). *Livelli di istruzione e partecipazione alle formazione | Anno 2020.* https://www.istat.it/it/files//2021/10/REPORT-LIVELLI-DI-ISTRUZIONE-2020.pdf

Istat. (2023). *Occupati e disoccupati. https://www.istat.it/it/files//2023/01/Occupati-e-disoccupati-novembre-2022.pdf*

Iyengar, S. S., & Lepper, M. R. (2000). When choice is demotivating: can one desire too much of a good thing? *Journal of Personality and Social Psychology, 79*(6), 995-1006. https://doi.org/10.1037/0022-3514.79.6.995

Jacobs, K., Petersen, L., H€orisch, J., & Battenfeld, D. (2018). Green thinking but thoughtless buying? An empirical extension of the value-attitude-behaviour hierarchy in sustainable clothing. *Journal of*

Cleaner Production, *203*, 1155–1169. https://doi.org/10.1016/j.jclepro.2018.07.320

Joint Research Centre. (2020), *Front-of-pack nutrition labelling schemes: a comprehensive review.* Publications Office of the European Union. https://doi.org/10.2760/180167, JRC113586.

Kahneman, D. (2011). *Thinking, fast and slow.* Farrar, Straus and Giroux.

Kahneman, D., & Thaler, R. (2006). Anomalies: Utility maximisation and experienced utility. *Journal of Economic Perspectives*, *20*, 221–234. https://doi.org/10.1257/089533006776526076

Kahneman, D., & Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica*, *47*(2), 263–291. https://doi.org/10.2307/1914185

Kaljonen, Salo, M., Lyytimäki, J., & Furman, E. (2020). From isolated labels and nudges to sustained tinkering: assessing long-term changes in sustainable eating at a lunch restaurant. *British Food Journal*, *122*(11), 3313–3329. https://doi.org/10.1108/BFJ-10-2019-0816

Kao, Y.-F., & Velupillai, K. V. (2015). Behavioural economics: Classical and modern. *The European Journal of the History of Economic Thought*, *22*(2), 236-271. https://doi.org/10.1080/09672567.2013.792366

Kanter, R., Vanderlee, L., & Vandevijvere, S. (2018). Front-of-package nutrition labelling policy: global progress and future directions. *Public Health Nutrition*, *21*(8), 1399–1408. https://doi.org/10.1017/S1368980018000010

Kappes, H. (2016, May 24). What is Behavioural Science at the LSE? *Blogs LSE.* https://blogs.lse.ac.uk/behaviouralscience/2016/05/24/what-is-behavioural-science-at-the-lse/

Karakaya, F., & Saracli, S. (2018). Impact of perceived risk of food nutrients and serving size on consumer involvement with food labels. *Nutrition & Food Science*, *48*(4), 549-560. https://doi.org/10.1108/NFS-08-2017-0174

Khan, Y., Hameed, I. & Akram, U. (2023). What drives attitude, purchase intention and consumer buying behavior toward organic food? A self-determination theory and theory of planned behavior perspective. *British Food Journal*, *125*(7), 2572-2587. https://doi.org/10.1108/BFJ-07-2022-0564

Kim, M. J., Hall, C. M., & Kim, D-K. (2020). Predicting environmentally friendly eating out behavior by value-attitude-behavior theory: does being vegetarian reduce food waste? *Journal of Sustainable Tourism*, *28*(6), 797-815. https://doi.org/10.1080/09669582.2019.1705461

Klöckner, C. A. (2013). A comprehensive model of the psychology of environmental behavior – A meta-analysis. *Global Environmental Change, 23,* 1028-1038. https://doi.org/10.1016/j.gloenvcha.2013.05.014

Kroese, F. M., Marchiori, D. R., & Ridder, D. T. D. d. (2016). Nudging healthy food choices: a field experiment at the train station. *Journal of Public Health*, *38*, e133-e137. https://doi.org/10.1093/pubmed/fdv096

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

Kummu, M., de Moel, H., Porkka, M., Siebert, S., Varis, O., & Ward, P.J. (2012). Lost food, wasted resources: Global food supply chain losses and their impacts on fresh- water, cropland, and fertiliser use. *Science of The Total Environment*, *438*, 477–489. https://doi.org/10.1016/j.scitotenv.2012.08.092

Lai, O. (2022, February 28). *Composting food to reduce food waste.* EARTH.ORG. https://earth.org/composting-food-to-reduce-food-waste/

Lally, P., Chipperfield, A., & Wardle, J. (2008). Healthy habits: efficacy of simple advice on weight control based on a habit-formation model. *International Journal of Obesity, 32*, 700-707. https://doi.org/10.1038/sj.ijo.0803771

Lazarus, R. S. (1991). *Emotion and Adaptation.* Oxford University Press.

Lee, M. R. F., Domingues, J. P., McAuliffe, G. A., Tichit, M., Accatino, F., & Takahashi, T. (2021). Nutrient provision capacity of alternative livestock farming systems per area of arable farmland required. *Scientific Reports*, *11*, 14975. https://doi.org/10.1038/s41598-021-93782-9

Lemken, D. (2021). Options to design more ethical and still successful default nudges: a review and recommendations. *Behavioural Public Policy*, 1-33. https://doi.org/10.1017/bpp.2021.33

Li, Y., Jin, Y., Borrion, A., & Li, H. (2018). Current status of food waste generation and management in China. *Bioresource Technology*, *274*, 654–665. https://doi.org/10.1016/j.biortech.2018.10.083

Liang, Y., Song, Q., Liu, G., & Li, J. (2021). Uncovering residents and restaurants' attitude and willingness toward effective food waste management: A case study of Macau. *Waste Management*, *130*, 107-116. https://doi.org/10.1016/j.wasman.2021.05.021

Lin, B., Wang, S., Fu, X., & Yi, X. (2023). Beyond local food consumption: The impact of local food consumption experience on cultural competence, eudaimonia and behavioral intention. *International Journal of Contemporary Hospitality Management*, *35*(1), 137-158. doi:https://doi.org/10.1108/IJCHM-01-2022-0099

Lipinski, B., Hanson, C., Lomax, J., Kitinja, L., Waite, R., & Searchinger, T. (2013). *Reducing Food Loss and Waste. Installment 2 of "Creating a Sustainable Food Future" [Working paper]. World Resources Institute.* https://files.wri.org/d8/s3fs-public/reducing_food_loss_and_waste.pdf

Lipper, L., Thornton, P., Campbell, B. M., Baedeker, T., Braimoh, A., Bwalya, M., Caron, P., Cattaneo, A., Garrity, D., Henry, K., Hottle, R., Jackson, L., Jarvis, A., Kossam, F., Mann, W., McCarthy, N., Meybeck, A., Neufeldt, H., Remington, T., … Torquebiau, E. F. (2014). Climate-smart agriculture for food security. *Nature Climate Change, 4,* 1068-1072. https://doi.org/10.1038/nclimate2437

Liu, S., Veugelers, P. J., Liu, C., & Ohinmaa, A. (2022). The cost effectiveness of taxation of sugary foods and beverages: A systematic review of economic evaluations. *Applied Health Economics and Health Policy*, *20*, 185-198. https://doi.org/10.1007/s40258-021-00685-x

Liu, Y. X. (2013). Consumers' willingness-to-pay for organic grain: a case study in Henan Province, China. *Journal of Agrotechnical Economics, 12*, 43-53.

Loewenstein, G., Bryce, C., Hagmann, D., & Rajpal, S. (2015). Warning: You are about to be nudged. *Behavioral Science & Policy*, *1*(1), 35–42. https://doi.org/10.1353/bsp.2015.0000

Loewenstein, G., O'Donoghue, T., & Rabin, M. (2003). Projection bias in predicting future utility. *Quarterly Journal of Economics, 118*(4), 1209-1248. https://doi.org/10.1162/003355303322552784

Mahajan, J. (1992). The overconfidence effect in marketing management predictions. *Journal of Marketing Research*, *29*, 329–342. https://doi.org/10.1177/002224379202900304

Maheswaran, D., Mackie, D. M., & Chaiken, S. (1992). Brand Name as a Heuristic Cue: The Effects of Task Importance and Expectancy Confirmation on Consumer Judgments. *Journal of Consumer Psychology*, *1*(4), 317-336. https://doi.org/10.1016/S1057-7408(08)80058-7

Maillet, M. A., & Grouzet, F. M. E. (2023). Understanding changes in eating behavior during the transition to university from a self-determination theory perspective: a systematic review. *Journal of American College Health*, *71*(2), 422-439. https://doi.org/10.1080/07448481.2021.1891922

Markham, D., Khare, A., & Beckman, T. (2014). Greenwashing: a proposal to restrict its spread. *Journal of Environmental Assessment Policy and Management*, *16*(4), 1450030.

Marshall, D., Bano, F., & Banas, K. (2022). A meaty issue: The effect of meat-related label terminology on the willingness to eat vegetarian foods. *Food Quality and Preference*, *96*, 104413. https://doi.org/10.1016/j.foodqual.2021.104413

Martinez-Sanchez, V., Tonini, D., Møller, F., & Astrup, T. F. (2016). Life-cycle costing of food waste management in Denmark: importance of indirect effects. *Environmental Science & Technology*, *50*, 4513-4523. https://doi.org/10.1021/acs.est.5b03536

Mason-D'Croz, D., Bogard, J. R., Sulser, T. B., Cenacchi, N., Dunston, S., Herrero, M., & Wiebe, K. (2019). Gaps between fruit and vegetable production, demand, and recommended consumption at global and national levels: an integrated modelling study. *Lancet Planet Health*, *3*, e318–e329. https://doi.org/10.1016/S2542-5196(19)30095-6

Massey, M., O'Cass, A., & Otahal, P. (2018). A meta-analytic study of the factors driving the purchase of organic food. *Appetite*, *125*, 418–427. https://doi.org/10.1016/j.appet.2018.02.029

Mertens, S., Herberz, M., Hahnel, U. J. J., & Brosch, T. (2022). The effectiveness of nudging: A meta-analysis of choice architecture interventions across behavioral domains. *PNAS*, *119*(1), e2107346118. https://doi.org/10.1073/pnas.2107346118

Mbow, C., Rosenzweig, C., Barioni, L. G., Benton, T. G., Herrero, M., Krishnapillai, M., Liwenga, E., Pradhan, P., Rivera-Ferre, M. G., Sapkota, T., Tubiello, F. N., & Xu, Y. (2019). Food Security. In P. R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, & J. Malley (Eds.), *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land*

management, food security, and greenhouse gas fluxes in terrestrial ecosystems [437-550]. https://www.ipcc.ch/site/assets/uploads/sites/4/2022/11/SRCCL_Chapter_5.pdf

Michaelsen, P., Johansson, L-O., & Hedesström, M. (2021). Experiencing default nudges: autonomy, manipulation, and choice-satisfaction as judged by people themselves. *Behavioural Public Policy*, 1-22. https://doi.org/10.1017/bpp.2021.5

Michie, S., Atkins, L., & West, R. (2014). *The Behavior Change Wheel. A Guide to Designing Interventions.* Silverback Publishing.

Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science*, *6*, 42. https://doi.org/10.1186/1748-5908-6-42

Mie, A., Andersen, H. R., Gunnarsson, S., Kahl, J., Kesse-Guyot, E., Rembialkowska, E., Quaglio, G., & Grandjean, P. (2017). Human health implications of organic food and organic agriculture: a comprehensive review. *Environmental Health*, *16*, 111. https://doi.org/10.1186/s12940-017-0315-4

Milkman, K. L., Beshears, J., Choi, J. J., Laibson, D., & Madrian, B. C. (2011). Using implementation intentions prompts to enhance influenza vaccination rates. *Proceedings of the National Academy of Sciences of the United States of America*, *108*(26), 10415–10420. http://www.jstor.org/stable/27978628

Moscovici, S. (1973). Foreword. In C. Herzlich (Ed.), *Health and Illness: A social analysis* (pp. IX-XIV). Academic Press.

Nasrollahi, Z., Hashemi, M., Bameri, S. & Mohamad Taghvaee, V. (2020). Environmental pollution, economic growth, population, industrialization, and technology in weak and strong sustainability: using STIRPAT model. Environment Development and Sustainability, 22, 1105–1122. https://doi.org/10.1007/s10668-018-0237-5

Newell, B. R., Lagnado, D. A., & Shanks, D. R. (2015). *Straight Choices: The Psychology of Decision Making*. Psychology Press. https://doi.org/10.4324/9781315727080

Nezlek, J. B., & Forestell, C. A. (2020). Vegetarianism as a social identity. *Current Opinion in Food Science*, *33*, 45-51. https://doi.org/10.1016/j.cofs.2019.12.005

Nguyen, D. D., Yeop, J. S., Choi, J., Kim, S., Chang, S. W., Jeon, B.-H., Guo, W., & Ngo, H. H. (2017). A new approach for concurrently improving performance of South Korean food waste valorization and renewable energy recovery via dry anaerobic digestion under mesophilic and thermophilic conditions. *Waste Management*, *66*, 161–168. https://doi.org/10.1016/j.wasman.2017.03.049

Office for National Statistics. (2020). *Family spending workbook 1: detailed expenditure and trends* [Dataset]. https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/expenditure/datasets/familyspendingworkbook1detailedexpenditureandtrends

Office for National Statistics. (2022). *Employment in the UK: December 2022.* https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/bulletins/employmentintheuk/december2022#employment-in-the-uk-data

Office for National Statistics. (2023). *Education, England and Wales: Census 2021.* https://www.ons.gov.uk/peoplepopulationandcommunity/educationandchildcare/bulletins/educationenglandandwales/census2021

Oosterveer, P. J. M., & Spaargaren, G. (2007). Shopping for green food in globalizing supermarkets: Sustainability at the consumption junction. In J. Pretty, A. S. Ball, T. Bnton, J. S. Guivant, D. R. Lee, D. Orr, M. J. Pfeffer, & H. Ward (Ed.), *The SAGE Handbook of Environment and Society* (pp. 411-428). https://www.researchgate.net/publication/40105617

Oskamp, S. (1982). Overconfidence in case-study judgments. In D. Kahneman, P. Slovic, & A. Tversky (Eds.), *Judgment Under Uncertainty: Heuristics and Biases* (pp 287–293). Cambridge University Press.

Ouellette, J. A., & Wood, W. (1998). Habit and intention in everyday life: The multiple processes by which past behavior predicts future behavior. *Psychological Bulletin, 124*, 54-74. https://doi.org/10.1037/0033-2909.124.1.54

Owen, M. (2018, September 24). *Top 10 reasons to reduce, recycle & reuse.* Sciencing. https://sciencing.com/top-10-reasons-reduce-recycle-reuse-3555.html

Parker, J. R., Paul, I., Hamilton, R., Rodriguez-Vila, O., & Bharadwaj, S. G. (2020). How Product Type and Organic Label Structure Combine to Influence Consumers' Evaluation of Organic Foods. *Journal of Public Policy & Marketing, 40*(3), 419-428. https://doi.org/10.1177/0743915620922873

Parkin, B. L., & Attwood, S. (2022). Menu design approaches to promote sustainable vegetarian food choices when dining out. *Journal of Environmental Psychology*, *79*, 101721. https://doi.org/10.1016/j.jenvp.2021.101721

Payne, C. R., Niculescu, M., Just, D. R., & Kelly, M. P. (2015). Shopper marketing nutrition interventions: Social norms on grocery carts increase produce spending without increasing shopper budgets. *Preventive Medicine Reports*, *2*, 287-291. https://doi.org/10.1016/j.pmedr.2015.04.007

Payne, J. W., Bettman, J. R., & Luce, M. F. (1998). Behavioral Decision Research: An Overview. In M. Birnbaum (Ed.), *Measurement, judgment and decision making* (pp. 303-359). Academic Press.

Pechey, R., Cartwright, E., Pilling, M., Hollands, G. J., Vasiljevic, M., Jebb, S. A., & Marteau, T. M. (2019). Impact of increasing the proportion of healthier foods available on energy purchased in

worksite cafeterias: A stepped wedge randomized controlled pilot trial. *Appetite*, *133*, 286-296.

Piernas, C., Cook, B., Stevens, R., Stewart, C., Hollowell, J., Scarborough, P., & Jebb, S. A. (2021). Estimating the effect of moving meat-free products to the meat aisle on sales of meat and meat-free products: A non-randomised controlled intervention study in a large UK supermarket chain. *PLoS Medicine*, *18*(7), e1003715. https://doi.org/10.1371/journal.pmed.1003715

Pilling, M., Clarke, N., Pechey, R., Hollands, G. J., & Marteau, T. M. (2020). The effect of wine glass size on volume of wine sold: a mega-analysis of studies in bars and restaurants. *Addiction*, *115*(9), 1660-1667.

Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. *Science*, *360*(6392), 987-992. https://doi.org/10.1126/science.aaq0216

PWC. (2018). *Market Vision. Commercial foodservice market in Italy.* https://www.pwc.com/it/it/publications/assets/docs/market-vision-foodservice.pdf

Radzyminska, M., Jakubowska, D., Staniewska, K. (2016). Consumer attitude and behaviour towards food waste. *Journal of Agribusiness and Rural Development,* *1*(39), 175-181. https://doi.org/10.17306/JARD.2016.20

Read, D., & van Leeuwen, B. (1998). Predicting hunger: The effects of appetite and delay on choice. *Organizational behaviour and human decision processes,* *76*(2), 189-205. https://doi.org/10.1006/obhd.1998.2803

Reed, D. D., Niileksela, C. R., & Kaplan, B. A. (2013). Behavioural Economics. *Behaviour Analysts in Practice*, *6*(1), 34-54. https://doi.org/10.1007%2FBF03391790

Reeve, J. R., Hoagland, L. A., Villalba, J. J., Carr, P. M., Atucha, A., Cambardella, C., Davis, D. R., & Delate, K. (2016). Organic Farming, Soil Health, and Food Quality: Considering Possible Links. *Advances*

in Agronomy, *137*, 319-367. http://dx.doi.org/10.1016/bs.agron.2015.12.003

Reynolds, Goucher, L., Quested, T., Bromley, S., Gillick, S., Wells, V. K., Evans, D., Koh, L., Carlsson Kanyama, A., Katzeff, C., Svenfelt, Å., & Jackson, P. (2019). Review: Consumption-stage food waste reduction interventions – What works and how to design better interventions. *Food Policy, 83,* 7–27. https://doi.org/10.1016/j.foodpol.2019.01.009

Ritchie, H. (2017). *Is organic really better for the environment than conventional agriculture?* https://ourworldindata.org/is-organic-agriculture-better-for-the-environment

Ritchie, H. (2019). *Food production is responsible for one-quarter of the world's greenhouse gas emissions.* https://ourworldindata.org/food-ghg-emissions

Ritchie, H., Rosado, P., & Roser, M. (2022). *Environmental impacts of food production.* https://ourworldindata.org/environmental-impacts-of-food#the-carbon-footprint-of-eu-diets-where-do-emissions-come-from

Rolker, H., Eisler, M., Gardenas, L., Deeney, M., & Takahashi, T. (2022). Food waste interventions in low-and-middle-income countries: A systematic literature review. *Resources, Conservation & Recycling*, *186*, 106534. https://doi.org/10.1016/j.resconrec.2022.106534

Romo, L. K., & Donovan-Kicken, E. (2012). "Actually, I Don't Eat Meat": A Multiple-Goals Perspective of Communication About Vegetarianism. *Communication Studies*, *63*(4), 405-420. https://doi.org/10.1080/10510974.2011.623752

Rothman, A. J., Sheeran, P., & Wood, W. (2009). Reflective and automatic processes in the initiation and maintenance of dietary change. *Annals of Behavioral Medicine, 38*(Suppl 1), S4-S17. https://doi.org/10.1007/s12160-009-9118-3

Tsiotsou, R. H., & Wirtz, J. (2015). The Three-Stage Model of Service Consumption. In J. R. Bryson & P. W. Daniels (Eds.), *The Handbook*

of Service Business: Management, Marketing, Innovation and Internationalisation (pp. 105-128). Edward Elgar.

Rouse, S. V. (2015). A reliability analysis of Mechanical Turk data. *Computers in Human Behaviour*, *43*, 304-307. https://doi.org/10.1016/j.chb.2014.11.004

Russell, S. V., Young, C. W., Unsworth, K. L., & Robinson, C. (2017). Bringing habits and emotions into food waste behavior. *Resources, Conservation & Recycling, 125,* 107-114. https://doi.org/10.1016/j.resconrec.2017.06.007

Samuelson, W., & Zeckhauser, R. (1988). Status Quo Bias in Decision Making. *Journal of Risk and Uncertainty*, *1*, 7-59. https://doi.org/10.1007/BF00055564

Sanjari, S. S. S., Jahn, S., & Boztug, Y. (2017). Dual-process theory and consumer response to front-of-package nutrition label formats. *Nutrition Reviews*, *75*(11), 871–882. https://doi.org/10.1093/nutrit/nux043

Sans, P., & Combris, P. (2015). World meat consumption patterns: An overview of the last fifty years (1961-2011). *Meat Science*, *109*, 106-111. https://doi.org/10.1016/j.meatsci.2015.05.012

Saulais, L., Massey, C., Perez-Cueto, F. J. A., Appleton, K. M., Dinnella, C., Monteleone, E., Depezay, L., Hartwell, H., & Giboreau, A. (2019). When are “Dish of the Day” nudges most effective to increase vegetable selection? *Food Policy*, *85*, 15-27. https://doi.org/10.1016/j.foodpol.2019.04.003

Savage, L. J. (1954). *The Foundations of Statistics*. Wiley.

Schahn, J., & Holzer, E. (1990). Studies of environmental concern: The role of knowledge, gender and background variables. *Environment and Behavior, 22*, 767-786. https://doi.org/10.1177/0013916590226003

Schösler, H., de Boer, J., & Boersema, J. J. (2014). Fostering more sustainable food choices: Can Self-Determination Theory help? *Food*

Quality and Preference, *35*, 59-69. https://doi.org/10.1016/j.foodqual.2014.01.008.

Secondi, L., Principato, L., Laureti, T. (2015). Household food waste behaviour in EU-27 countries: A multilevel analysis. *Food Policy, 56,* 25-40. https://doi.org/10.1016/j.foodpol.2015.07.007

Sharma, R., Nguyen, T. T., & Grote, U. (2018). Changing consumption patterns – drivers and the environmental impact. *Sustainability*, *10*, 4190. https://doi.org/10.3390/su10114190

Shue, K., & Luttmer, E. F. P. (2009). Who misvotes? The effect of differential cognition costs on election outcomes. *American Economic Journal: Economic Policy*, *1*(1), 229-257. https://doi.org/10.1257/pol.1.1.229

Šimčikas, S. (2018, August 16). *Is the percentage of vegetarians and vegans in the U.S. increasing?* Animal Charity Evaluators. https://animalcharityevaluators.org/blog/is-the-percentage-of-vegetarians-and-vegans-in-the-u-s-increasing/

Simon, H. A. (1956). Rational choice and the structure of environments. *Psychological Review*, *63*, 129-138. https://doi.org/10.1037/h0042769

Simonson, I. (1990). The effect of purchase quantity and timing on variety seeking behavior. *Journal of Marketing Research*, *27*, 150-162. https://doi.org/10.1177/002224379002700203

Soil Association. (2019). *Rise of the conscious consumer drives sales as UK organic market hits £2.33 billion after seventh year of growth.* https://www.soilassociation.org/press-centre/press-releases/organic-market-report-2019/

Springmann, M., Clark, M., Mason-D'Croz, D., Wiebe, K., Bodirsky, B. L., Lassaletta, L., de Vries, W., Vermeulen, S. J., Herrero, M., Carlson, K. M., Jonell, M., Troell, M., DeClerck, F., Gordon, L. J., Zurayk, R., Scarborough, P., Rayner, M., Loken, B., Fanzo, J., … Willett, W. (2018). Options for keeping the food system within environmental limits. *Nature (London)*, *562*(7728), 519–525. https://doi.org/10.1038/s41586-018-0594-0

Springmann, M., Mason-D'Croz, D., Robinson, S., Wiebe, K., Godfray, H. C. J., Rayner, M., & Scarborough, P. (2017). Mitigation potential and global health impacts from emissions pricing of food commodities. *Nature Climate Change*, *7*, 69-76. https://doi.org/10.1038/nclimate3155

Springmann, M., Mozaffarian, D., Rosenzweig, C., & Micha, R. (2021). What we eat matters: Health and environmental impacts of diets worldwide. In Independent Expert Group (Eds.), *Global Nutrition Report* (pp. 34-49). https://globalnutritionreport.org/reports/2021-global-nutrition-report/health-and-environmental-impacts-of-diets-worldwide/

Steffel, M., Williams, E. F., & Pogacar, R. (2016). Ethically deployed defaults: Transparency and consumer protection through disclosure and preference articulation. *Journal of Marketing Research*, *53*, 865-880. https://doi.org/10.1509/jmr.14.0421

Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behavior: An integrative review and research agenda. *Journal of Environmental Psychology, 29,* 309-317. https://doi.org/10.1016/j.jenvp.2008.10.004

Stenmarck, A., Jensen, C., Quested, T., & Moates, G. (2016). *FUSIONS. Estimates of European food waste levels.* http://eu-fusions.org/phocadownload/Publications/Estimates%20of%20European%20food%20waste%20levels.pdf

Stewart, C., Piernas, C., Cook, B., Jebb, S. A. (2021). Trends in UK meat consumption: analysis of data from years 1-11 (2008-09 to 2018-19) of the National Diet and Nutrition Survey rolling programme. *Lancet Planet Health*, *5*, e699-708. https://doi.org/10.1016/S2542-5196(21)00228-X

Stones, B. (2019, December 4). *Aerobic and Anaerobic Digestion. Environmental Monitoring Solutions.* https://www.em-solutions.co.uk/insights/aerobic-and-anaerobic-digestion/

Sunstein, C. R. (2018). “Better off, as judged by themselves”: a comment on evaluating nudges. *International Review of Economics*, *65*, 1–8. https://doi.org/10.1007/s12232-017-0280-9

Tajfel, H., & Turner, J. (2001). An integrative theory of intergroup conflict. In M. A. Hogg & D. Abrams (Eds.), *Intergroup relations: Essential readings* (pp. 94–109). Psychology Press.

Takacs, B., Stegemann, J. A., Kalea, A. Z., & Borrion, A. (2022). Comparison of environmental impacts of individual meals – Does it really make a difference to choose plant-based meals instead of meat-based ones? *Journal of Cleaner Production*, *379*, 134782. https://doi.org/10.1016/j.jclepro.2022.134782

Talati, Z., Pettigrew, S., Kelly, B., Ball, K., Dixon, H., & Shilton, T. (2016). Consumers’ responses to front-of-pack labels that vary by interpretive content. Appetite, 101, 205–213. https://doi.org/10.1016/j.appet.2016.03.009

Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth and happiness*. Penguin Books.

The Behavioural Insights Team. (n.d.). *EAST. Four simple ways to apply behavioural insights.* https://www.bi.team/publications/east-four-simple-ways-to-apply-behavioural-insights/

Thorndike, A. N., Bright, O-J. M., Dimond, M. A., Fishman, R., Levy, D. E. (2016). Choice architecture to promote fruit and vegetable purchases by families participating in the Special Supplemental Program for Women, Infants, and Children (WIC): randomized corner store pilot study. *Public Health Nutrition, 20*(7), 1297-1305. https://doi.org/10.1017/S1368980016003074

Tiwari, B. K., Norton, T., Holden, N. M. (2014). *Sustainable Food Processing.* John Wiley & Sons, Ltd.

Tonglet, M., Phillips, P. S., & Read, A. D. (2004). Using the Theory of Planned Behavior to investigate the determinants of recycling behavior: a case study from Brixworth, UK. *Resources, Conservation*

and Recycling, 41(3), 191–214. https://doi.org/10.1016/j.resconrec.2003.11.001

Tranter, R. B., Bennett, R. M., & Costa, L. (2009). Consumers' willingness-to-pay for organic conversion-grade food: evidence from five EU countries. *Food Policy, 34*(3), 287-294. https://doi.org/10.1016/j.foodpol.2009.03.001

Tsai, C. I., Klayman, J., & Hastie, R. (2008). Effects of amount of information on judgment accuracy and confidence. *Organizational Behavior and Human Decision Processes*, *107*, 97-105. https://doi.org/10.1016/j.obhdp.2008.01.005

Tuomisto, H. L., Hodge, I. D., Riordan, P., Macdonald, D. W. (2012). Does organic farming reduce environmental impacts? A meta-analysis of European research. *Journal of Environmental Management*, *112*, 309–320. https://doi.org/10.1016/j.jenvman.2012.08.018

UK Government. (2023, April 21). *Organic food: labelling and advertising rules.* Gov.uk. https://www.gov.uk/guidance/organic-food-labelling-rules

United Nations International Children's Emergency Fund & World Health Organization. (2015). *Progress on Sanitation and Drinking Water. 2015 Update and MDG Assessment.* https://www.who.int/publications/i/item/9789241509145

United Nations. (n.d.a). *Social Development for Sustainable Development.* United Nations Department of Economic and Social Affairs. https://www.un.org/development/desa/dspd/2030agenda-sdgs.html

United Nations. (n.d.b). *The 17 Goals.* United Nations Department of Economic and Social Affairs. https://sdgs.un.org/goals

United States Department of Agriculture, Economic Research Service. (2014). *The estimated amount, value, and calories of postharvest food losses at the retail and consumer levels in the United States.* https://www.ers.usda.gov/webdocs/publications/43833/43680_eib121.pdf?v=0

Van Bussel, L. M., Kuijsten, A., Mars, M., & Van ‘t Veer, P. (2022). Consumers’ perceptions on food-related sustainability: A systematic review. *Journal of Cleaner Production*, *341*, 130904. https://doi.org/10.1016/j.jclepro.2022.130904

van den Berg, S. W., van den Brink, A. C., Wagemakers, A., & den Broeder, L. Reducing meat consumption: The influence of life course transitions, barriers and enablers, and effective strategies according to young Dutch adults. *Food Quality and Preference*, *100*, 104623. https://doi.org/10.1016/j.foodqual.2022.104623.

van der Werf, P., Seabrook, J. A., & Gilliland, J. A. (2021). “Reduce food waste, save money”: Testing a novel intervention to reduce household food waste. *Environment and Behavior*, *53*(2), 151-183. https://doi.org/10.1177/0013916519875180

van Trijp, H. (2014) *Encouraging Sustainable Behavior: Psychology and the Environment.* Taylor & Francis.

Vandana, S. (2016). *The Violence of the Green Revolution. Third World Agriculture, Ecology, and Politics.* University Press of Kentucky.

Vanham, D., Bouraoui, F., Leip, A., Grizzetti, B., & Bidoglio, G. (2015). Lost water and nitrogen resources due to EU consumer food waste. *Environmental Research Letters*, *10*(8), 1–15. https://doi.org/10.1088/1748-9326/10/8/084008

Vassallo, M., Scalvedi, M. L., & Saba, A. (2016). Investigating psychosocial determinants in influencing sustainable food consumption in Italy. *International Journal of Consumer Studies, 40,* 422-434. https://doi.org/10.1111/ijcs.12268

Vegetarian Society. (n.d.). *The Vegetarian Society Approved trademarks.* https://vegsoc.org/vegetarian-and-vegan-approved-trademarks/

Venkat, K. (2012). The climate change and economic impacts of food waste in the United States. *International Journal on Food System Dynamics*, *2*(4), 431–446. https://doi.org/10.18461/ijfsd.v2i4.247

Verplanken, B., & Orbell, S. (2003). Reflections on Past Behavior: A Self-Report Index of Habit Strength. *Journal of Applied Social Psychology, 33*(6), 1313-1330. https://doi.org/10.1111/j.1559-1816.2003.tb01951.x

Visschers, V. H. M., Wickli, N., & Siegrist, M. (2016). Sorting out food waste behavior: A survey on the motivators and barriers of self-reported amounts of food waste in households. *Journal of Environmental Psychology, 45,* 66-78. https://doi.org/10.1016/j.jenvp.2015.11.007

Vitale, M., Giosuè, A., Vaccaro, O., Riccardi, G. (2021). Recent trends in dietary habits of the Italian population: Potential impact on health and the environment. *Nutrients, 13*, 476. https://doi.org/10.3390/nu13020476

Von Neumann, J., & Morgenstern, O. (1947). *Theory of games and economic behavior* (2nd ed.). Princeton University Press.

Wachner, J., Adriaanse, M., & De Ridder, D. (2020). The influence of nudge transparency on the experience of autonomy. *Comprehensive Results in Social Psychology*, 1–16. https://doi.org/10.1080/23743603.2020.1808782

Wansink, B., & Hanks, A. S. (2013). Slim by Design: Serving Healthy Foods First in Buffet Lines Improves Overall Meal Selection. *PLoS ONE*, *8*(10), e77055. https://link-gale-com.libproxy.ucl.ac.uk/apps/doc/A478132924/AONE?u=ucl_ttda&sid=bookmark-AONE&xid=d8275897

Wansink, B., & Sobal, J. (2006). Mindless Eating: The 200 Daily Food Decisions We Overlook. *Environment and Behavior, 39*(1), 106-123. https://doi.org/10.1177/0013916506295573

Wansink, B., & van Ittersum, K. (2013). Portion size me: Plate-size induced consumption norms and win-win solutions for reducing food intake and waste. *Journal of Experimental Psychology: Applied*, *19*, 320–332. https://doi.org/10.1037/a0035053

Waterlander, W. E., de Boer, M. R., Schuit, A. J., Seidell, J. C., Steenhuis, I. HM. (2013). Price discounts significantly enhance fruit and vegetable purchases when combined with nutrition education: a randomized controlled supermarket trial. *American Journal of Clinical Nutrition, 97,* 886-895. https://doi.org/10.3945/ajcn.112.041632

Webb, D., Soutar, G. N., Mazzarol, T., & Saldaris, P. (2013). Self-Determination Theory and consumer behavioral change: Evidence from a household energy-saving behavior study. *Journal of Environmental Psychology, 35,* 59–66. https://doi.org/10.1016/j.jenvp.2013.04.003

Wenlock, R., Buss, D., Derry, B., & Dixon, E. (1980). Household food wastage in Britain. *British Journal of Nutrition, 43,* 53-70. https://doi.org/10.1079/BJN19800064

West, R., & West, J. (2019). *Energise. The secrets of motivation.* Silverback Publishing.

Westminster City Council. (2020). *Westminster City Council food waste service focus groups. Summary Report.*

Wharton, C., Vizcaino, M., Berardy, A., & Opejin, A. (2021). Waste watchers: A food waste reduction intervention among households in Arizona. *Resources, Conservation & Recycling*, *164*, 105109. https://doi.org/10.1016/j.resconrec.2020.105109

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A., Jonell, M., Clark, M., Gordon, L. J., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J. A., De Vries, W., Majele Sibanda, L., Afshin, A., … Murray, C. (2019). Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems. *Lancet (London, England)*, *393*(10170), 447–492. https://doi.org/10.1016/S0140-6736(18)31788-4

Williams, C. M. (2002). Nutritional quality of organic food: shades of grey or shades of green? *Proceedings of the Nutrition Society*, *61*(1), 19–24. https://doi.org/10.1079/PNS2001126

Wirsenius, S., Hedenus, F., & Mohlin, K. (2011). Greenhouse gas taxes on animal food products: rationale, tax scheme and climate mitigation effects. *Climate Change*, *108*, 159-184. https://doi.org/10.1007/s10584-010-9971-x

World Health Organization. (n.d.). *One health.* World Health Organization. https://www.who.int/health-topics/one-health#tab=tab_1

World Health Organization. (2022). *Seventy-fifth world health assembly. Provisional agenda item 18.2.* https://cdn.who.int/media/docs/default-source/documents/behavioural-science-a75_25.pdf?sfvrsn=c6319537_3&download=true

WRAP. (2013a). *Household Food and Drink Waste in the United Kingdom 2012.* https://wrap.org.uk/sites/files/wrap/hhfdw-2012-main.pdf.pdf

WRAP. (2013b). *West London Food Waste Prevention Campaign Evaluation Report.* https://wrap.org.uk/sites/default/files/2020-08/WRAP-West%20London%20Food%20Waste%20Campaign%20Evaluation%20Report_1.pdf

WRAP. (2021). *Food Surplus and Waste in the UK – Key Facts.* https://wrap.org.uk/sites/default/files/2021--06/Food%20Surplus%20and%20Waste%20in%20the%20UK%20Key%20Facts%20June%202021.pdf

WRAP. (n.d.a). *Introduction to the Food Waste Reduction Roadmap and how to get involved.* https://wrap.org.uk/resources/guide/introduction-food-waste-reduction-roadmap-and-how-get-involved

WRAP. (n.d.b). *The Courtauld Commitment 2030.* https://wrap.org.uk/taking-action/food-drink/initiatives/courtauld-commitment

Xiao, H., Bao, S., Ren, J., Xu, Z., Xue, S., & Liu, J. (2024). Global transboundary synergies and trade-offs among Sustainable

Development Goals from an integrated sustainability perspective. *Nature Communications*, *15*, 500. https://doi.org/10.1038/s41467-023-44679-w

Xie, J., Gao, Z., Swisher, M., & Zhao, X. (2016). Consumers' preferences for fresh broccolis: interactive effects between country of origin and organic labels. *Agricultural Economics, 47*, 181-191. https://doi.org/10.1111/agec.12193

Yardley, L., Morrison, L., Bradbury, K., & Muller, I. (2015). The Person-Based Approach to Intervention Development: Application to Digital Health-Related Behavior Change Interventions. *Journal of Medical Internet Research, 17*(1), e30. https://doi.org/10.2196/jmir.4055

Zacharakis, A. L., & Shepherd, D. A. (2001). The nature of information and overconfidence on venture capitalists' decision making. *Journal of Business Venturing*, *16*, 311-332.

Zanoli, R., Scarpa, R., Napolitano, F., Piasentier, E., Naspetti, S., & Bruschi, V. (2012). Organic label as an identifier of environmentally related quality: A consumer choice experiment on beef in Italy. *Renewable Agriculture and Food Systems, 28*(1), 70-79.

Zhang, H., Duan, H., Andric, J. M., Song, M., & Yang, B. (2018). Characterization of household food waste and strategies for its reduction: A Shenzhen City case study. *Waste Management, 78,* 426-433. https://doi.org/10.1016/j.wasman.2018.06.010

Zhao, Z., Cai, M., Wang, F., Winkler, J. A., Connor, T., Chung, M. G., Zhang, J., Yang, H., Xu, Z., Tang, Y., Ouyang, Z., Zhang, H., & Liu, J. (2021). Synergies and tradeoffs among Sustainable Development Goals across boundaries in a metacoupled world. *Science of The Total Environment*, *751*, 141749. https://doi.org/10.1016/j.scitotenv.2020.141749.

Appendix A

Chapter 4

Examples of dishes from the menus from the study period (summer)

Restaurant A's menu

Vegetarian starter: Truffle burrata, English heritage tomatoes, pane carasau.

Other starter: Beef tartare, whipped hen's yolk, mustard, grissini.

Vegetarian main: Courgette tortelloni, shaved truffle, roast radicchio, horseradish.

Other main: Wild Cornish turbot on-the-bone, butter sauce, sesame asparagus.

Dessert: Strawberry, marshmallow, meringue.

Restaurant B's menu

Plant-based starter: Beetroot and heritage tomatoes, tofu mayo, sourdough.

Other starter: Spicy chicken wings.

Plant-based main: Roast cauliflower and sweet potato, spinach pancake, walnuts, harissa aioli.

Other main: Salmon fillet, Puy lentils, spinach, salsa verde.

Dessert: Sticky toffee pudding, salted caramel ice cream.

Examples of dishes from the menus from a different period (winter)

Restaurant A's menu

Vegetarian starter: Burrata, pumpkin relish, pumpkin seed granola.

Other starter: Pressed Barbary duck terrine, smoked duck breast, cranberry relish, sourdough crisps.

Plant-based main: Roast celeriac, wild mushrooms, cavolo nero, chestnut sauce.

Other main: Slow cooked Welsh lamb shoulder, creamed mashed potatoes, braised red cabbage, minted lamb jus.

Dessert: Chocolate & orange tart, vanilla ice cream.

Restaurant B's menu

Vegetarian starter: Artisan goat's cheese, pumpkin relish & crumb.

Other starter: Cured sea trout, pickled cucumber, wholegrain mustard dressing.

Plant-based main: Roast celeriac, wild mushrooms, cavolo nero, chestnut sauce.

Other main: Slow braised beef cheeks, creamed mashed potatoes, Savoy cabbage, red wine jus.

Dessert: Sticky toffee pudding, salted caramel sauce, Chantilly cream Cashel Blue, chutney, walnut & raisin toast.

Appendix B

Chapter 6

Food waste weekly questionnaire

This weekly questionnaire contains 3 questions about your food waste. Please note: The term "food waste" refers to avoidable food waste, that is food that could have been eaten but was not. The non-edible parts of food (such as bones, seeds, and skin) do not count as food waste.

How much food waste have you got this week? Please weigh your food waste bucket and insert the value in grams here.

Please also weigh your food waste bucket when it is empty. Insert its weight in grams. If you do not have a bucket and are using bags only instead, then please insert the weight of your bag.

Which items went to waste this week? Please tick as appropriate. (Options given: meat, fish, fresh fruit and vegetable, cheese and milk, pre-packaged meals, other).

If you use a compost bin, how much waste went into the bin? (If you do not use a compost bin, please insert 0.)

Leaflet


LOVE FOOD hate waste
wrap
UCL
10 TIPS TO REDUCE YOUR FOOD WASTE (scan for more info)
1. Plan your shopping.
2. Use your freezer to make your food last longer.
3. Use leftover recipes to make the most of your food.
4. Store your food correctly.
5. Understand use by and best before dates.
6. Plan your portions.
7. Plan your kids' portions.
8. Keep track of what you have wasted.
9. Make the most of your meat and fish.
10. Take care of your fridge.

Letter

Dear participant,

Thank you for taking the time to help us with our research.

In 2019, Westminster City Council used focus groups[1] to collect information about how its residents experience food waste recycling. It was found that:

- Very few residents knew exactly what their food waste would be used for.
- Misassumptions about food waste led participants to change their behaviours and sort their waste in the wrong way.
- Most participants reported that they have probably been producing more food waste after the food waste collection service was implemented because they feel less guilty about disposing of it.

We therefore encourage you to:

- Find out *how your local council disposes of your food waste* (if this service is available), and what your food waste is used for.[2]
- Remember that *reducing your food waste can help both yourself and the environment*[3]:

7 million tonnes of food and drink went to waste in the UK in 2012.

4.2 million tonnes of this waste were avoidable.

"If we could cut this portion of waste down, we would **reduce CO_2 emissions by 4.4 million tonnes, saving households £400** or more!"

[1] Westminster City Council Food Waste Service Focus Groups – Summary Report (2020).
[2] How? Search on Google the name of your local council and "food waste recycling collection", and you will find an official council page with all the information you need.
[3] Household Food and Drink Waste in the United Kingdom 2012 (WRAP, 2013).