NUDGING THE FOOD BASKET GREEN: THE EFFECTS OF COMMITMENT AND BADGES ON THE CARBON FOOTPRINT OF FOOD SHOPPING

Luca Panzone [a,b], Natasha Auch [a], Daniel John Zizzo [c]

[a] School of Natural and Environmental Science, Newcastle University

[b] The Alan Turing Institute

[c] School of Economics, The University of Queensland

Abstract

We use an incentive-compatible experimental online supermarket to test the role of commitment and badges in reducing the carbon footprint of grocery shopping. In the experiment, some participants had the opportunity to voluntarily commit to a low carbon footprint basket before their online grocery shopping; while the commitment was forced upon other participants. We also study the impact of an online badge as a soft reward for the achievement of a low carbon footprint basket. Participants from the general population shopped over two weeks, with the experimental stimuli only in week 2; and received their shopping baskets and any unspent budget. Results indicate that requesting a commitment prior to entering the store leads to a reduction in carbon footprint of 8-9%. The online badge led to non-significant reductions in carbon footprint. Commitment mechanisms, either forced or voluntary, appear effective in motivating an environmental goal and search for low-carbon options, particularly in those accepting the commitment.

Keywords: sustainable consumption, commitment, field experiment, carbon footprint, food consumption.

JEL codes: C54; C93; D12; D91; Q18; Q56

Acknowledgements: We are grateful to the ESRC, N8 Agri-food, and Unilever for generously providing support to this project; and to Steve Hall for programming the supermarket used in the experiment. We are also thankful for feedback received from Céline Nauges, Diogo De Souza Monteiro, participants at the 2021 ESA Global Meetings (7-9 July 2021), the 9th

European Conference on Sensory and Consumer Research (13-16 December 2020), the 6th Advance in Field Experiment (AFE) Conference (23-24 September 2020), and the 1st Cognitive Economics conference (8-9 November 2019), for useful feedback on presentations and earlier versions of this document. A special thank you goes to participants, and to the students who helped with the distribution side of the experiment. The usual disclaimer applies.

1. INTRODUCTION

Human consumption has an impact on the environment: the production, delivery, and storage of all products available in the marketplace require the emission of greenhouse gases (GHG) (Camilleri et al. 2019; Manderson and Considine 2018; Panzone et al. 2020; Vermeulen, Campbell, and Ingram 2012). The environmental impact of a product is often summarised in terms of its carbon footprint[1], expressed as grams of carbon dioxide equivalent (gCO_2e) for that product. This represents the total GHG (for instance, CO_2, methane, CFCs) emitted directly and indirectly to supply the product to the marketplace (Carbon Trust 2018). Carbon dioxide (CO_2) measurements have shown that the increase in consumption observed since the 1950s has been accompanied by a steady increase in atmospheric CO_2 (Keeling 2008; Nordebo, Naeem, and Tans 2020), which is often blamed for the increase in world temperatures (Ekwurzel et al. 2017; Mora et al. 2018). Food choices represent a large share of the GHG emissions produced at household level, with current estimates indicating that food consumption accounts for up to 37% of household GHG (Poore and Nemecek 2018; Springmann et al. 2018). The challenges of changing households' choices and behaviour have led to calls for interventions targeting consumer behaviour specifically (Dietz et al. 2009; Vandenbergh and Steinemann 2007).

Consumers have limited incentives to reduce the carbon emissions from their consumption, and face several psychological barriers to environmental change (Gifford 2011; Steg 2016). The decision to engage in pro-social behaviours requires consumers to forgo private consumption to the benefits of an unknown third party (e.g., Andreoni 1990; Daube and Ulph 2016); and the negative effects of climate change are often perceived as hypothetical and both geographically and temporally distant (Weber 2006, 2018). Moreover, occasional changes in behaviour are unlikely to keep the increase in global temperatures below the target of 1.5°C above pre-industrial levels advocated by the IPCC[2]: such a commitment requires consumers to consistently privilege behaviours that have the least environmental impact rather than alternate desirable and undesirable choices (Galizzi and Whitmarsh 2019; Truelove et al. 2014). This is particularly challenging in the case of grocery shopping, because a typical shopping trip consists of a long sequence of choices (Panzone et al. 2021a; Sheehan and Van Ittersum 2018; van Ittersum, Pennings, and Wansink 2010), targeting a range of consumption goals (Steptoe,

[1] Other summary metrics also exist, and the most common alternatives to carbon footprint are water footprint and ecological footprint. See Galli et al. (2012) for detail. We focus on carbon footprint because this is the metric commonly used in climate change policy (Metcalf and Weisbach 2009; Pearce 1991).
[2] See https://www.ipcc.ch/sr15/

Pollard, and Wardle 1995). Additionally, experimental studies show that self-regulatory resources deplete over time (Effron, Bryan, and Murnighan 2015; Effron and Conway 2015; Gino et al. 2011; Monin and Jordan 2009), and pro-social behaviour may become less likely as the number of choices consumers make increases (see Fig. 2 in Panzone et al. 2021a).

Nudging is a possible strategy to motivate consistent sustainable consumption (Carlsson et al. 2021; Sunstein and Reisch 2014). The nudges we focus on are commitments and badges. The literature (detailed in section 2) suggests that commitments (as in Baca-Motes et al. 2013) may reduce the carbon footprint of consumers: they may elicit a preference for promise-keeping (Vanberg 2008) or compliance to a social norm of promise keeping (Ellingsen and Johannesson 2004; van der Werff, Taufik, and Venhoeven 2019) or other forms of social compliance (e.g. Karakostas and Zizzo 2016 and Charness and Dufwenberg 2006). Empirically, they have been found effective to some degree in a different setting (towel reuse: Baca-Motes et al. 2013). In our experiment, consumers commit to keeping their overall carbon footprint below an ambitious threshold (the bottom 20% of the pre-intervention distribution). For some, the commitment was voluntary and determined by their pro-social preferences, while for others it was imposed.

The literature (detailed in section 2) also indicates that badges can help consumers reduce the carbon footprint their food shopping. Gamification is becoming an important element of human-computer interactions (Hamari 2017; Hock, Bagchi, and Anderson 2019; Sailer et al. 2017; Whittaker, Russell-Bennett, and Mulcahy 2021). Badges are often considered relevant behavioural motivators because they provide a soft (that is, psychological) reward when a specific goal is achieved (Edwards et al. 2016; Hamari 2017; Sailer et al. 2017). Badges also allow monitoring of a metric (carbon footprint) they may not be very familiar with (Panzone, Lemke and Petersen, 2016; Camilleri et al., 2019), and potentially provide a self-signal of the achievement of a sustainability goal (Gneezy et al. 2012a). Consequently, some consumers saw a badge whenever they were in the bottom quintile of the carbon footprint distribution.

Methodologically, the study uses an incentive-compatible framed field experiment (Harrison and List 2004) in an online store that provides real-time basket level CO_2e data. Online shopping is a fast-growing retail segment (Panzone, Larcom, and She 2021b), and online interventions can be implemented at low-cost, with potential for long-term increases in the sustainability of consumer choices (Vadakkepatt et al. 2020) and improved resilience of the retail sector (Macfadyen et al. 2015).

This article is structured as follows. The next section presents some relevant theoretical background and experimental hypotheses, and a stylised model of behaviour. Section 3 outlines the data collection process, which used an experimental online supermarket to measure the carbon footprint of consumer choices. Section 4 explains the econometric model used in the analysis. The results, presented in section 5, show that voluntary and forced commitments cause a reduction in the carbon footprint of shopping baskets of similar magnitude. The badge does not have a significant effect. Section 6 discusses the results, and Section 7 concludes.

2. BOUNDED WILL-POWER AND THE COMMITMENT TO LOW-CARBON FOOD SHOPPING

2.1. Bounded willpower in sequential decisions

The pursuit of a consumption goal requires an individual to self-regulate, to ensure all her decisions are conducive to the achievement of this goal (Baumeister 2002; Fishbach and Dhar 2007; Zhong, Liljenquist, and Cain 2009). The strength model of self-regulation (Baumeister 2002; Baumeister and Heatherton 1996; Gino, Krupka, and Weber 2013) postulates that consumers hold a set of personal values, called *standards*, which determines the extent by which a specific act is considered right or wrong; consumers then *monitor* alignment of behaviour with their values. When monitoring identifies a conflict between short-term interest and long-term goals, the consumer exert *willpower* to ensure the long-term goals are given priority. However, consumers often display *bounded willpowe*r (Jolls, Sunstein, and Thaler 1998): they take actions that they know conflict with their own values and will hinder the pursuit of long-term goals. The effective use of willpower requires individuals to use physical and cognitive resources to identify a temptation and resolve it (Baumeister 2002; Fishbach and Hofmann 2015; Gino et al. 2011; Mullainathan and Thaler 2000), but these resources are finite, and willpower is costly, limiting the ability of consumers to self-regulate as these resources are used (Baumeister and Vohs 2016). Consumers often recognise that they have limited willpower, and develop strategies to facilitate their ability to self-regulate: for instance, consumers may ration their self-control, breaking down "global" self-control needs into individual choices, to ensure willpower is exercised only in decisions that need it (Wertenbroch 2003); or remove tempting alternatives from a choice sets to save resources for willpower, even when they do not expect to succumb to temptations (Gul and Pesendorfer 2001).

2.2. Commitment and bounded willpower

The commitment to a clear, actionable goal can be a suitable strategy to nudge more consistent sustainable (low-carbon) consumer behaviour, and motivate value-behaviour consistency over time (Baca-Motes et al. 2013; Gneezy et al. 2012b; Sadoff, Samek, and Sprenger 2020). The achievement of a goal requires this goal to be clear and concrete (Locke and Latham 2006). However, Lee and Ariely (2006) show that consumers approach a shopping task with fuzzy goals, which become more concrete as the shopping trip progresses. Recent research indicates that just giving consumers a low-carbon goal is not effective in reducing the carbon footprint of online food shopping (Panzone et al. 2021c), but a similar low-carbon goal is effective when monitorable (Kanay et al. 2021). A commitment requested prior to entering a store can provide consumers with a clear, actionable goal, which can be implemented during the shopping trip, ensuring that consumers who hold high environmental preferences use them consistently over time (Jia et al. 2017; Rogers, Milkman, and Volpp 2014; Steg 2016; van der Werff et al. 2019). Previous research in the environmental domain has shown that consumers who committed to an environmental goal were more likely to: use public transport (Matthies, Klöckner, and Preißner 2006); conserve water by taking shorter showers (Dickerson et al. 1992); reduce their energy consumption (van der Werff et al. 2019); and re-use their hotel bath towels (Baca-Motes et al. 2013). Meta-analytical research (Lokhorst et al. 2013) shows that commitment manipulations increase the likelihood of environmental behaviours, with an effect that can last over time.

The literature identifies two type of commitments (Brocas, Carrillo, and Dewatripont 2004; Bryan, Karlan, and Nelson 2010; Burke, Luoto, and Perez-Arce 2018; Himmler, Jäckle, and Weinschenk 2019). *Hard* commitments motivate by providing clear economic (dis-)incentives for (non-)compliance; conversely, *soft* commitments impose only psychological (i.e., non-monetary) rewards (costs) for keeping (violating) a commitment. This literature indicates that soft commitments can be as effective as hard commitments, providing several explanations. Firstly, in the presence of conflicting goals, goal commitment increases the motivation to pursue a focal goal over another (Fishbach and Dhar 2005). Second, commitment may activate self-image concerns (Ariely, Bracha, and Meier 2009; Baca-Motes et al. 2013; Falk 2021; Mazar, Amir, and Ariely 2008), which motivate consumers to respond by behaving in line with the core values of their self-image (Sherman and Cohen 2006; Steele 1988). Third, commitments may activate the need to comply with social norms, leading to feelings of guilt if such social norms are broken (Charness and Dufwenberg 2006; Matthies et al. 2006;

Theotokis and Manganari 2015). Fourth, individuals may have innate preferences for promise-keeping (Ellingsen and Johannesson 2004; van der Werff et al. 2019; Vanberg 2008), experiencing – or expecting – guilt when breaking promises (Charness and Dufwenberg 2006; Ellingsen et al. 2010). Finally, when the opportunity or requirement of a commitment is seen as coming from an authority, there may be a desire to comply (Karakostas and Zizzo 2016). Commitments are cost-elastic: individuals respond strongly to small increases in hard (Houser et al. 2018) as well as soft incentives (Charness and Dufwenberg 2006), even when penalties are self-imposed (Trope and Fishbach 2000).

2.3. Voluntary and Forced Commitment, and the Carbon Footprint of Food Baskets

While soft commitments can be effective in changing behaviour, their effectiveness may depend on whether the origin of this decision is internal or external to the decision-maker (Gino et al. 2013). In a **voluntary** commitment, the participant *chooses* to commit or not. The decision is *endogenous* (Kruglanski 1975), because the same internal drivers (e.g., intrinsic motivation) motivate both the decision to commit to a low-carbon basket, and to reduce the carbon footprint of the basket. By gathering the interest on environmental preservation in motivated consumers, the commitment is expected to lead to a reduction in the carbon footprint of the food baskets, compared to a control with no commitment. Our first hypothesis is:

> *H_1: A voluntary commitment leads to a lower carbon footprint than a control group with no commitment.*

Consumers who have an interest in environmental preservation are those more likely to commit to a low-carbon basket because the cause align well with their personal interests (Baca-Motes et al. 2013; Matthies et al. 2006; Schwartz et al. 2014). Consumers may also accept the commitment because they recognise they have limited willpower (Ariely and Wertenbroch 2002; O'Donoghue and Rabin 1999, 2001), using the commitment to constraint their behaviour (Bénabou and Tirole 2011; Schwartz et al. 2014). Additionally, consumers may accept a commitment to pre-empt a negative emotional state – such as feelings of guilt for damaging for the environment – after the decision has been made (Matthies et al. 2006; Richins 1997; Schwarz 2000; Tangney, Stuewig, and Mashek 2007; Weber and Johnson 2009).

In a **forced** commitment, the participant is forced to commit to the goal in order to continue shopping online, and the decision is *imposed* externally, for instance by a paternalistic policymaker (or the research team in our online supermarket). In this case, the decision is

exogenous (Kruglanski 1975), because the behaviour is not driven by the environmental preferences of the consumer. Note that while we use the term "forced" to describe such a commitment, participants unwilling to commit could opt-out from the experiment unnoticed, and the commitment was not actually enforced. While forced choices can cause psychological discomfort, and even reactance (Botti et al. 2008; Dhar and Simonson 2003), they can also encourage motivated participants to explore alternatives that they do not usually consider (Larcom, Rauch, and Willems 2017). As a result, participants in this group are expected to reduce the carbon footprint of their basket. This leads to the second hypothesis:

H_2: A forced commitment leads to a lower carbon footprint than a control group with no commitment.

It is not clear *ex ante* what prediction can be made in terms of the relative performance of the two forms of commitment. Voluntary commitment may be less effective than forced commitment if those individuals who commit are already more sustainable than the average consumer: in this case, the marginal costs of reducing the carbon footprint of those who commit are high, leading to smaller changes compared to a commitment requested to those consumers with lower carbon abatement costs. Forced commitment may also make a stronger case for the existence of a social norm to comply to. This leads to our third hypothesis:

H_{3a}: A voluntary commitment is less effective in reducing carbon footprint than a forced commitment

However, if the failure to be sustainable is due to personal limitations, e.g., lack of knowledge, a voluntary commitment may be more effective than a forced commitment, because those who accept voluntarily are more motivated to search harder for low-carbon options. This point is particularly relevant for the case of carbon footprint, which consumers do not know well (Camilleri et al. 2019; Panzone, Lemke, and Petersen 2016; Panzone et al. 2020). Moreover, a forced commitment might cause reactance (Botti et al. 2008; Sunstein 2017), therefore reducing the effectiveness relative to a voluntary decision. Then, hypothesis H_{3a} becomes:

H_{3b}: A voluntary commitment is more effective in reducing carbon footprint than a forced commitment

2.4. Rewarding commitment through dynamic badges

Along with commitments, in this study we also explore the role of soft rewards. Badges are a gamification element awarded upon the achievement of a specific goal (Edwards et al. 2016; Hamari 2017; Sailer et al. 2017). Apart from consumption utility, choices contain diagnostic utility (e.g. Bodner and Prelec, 2003), and consumers can use badges to signal to themselves (self-signalling) and others (social-signalling) that that they care for the behaviour (Baca-Motes et al. 2013; Brick, Sherman, and Kim 2017; Gneezy et al. 2012a; Sexton and Sexton 2014; van der Weele and von Siemens 2020). Badges may operate through four main pathways. First, a badge may increase the *awareness* of an environmental goal, therefore making it more likely for it to be pursued. Second, a badge may allow consumers to *self-monitor* behaviour (Edwards et al. 2016): the presence of a badge given to a low-carbon basket signals to the individual that their behaviour is in line with their own values of environmental preservation, and willpower to refrain from purchasing high-carbon items is not needed. Third, a badge provides *feedback* on the behaviour being monitored (Sailer et al. 2017): through the badge the consumer learns of having done something socially "desirable" when the badge is present (a low-carbon basket), or "undesirable" when the badge is absent (a high-carbon basket). Finally, badges self-signal pure *achievement* of a goal, therefore providing a soft reward (Sailer et al. 2017; Whittaker et al. 2021) that can motivate further goal pursuit particularly if success is interpreted as commitment to the goal (see Fishbach, Eyal, and Finkelstein 2010).

Prior research presents mixed findings on the effectiveness of badges in other settings. Baca-Motes et al. (2013) show that signalling, in the form of a pin that has a specific meaning to the consumer only, but which is visible to others, had a significant, if relatively small, effect on the reuse of hotel towels. Conversely, van der Weele and von Siemens (2020) found that bracelets reminding of pro-social behaviour (e.g., donations to the Red Cross), visible to the decision-maker only, failed to motivate further pro-social behaviour. Overall, research indicates that the effect of self-signalling is stronger if it requires a costly change in behaviour (Gneezy et al., 2012), as is the case of dietary change. Our fourth hypothesis is:

H_4: A visible badge leads to a lower carbon footprint than the control group.

2.5. Economic model[3]

2.5.1. Optimal consumption

To formalise our previous analysis, we propose a simple model of consumer behaviour. Imagine a consumer *i* shopping in a marketplace with $n+1$ goods, indexed as *j*. Good *0* is a numeraire good with unit price and zero carbon footprint; all other goods have prices $p = (p_1, \dots, p_n)$, and carbon footprint $\kappa = (\kappa_1, \dots, \kappa_n)$. We denote a consumption bundle by $(x_0, x) = (x_0, x_1, \dots, x_n)$, and the consumer's budget constraint by $x_0 + \sum_i p_j x_j \leq I$, where I is income. The carbon footprint of any chosen bundle (x_0, x) is $C(x) = \sum_j \kappa_j x_j$. Following Bodner and Prelec (2003) and related research (e.g., Bénabou and Tirole 2011; Dubé, Luo, and Fang 2017), the consumer's utility is the sum of two components: the pure *consumption utility*; and *ego (or diagnostic) utility*. ***Consumption utility*** is given by $V(x_{0,}x_1, \dots, x_n) = x_0 + U(x_1, \dots, x_n) = x_0 + U(x)$, where the (constant) marginal utility of good *0* is set to 1. In the absence of any moral concern associated to carbon footprint, the consumption bundle that maximises consumption utility is $(\bar{x}_0, \bar{x})$, where we assume that $\bar{x}_0 > 0$, and the consumer's carbon footprint would be $\bar{C} = \sum_j \kappa_j \bar{x}_j$.

The consumer's net ***ego utility*** depends on the individual's carbon footprint, which has a negative impact on the environmental public good. Ego utility allows consumers interested in reducing their carbon footprint to derive additional utility from signalling to themselves and others their interest for the environment (Baca-Motes et al. 2013; Brick et al. 2017; Gneezy et al. 2012a; Sexton and Sexton 2014). The consumer's net ***ego utility*** consists of two elements: firstly, the consumer derives a moral benefit from reducing her carbon footprint to $C(x) < \bar{C}$, given by $B(x) = \beta[\bar{C} - C(x)]$, where β is the marginal benefit of carbon reduction. However, the consumer incurs a real cost (effort) of reducing carbon footprint (e.g., searching for information) given by $E(x) = \gamma_0[\bar{C} - C(x)] + 0.5\gamma_1[\bar{C} - C(x)]^2$, and the marginal cost is $\gamma_0 + \gamma_1[\bar{C} - C(x)]$, equalling zero when $x = \bar{x}$. We assume that the marginal cost of reducing carbon footprint when $x = \bar{x}$ is less than the marginal benefit, implying that it will always pay the consumer to reduce carbon footprint below $\bar{C}$. Then, the consumer will not reduce carbon footprint below the level $\bar{\bar{C}} = \bar{C} - \frac{\beta}{\gamma}$, the point at which marginal cost has risen to equal marginal benefit. Finally, while the costs of reducing carbon footprint are incurred

[3] We are grateful to Alistair Ulph for opinions and advice on this section.

immediately, its benefits may be delayed, with a discount factor $\delta < 1$; consequently, the consumer's benefits are $\delta\beta[\bar{C} - C(x)]$.

Putting this together, the consumer's objective function can now be written as:

$$V(x, \beta, \delta, \gamma_0, \gamma_1) = [I - px] + U(x) + \delta\beta[\bar{C} - C(x)] - \gamma_0[\bar{C} - C(x)] - 0.5\gamma_1[\bar{C} - C(x)]^2$$

Redefining the consumer's utility function as $\widehat{U}(x) = U(x) - 0.5\gamma_1[\bar{C} - C(x)]^2$, and defining $\phi \equiv \delta\beta - \gamma_0 > 0$ as the *net marginal benefit* of reducing carbon footprint, which is increasing in β and δ and decreasing in γ_0, the consumer's objective function becomes

$$\tilde{V}(x, \phi) = [I - px] + \widehat{U}(x) - \phi[\bar{C} - C(x)] \quad (1)$$

The consumer's optimal choice of consumption bundle $(\hat{x}_1, \dots, \hat{x}_j, \dots, \hat{x}_n)$ is the solution of the set of first-order conditions[4]

$$\frac{\partial \tilde{V}}{\partial x_j} = p_j + \phi\kappa_j = q_j \quad (2)$$

for $j = 1, \dots, n$. The resulting demands are $\hat{x}_j(q_1, \dots, q_n)$. The term $q_j = p_j + \phi\kappa_j$ is the 'implicit' price of good *j*, inclusive of the net benefit of carbon reduction.

2.5.2. The impact of the interventions on demand

As indicated previously, the experiment presents three interventions: a voluntary commitment, *L*; a forced commitment, *F*, and a badge, *D*. As described above, the badge increases the perceived benefit of a change by providing an intangible reward (Hamari 2017; Sailer et al. 2017); and both commitments increase the motivation to engage in goal pursuit (Baca-Motes et al. 2013; Fishbach and Dhar 2005; Schwartz et al. 2014). As a result, these interventions reduce carbon footprint by increasing the net marginal benefit of reducing carbon footprint, ϕ, either by increasing the marginal benefit β, increasing the discount factor δ, or reducing the marginal cost γ. The increase in ϕ raises the implicit prices of all goods *j*, with a larger increase for products with high carbon footprint. These increases in implicit prices affect the demand for all goods, and consumers will substitute away from high carbon products to lower carbon products, also increasing the demand for x_0. Notably, the reduction in the demand for high carbon products by one unit reduces carbon footprint faster than reducing the demand for a low carbon product by one unit. Denoting by Y_m the scale of a particular intervention *m = L, F, D* the impact of the intervention on the carbon footprint of the basket corresponds to

$$\frac{\partial C}{\partial Y_m} = \left(\sum_j \kappa_j \sum_l \kappa_l \frac{\partial \hat{x}_j}{\partial q_l}\right) \frac{\partial \phi}{\partial Y_m} \quad (3)$$

[4] Note that the essential conclusions of this section do not depend on the special functional forms we have used.

In equation (3), the increase in implicit price is greater the larger is a product's carbon footprint. Consequently, the interventions reduce the carbon footprint of a basket by inducing consumers to substitute from high- to low-carbon products, or to increase x_0. However, equation (3) does not allow determining the hierarchy of the effect of L, F, and D.

3. METHOD

3.1. NU-food Portal

Sales data for all participants were collected using Newcastle University's NU-food online supermarket. The store contains 908 different stock-keeping units (SKUs). For each SKU, the store contains information including: the name and image of the product; its price; its macro-nutritional information; and the carbon footprint from published sources[5]. Consumers could access the carbon footprint and nutritional composition of each product by moving a cursor onto a specific icon (Figure 1); the system recorded how long the window with the information remained open. Consumers could search for products using a search box. The carbon and nutritional content of the basket was always accessible, and updated in real-time as consumers added or removed products. The NU-food portal could be accessed from anywhere and on any type of electronic device with Internet (computer, tablet, or phone), and consumers had no interaction with the research team during their experiment (other than via email for technical queries). These features were available to all participants in all weeks.

3.2. Participant recruitment

The experiment was advertised by posters in offices and leisure facilities, such as cafés and community centres, around the city of Newcastle upon Tyne (UK). 1,355 people from the general public registered interest to participate in an online shopping study. Of these, 1,206 were randomly chosen to participate, and randomly assigned to an experimental group (as indicated below). 677 participants completed the two weeks of shopping in the main experiment. An additional 48 participants completed the experiment in a separate group, used to test whether information on carbon footprint in the store primed choices; results in Appendix 1 fails to reject the null hypothesis of no priming effects.

[5] See e.g., Panzone et al. (2018), Clune, Crossin, and Verghese (2017), Drewnowski et al. (2015), Scarborough et al. (2014).

Each participant was paid a £5 fee purely in recognition of their time. Before starting the experiment, participants had to register; at this stage, they were given an anonymous login, and could choose a personal password. Once registered, participants had to give explicit consent by filling an online form outlining the terms and conditions of the experiment.

3.3. Experimental procedure

The methodological approach follows Panzone et al. (2018). In a framed field experiment (Harrison and List 2004), for two consecutive weeks participants were given a virtual weekly budget of £25.00 to shop on NU-food.[6] Participants could enter the store as many times as they wanted during each experimental week, but they could only complete each week's overall transaction once. To ensure this was the case, the check-out functionality was de-activated once the transaction was completed, and re-activated at 9am on the following Monday. Participants could spend as much as they wanted from the £25 budget, knowing that any unspent budget would be given to them. After the second shopping session (including the final questionnaire) was submitted, one of the two weeks of shopping was randomly chosen by the computer for the participant to collect at Newcastle University; any unspent budget for the randomly selected week only was also returned to participants upon collection. Participants were told that their shopping collection would be at least one week after their second week of shopping.

3.4. The low-carbon footprint threshold

The manipulations proposed in this research require the definition of a threshold that defines sustainability in terms of gCO_2e, both for the badge and the commitment. The threshold was defined as $180gCO_2e/100g$: below these thresholds, baskets were considered low-carbon, while above it they were considered high-carbon baskets. The value of $180gCO_2e/100g$ refers to around the bottom 30% of the carbon footprint distribution in the baseline week of Panzone et al. (2018), and the bottom 20% of the baseline week in this research.

The normalisation of the goal by weight ensures the optimal strategy for consumer to reduce their carbon footprint is buying low-carbon goods: in the experimental supermarket, a goal defined in terms of absolute carbon reduction (e.g., buy less than 20,000 gCO_2e) can be

[6] The present store contains a much larger choice set, with both private labels and known brands: >900 products vs <600 in (Demarque et al. 2015; Kanay et al. 2021; Muller, Lacroix, and Ruffieux 2019); Panzone et al. (2021c); (Panzone et al. 2018) and Panzone et al. (2018); <300 in Muller et al. (2019), and <200 in Demarque et al. (2015) and Hilton et al. (2014). Moreover, all participants in this experiments received one of their two food baskets in full, while Kanay et al. (2021) and Demarque et al. (2015) give baskets to 20-25% of the participants, and Muller et al. (2019) give all participants only one quarter of the food in their basket.

achieved by spending less, with the incentive to cash in more of the budget and buy high-carbon options (e.g., meat) outside the experimental store. Conversely, the carbon footprint per weight can only be reduced by buying low-carbon options: buying less can decrease as well as increase the carbon footprint of the basket, and the normalised goal can be only met by buying low-carbon items. This adjustment also has also real-life appeal, as retailers would want to ensure that consumers reduce their carbon footprint whilst buying the same amount of goods.

3.5. Experimental manipulations

The experimental design consists of a mixed design, using 2 (virtual badge vs. no virtual badge) x 3 (no commitment vs. voluntary commitment vs. forced commitment) orthogonal between-participants design (Figure 2), over two experimental weeks (the within component). In week 1 of the experiment, participants shopped without any intervention in place; consumers were then randomly allocated to an experimental group in week 2, as described below.

3.5.1. Control

In this group, participants shopped in the experimental store without any additional stimulus.

3.5.2. Badge

In week two in the Badge treatment, participants were told that a badge would appear on the screen whenever they had a low-carbon basket. They were explained that "Based on previous studies, a low carbon shopping basket is one which is lower than 180gCO2/100g". Whilst shopping, the participant would see the badge[7] (Figure 3) whenever their carbon footprint was equal to or below 180g CO_2e/100g, and would disappear if basket was above the threshold and only to return if the shopping basket was below (or equal to) the threshold.

3.5.3. Voluntary Commitment

A voluntary commitment is the voluntary decision to accept the promise to keep the carbon footprint of the food basket below the sustainable threshold. In this group, participants were asked "Will you commit to check out with a low carbon footprint basket?", whilst being told that "Based on previous studies, a low carbon shopping basket is one which is lower than 180gCO2/100g". Participants could proceed to the store after ticking the commitment

[7] The badge was chosen in a pilot to 136 participants, who had to rate eight potential images using a scale of 0-100 on their ability to convey a message of "being friendly to the environment", and to motivate them to act in an environmentally friendly manner. This image scored first in both instances, with 76/100 on its ability to give an environmentally friendly message; and 70/100 on its ability to motivate environmentally friendly behaviour.

acceptance ("I am interested in protecting the environment; therefore, I commit to keeping the carbon footprint of my basket below 180gCO2/100g") or commitment rejection ("I do not want to commit myself to keeping the carbon footprint below 180gCO2/100g") box, respectively (Figure 4). The threshold was not enforced, and participants could check out independently of whether they exceeded the threshold or not.

3.5.4. Forced Commitment

A forced commitment required the consumer to accept the promise to keep the carbon footprint of the food basket below the sustainable threshold. Participants had to tick the commitment box to be able to shop. The manipulation was identical to the voluntary commitment indicated above; however, participants could only tick the commitment acceptance box ("I am interested in protecting the environment; therefore, I commit to keeping the carbon footprint of my basket below 180gCO2/100g") to proceed into the store. They could not choose to reject the commitment (Figure 5), though they could simply leave the online supermarket. Participants could not continue without ticking, and if they clicked on "Start shopping" without accepting the commitment, an error window asked participants to tick the box before proceeding (the software recorded this information. The threshold was not enforced, and participants could check out independently of whether they exceeded the threshold or not.

3.5.5. Interaction between commitment and badge

Both the voluntary and the forced commitment manipulations were interacted with the badge manipulation. This interaction entailed that participants could see the badge whenever their commitment was achieved, and the badge would disappear if their carbon footprint was above the low-carbon threshold.

3.6. Behavioural outcome

The behavioural outcome of interest is the total carbon footprint (in gCO_2e) of the basket. This outcome aligns with the ambition of the policymaker to reduce the total carbon footprint from grocery shopping by reducing it at basket level. The metric differs from the weight-normalised goal given to consumers, which translated a policy objective (absolute carbon reduction) into a goal relevant for consumers and retailers (as explained in section 3.4).

3.7. Final questionnaires

After submitting their basket, each week participants completed a questionnaire. In both weeks, they were asked about their shopping trip (e.g., shopping goals, type of shopping trip), inventory, and recorded their self-control scale (Tangney, Baumeister, and Boone 2004) and moral self-image (Jordan, Leliveld, and Tenbrunsel 2015). In addition, the questionnaire in week 1 collected demographic information (gender, age, postcode, education, income, household size); in week 2, it also collected attitudes and self-perception towards health and the environment (Cornelissen et al. 2008), health and environmental social and self-signalling (own elaborations, based on Bem 1967; Dubé et al. 2017), health and environmental identity (Aquino and Reed 2002), and their ethical mindset (Cornelissen et al. 2013).[8] Finally, a follow-up questionnaire was handed to participants when they came to collect their food, to explore whether consumers felt the commitment was binding, as explained in detail in Appendix 2

4. ECONOMETRIC MODEL

The econometric estimation of the average treatment effect (ATE) of a manipulation follows Panzone et al. (2021a), who use a Difference-in-difference (DID) estimator (Bertrand, Duflo, and Mullainathan 2004; Imbens and Wooldridge 2009; Wing, Simon, and Bello-Gomez 2018).. In the experiment, participants shopped over 2 successive weeks. Week 1 is a baseline week, where no intervention is in place. In week 2 participants are allocated to a treatment k = 0, 1, …, 5, where k = 0 is the control group, and k = 1, …, 5 are the experimental groups. Within each week t = *1, 2*, participants i purchase a basket with total normalised carbon footprint C_{it} (in $gCO_2e/100g$): we label this as the consumer's *carbon footprint* for short. The impact of the intervention, that is the ATE, is then estimated as difference between the average change observed in the treated individuals and the change in individuals in the control group over the same time (Imbens and Wooldridge 2009), or

$$\phi_{k2} \equiv [\bar{C}_{k2} - \bar{C}_{k1}] - [\bar{C}_{02} - \bar{C}_{01}] \quad k = 1,\ldots,5 \tag{4}$$

where $\bar{C}_{kt}$ is average carbon footprint of individuals in experimental group k in week t.

This approach acknowledges that changes in behaviour between groups from the baseline week to the experimental week could be driven by factors other than the experimental stimuli (e.g., social media, interaction between participants), which the experimenter cannot see. Equation (4) removes all unobservable effects by removing the change that would have

[8] We also added the questions of the short social desirability scale (Stöber 2001), but due to a software glitch this data was not collected.

occurred in the absence of stimuli: this item corresponds to the change in the control group, captured by the term $(\bar{C}_{02} - \bar{C}_{01})$. Crucially, because the treatment is randomly allocated, there is no self-selection into a treatment, ensuring the absence of endogeneity in the DID estimator. In a linear equation, the ATE, ϕ_k, is estimated using the regression

$$C_{it} = \alpha_{0i} + \sum_{k=1}^{k=5} \alpha_{1k} G_{ik} + \alpha_2 W_t + \sum_{k=1}^{k=5} \phi_k W_t G_{ik} + \nu_{it} \quad (5)$$

where W_t refers to a dummy equal 1 if $t = 2$ (zero otherwise); and G_{ik} refers to a set of dummies capturing the experimental stimuli (zero for the control group). Finally, α_{0i} refers to individual-specific fixed effects, which capture time-invariant personal attitudes and characteristics.

5. RESULTS

5.1. Demographic and shopping characteristics of the sample

Table 1 presents the summary characteristics of the 677 participants who shopped and completed the final questionnaire. The sample is characterised by a majority of professional (non-student) workers (84%), females (69%), primarily in the 25-44 year-old range (60%), most commonly in possession of an undergraduate degree or above (70%) and with a relatively high income. A series of χ^2 tests shows that groups did not differ significantly in their demographic composition (Table 1), nor in their personal attitudes and beliefs (Table 2). All groups register comparable in-store expenditures in week 1, with the only exception of the forced commitment group, whose expenditures are slightly larger than the control group only in week 1. All other summary basket characteristics, including carbon footprint, do not differ significantly across groups in week 1 (Table 3). Overall, these summary statistics indicate that the random assignment of subjects to treatments was broadly effective.[9]

The mean average spend in the overall sample was £23.47 in week 1 (range: £1.15-£25, N = 677), with 90% of participants spending £20.18 or more; and £23.00 in week 2 (range: £0.59-£25, N = 677), with 90% of participants spending £19.09 or more. Most shoppers saw this exercise as a top-up shopping trip (26% in week 1, 28% in week 2) or part of a full weekly shopping trip (58% in week 1, 57% in week 2); while for a minority of consumers this occasion was a full-size weekly shopping trip (12% in week 1, 9% in in week 2), or as an "unusual" weekly shopping trip (4% in week 1 and 6% in week 2).

[9] The Difference-in-difference approach we use (see section 4) corrects for unobservable time-invariant characteristics, and for purely time-varying factors via the week dummies. In some specifications, we also correct for key time- and individual-varying characteristics (e.g., attitudes), to remove as much heterogeneity as possible.

Table 3 and Figure 6 show that, apart from the control and the simple badge group, there was a reduction in the average total carbon footprint of shopping baskets in week 2, compared to week 1. This result is supported by a Kolmogorov-Smirnov test, which shows that the distribution of carbon footprint had a statistically significant leftwards shift in week 2 ($D=0.10$, $p<0.001$). An analysis of the carbon footprint in week 1 indicates that the low-carbon footprint threshold (180 $gCO_2e/100g$ of basket) represents the bottom quintile of the distribution, representing an ambitious goal. The drop in carbon footprint came with no significant change in basket weight; while the voluntary commitment group, and the forced commitment with badge group recorded a drop in kilocalories (Table 3). Finally, while the forced commitment group spent slightly more than other groups in week 1, expenditures were in line with the rest of the sample in week 2 (Table 3).

Finally, Figure 7 shows how the consumer goal ($gCO_2e/100g$) changed as participants added items to their baskets: in all groups, the median cumulative carbon footprint per 100g tended to start relatively low and grow, then declining towards the end of the shopping trip; in week 2, the commitment groups show an earlier decline in the carbon footprint by weight. Figure 8 shows that this decline happened particularly early for those who committed to the goal, for whom the median food basket remained below 200 $gCO_2e/100g$ most of the time, and started moving towards the threshold from the fourth choice.

5.2. Manipulation checks

To determine how the commitment manipulation operated, we estimate the impact of the manipulation on goal pursuit and search. Specifically, consumers reported the consumption goals they targeted in the shopping trip they had just completed, a list that also included an environmental goal. Probit regressions (Table 4) indicate that both voluntary and forced commitments increased the probability of reporting an environmental goal pursuit, relative to the control group[10], by 16-20%, depending on the specification of the regression. ANOVA-style tests (table 5) also reveal that participants in the commitment groups spent more time looking at the carbon footprint of products, searching for this information on more products. Finally, participants facing a forced treatment scored higher in self-signalling and, marginally, on self-control (Tables A5 and A6 in Appendix 3).

[10] The same analysis on week 1 data shows no significant coefficients for the treatment variables.

5.3. Who commits?

To identify selection effects in the decision to commit to a lower carbon footprint, we explore what drives individual commitment. In the voluntary commitment group, participants decided whether to accept or reject the request to commit to a low-carbon basket goal. Participants facing a forced commitment did not have the choice, and, if they tried to proceed without accepting the commitment, an error message would request ticking the commitment box as a condition to proceed; the initial failure to tick the commitment box may be driven by limited interest for the environment, or by a limited ability to execute the experimental instructions (e.g., not understanding there is a box to tick). A Probit regression (Table 6) indicates that the decision to voluntarily commit correlates with the self-signalling score, and symbolisation component of the environmental identity, in line with previous research (Effron and Conway 2015; Gneezy et al. 2012a; Steg 2016); the decision is unrelated to self-control, self-image, or social signalling. Conversely, in the forced commitment treatment, those who try to proceed without ticking are older consumers, who may have low computer literacy, and consumers scoring low in the symbolised component of environmental identity. Knowing that a badge will be present does not affect the likelihood of making a commitment.

5.4. Commitments, badges, and the low-carbon footprint thresholds

Table 7 shows the commitment rates by treatment group. When consumers are asked to voluntarily commit, 54-56% accepts. The high acceptance rate is consistent with Ariely and Wertenbroch (2002), who find that individuals recognise they have self-control problems, and accept to incur additional costs to ensure they behave in line with their own values. When commitment is forced, 79-82% of participants ticked the box straight away, while 18-21% of consumers tried to proceed without ticking the commitment box. A χ^2 test shows that consumers who committed voluntarily were more likely to meet the low-carbon footprint threshold in week 2 than those who voluntarily did not commit (χ^2 =10.71, p = 0.001); this relationship is weaker under forced commitment (χ^2 =2.74, p = 0.098). A Probit regression (Table 8) shows that, relative to the control group, in week 2 the voluntary commitment increases the likelihood of meeting the low-carbon footprint threshold by around +17%, a value going to +14-15% in the presence of a forced commitment. The presence of a badge has no impact on the likelihood of meeting the threshold. Male participants and households with more adults are less likely to meet the threshold; while individuals with high self-signalling score and internalised environmental identity score are more likely to meet the threshold.

5.5. The impact of commitment and badges on the carbon footprint of food baskets

This section presents the estimated impact of the experimental stimuli on the carbon footprint of the food baskets of consumers. We use the econometric model presented in section 4. In the analyses that follow, the dependent variable is the total CO_2e in the basket of the consumer in the experimental week, in gCO_2e. Results refer to a fixed-effects panel Difference-in-difference (DID) estimator, with bootstrapped standard errors clustered at individual consumer level, and stratified by treatment group. A series of Hausman tests indicates that random and fixed effects are equivalent; we retain a fixed effects estimator for consistency with the DID literature. This approach estimates the change in carbon footprint in the presence of the experimental stimuli over time, removing the change over the same period observed in the control group. The half-elasticity, which measures the impact of the intervention in percentage points, is estimated as[11]

$$\varepsilon = \frac{\partial C_{it}}{\partial W_t G_i} \frac{1}{C_{it}} = \phi \frac{1}{C_{it}}$$

The parameter ε indicates the % change in carbon footprint when the treatment dummy is 1.

Table 9 presents the key results of this article, omitting the interaction between treatments, which add noise to the estimation. A regression with simple treatment effects is reported in Table A7 in Appendix 3 for reference; while results with all the interactions are available in Table A8 in the Appendix.

In table 9 (and Table A8 in Appendix 3), model A regresses the carbon footprint of the food basket over a single joint commitment variable, equal to one for participants in any commitment group. Model B treats the two sources of commitment – voluntary vs forced – separately, therefore isolating the 3 main effects (badge, voluntary commitment, and forced commitment). Model C separates those who voluntarily accepted and those who voluntarily rejected the voluntary commitment, to observe whether the two groups behaved differently. Importantly, in model C individuals self-selected in or out of the commitment group driven by personal preferences (as shown in Table 6), and the results should not be interpreted as the causal impact of the commitment, but rather as the change in carbon footprint in the segment of consumers with strong preferences for environmental preservation. All the three regressions are estimated with and without time-varying attitudinal variables: self-control; environmental

[11] Half-elasticities have been calculated at individual level, and then averaged out to give the sample average.

self-image, self-signalling, and social signalling – none of these metrics explain differences in carbon footprint in any regression, and they are not discussed further.

Model A indicates that the presence of a commitment reduce the carbon footprint of the food baskets by 1,900-2,000gCO_2e, a reduction of around 8-9% in carbon footprint (half-elasticity: ε = -0.08/-0.09). Model B indicates that both commitments contribute to comparable reductions in carbon footprint: the voluntary commitment leads to a reduction of ~1,800 gCO_2e, an 8% reduction (ε =-0.08); while the forced commitment causes a reduction of ~2,000-2,100 gCO_2e, a reduction of 9-10% (ε =-0.09-0.10). Finally, model C indicates that the reduction caused by a voluntary commitment is driven by those consumers who accepted the commitment: they reduced their carbon footprint by ~3,000 gCO_2e, a 13-14% reduction (ε = -0.13-0.14), while those who refused recorded a small reduction of 300 gCO_2e (ε = -0.01). In model C, a forced commitment caused a reduction in carbon footprint of ~2000-2100 gCO_2e (ε = -0.09/-0.10). Effect sizes change slightly when interaction terms are included, particularly for the forced commitment manipulation (Table A8, Appendix 3). To put the results into perspective[12], driving 1 mile with an average passenger vehicle emits 398 gCO_2e; while charging one smartphone emits 8.22 gCO_2e. Overall, these results provide support to hypotheses H_1 and H_2. Wald tests found no statistical difference between the two types of commitments, providing no support for H_{3a} and H_{3b}.

The presence of the badge led to a non-significant reduction of 800-900 gCO_2e across all models, equivalent to a 3-4% reduction (ε = -0.03/-0.04). Table 9 indicates that the presence of a badge did not interact significantly with any of the commitment variables, providing no support to hypothesis H_4.

Table 10 summarises how consumers allocated their £25 across food categories and savings. This table indicates that in week 2 consumers in the voluntary commitment groups consumed more fruit and vegetables, and reduced their consumption of dairy and eggs, other products of vegetarian origin, and drinks. Those in the forced commitment increased savings, and reduced consumption of dairy and eggs, and other products. Interestingly, consumers did not reduce their consumption of meat, despite the large potential carbon savings in this category (Poore and Nemecek 2018). Finally, Figure 9 shows that carbon reductions were larger in consumers with larger carbon footprints in week 1; the trend is negative also in the control group, although the slope appears steeper in the commitment groups. This figure suggests that

[12] See https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references

the distributional effects of the intervention are in the right direction (Sunstein 2021), as carbon savings are larger for those consumers who have larger carbon footprint at baseline.

6. DISCUSSION

This research studied the role of commitment and badges in driving lower carbon footprint food choices. Results indicate that making a commitment prior to entering the store leads to a reduction in carbon footprint of around 8 to 9%. In the group where commitment is voluntary, the reduction is driven by those consumers who accept the commitment, which record a reduction of around 13% in carbon footprint. This section contextualises this research in light of the existing literature, from the perspective of both the academia, and policy practice.

6.1. How goal commitment influences consumer decisions

This study shows that asking consumers to commit prior to entering the online retailer increased the sustainability of their decisions. While the literature indicates that commitments require a mechanism that ensures the commitment is kept (Brocas et al. 2004; Bryan et al. 2010; Burke et al. 2018; Rogers et al. 2014; Schwartz et al. 2014), this study shows that compliance to the commitment is high even in the absence of any enforcement. When commitment is voluntary, the reduction in carbon footprint is driven by those consumers who accept the commitment, who register a large drop in carbon emissions; while those who did not commit registered a very small change in carbon footprint. On average, the effect of the voluntary commitment is close in magnitude to the forced commitment. This result is comparable to the findings in Bulte, List, and van Soest (2019), who test the impact of a claw-back to motivate productivity, where the employer pays a bonus up front and takes it back if the worker fails to meet a target: the claw-back increased productivity in those workers who used it as a commitment device; and backfired in workers who did not like the claw-back, cancelling the effect of the former group. In our study, the soft commitment ensured that we did not observe reactance in those who did not commit, with an overall net reduction in GHG emissions. Further research could explore mechanisms that can persuade more consumers to accept the commitment, potentially leading to further reductions in carbon footprint.

This research contributes to previous research by providing a better understanding of the role of sustainability goals in driving transitions to low-carbon grocery shopping. On the one hand, Panzone et al. (2021c) shows that the provision of a clear sustainability goal (“Keep carbon low”) is not enough to achieve significant reductions in carbon footprint in an online retailer. Conversely, Kanay et al. (2021) shows that setting a clear goal (“Limiting climate

change") combined with a monitoring device (a colour-coded "thermometer") is instead effective in reducing the carbon footprint from grocery shopping. Our study shows that asking or forcing consumers to commit to the environmental goal achieves comparable reductions even without a goal monitoring mechanism.

The economic model indicates that consumer grocery choices provide pure consumption utility, as well as diagnostic utility, which can be activated through several mechanisms. For example, the mere presence of the commitment coming from a favourable authority (in this case, a trusted academic institution) might have been enough to motivate compliance (see also Karakostas and Zizzo 2016). This effect may have been especially evident in Kanay et al. (2021), because the way the goal is set is almost a textbook representation of how an experimenter may demand a result from their subjects (de Quidt, Haushofer, and Roth 2018; Zizzo 2010). While insightful, this manipulation may be harder to replicate in natural world grocery shopping than our commitment[13]. The manipulation of Kanay et al. (2021), as well as our commitment manipulation, may operate also through a social norm compliance channel (as reviewed in section 2.2). Thirdly, our commitment manipulation may specifically elicit a preference for promise-keeping (Vanberg 2008) or compliance to a social norm of promise keeping (Ellingsen and Johannesson 2004; van der Werff et al. 2019). However, we find no evidence that commitments operated by altering the self-image of the consumer.

Conversely, badges do not cause a significant reduction in carbon footprint. While badges can increase self-efficacy (Sailer et al. 2017) and engagement (Hamari 2017), the limited impact observed in this article indicates that consumers may not need a soft reward to motivate their compliance to a commitment. This result is likely linked to the private nature of the badge: in Baca-Motes et al. (2013), a signalling pin visible to third parties, therefore allowing for social signalling, had a significantly positive impact on the reuse of hotel bath towels; on the other hand, van der Weele and von Siemens (2020) show that a bracelet – which cannot be seen by third parties – does not motivate pro-social behaviour. Our results support the latter research, suggesting that consumers use signalling badges to communicate their pro-social preferences to others, rather than to themselves. An alternative explanation is that the badge had no actual meaning to consumers: while respondents to a pilot survey viewed this badge as motivating, a

[13] In our study, one way we limited the extent to which a commitment could be interpreted as a request by the experimenter was to provide nutritional as well as environmental information on the products, a feature which we see as ecologically valid given the ubiquitous nature of health information being provided on food.

more recognisable badge (e.g., a WWF badge) might have been more effective. Nonetheless, further research is needed to better understand how signalling operates.

6.2. Policy implications: Retail design and the protection of the public good

Sustainable consumption – intended as consumption that does not have long-term negative effects on the environment, for instance, having a low carbon footprint – is increasingly relevant for public policy and corporate social responsibility, as government place effort in the achievement of internationally agreed carbon consumption targets (IPCC 2018). The key policy implication of this research is that part of this process can be achieved without fully delegating the responsibility to governments. In fact, the design of the supermarket, which is in the control of the retailers themselves, can play a strategic role of support to governmental policies targeting environmental protection. Nudges are becoming increasingly prominent in addressing social problems (Cadario and Chandon 2019; Loewenstein and Chater 2017; Mills 2020; Schwartz, Milfont, and Hilton 2019; Tannenbaum, Fox, and Rogers 2017), and they can be implemented quickly and without a need for regulation. At the same time, nudges can be designed to increase knowledge about the decisions consumers face, increasing competences that consumers can use also outside the retail space (Hertwig and Grüne-Yanoff 2017).

Online environments are particularly suitable to the design of nudges and complex interventions targeting large-scale changes in behaviour (Lorenz-Spreen et al. 2020; Rogers et al. 2014; Todd, Rogers, and Payne 2013). The commitments presented in this article can be easily implemented in online shops, in conjunction with rewards (a discount following a successful commitment in Schwartz et al. 2014), penalties (blocked withdrawals in Burke et al. 2018), or within a more complex gamified environment (Hamari, Koivisto, and Sarsa 2014; Hock et al. 2019; Whittaker et al. 2021). This is a promising area for further research. For instance, Schwartz et al. (2014) show that conditioning a promotion on the achievement of a health goal that consumers voluntarily commit to can increase fruit and vegetables sales. While Schwartz et al. (2014) enforced the commitment by linking it to the reward, our article shows that a soft commitment has the potential to be effective (as in Burke et al. 2018; and Himmler et al. 2019). Similarly, Burke et al. (2018) show that for savings decisions, which like food shopping require multiple decisions over time, soft commitments are more effective than hard ones in the short run; but hard commitments become more effective after 6 months. Consequently, our results might be somewhat different if a longer time window was used.

Finally, the voluntary commitment nudge presented in this work can be seen as a hyper-nudge. Hyper-nudging refers to the use of nudges that are personalised around the user in either the choice task, or the method of nudging (Mills 2020; Yeung 2017). As an example, online retailers often target consumers with incentives (e.g., a discount on diapers for babies) based on past, related behaviour observed in the store (e.g., the purchase of baby food), using past purchases to reveal information (the household has a baby) otherwise unobservable to the marketeer. Hyper-nudges allow for more precise targeting in settings with large preference heterogeneity, optimising the use of resources. Compared with the forced commitment, the voluntary commitment contains information on the environmental preferences of the user, which the marketer can use to identify environmentally motivated individuals within the market, information that could be used to design different promotions that further reduce carbon footprint in the same domain (food) or in other environmental domains (e.g., energy).

6.3. Limitations and future research

A key limitation of this research, typical of experimental work, is the short time window (two weeks), which limits the ability to observe the impact of a nudge over time. Randomised trials have shown that the effectiveness of nudges targeting a reduction in energy consumption remains fairly stable over time, but erode slowly when the nudge is removed (Allcott and Taubinsky, 2015). Similarly, the differential effect of soft and hard commitments can reverse over time (Burke et al. 2018), and understanding these dynamics can lead to a more effective design of the nudge. More generally, a long time horizon can lead to a better understanding of how consumers engage with change (Riefer et al. 2017), and how regulation shapes pro-environmental motivation and knowledge (Steg 2016). This is particularly important for food consumption, where environmental preservation may conflict with private goals such as health or saving money, or with other environmental goals such as a low-plastic grocery basket. A second possible limitation is the lack of enforcement in the commitment manipulations: Appendix 2 shows that more than 40% of participants thought that the commitment was not binding, and results might have been stronger if the commitment was enforced (as in Burke et al. 2018; Schwartz et al. 2014). However, enforcement in this type of commitments would change a nudge into an imposition, which is likely to be unpalatable to both consumers and retailers. Our results indicate that a simple pledge is sufficient to change behaviour.

A more serious potential limitation refers to the ecological validity of the experiment. The online store required consumers to behave as they would normally do when shopping for food, whilst aware of being in an experiment. The delivery of one food basket, and the absence

of interaction with the experimenter increased the likelihood that participants made optimal choices. Questions remain over the scalability of the results in this article (Al-Ubaydli, List, and Suskind 2019): moving from students (in Panzone et al. 2021a; Panzone et al. 2018) to the general population (in this study) gives slightly smaller effects, and research is needed to explore the scalability of these experiments. Linked to incentive-compatibility, the "free" £25 budget may have caused a "house money effect" (Thaler and Johnson 1990): participants may have felt the budget was a gift, which they spent on goods they would not normally buy (e.g., relative luxury goods). Experimental research shows this effect may not affect public goods (Clark 2002), and it did not occur in the pilot of another study using an experimental online supermarket (Zizzo et al. 2021). A final limitation, common in experimental supermarkets, is the inability to control for potential substitution between grocery shopping in the experiment and grocery shopping outside the experiment. Zizzo et al. (2021) provide evidence that the results of their supermarket interventions were unaffected by such substitution effects. Nevertheless, this remains an important avenue for future research.

7. CONCLUSION

This article reports the results from an experiment testing the role of commitments and badges promoting the reduction in carbon footprint from online food shopping. Using an experimental online supermarket, we show that non-binding commitments can be significant in reducing the carbon footprint from food consumption. The findings presented in this article show that the design of the retail environment has an important impact on what consumers choose, and on the carbon footprint of their basket. We hope the results of this study will convince retailers to commit to helping their customers reduce the carbon footprint of their food shopping.

BIBLIOGRAPHY

Al-Ubaydli, O., J. A. List, and D. Suskind (2019), "The Science of Using Science: Towards an Understanding of the Threats to Scaling Experiments," in *NBER Working Paper*.

Andreoni, J. (1990), "Impure Altruism and Donations to Public Goods: A Theory of Warm-Glow Giving," *The Economic Journal*, 100 (401), 464-77.

Aquino, K. and A. I. Reed (2002), "The Self-Importance of Moral Identity," *Journal of Personality and Social Psychology*, 83 (6), 1423-40.

Ariely, D., A. Bracha, and S. Meier (2009), "Doing Good or Doing Well? Image Motivation and Monetary Incentives in Behaving Prosocially," *American Economic Review*, 99 (1), 544-55.

Ariely, D. and K. Wertenbroch (2002), "Procrastination, Deadlines, and Performance: Self-Control by Precommitment," *Psychological Science*, 13 (3), 219-24.

Baca-Motes, K., A. Brown, A. Gneezy, E. A. Keenan, and L. D. Nelson (2013), "Commitment and Behavior Change: Evidence from the Field," *Journal of Consumer Research*, 39 (5), 1070-84.

Baumeister, R. F. (2002), "Yielding to Temptation: Self-Control Failure, Impulsive Purchasing, and Consumer Behavior," *Journal of Consumer Research*, 28 (4), 670-76.

Baumeister, R. F. and T. F. Heatherton (1996), "Self-Regulation Failure: An Overview," *Psychological Inquiry*, 7 (1), 1-15.

Baumeister, R. F. and K. D. Vohs (2016), "Chapter Two - Strength Model of Self-Regulation as Limited Resource: Assessment, Controversies, Update," in *Advances in Experimental Social Psychology*, Vol. 54, ed. James M. Olson and Mark P. Zanna: Academic Press, 67-127.

Bem, D. J. (1967), "Self-Perception: An Alternative Interpretation of Cognitive Dissonance Phenomena," *Psychological Review*, 74 (3), 183-200.

Bénabou, R. and J. Tirole (2011), "Identity, Morals, and Taboos: Beliefs as Assets *," *The Quarterly Journal of Economics*, 126 (2), 805-55.

Bertrand, M., E. Duflo, and S. Mullainathan (2004), "How Much Should We Trust Differences-in-Differences Estimates?," *The Quarterly Journal of Economics*, 119 (1), 249-75.

Bodner, R. and D. Prelec (2003), "Self-Signaling and Diagnostic Utility in Everyday Decision Making," in *The Psychology of Economic Decisions*, Vol. 1, ed. Isabelle Brocas and Juan D. Carrillo, Oxford: Oxford University Press, 26.

Botti, S., S. Broniarczyk, G. Häubl, R. Hill, Y. Huang, B. Kahn, P. Kopalle, D. Lehmann, J. Urbany, and B. Wansink (2008), "Choice under Restrictions," *Marketing Letters*, 19 (3), 183-99.

Brick, C., D. K. Sherman, and H. S. Kim (2017), "“Green to Be Seen” and “Brown to Keep Down”: Visibility Moderates the Effect of Identity on Pro-Environmental Behavior," *Journal of Environmental Psychology*, 51, 226-38.

Brocas, I., J. D. Carrillo, and M. Dewatripont (2004), "Commitment Devices under Self-Control Problems: An Overview," in *The Psychology of Economic Decisions*, Vol. 2, 49-67.

Bryan, G., D. Karlan, and S. Nelson (2010), "Commitment Devices," *Annual Review of Economics*, 2 (1), 671-98.

Bulte, E., J. A. List, and D. van Soest (2019), "Toward an Understanding of the Welfare Effects of Nudges: Evidence from a Field Experiment in Uganda," Vol. Natural Field Experiments: The Field Experiments Website.

Burke, J., J. Luoto, and F. Perez-Arce (2018), "Soft Versus Hard Commitments: A Test on Savings Behaviors," *Journal of Consumer Affairs*, 52 (3), 733-45.

Cadario, R. and P. Chandon (2019), "Which Healthy Eating Nudges Work Best? A Meta-Analysis of Field Experiments," *Marketing Science*, 39 (3), 465-86.
Camilleri, A. R., R. P. Larrick, S. Hossain, and D. Patino-Echeverri (2019), "Consumers Underestimate the Emissions Associated with Food but Are Aided by Labels," *Nature Climate Change*, 9 (1), 53-58.
Carbon Trust (2018), "Carbon Footprinting," London.
Carlsson, F., C. Gravert, O. Johansson-Stenman, and V. Kurz (2021), "The Use of Green Nudges as an Environmental Policy Instrument," *Review of Environmental Economics and Policy*, 15 (2), 216-37.
Charness, G. and M. Dufwenberg (2006), "Promises and Partnership," *Econometrica*, 74 (6), 1579-601.
Clark, J. (2002), "House Money Effects in Public Good Experiments," *Experimental Economics*, 5 (3), 223-31.
Clune, S., E. Crossin, and K. Verghese (2017), "Systematic Review of Greenhouse Gas Emissions for Different Fresh Food Categories," *Journal of Cleaner Production*, 140, Part 2, 766-83.
Cornelissen, G., M. R. Bashshur, J. Rode, and M. Le Menestrel (2013), "Rules or Consequences? The Role of Ethical Mind-Sets in Moral Dynamics," *Psychological Science*, 24 (4), 482-88.
Cornelissen, G., M. Pandelaere, L. Warlop, and S. Dewitte (2008), "Positive Cueing: Promoting Sustainable Consumer Behavior by Cueing Common Environmental Behaviors as Environmental," *International Journal of Research in Marketing*, 25 (1), 46-55.
Daube, M. and D. Ulph (2016), "Moral Behaviour, Altruism and Environmental Policy," *Environmental and Resource Economics*, 63 (2), 505-22.
de Quidt, J., J. Haushofer, and C. Roth (2018), "Measuring and Bounding Experimenter Demand," *American Economic Review*, 108 (11), 3266-302.
Demarque, C., L. Charalambides, D. J. Hilton, and L. Waroquier (2015), "Nudging Sustainable Consumption: The Use of Descriptive Norms to Promote a Minority Behavior in a Realistic Online Shopping Environment," *Journal of Environmental Psychology*, 43, 166-74.
Dhar, R. and I. Simonson (2003), "The Effect of Forced Choice on Choice," *Journal of Marketing Research*, 40 (2), 146-60.
Dickerson, C. A., R. Thibodeau, E. Aronson, and D. Miller (1992), "Using Cognitive Dissonance to Encourage Water Conservation," *Journal of Applied Social Psychology*, 22 (11), 841-54.
Dietz, T., G. T. Gardner, J. Gilligan, P. C. Stern, and M. P. Vandenbergh (2009), "Household Actions Can Provide a Behavioral Wedge to Rapidly Reduce Us Carbon Emissions," *Proceedings of the National Academy of Sciences*, 106 (44), 18452-56.
Drewnowski, A., C. D. Rehm, A. Martin, E. O. Verger, M. Voinnesson, and P. Imbert (2015), "Energy and Nutrient Density of Foods in Relation to Their Carbon Footprint," *The American Journal of Clinical Nutrition*, 101 (1), 184-91.
Dubé, J.-P., X. Luo, and Z. Fang (2017), "Self-Signaling and Prosocial Behavior: A Cause Marketing Experiment," *Marketing Science*, 36 (2), 161-86.
Edwards, E. A., J. Lumsden, C. Rivas, L. Steed, L. A. Edwards, A. Thiyagarajan, R. Sohanpal, H. Caton, C. J. Griffiths, M. R. Munafò, S. Taylor, and R. T. Walton (2016), "Gamification for Health Promotion: Systematic Review of Behaviour Change Techniques in Smartphone Apps," *BMJ Open*, 6 (10), e012447.
Effron, D. A., C. J. Bryan, and J. K. Murnighan (2015), "Cheating at the End to Avoid Regret," *J Pers Soc Psychol*, 109 (3), 395-414.

Effron, D. A. and P. Conway (2015), "When Virtue Leads to Villainy: Advances in Research on Moral Self-Licensing," *Current Opinion in Psychology*, 6, 32-35.
Ekwurzel, B., J. Boneham, M. W. Dalton, R. Heede, R. J. Mera, M. R. Allen, and P. C. Frumhoff (2017), "The Rise in Global Atmospheric Co2, Surface Temperature, and Sea Level from Emissions Traced to Major Carbon Producers," *Climatic Change*, 144 (4), 579-90.
Ellingsen, T. and M. Johannesson (2004), "Promises, Threats and Fairness," *The Economic Journal*, 114 (495), 397-420.
Ellingsen, T., M. Johannesson, S. Tjøtta, and G. Torsvik (2010), "Testing Guilt Aversion," *Games and Economic Behavior*, 68 (1), 95-107.
Falk, A. (2021), "Facing Yourself – a Note on Self-Image," *Journal of Economic Behavior & Organization*, 186, 724-34.
Fishbach, A. and R. Dhar (2005), "Goals as Excuses or Guides: The Liberating Effect of Perceived Goal Progress on Choice," *Journal of Consumer Research*, 32 (3), 370-77.
--- (2007), "Dynamics of Goal-Based Choice," in *Handbook of Consumer Psychology*, ed. Curtis P. Haugtvedt, Paul M. Herr and Frank R. Kardes, New York Routledge, 611-37.
Fishbach, A., T. Eyal, and S. R. Finkelstein (2010), "How Positive and Negative Feedback Motivate Goal Pursuit," *Social and Personality Psychology Compass*, 4 (8), 517-30.
Fishbach, A. and W. Hofmann (2015), "Nudging Self-Control: A Smartphone Intervention of Temptation Anticipation and Goal Resolution Improves Everyday Goal Progress," *Motivation Science*, 1 (3), 137-50.
Forwood, S. E., A. L. Ahern, G. J. Hollands, Y.-L. Ng, and T. M. Marteau (2015), "Priming Healthy Eating. You Can't Prime All the People All of the Time," *Appetite*, 89, 93-102.
Galizzi, M. M. and L. Whitmarsh (2019), "How to Measure Behavioral Spillovers: A Methodological Review and Checklist," *Frontiers in psychology*, 10 (342).
Galli, A., T. Wiedmann, E. Ercin, D. Knoblauch, B. Ewing, and S. Giljum (2012), "Integrating Ecological, Carbon and Water Footprint into a "Footprint Family" of Indicators: Definition and Role in Tracking Human Pressure on the Planet," *Ecological Indicators*, 16, 100-12.
Gifford, R. (2011), "The Dragons of Inaction: Psychological Barriers That Limit Climate Change Mitigation and Adaptation," *American Psychologist*, 66 (4), 290-302.
Gino, F., E. L. Krupka, and R. A. Weber (2013), "License to Cheat: Voluntary Regulation and Ethical Behavior," *Management Science*, 59 (10), 2187-203.
Gino, F., M. E. Schweitzer, N. L. Mead, and D. Ariely (2011), "Unable to Resist Temptation: How Self-Control Depletion Promotes Unethical Behavior," *Organizational Behavior and Human Decision Processes*, 115 (2), 191-203.
Gneezy, A., U. Gneezy, G. Riener, and L. D. Nelson (2012a), "Pay-What-You-Want, Identity, and Self-Signaling in Markets," *Proceedings of the National Academy of Sciences*, 109 (19), 7236-40.
Gneezy, A., A. Imas, A. Brown, L. D. Nelson, and M. I. Norton (2012b), "Paying to Be Nice: Consistency and Costly Prosocial Behavior," *Management Science*, 58 (1), 179-87.
Gul, F. and W. Pesendorfer (2001), "Temptation and Self-Control," *Econometrica*, 69 (6), 1403-35.
Hamari, J. (2017), "Do Badges Increase User Activity? A Field Experiment on the Effects of Gamification," *Computers in Human Behavior*, 71, 469-78.
Hamari, J., J. Koivisto, and H. Sarsa (2014), "Does Gamification Work? - a Literature Review of Empirical Studies on Gamification," in *Proceedings of the 2014 47th*

Hawaii International Conference on System Sciences: IEEE Computer Society, 3025-34.
Harrison, G. W. and J. A. List (2004), "Field Experiments," *Journal of Economic Literature*, 42 (4), 1009-55.
Hertwig, R. and T. Grüne-Yanoff (2017), "Nudging and Boosting: Steering or Empowering Good Decisions," *Perspectives on Psychological Science*, 12 (6), 973-86.
Hilton, D., L. Charalambides, C. Demarque, L. Waroquier, and C. Raux (2014), "A Tax Can Nudge: The Impact of an Environmentally Motivated Bonus/Malus Fiscal System on Transport Preferences," *Journal of Economic Psychology*, 42, 17-27.
Himmler, O., R. Jäckle, and P. Weinschenk (2019), "Soft Commitments, Reminders, and Academic Performance," *American Economic Journal: Applied Economics*, 11 (2), 114-42.
Hock, S. J., R. Bagchi, and T. M. Anderson (2019), "Promotional Games Increase Consumer Conversion Rates and Spending," *Journal of Consumer Research*, 47 (1), 79-99.
Houser, D., D. Schunk, J. Winter, and E. Xiao (2018), "Temptation and Commitment in the Laboratory," *Games and Economic Behavior*, 107, 329-44.
Imbens, G. W. and J. M. Wooldridge (2009), "Recent Developments in the Econometrics of Program Evaluation," *Journal of Economic Literature*, 47 (1), 5-86.
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 ".
Jia, F., K. Soucie, S. Alisat, D. Curtin, and M. Pratt (2017), "Are Environmental Issues Moral Issues? Moral Identity in Relation to Protecting the Natural World," *Journal of Environmental Psychology*, 52, 104-13.
Jolls, C., C. R. Sunstein, and R. Thaler (1998), "A Behavioral Approach to Law and Economics," *Stanford Law Review*, 50 (5), 1471-550.
Jordan, J., M. C. Leliveld, and A. E. Tenbrunsel (2015), "The Moral Self-Image Scale: Measuring and Understanding the Malleability of the Moral Self," *Frontiers in psychology*, 6 (1878).
Kanay, A., D. Hilton, L. Charalambides, J.-B. Corrégé, E. Inaudi, L. Waroquier, and S. Cézéra (2021), "Making the Carbon Basket Count: Goal Setting Promotes Sustainable Consumption in a Simulated Online Supermarket," *Journal of Economic Psychology*, 83, 102348.
Karakostas, A. and D. J. Zizzo (2016), "Compliance and the Power of Authority," *Journal of Economic Behavior & Organization*, 124, 67-80.
Keeling, R. F. (2008), "Recording Earth's Vital Signs," *Science*, 319 (5871), 1771-72.
Kruglanski, A. W. (1975), "The Endogenous-Exogenous Partition in Attribution Theory," *Psychological Review*, 82 (6), 387-406.
Larcom, S., F. Rauch, and T. Willems (2017), "The Benefits of Forced Experimentation: Striking Evidence from the London Underground Network*," *The Quarterly Journal of Economics*, 132 (4), 2019-55.
Lee, L. and D. Ariely (2006), "Shopping Goals, Goal Concreteness, and Conditional Promotions," *Journal of Consumer Research*, 33 (1), 60-70.
Locke, E. A. and G. P. Latham (2006), "New Directions in Goal-Setting Theory," *Current Directions in Psychological Science*, 15 (5), 265-68.
Loewenstein, G. and N. Chater (2017), "Putting Nudges in Perspective," *Behavioural Public Policy*, 1 (1), 26-53.

Lokhorst, A. M., C. Werner, H. Staats, E. van Dijk, and J. L. Gale (2013), "Commitment and Behavior Change: A Meta-Analysis and Critical Review of Commitment-Making Strategies in Environmental Research," *Environment and Behavior*, 45 (1), 3-34.
Lorenz-Spreen, P., S. Lewandowsky, C. R. Sunstein, and R. Hertwig (2020), "How Behavioural Sciences Can Promote Truth, Autonomy and Democratic Discourse Online," *Nature Human Behaviour*, 4 (11), 1102-09.
Macfadyen, S., J. M. Tylianakis, D. K. Letourneau, T. G. Benton, P. Tittonell, M. P. Perring, C. Gómez-Creutzberg, A. Báldi, J. M. Holland, L. Broadhurst, K. Okabe, A. R. Renwick, B. Gemmill-Herren, and H. G. Smith (2015), "The Role of Food Retailers in Improving Resilience in Global Food Supply," *Global Food Security*, 7, 1-8.
Manderson, E. J. and T. J. Considine (2018), "An Economic Perspective on Industrial Ecology," *Review of Environmental Economics and Policy*, 12 (2), 304-23.
Matthies, E., C. A. Klöckner, and C. L. Preißner (2006), "Applying a Modified Moral Decision Making Model to Change Habitual Car Use: How Can Commitment Be Effective?," *Applied Psychology*, 55 (1), 91-106.
Mazar, N., O. Amir, and D. Ariely (2008), "The Dishonesty of Honest People: A Theory of Self-Concept Maintenance," *Journal of Marketing Research*, 45 (6), 633-44.
Metcalf, G. E. and D. Weisbach (2009), "The Design of a Carbon Tax," *Harvard Environmental Law Review*, 33, 499-556.
Mills, S. (2020), "Personalized Nudging," *Behavioural Public Policy*, 1-10.
Monin, B. and A. H. Jordan (2009), "The Dynamic Moral Self: A Social Psychological Perspective," in *Personality, Identity, and Character: Explorations in Moral Psychology*, ed. Darcia Narvaez and Daniel K. Lapsley, New York (USA): Cambridge University Press, 341-54.
Mora, C., D. Spirandelli, E. C. Franklin, J. Lynham, M. B. Kantar, W. Miles, C. Z. Smith, K. Freel, J. Moy, L. V. Louis, E. W. Barba, K. Bettinger, A. G. Frazier, J. F. Colburn Ix, N. Hanasaki, E. Hawkins, Y. Hirabayashi, W. Knorr, C. M. Little, K. Emanuel, J. Sheffield, J. A. Patz, and C. L. Hunter (2018), "Broad Threat to Humanity from Cumulative Climate Hazards Intensified by Greenhouse Gas Emissions," *Nature Climate Change*, 8 (12), 1062-71.
Mullainathan, S. and R. H. Thaler (2000), "Behavioral Economics," National Bureau of Economic Research.
Muller, L., A. Lacroix, and B. Ruffieux (2019), "Environmental Labelling and Consumption Changes: A Food Choice Experiment," *Environmental and Resource Economics*, 73 (3), 871-97.
Nordebo, S., M. F. Naeem, and P. Tans (2020), "Estimating the Short-Time Rate of Change in the Trend of the Keeling Curve," *Scientific Reports*, 10 (1), 21222.
O'Donoghue, T. and M. Rabin (1999), "Doing It Now or Later," *American Economic Review*, 89 (1), 103-24.
--- (2001), "Choice and Procrastination," *The Quarterly Journal of Economics*, 116 (1), 121-60.
Panzone, L., A. Ulph, D. Hilton, I. Gortemaker, and I. Tajudeen (2021a), "Express: Sustainable by Design: Choice Architecture and the Carbon Footprint of Grocery Shopping," *Journal of Public Policy & Marketing*, 07439156211008898.
Panzone, L. A., S. Larcom, and P.-W. She (2021b), "Estimating the Impact of the First Covid-19 Lockdown on Uk Food Retailers and the Restaurant Sector," *Global Food Security*, 28, 100495.
Panzone, L. A., F. Lemke, and H. L. Petersen (2016), "Biases in Consumers' Assessment of Environmental Damage in Food Chains and How Investments in Reputation Can Help," *Technological Forecasting and Social Change*, 111, 327-37.

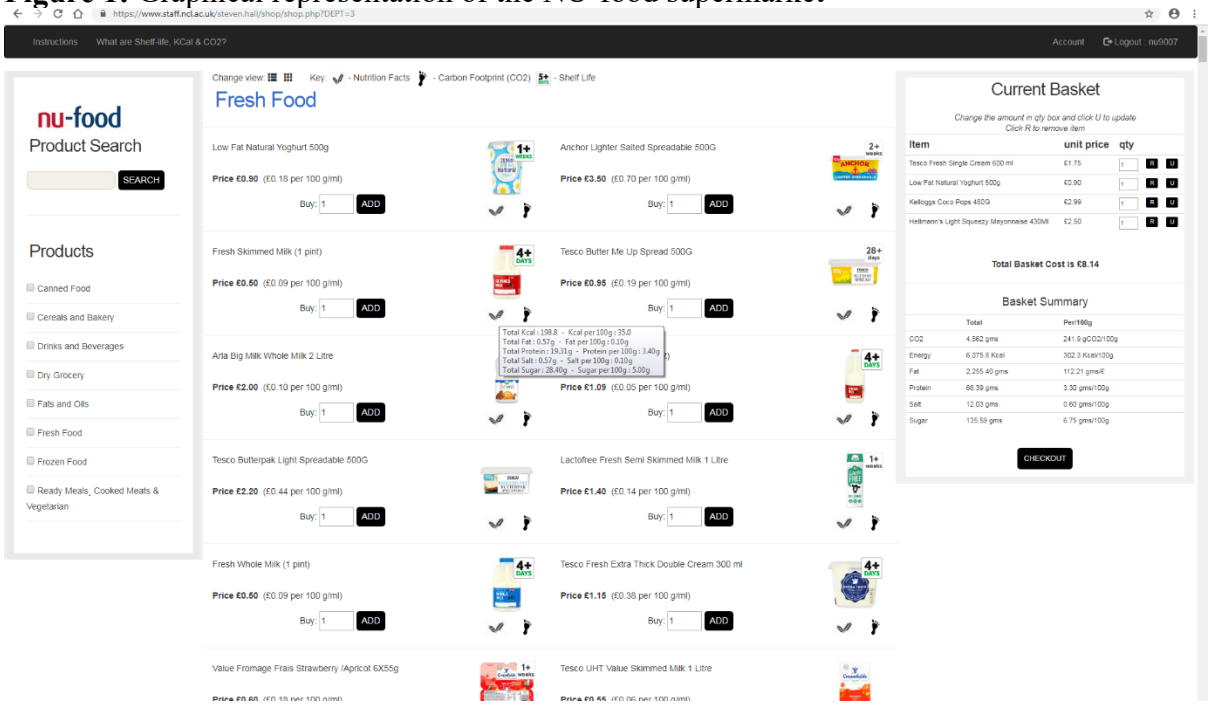
Panzone, L. A., F. F. Sniehotta, R. Comber, and F. Lemke (2020), "The Effect of Traffic-Light Labels and Time Pressure on Estimating Kilocalories and Carbon Footprint of Food," *Appetite*, 155, 104794.
Panzone, L. A., A. Ulph, D. Hilton, I. Gortemaker, and I. A. Tajudeen (2021c), "Sustainable by Design: Choice Architecture and the Carbon Footprint of Grocery Shopping," *Journal of Public Policy & Marketing*, 40 (4), 463-86.
Panzone, L. A., A. Ulph, D. J. Zizzo, D. Hilton, and A. Clear (2018), "The Impact of Environmental Recall and Carbon Taxation on the Carbon Footprint of Supermarket Shopping," *Journal of Environmental Economics and Management*.
Papies, E. K. (2016), "Goal Priming as a Situated Intervention Tool," *Current Opinion in Psychology*, 12, 12-16.
Pearce, D. (1991), "The Role of Carbon Taxes in Adjusting to Global Warming," *The Economic Journal*, 101 (407), 938-48.
Poore, J. and T. Nemecek (2018), "Reducing Food's Environmental Impacts through Producers and Consumers," *Science*, 360 (6392), 987-92.
Richins, M. L. (1997), "Measuring Emotions in the Consumption Experience," *Journal of Consumer Research*, 24 (2), 127-46.
Riefer, P. S., R. Prior, N. Blair, G. Pavey, and B. C. Love (2017), "Coherency-Maximizing Exploration in the Supermarket," *Nature Human Behaviour*, 1 (1), 0017.
Rogers, T., K. L. Milkman, and K. G. Volpp (2014), "Commitment Devices: Using Initiatives to Change Behavior," *JAMA*, 311 (20), 2065-66.
Sadoff, S., A. Samek, and C. Sprenger (2020), "Dynamic Inconsistency in Food Choice: Experimental Evidence from Two Food Deserts," *The Review of Economic Studies*, 87 (4), 1954-88.
Sailer, M., J. U. Hense, S. K. Mayr, and H. Mandl (2017), "How Gamification Motivates: An Experimental Study of the Effects of Specific Game Design Elements on Psychological Need Satisfaction," *Computers in Human Behavior*, 69, 371-80.
Scarborough, P., P. N. Appleby, A. Mizdrak, A. D. M. Briggs, R. C. Travis, K. E. Bradbury, and T. J. Key (2014), "Dietary Greenhouse Gas Emissions of Meat-Eaters, Fish-Eaters, Vegetarians and Vegans in the Uk," *Climatic Change*, 125 (2), 179-92.
Schwartz, D., T. L. Milfont, and D. Hilton (2019), "The Interplay between Intrinsic Motivation, Financial Incentives and Nudges in Sustainable Consumption," in *A Research Agenda for Economic Psychology*: Edward Elgar Publishing.
Schwartz, J., D. Mochon, L. Wyper, J. Maroba, D. Patel, and D. Ariely (2014), "Healthier by Precommitment," *Psychological Science*, 25 (2), 538-46.
Schwarz, N. (2000), "Emotion, Cognition, and Decision Making," *Cognition and Emotion*, 14 (4), 433-40.
Sexton, S. E. and A. L. Sexton (2014), "Conspicuous Conservation: The Prius Halo and Willingness to Pay for Environmental Bona Fides," *Journal of Environmental Economics and Management*, 67 (3), 303-17.
Sheehan, D. and K. Van Ittersum (2018), "In-Store Spending Dynamics: How Budgets Invert Relative-Spending Patterns," *Journal of Consumer Research*, 45 (1), 49-67.
Sherman, D. K. and G. L. Cohen (2006), "The Psychology of Self-Defense: Self-Affirmation Theory," in *Advances in Experimental Social Psychology, Vol 38.*, San Diego, CA, US: Elsevier Academic Press, 183-242.
Springmann, M., M. Clark, D. Mason-D'Croz, K. Wiebe, B. L. Bodirsky, L. Lassaletta, W. de Vries, S. J. Vermeulen, M. Herrero, K. M. Carlson, M. Jonell, M. Troell, F. DeClerck, L. J. Gordon, R. Zurayk, P. Scarborough, M. Rayner, B. Loken, J. Fanzo, H. C. J. Godfray, D. Tilman, J. Rockström, and W. Willett (2018), "Options for Keeping the Food System within Environmental Limits," *Nature*, 562 (7728), 519-25.

Steele, C. M. (1988), "The Psychology of Self-Affirmation: Sustaining the Integrity of the Self," in *Advances in Experimental Social Psychology*, Vol. 21, ed. Leonard Berkowitz: Academic Press, 261-302.
Steg, L. (2016), "Values, Norms, and Intrinsic Motivation to Act Proenvironmentally," *Annual Review of Environment and Resources*, 41 (1), 277-92.
Steptoe, A., T. M. Pollard, and J. Wardle (1995), "Development of a Measure of the Motives Underlying the Selection of Food: The Food Choice Questionnaire," *Appetite*, 25 (3), 267-84.
Stöber, J. (2001), "The Social Desirability Scale-17 (Sds-17): Convergent Validity, Discriminant Validity, and Relationship with Age," *European Journal of Psychological Assessment*, 17 (3), 222-32.
Sunstein, C. R. (2017), "Nudges That Fail," *Behavioural Public Policy*, 1 (1), 4-25.
--- (2021), "The Distributional Effects of Nudges," *Nature Human Behaviour*.
Sunstein, C. R. and L. A. Reisch (2014), "Automatically Green: Behavioral Economics and Environmental Protection," *Harvard Environmental Law Review*, 38 (1), 127-58.
Tangney, J. P., R. F. Baumeister, and A. L. Boone (2004), "High Self-Control Predicts Good Adjustment, Less Pathology, Better Grades, and Interpersonal Success," *Journal of Personality*, 72 (2), 271-324.
Tangney, J. P., J. Stuewig, and D. J. Mashek (2007), "Moral Emotions and Moral Behavior," *Annual Review of Psychology*, 58 (1), 345-72.
Tannenbaum, D., C. R. Fox, and T. Rogers (2017), "On the Misplaced Politics of Behavioural Policy Interventions," *Nature Human Behaviour*, 1 (7), 0130.
Thaler, R. H. and E. J. Johnson (1990), "Gambling with the House Money and Trying to Break Even: The Effects of Prior Outcomes on Risky Choice," *Management Science*, 36 (6), 643-60.
Theotokis, A. and E. Manganari (2015), "The Impact of Choice Architecture on Sustainable Consumer Behavior: The Role of Guilt," *Journal of Business Ethics*, 131 (2), 423-37.
Todd, P. M., Y. Rogers, and S. J. Payne (2013), "Nudging the Trolley in the Supermarket: How to Deliver the Right Information to Shoppers," in *Developments in Technologies for Human-Centric Mobile Computing and Applications*, ed. Joanna Lumsden, Hershey, PA, USA: IGI Global, 99-113.
Trope, Y. and A. Fishbach (2000), "Counteractive Self-Control in Overcoming Temptation," *J Pers Soc Psychol*, 79 (4), 493-506.
Truelove, H. B., A. R. Carrico, E. U. Weber, K. T. Raimi, and M. P. Vandenbergh (2014), "Positive and Negative Spillover of Pro-Environmental Behavior: An Integrative Review and Theoretical Framework," *Global Environmental Change*, 29, 127-38.
Vadakkepatt, G. G., K. P. Winterich, V. Mittal, W. Zinn, L. Beitelspacher, J. Aloysius, J. Ginger, and J. Reilman (2020), "Sustainable Retailing," *Journal of Retailing*.
van der Weele, J. J. and F. A. von Siemens (2020), "Bracelets of Pride and Guilt? An Experimental Test of Self-Signaling," *Journal of Economic Behavior & Organization*, 172, 280-91.
van der Werff, E., D. Taufik, and L. Venhoeven (2019), "Pull the Plug: How Private Commitment Strategies Can Strengthen Personal Norms and Promote Energy-Saving in the Netherlands," *Energy Research & Social Science*, 54, 26-33.
van Ittersum, K., J. M. E. Pennings, and B. Wansink (2010), "Trying Harder and Doing Worse: How Grocery Shoppers Track in-Store Spending," *Journal of Marketing*, 74 (2), 90-104.
Vanberg, C. (2008), "Why Do People Keep Their Promises? An Experimental Test of Two Explanations1," *Econometrica*, 76 (6), 1467-80.

Vandenbergh, M. P. and A. C. Steinemann (2007), "The Carbon-Neutral Individual," *New York University Law Review*, 82, 1673-745.
Vermeulen, S. J., B. M. Campbell, and J. S. I. Ingram (2012), "Climate Change and Food Systems," *Annual Review of Environment and Resources*, 37 (1), 195-222.
Walsh, D. (2014), "Attenuating Depletion Using Goal Priming," *Journal of Consumer Psychology*, 24 (4), 497-505.
Weber, E. U. (2006), "Experience-Based and Description-Based Perceptions of Long-Term Risk: Why Global Warming Does Not Scare Us (yet)," *Climatic Change*, 77 (1), 103-20.
--- (2018), "Perception Matters: The Pitfalls of Misperceiving Psychological Barriers to Climate Policy," *Perspectives on Psychological Science*, 13 (4), 508-11.
Weber, E. U. and E. J. Johnson (2009), "Mindful Judgment and Decision Making," *Annual Review of Psychology*, 60, 53-85.
Wertenbroch, K. (2003), "Self-Rationing: Self-Control in Consumer Choice," in *Time and Decision: Economic and Psychological Perspectives on Intertemporal Choice.*, New York, NY, US: Russell Sage Foundation, 491-516.
Whittaker, L., R. Russell-Bennett, and R. Mulcahy (2021), "Reward-Based or Meaningful Gaming? A Field Study on Game Mechanics and Serious Games for Sustainability," *Psychology & Marketing*, 38, 981-1000.
Wing, C., K. Simon, and R. A. Bello-Gomez (2018), "Designing Difference in Difference Studies: Best Practices for Public Health Policy Research," *Annual Review of Public Health*, 39 (1), 453-69.
Yeung, K. (2017), "'Hypernudge': Big Data as a Mode of Regulation by Design," *Information, Communication & Society*, 20 (1), 118-36.
Zhong, C.-B., K. A. Liljenquist, and D. M. Cain (2009), "Moral Self-Regulation," in *Psychological Perspectives on Ethical Behavior and Decision Making*, ed. David De Cremer, Charlotte, NC: Information Age Publishing, INC., 75-89.
Zizzo, D. J. (2010), "Experimenter Demand Effects in Economic Experiments," *Experimental Economics*, 13 (1), 75-98.
Zizzo, D. J., M. Parravano, R. Nakamura, S. Forwood, and M. Suhrcke (2021), "The Impact of Taxation and Signposting on Diet: An Online Field Study with Breakfast Cereals and Soft Drinks," *Experimental Economics*.

FIGURES

Figure 1: Graphical representation of the NU-food supermarket



Note: The information on CO_2e and macronutrients data was only visible to participants when they hovered over the respective icon with the mouse.

Figure 2 Experimental design of the main treatments.

		Commitment		
		No	**Voluntary**	**Forced**
Badge	**No**	*Control* n=127	*Voluntary* n=100	*Forced* n=116
	Yes	*Badge* n=106	*Voluntary + Badge* n=110	*Forced + Badge* n=118

Figure 3: The virtual badge.

Figure 4: Graphical representation of the Voluntary Commitment with Badge.

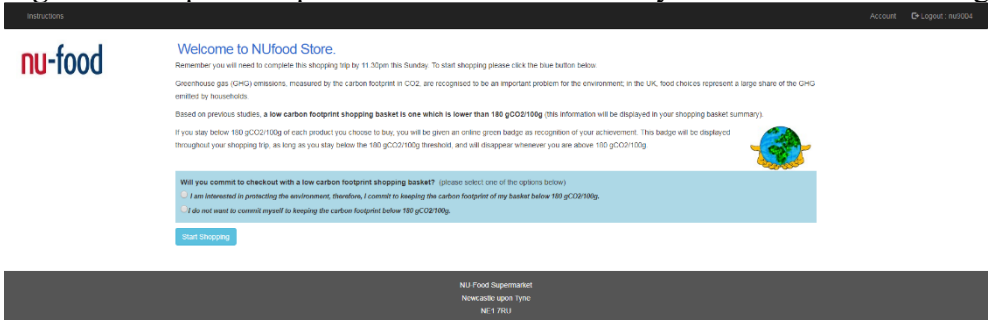


Figure 5: Graphical representation of the Forced Commitment with Badge.

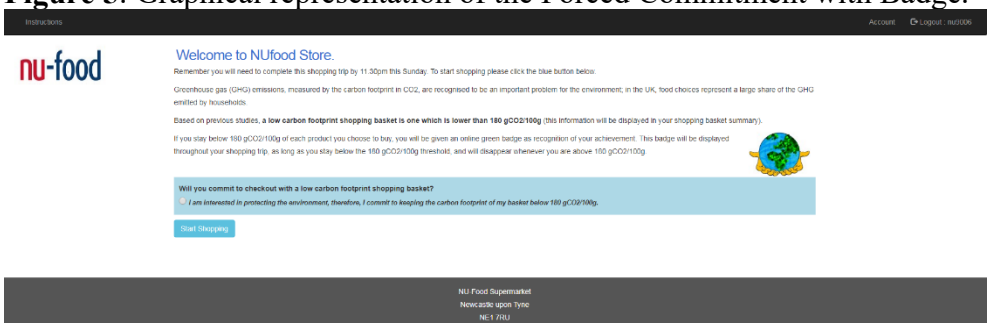


Figure 6: Median carbon footprint, by week and group

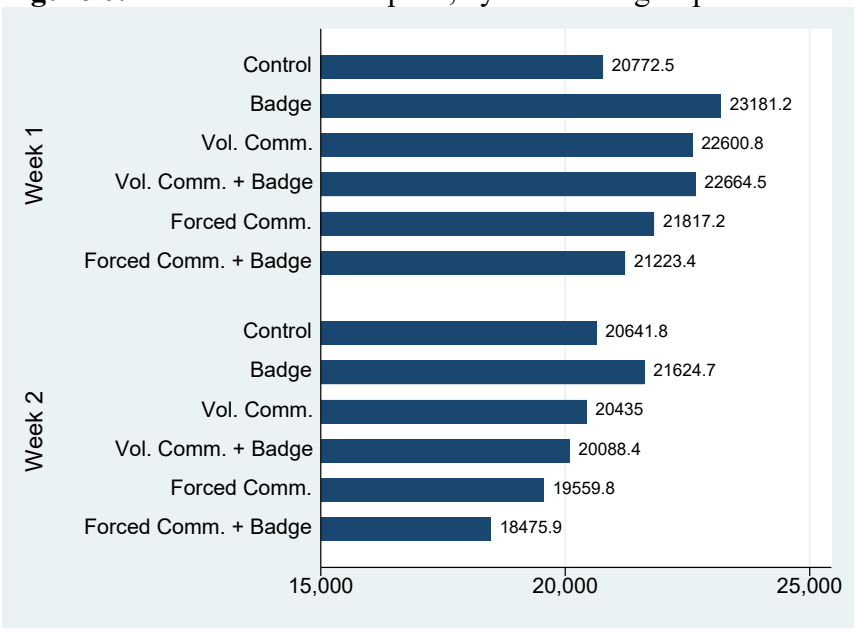
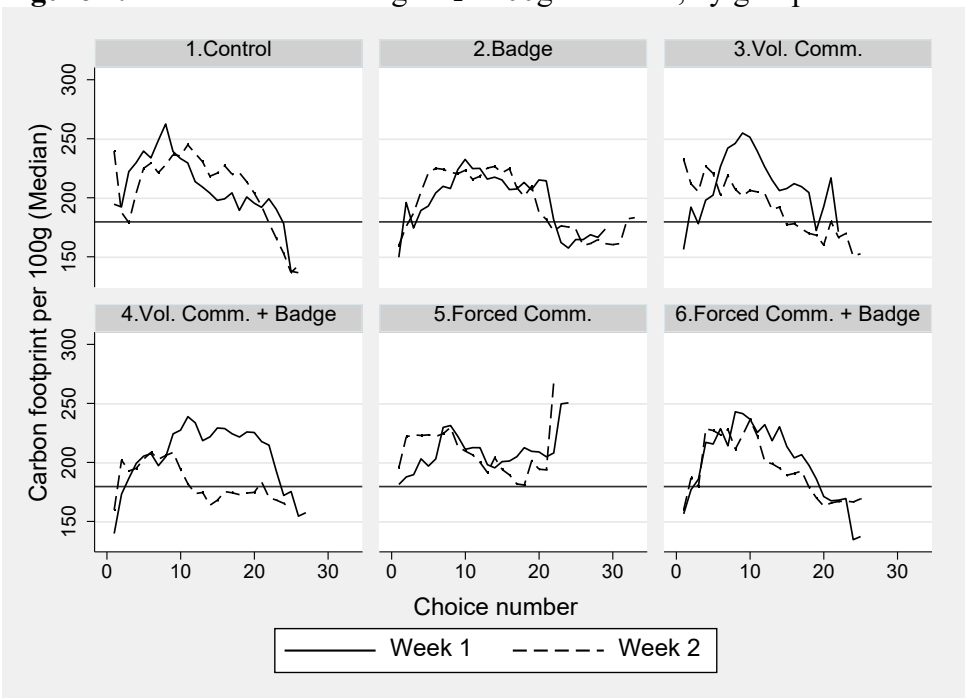
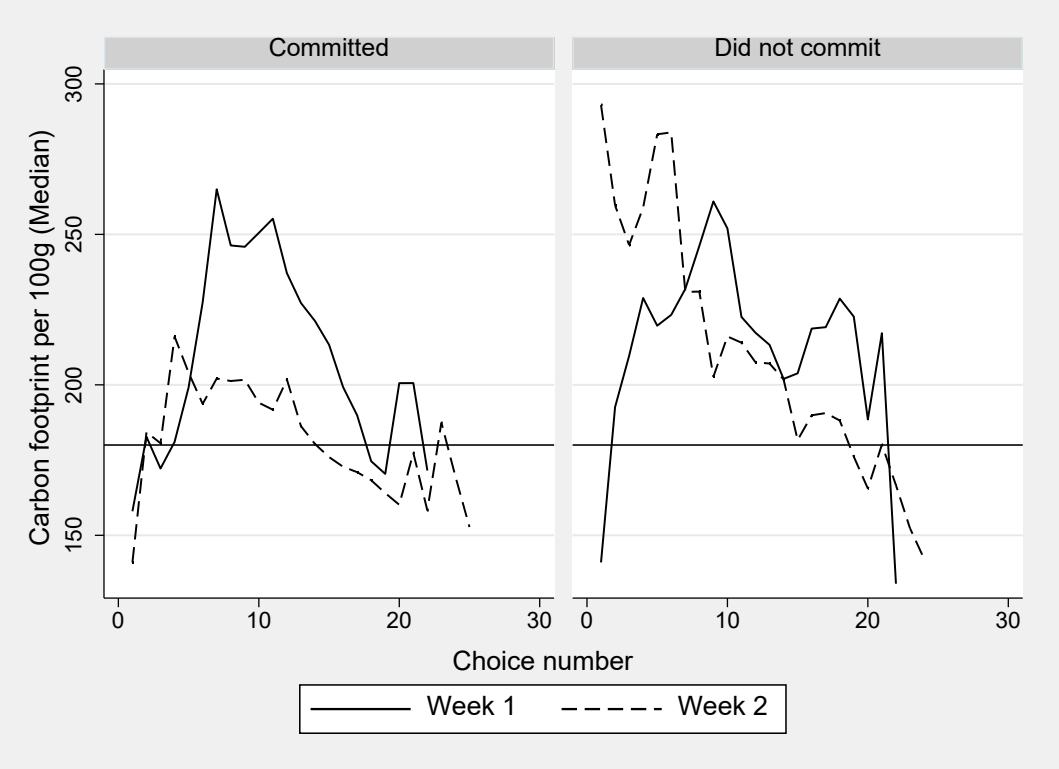


Figure 7: Median cumulative $gCO_2e/100g$ of basket, by group and week



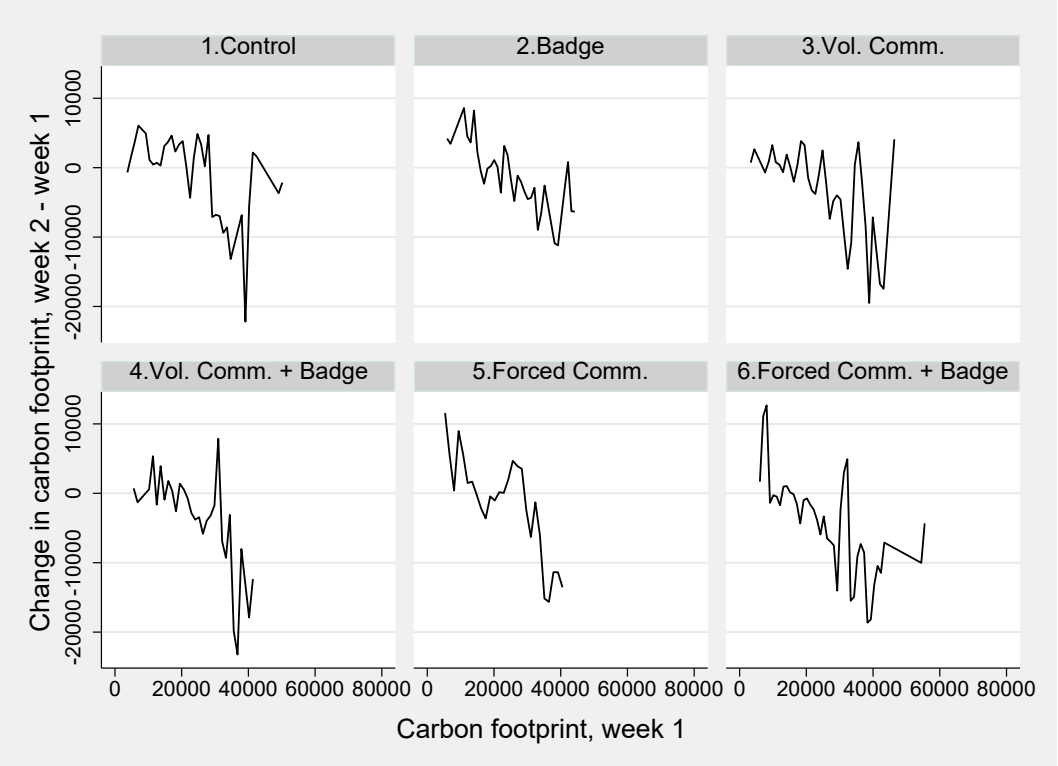
Note: the horizontal black line refers to the low carbon threshold of 180 gCO2e/100g basket weight.

Figure 8: Median cumulative gCO_2e/100g of basket, by group, week and commitment



Note: the horizontal black line refers to the low carbon threshold of 180 gCO2e/100g basket weight.

Figure 9: Local polynomial regression (degree 0) of the change in carbon footprint, and carbon footprint at baseline



TABLES

Table 1: Average demographics of the sample, by group

	Control	Badge	Voluntary Comm.	Forced Comm.+Badge	Forced Comm.	Forced Comm+Badge	χ^2
Male	0.30	0.34	0.22	0.31	0.32	0.31	3.47
Age	35.37	38.36	37.06	36.55	35.42	36.95	4.20
Children (age: 0-5)	0.20	0.15	0.19	0.21	0.19	0.14	2.39
Children (age:6-10)	0.10	0.12	0.20	0.16	0.16	0.27	1.76
Teenagers (age:11-17)	0.20	0.22	0.15	0.19	0.29	0.19	1.72
Adults (age: 18+)	1.87	1.86	1.87	1.76	1.96	1.77	7.70
Education							
– **PG degree**	0.32	0.30	0.34	0.33	0.30	0.34	17.34
– **UG degree**	0.37	0.45	0.43	0.33	0.34	0.32	
– **Further education**	0.15	0.13	0.10	0.19	0.17	0.15	
– **Secondary**	0.13	0.08	0.11	0.14	0.16	0.18	
– **Other**	0.04	0.03	0.01	0.02	0.03	0.01	
Income							
– **Up to £12,999**	0.06	0.03	0.11	0.10	0.04	0.07	33.80
– **£13,000-£18,999**	0.12	0.08	0.11	0.12	0.10	0.09	
– **£19,000-25,999**	0.17	0.15	0.13	0.12	0.11	0.16	
– **£26,000-£31,999**	0.08	0.09	0.12	0.12	0.07	0.13	
– **£32,000-£47,999**	0.25	0.23	0.24	0.19	0.29	0.19	
– **£48,000-£64,999**	0.13	0.16	0.14	0.15	0.17	0.16	
– **Above £65,000**	0.13	0.17	0.09	0.12	0.10	0.17	
– **Prefer not to say**	0.06	0.08	0.06	0.08	0.12	0.02	
Observations	127	106	116	118	100	110	

N=677. For gender, age, and family size variables, the χ^2 statistics refers to a Kruskal-Wallis equality-of-populations rank test; while for education and income, the χ^2 statistics refers to a Pearson χ^2 test of association. Statistical significance is indicated as follows * = $p < 0.10$; ** = $p < 0.05$; *** = $p < 0.01$.

Table 2: Average attitudes of the sample, by group

	Week	Control	Badge	Voluntary Comm.	Voluntary Comm.+Badge	Forced Comm.	Forced Comm.+Badge	χ^2
Self-signalling	**1**	3.75	3.63	3.84	3.66	3.43	3.75	5.11
	2	3.51**	3.64	3.81	3.72	3.74*	3.98	6.71
Social-signalling	**1**	3.33	3.49	3.46	3.53	3.25	3.36	1.88
	2	3.31	3.43	3.47	3.57	3.40	3.45	1.65
Environmental	**1**	3.57	3.51	3.50	3.50	3.53	3.55	0.50
self-image	**2**	3.63	3.51	3.56	3.63	3.53	3.63	0.87
Self-control	**1**	3.18	3.10	3.08	3.20	3.10	3.04	4.94
	2	3.17	3.00***	3.05	3.19	3.11	3.05	8.75
Environmental	**1**	4.80	4.77	4.96	5.02	5.02	4.87	2.92
attitudes	**2**	4.81	4.74	4.98	4.76***	4.82	4.71	0.85
Environmental	**1**	3.76	3.73	3.98	3.74	3.73	3.87	2.12
Self-perception	**2**	3.85	3.67	3.94	3.83	4.06**	4.02	5.06
Env. Identity								
– **Internalization**	**2**	2.51	2.50	2.56	2.47	2.53	2.51	2.38
– **Symbolization**	**2**	1.46	1.44	1.54	1.53	1.57	1.55	3.94

Observations		127	106	116	118	100	110	

N=677. Weekly within-participant comparisons are based on a Wilcoxon sign-rank test (the test is not available for the identity variables as they were collected only once). The χ^2 statistics refers to a Kruskal-Wallis equality-of-populations rank test Statistical significance is indicated as follows * = p < 0.10; ** = p < 0.05; *** = p < 0.01.

Table 3: Summary basket characteristics, averages by week and treatment group

	Week	Control	Badge	Voluntary Comm.	Forced Comm.+Badge	Forced Comm.	Forced Comm.+Badge	Kruskal-Wallis χ^2
Total GHG	**1**	22,680	23,844	22,885	23,731	23,290	23,961	2.06
(gCO_2e)	**2**	22,457	22,928	20,617**	21,206***	21,496**	20,341***	7.03
Total energy	**1**	14,301	15,341	15,182	14,084	14,252	14,533	3.39
(kcal)	**2**	13,535	14,127	13,624***	13,504	13,537	12,384***	5.50
Basket weight	**1**	8.733	9.472	9.039	9.248	9.479	9.012	3.093
(Kg)	**2**	8.249	8.995	8.545	8.506	8.525	8.429	2.815
Expenditure	**1**	23.01	23.68	23.33	23.47	23.85[a]	23.59	11.56**
(£)	**2**	22.73	23.54	22.73	22.99	23.22***	22.88	2.34
Observations		127	106	116	118	100	110	

Weekly within-participant comparisons are based on a Wilcoxon sign-rank test. N=677. Statistical significance is indicated as follows * = p < 0.10; ** = p < 0.05; *** = p < 0.01. [a]: this group differs from the Control group (only) at p<0.05, based on a Dunn test with Bonferroni adjustment; no other pairing has a significant difference at p<0.05.

Table 4: Probability of shopping with an environmental goal, week 2

	Coefficient	S.E.	Coefficient	S.E.
Intercept	-0.8529***	0.1272	-2.7943	0.5050
Badge	0.0380	0.1874	0.0079	0.2026
Vol. Comm	0.5229***	0.1740	0.4118**	0.1868
Badge * Vol. Comm.	0.0562	0.2506	0.2037	0.2703
Forced. Comm.	0.6510***	0.1793	0.6371***	0.1927
Badge * Forced. Comm.	-0.1368	0.2566	-0.1931	0.2761
Self-control			-0.0709	0.0884
Env. self-image			0.0314	0.0378
Env. self-signalling			0.2100***	0.0557
Env. social signalling			-0.0386	0.0483
Env. Identity – Symbolization			0.4629***	0.1401
Env. Identity – Internalization			0.3355***	0.1173
Male			-0.1553	0.1236
Age			0.0033	0.0049
Young children (age: 0-5)			-0.1898	0.1234
Children (age:6-10 years)			0.0986	0.1168
Teenagers (age:11-17)			-0.0264	0.1120
Adults (age: 18+)			-0.0936	0.0730
Income dummies	No		Yes	
Marginal effects[†]				
Badge	0.0043	0.0354	0.0056	0.0331
Vol. Comm	0.1957***	0.0432	0.1592***	0.0412
Forced. Comm.	0.2095***	0.0449	0.1696***	0.0430
Observations	677		677	
χ2	27.65***		131.83***	
Log pseudolikelihood	-414.51		-362.42	
Pseudo R2	0.03		0.15	

Results are based on two probit regressions. Statistical significance is as follows * = p < 0.10; ** = p < 0.05; *** = p < 0.01. †: standard errors are calculated using the Delta method.

Table 5: Repeated measure ANOVA, chi2 values

Reading	**CO_2 information**		**Nutrients information**	
	Seconds Panel Tobit	**Nr SKUs** Panel Tobit	**Seconds** Panel Tobit	**Nr SKUs** Panel Tobit
Badge x week	2.17	1.33	1.02	0.22
Voluntary Comm. x week	4.96**	5.78**	1.41	0.07
Forced Comm. x week	10.55*** (increase)	15.17*** (increase)	1.55	0.66
Voluntary Comm. x Badge x week	0.42	0.04	0.72	0.40
Forced Comm. x Badge x week	0.30	0.93	2.23	0.87

Note: All panel regressions refer to random-effects estimators. Regressions used no covariates besides treatment dummies. Statistical significance is as follows * = p < 0.10; ** = p < 0.05; *** = p < 0.01.

Table 6: Probit regressions on the likelihood of commitment, by commitment type

	Voluntary		**Forced**	
	Coef.	**S.E.**	**Coef.**	**S.E.**
Intercept	-3.2792***	0.8441	-0.4875	0.9762
Badge present	0.0382	0.1799	0.0281	0.2353
Self-control	0.0001	0.1514	0.1406	0.1719
Env. self-image	0.0024	0.0633	0.0532	0.0733
Env. self-signalling	0.3032***	0.1024	0.1485	0.1344
Env. social signalling	-0.0688	0.0845	-0.1258	0.1104
Env. Identity – Symbolization	0.7079***	0.2272	0.5877**	0.2712
Env. Identity – Internalization	0.1214	0.1882	0.3602	0.2319
Male	-0.1181	0.2048	-0.2525	0.2309
Age	0.0056	0.0087	-0.0357***	0.0104
Children (age: 0-5)	-0.1005	0.1956	0.1270	0.2676
Children (age:6-10 years)	-0.0954	0.2100	-0.1593	0.1866
Teenagers (age:11-17)	0.4149**	0.2021	0.0543	0.1851
Adults (age: 18+)	-0.0191	0.1113	0.1747	0.1890
Income dummies	Yes		Yes	
Observations	234		210	
$\chi 2$	54.15***		43.82***	
Log pseudolikelihood	-133.43		-84.07	
Pseudo R2	0.17		0.19	

Statistical significance is as follows * = p < 0.10; ** = p < 0.05; *** = p < 0.01.

Table 7: Commitment rates by group

Treatment	**Participants**	**Accepting commitment**	**Acceptance rates**	**Threshold met**	**Success rate[§]**
Voluntary commitment	116	65	56%	38	33%
Voluntary commitment + Badge	118	64	54%	45	38%
Forced commitment	100	79[†]	79%	34	34%
Forced commitment + Badge	110	90[†]	82%	39	35%

[†] In the case of the voluntary commitment treatments, the failure to accept is intended as whether the individual willingly or mistakenly tried to avoid the commitment, clicking to proceed without ticking the commitment box.
[§] In the control group in week 2, 19% of participants met the low-carbon footprint threshold.

Table 8: Determinants of achievement of the commitment

	No attitudes		With attitudes	
	Interaction	**No interaction**	**Interaction**	**No interaction**
Intercept	-0.8817***	-0.9057***	-1.6259***	-1.6601***
S.E.	0.1285	0.1067	0.5147	0.5091
Badge	-0.0011	0.0514	0.0127	0.0746
S.E.	0.1906	0.1032	0.1949	0.1087
Voluntary Comm.	0.4351**	0.4954***	0.4796***	0.5529***
S.E.	0.1764	0.1269	0.1829	0.1323
Voluntary Comm. x Badge	0.1235		0.1505	
S.E.	0.2545		0.2599	
Forced Comm.	0.4418**	0.4480***	0.4624**	0.4647***
S.E.	0.1828	0.1307	0.1881	0.1361
Forced Comm. x Badge	0.0186		0.01161	
S.E.	0.2617		0.2708	
Male			-0.2551**	-0.2511**
S.E.			0.1233	0.1236
Age			-0.0125**	-0.0127**
S.E.			0.0053	0.0053
Children age: 0-5			-0.0347	-0.0299
S.E.			0.1158	0.1156
Children age:6-10 years			-0.1232	-0.1278
S.E.			0.1197	0.1193
Teenagers age:11-17			0.1434	0.1485
S.E.			0.1106	0.1107
Adults age: 18+			-0.2301***	-0.2308***
S.E.			0.0764	0.0761
Self-control			-0.0631	-0.0566
S.E.			0.0867	0.0865
Env. self-image			0.0393	0.0392
S.E.			0.0377	0.0379
Env. self-signalling			0.1419***	0.1402**
S.E.			0.0549	0.0549
Env. social signalling			-0.03524	-0.0347
S.E.			0.04721	0.0472
Env. Identity – Internalization			0.5530***	0.5519***
S.E.			0.1456	0.1456
Env. Identity – Symbolization			-0.158	-0.1575
S.E.			0.1264	0.1268
Income dummies			Yes	Yes
Marginal effects				
Badge	.0175	.0171	.0229	0.0229
S.E.	.0344	.0344	.0333	0.0333
Voluntary Comm.	0.1659***	0.1654***	0.1704***	0.1699***
S.E.	0.0412	0.0411	0.0396	0.0396
Forced Comm.	0.1505***	0.1495***	0.1438***	0.1428***
S.E.	0.0427	0.0426	0.0411	0.0410
Observations	677	677	677	677
Pseudo R^2	0.0233	0.0230	0.0977	0.0972

Log-likelihood	-397.86	-398.01	-367.56	-367.77
χ^2	18.441***	18.076***	76.166***	75.892***

Note: estimates are based on a Probit regression. Statistical significance is as follows * = p < 0.10; ** = p < 0.05; *** = p < 0.01.

Table 9: DID estimates, main effects only

	No attitudes			**With attitudes**		
	A	**B**	**C**	**A**	**B**	**C**
Intercept	23379.1***	23379.1***	23379.1***	25160.3***	25123.5***	25128.6***
S.E.	386.1	386.1	386.1	3183.4	3207.9	3183.2
Week 2 (W2)	-129.9	-131.8	-124.1	-166.2	-166.4	-156
S.E.	630.5	630.7	629.9	640.1	640.1	639.1
Badge x W2	-898.2	-893.9	-910.8	-859.9	-857	-877
S.E.	644.9	645.7	644.5	647	647.6	647.1
All comm. x W2	-1973.6***			-1876.5***		
S.E.	663.2			676.2		
Vol. Comm. x W2		-1815.0**			-1757.4**	
S.E.		747.8			752.1	
Forced Comm. x W2		-2151.0**	-2149.8**		-2013.1**	-2020.2**
S.E.		840	840.2		858.5	858.3
Vol. Comm. (Y) x W2			-3034.4***			-2927.6***
S.E.			955.1			958.4
Vol. Comm. (N) x W2			-314.9			-323.3
S.E.			883			883.4
All comm. x Badge x W2						
S.E.						
Vol. Comm. x Badge x W2						
S.E.						
Forced Comm. x Badge x W2						
S.E.						
Vol. Comm. (Y) x Badge x W2						
S.E.						
Vol. Comm. (N) x Badge x W2						
S.E.						
Self-control				377.5	384.8	349.7
S.E.				950.4	955.6	952
Self-image				-248.6	-249.7	-245.6
S.E.				210.8	210.4	208.3
Self-signalling				-314.8	-309	-280.8
S.E.				301.1	301	299.3
Social signalling				-271.1	-272.1	-276.3
S.E.				227.9	228.1	231.2
Observations	1,354	1,354	1,354	1,354	1,354	1,354
Participants	677	677	677	677	677	677
Overall R2	0.055	0.056	0.063	0.066	0.066	0.073
Log-likelihood	-13290	-13289.9	-13284.4	-13282.8	-13282.7	-13277.6
χ^2	42.41***	42.52***	44.63***	49.38***	49.70***	51.91***
Wald test χ2						

Vol. Comm. = Forced Comm.		0.15			0.09	
Vol. Comm.+Badge = Forced Comm.+Badge						
Half-elasticities						
All comm.	-0.0882***			-0.0841***		
Vol. Comm.		-0.0811**			-0.0787**	
Forced Comm.		-0.0961**	-0.0961**		-0.0902**	-0.0906**
Badge	-0.0401	-0.0399	-0.0407	-0.0384	-0.0383	-0.0392
Vol. Comm. (Y)			-0.1357***			-0.1312***
Vol. Comm. (N)			-0.0141			-0.0145

Note: model A regresses the carbon footprint over a single joint commitment variable; model B treats the two sources of commitment – voluntary vs forced – separately; while model C separates those who voluntarily accepted vs rejected the commitment. Statistical significance is as follows * = p < 0.10; ** = p < 0.05; *** = p < 0.01.

Table 10: Share of the £25 budget allocated for each food category and savings

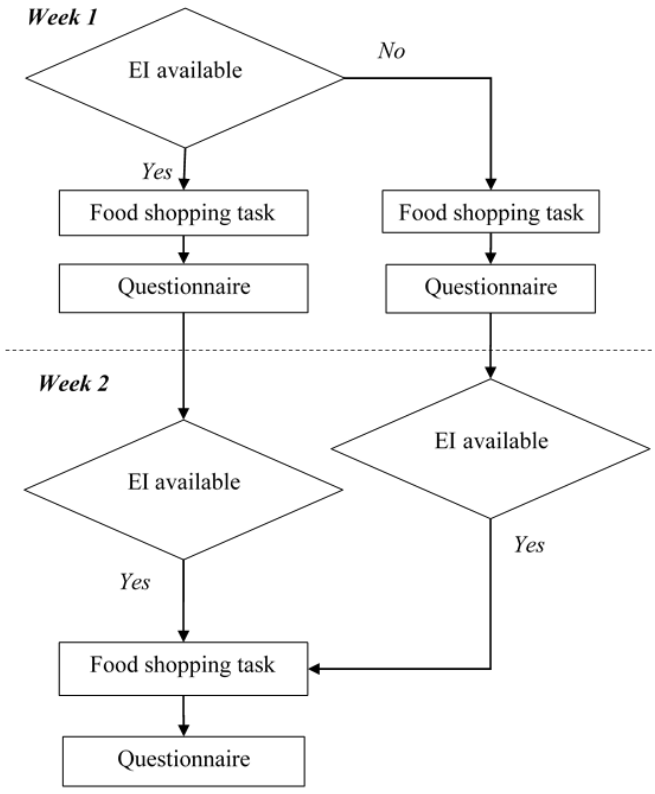
Treatment	Week	Fruit & Vegetables	Other Vegetarian	Meat & fish	Eggs & Dairy	Drinks	Other	Savings
Control	1	0.20	0.17	0.29	0.11	0.05	0.10	0.08
	2	0.19*	0.17	0.31	0.09***	0.05	0.11	0.09
Badge	1	0.21	0.20	0.29	0.09	0.06	0.10	0.05
	2	0.22	0.20	0.27	0.10	0.07	0.09	0.06*
Voluntary Comm.	1	0.23	0.17	0.29	0.10	0.05	0.10	0.07
	2	0.27***	0.15***	0.28	0.07**	0.04	0.09	0.09
Voluntary Comm.+Badge	1	0.20	0.18	0.28	0.10	0.06	0.12	0.06
	2	0.24**	0.17	0.29	0.07***	0.04**	0.11	0.08
Forced Comm.	1	0.24	0.17	0.31	0.09	0.06	0.09	0.05
	2	0.26	0.18	0.29	0.08	0.04	0.08	0.07***
Forced Comm.+Badge	1	0.20	0.18	0.30	0.10	0.06	0.11	0.06
	2	0.22	0.16	0.29	0.07***	0.07	0.09**	0.08
χ^2	1	4.14	4.31	1.27	1.61	4.81	7.16	11.57**
	2	13.79**	9.98*	2.21	7.36	8.80	6.40	2.34

N=677. Values refer to mean expenditure shares of the £25 budget. Weekly within-participant comparisons are based on a Wilcoxon sign-rank test (the test is not available for the identity variables as they were collected only once). The χ^2 statistics refers to a Kruskal-Wallis equality-of-populations rank test Statistical significance is indicated as follows * = p < 0.10; ** = p < 0.05; *** = p < 0.01.
Categories are defined as follows: Fruit & Vegetables = pulses, vegetables, and fruit (incl. nuts), fresh, canned, dried, or frozen; Other vegetarian = pasta, rice, breakfast cereal, bread and bakery products, margarine, oils, meat-free products (e.g., Quorn, frozen or refrigerated); Meat & fish = all fish and meat, fresh, canned, chilled, or frozen; Dairy & eggs = all dairy products (e.g., cheese, milk, yogurt), eggs; Drinks = non-dairy milk, soft drinks, bottled water, fruit juice; Others = cupboard goods, tea and coffee, packet soup, frozen desserts, soup, crisps, jam, honey & peanut butter, confectionery.

Appendix 1: Environmental information did not prime consumers

A "No carbon information" treatment (n=48) was used to test whether the presence of information on carbon footprint affected the behaviour of consumers by priming (Forwood et al. 2015; Papies 2016; Walsh 2014), or purely through the presence of relevant information during the choice task. In this group, information on the carbon footprint of the products and of the baskets, and the explanation on what carbon footprint is, was unavailable to shoppers in week one, and only appeared in week 2. The behaviour of this group is then compared against the control of the main experiment, for whom information was available in both weeks. The flowchart of the test is presented in figure A1. The descriptive characteristics of the participants in this group are reported in tables A1 and A2; these do not differ from the control group. Table A3 indicates that this information did not change behaviour significantly. Rather, Table A3 shows that the "No carbon information" group showed a slight increase in the carbon footprint of the shopping basket in week 2 relative to week1; however, a Kruskal-Wallis rank test indicates that the carbon footprint was not significantly different across the two groups in both weeks (week 1: $\chi^2(1) = 1.939$, $p = 0.1638$; week 2: $\chi^2(1) = 1.080$, $p = 0.2986$).

Figure A1: flowchart of the test of the role of information on consumer behaviour



Note: EI = Environmental Information

Table A1: Summary demographics of the "No-Carbon information" group

		Mean	χ^2
Male		0.38	0.84
Age		35.27	0.23
Young children (0-5 years)		0.33	2.16
Children (6-10 years)		0.15	0.63
Teenagers (11-17 years)		0.13	1.53
Adults (18 years or older)		1.81	0.02
Education	– **Postgraduate university degree**	0.27	2.09
	– **Undergraduate university degree**	0.33	
	– **Further education (HNC/HND)**	0.23	
	– **Secondary education**	0.15	
	– **Others**	0.02	
Income	– **Up to £12,999**	0.15	6.99
	– **£13,000-£18,999**	0.13	
	– **£19,000-25,999**	0.13	
	– **£26,000-£31,999**	0.06	
	– **£32,000-£47,999**	0.17	
	– **£48,000-£64,999**	0.19	
	– **Above £65,000**	0.08	
	– **Prefer not to say**	0.10	
Observations		48	

For gender, age, and family size variables, the χ^2 statistics refers to a Kruskal-Wallis equality-of-populations rank test comparing of this group with the Control group; while for education and income, the χ^2 statistics refers to a Pearson χ^2 test of association, including only this group and the Control group. The statistics for the Control group are reported in table 1. Statistical significance is indicated as follows * = $p < 0.10$; ** = $p < 0.05$; *** = $p < 0.01$.

Table A2: Descriptive statistics comparing attitudes across treatments in week 1.

	Week 1		Week 2	
	Mean	χ^2	**Mean**	χ^2
Self-signalling	4.13	2.03	3.84*	1.97
Social-signalling	3.60	0.81	3.63	1.58
Environmental self-image	4.00	2.19	3.94	0.97
Self-control	3.19	0.06	3.14	0.06
Environmental attitudes	5.17	2.19	4.60***	1.10
Environmental Self-perception	4.44	6.21**	3.81***	0.04
Env. Identity – Internalization			2.43	1.05
Env. Identity – Symbolization			1.55	0.24
Observations	48			

Note: the χ^2 statistics refers to a Kruskal-Wallis equality-of-populations rank test comparing of this group with the Control group, the statistics of which are reported in table 1. The comparison of means across weeks is based on a Wilcoxon sign-rank test (the test is not available for the identity variables as they were collected only once). Statistical significance is indicated as follows: * = $p < 0.10$; ** = $p < 0.05$; *** = $p < 0.01$.

Table A3: Mean basket statistics of the "No Carbon Information" group

Mean	**Week 1**	**Week 2**
Carbon footprint	20,620	20,945
Expenditures	23.44	23.44
Kilocalories	12,318	11,846

Means are not significantly different across week on the basis of a Wilcoxon sign-rank.

Appendix 2: Follow-up survey

When collecting the basket, participants were handed a short feedback questionnaire, which asked them whether they understood what the commitment meant. The question posed was

> Thank you very much for participating in our research.
>
> Whilst shopping in the second week, you may have been asked if you would commit to a low carbon footprint shopping basket – that is, a basket below 180 gCO2/100g.
>
> Did you believe that ticking *"I am interested in protecting the environment, therefore, I commit to keeping the carbon footprint of my basket below 180 gCO2/100g"* meant that you could **only** checkout if you had a carbon footprint below 180 gCO2/100g?
>
> Please tick one of the boxes:
>
> - **NO,** I did **not** believe that by clicking "I commit to keeping the carbon footprint of my basket below 180 gCO2/100g" I would be allowed to checkout **only** if I had a shopping basket carbon footprint below 180 gCO2/100g.
> - **YES,** I believed that by ticking "I commit to keeping the carbon footprint of my basket below 180 gCO2/100g" I could checkout **only** if I had a shopping basket carbon footprint below 180 gCO2/100g.
> - I do not know

Of the 452 participants in the 4 commitment groups, 355 (78.7%) completed the questionnaire. Results show that only around 40% of those facing a voluntary commitment, and 41-48% of those facing a forced commitment, believed the commitment would be actually enforced. As the question was answered two weeks after the experiment, these percentages may over-rely on memory. Percentages may have been higher if collected during the experiment, as participants may have answered knowing the answer, and some may have felt "tested" on whether they saw through the experiment.

Table A4: Number of participants who believed commitment was enforced

Group	No	Yes	Don't Know	% Yes
Voluntary Comm.	46	37	7	41.1%
Voluntary Comm. + Badge	52	36	7	37.9%
Forced Comm.	34	41	10	48.2%
Forced Comm. + Badge	46	35	4	41.2%

Appendix 3: Additional analysis

Figure A2: Distribution of carbon footprint, by group and week.

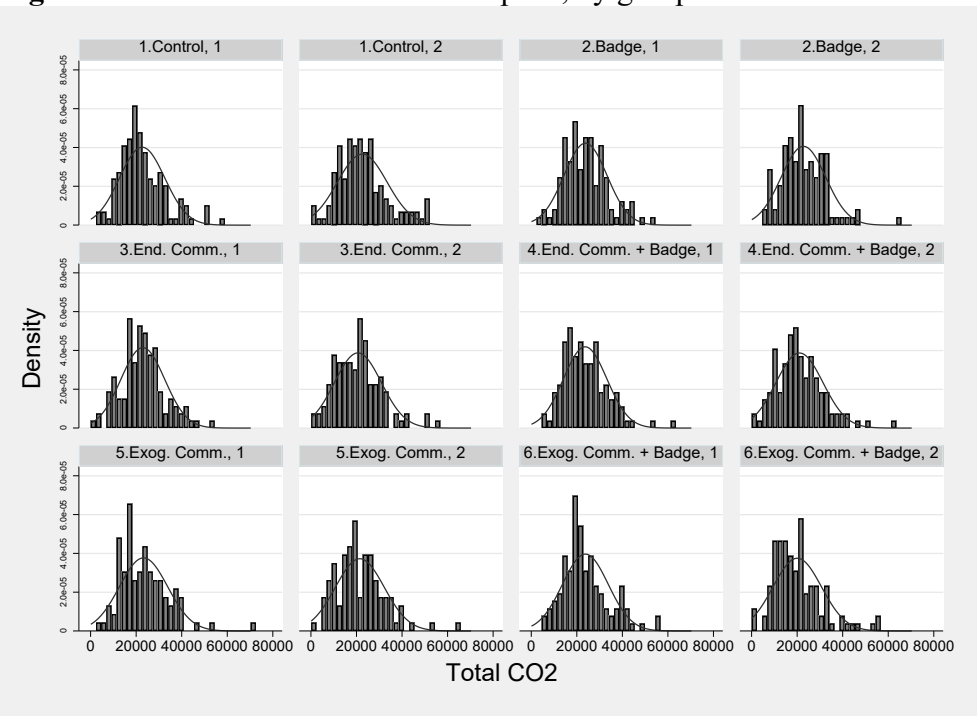


Table A5: Repeated measure ANOVA testing the impact of the manipulations on environmental preferences

	Environmental preferences					
Metric	**Self-control**	**Self-signalling**	**Self-image**	**Self-perception**	**Attitudes**	**Social signalling**
Panel model	OLS		Ordered probit			
Badge	0.04	0.00	0.32	0.07	0.83	0.07
Vol. Comm.	1.29	0.88	0.02	0.01	1.02	0.16
Forced Comm.	3.04* (increase)	7.93*** (increase)	0.11	2.57	1.95	1.00
Vol. Comm. x Badge	2.38	0.36	0.05	1.19	1.08	0.03
Forced Comm. x Badge	1.31	1.51	0.49	0.07	0.10	0.00

Note: All panel regressions refer to random-effects estimators. Regressions used no covariates besides treatment dummies. Results refer to the main effect interacted with the week 2 dummy. Statistical significance is as follows * = p < 0.10; ** = p < 0.05; *** = p < 0.01.

Table A6: ANOVA testing the impact of the manipulations on environmental identity

	Env. Identity – Symbolization	**Env. Identity – Internalization**
	OLS	OLS
Badge	0.15	0.01
Voluntary Comm.	1.21	0.63
Forced Comm.	1.95	0.09
Voluntary Comm. x Badge	0.04	0.71
Forced Comm. x Badge	0.01	0.02

Note: Estimates refer to an ordinary least square regression. Regressions used no covariates besides treatment dummies. Statistical significance is as follows * = p < 0.10; ** = p < 0.05; *** = p < 0.01.

Table A7: DID estimates, treatment effects

	Treatment only		Treatment + attitudes	
	Coefficient	**S.E.**	**Coefficient**	**S.E.**
Intercept	23,379.1***	386.12	25,142.3***	3,223.7
Week 2	-223.24	787.87	-282.71	791.6
Badge x Week 2	-692.94	1,101.8	-603.61	1,114.0
Voluntary Comm. x Week 2	-2,044.6*	1,091.9	-1,965.2*	1,096.8
Voluntary Comm. x Badge x Week 2	-2,301.8**	1,092.7	-2,179.4**	1,100.0
Forced Comm. x Week 2	-1,571.1	1,269.7	-1,373.7	1,272.2
Forced Comm. x Badge x Week 2	-3,397.5***	1,162.5	-3,224.9***	1,178.1
Self-control			386.29	961.61
Self-image			-248.41	210.35
Self-signalling			-318.45	301.19
Social signalling			-270.18	228.61
Observations	1354		1354	
Participants	677		677	
Overall R^2	0.0115		0.0148	
χ^2	44.513***		52.32***	
Wald test χ^2				
Vol. Comm = (Vol. Comm + Badge)	0.06		0.04	
Forced Comm. = (Forced Comm. + Badge)	1.9		1.97	
Vol. Comm = Forced Comm.	0.14		0.22	
(Vol. Comm + Badge) = (Forced Comm. + Badge)	0.86		0.79	

Statistical significance is as follows * = p < 0.10; ** = p < 0.05; *** = p < 0.01.

Table A8: DID estimates, with interaction effects

	No attitudes			With attitudes		
	A	**B**	**C**	**A**	**B**	**C**
Intercept	23379.1***	23379.1***	23358.1***	25121.6***	25142.3***	24972.1***
S.E.	386.1	386.1	384	3206.7	3223.7	3210.5
Week 2 (W2)	-223.2	-223.2		-282.6	-282.7	
S.E.	787.9	787.9		791.4	791.6	
Badge x W2	-692.9	-692.9	-916.2	-603.2	-603.6	-885.7
S.E.	1101.8	1101.8	734.4	1113.9	1114	755.4
All comm. x W2	-1825.4*			-1691.5*		
S.E.	989.2			994.3		
Vol. Comm. x W2		-2044.6*			-1965.2*	
S.E.		1091.9			1096.8	
Forced Comm. x W2		-1571.1	-1794.3*		-1373.7	-1666.0*
S.E.		1269.7	990		1272.2	984.5
Vol. Comm. (Y) x W2			-4060.4***			-4021.6***
S.E.			1042.4			1053.7
Vol. Comm. (N) x W2			16.8			16.8
S.E.			1076.2			1070.2
All comm. x Badge x W2	-312.1			-389.4		
S.E.	1427.7			1440		

Vol. Comm. x Badge x W2		435.8			389.4	
S.E.		1575.6			1582	
Forced Comm. x Badge x W2		-1133.5	-910.3		-1247.5	-963.2
S.E.		1772.4	1559.8		1781.1	1572.9
Vol. Comm. (Y) x Badge x W2			1823.2			1904.4
S.E.			1789.5			1796.6
Vol. Comm. (N) x Badge x W2			-881			-956
S.E.			1610			1625.9
Self-control				391.4	386.3	403
S.E.				958.2	961.6	961.8
Self-image				-247.8	-248.4	-248.1
S.E.				210.9	210.4	209.7
Self-signalling				-318.2	-318.5	-283.5
S.E.				301.2	301.2	296.6
Social signalling				-269.7	-270.2	-281.1
S.E.				228.3	228.6	229.8
Observations	1354	1354	1354	1354	1354	1354
Participants	677	677	677	677	677	677
Overall R2	0.056	0.057	0.066	0.066	0.067	0.076
Log-likelihood	-13290	-13289	-13282.3	-13282.7	-13281.7	-13275.2
χ^2	42.45***	44.51***	50.38***	49.40***	52.32***	57.87***
Wald test χ2						
Vol. Comm. = Forced Comm.		0.14			0.22	
Vol. Comm.+Badge = Forced Comm.+Badge		0.81			0.9	
Half-elasticities						
All comm.	-0.0816*			-0.0758*		
Vol. Comm.		-0.0914*			-0.0880*	
Forced Comm.		-0.0702	-0.0803*		-0.0617	-0.0748*
Badge	-0.0310	-0.0310	-0.0410	-0.0269	-0.0269	-0.0396
Vol. Comm. (Y)			-0.1817***			-0.1803***
Vol. Comm. (N)			0.0008			0.0008

Note: model A regresses the carbon footprint over a single joint commitment variable; model B treats the two sources of commitment – voluntary vs forced – separately; while model C separates those who voluntarily accepted vs rejected the commitment. Statistical significance is as follows * = $p < 0.10$; ** = $p < 0.05$; *** = $p < 0.00$.

Online Appendix 1: instructions to participants in week 2

Table OA1: Detail instructions to participants in the experiment, by group

a) Control, No carbon information, Badge

CONTROL	**NO CARBON INFORMATION**	**BADGE**
Welcome to NUfood Store. Remember you will need to complete this shopping trip by 11.30pm this Sunday. To start shopping please click the blue button below. Blue button: "START SHOPPING"	Welcome to NUfood Store. Remember you will need to complete this shopping trip by 11.30pm this Sunday. To start shopping please click the blue button below. Blue button: "START SHOPPING"	Welcome to NUfood Store. Remember you will need to complete this shopping trip by 11.30pm this Sunday. To start shopping please click the blue button below. Greenhouse gas (GHG) emission, measured by the carbon footprint in CO2, are recognised to be an important problem for the environment; in the UK, food choices represent a large share of the GHG emitted by households. Based on previous studies, **a low carbon footprint shopping basket is one which is lower than 180 gCO2/100g** (this information will be displayed in your shopping basket summary). If you stay below 180 g/CO2/100g of each product you choose to buy, you will be given an online green badge as recognition of your achievement. This badge will be displayed throughout your shopping trip, as long as you stay below the 180 g/CO2/100g threshold, and will disappear whenever you are above 180 g/CO2/100g. Blue button: "START SHOPPING"

b) Voluntary commitment groups

VOLUNTARY COMMITMENT	VOLUNTARY COMMITMENT + BADGE
Welcome to NUfood Store. Remember you will need to complete this shopping trip by 11.30pm this Sunday. To start shopping please click the blue button below. Greenhouse gas (GHG) emission, measured by the carbon footprint in CO2, are recognised to be an important problem for the environment; in the UK, food choices represent a large share of the GHG emitted by households. Based on previous studies, **a low carbon footprint shopping basket is one which is lower than 180 gCO2/100g** (this information will be displayed in your shopping basket summary). Blue box with choices: Will you commit to checkout with a low carbon footprint shopping basket? (please select one of the options below) □ I am interested in protecting the environment, therefore, I commit to keeping the carbon footprint of my basket below 180gCO_2/100g □ I do not want to commit myself to keeping the carbon footprint below 180gCO_2/100g Blue button: "START SHOPPING"	Welcome to NUfood Store. Remember you will need to complete this shopping trip by 11.30pm this Sunday. To start shopping please click the blue button below. Greenhouse gas (GHG) emission, measured by the carbon footprint in CO2, are recognised to be an important problem for the environment; in the UK, food choices represent a large share of the GHG emitted by households. Based on previous studies, **a low carbon footprint shopping basket is one which is lower than 180 gCO2/100g** (this information will be displayed in your shopping basket summary). If you stay below 180 g/CO2/100g of each product you choose to buy, you will be given an online green badge as recognition of your achievement. This badge will be displayed throughout your shopping trip, as long as you stay below the 180 g/CO2/100g threshold, and will disappear whenever you are above 180 g/CO2/100g. Blue box with choices: Will you commit to checkout with a low carbon footprint shopping basket? (please select one of the options below) □ I am interested in protecting the environment, therefore, I commit to keeping the carbon footprint of my basket below 180gCO_2/100g □ I do not want to commit myself to keeping the carbon footprint below 180gCO_2/100g Blue button: "START SHOPPING"

c) Forced commitment groups

FORCED COMMITMENT	**FORCED COMMITMENT + BADGE**
Welcome to NUfood Store. Remember you will need to complete this shopping trip by 11.30pm this Sunday. To start shopping please click the blue button below. Greenhouse gas (GHG) emission, measured by the carbon footprint in CO2, are recognised to be an important problem for the environment; in the UK, food choices represent a large share of the GHG emitted by households. Based on previous studies, **a low carbon footprint shopping basket is one which is lower than 180 gCO2/100g** (this information will be displayed in your shopping basket summary). Blue box with choices: Will you commit to checkout with a low carbon footprint shopping basket? (please select one of the options below) □ I am interested in protecting the environment, therefore, I commit to keeping the carbon footprint of my basket below 180gCO_2/100g Blue button: "START SHOPPING"	Welcome to NUfood Store. Remember you will need to complete this shopping trip by 11.30pm this Sunday. To start shopping please click the blue button below. Greenhouse gas (GHG) emission, measured by the carbon footprint in CO2, are recognised to be an important problem for the environment; in the UK, food choices represent a large share of the GHG emitted by households. Based on previous studies, **a low carbon footprint shopping basket is one which is lower than 180 gCO2/100g** (this information will be displayed in your shopping basket summary). If you stay below 180 g/CO2/100g of each product you choose to buy, you will be given an online green badge as recognition of your achievement. This badge will be displayed throughout your shopping trip, as long as you stay below the 180 g/CO2/100g threshold, and will disappear whenever you are above 180 g/CO2/100g. Blue box with choices: Will you commit to checkout with a low carbon footprint shopping basket? (please select one of the options below) □ I am interested in protecting the environment, therefore, I commit to keeping the carbon footprint of my basket below 180gCO_2/100g Blue button: "START SHOPPING"

Online Appendix 2 Final questionnaires

NU-food Supermarket Questionnaires

Week 1

Would you characterise the shopping trip you have just made

- o A top-up shopping trip (you purchased a little just to increase the stock of a few items in your kitchen)
- o Part of a typical shopping trip (you purchased some items that you need stocking up at home)
- o A full-size typical weekly shopping trip (you purchased as much as you could of what you need stocking up at home)
- o An atypical weekly shopping trip (you bought some things you need, but also made several unplanned purchases)

What were the main objectives of this shopping trip? Please tick any relevant objectives, ranking them for the most important to the least important to you. [adapted from (Steptoe et al 1995)]

		Rank
Buy food that **is easy to prepare**	o	
Buy food that **contains no additives**	o	
Buy food that **is low in calories**	o	
Buy food that **is familiar**	o	
Buy food that **keeps me healthy**	o	
Buy food that **I like**	o	
Buy food that **helps me with cope with stress**	o	
Buy food that **is not expensive**	o	
Buy food that **is friendly to the environment**	o	
Buy food that **protects the welfare of animals**	o	
Buy a **wide variety** of foods	o	
Buy food that is **the best possible quality**	o	
Buy food that is **produced in Britain**	o	

How much did you spend last week on food? (please consider only supermarkets, corner shops, and other retailer, not cafés, restaurants, and bars).

Are there any products you had not expected to purchase today?

Thinking about today's shopping, would you say that you bought enough of what you needed?

	I never buy this product	I bought enough of this product in this NU-food shop today	I may buy more of this outside of the NU-food shop
Beans, peas, and lentils	○	○	○
Bottled Water, Fruit Juice, and Soft Drinks	○	○	○
Oil, margarine, and butter	○	○	○
Cheese, milk, and other dairy products	○	○	○
Fish (fresh, frozen, or processed)	○	○	○
Bread and bakery products	○	○	○
Meat (fresh, frozen, or processed)	○	○	○
Vegetables (fresh, frozen, or processed)	○	○	○
Fruit (fresh, frozen, or processed)	○	○	○
Rice and Pasta	○	○	○
Breakfast Cereal	○	○	○
Eggs	○	○	○
Non-Dairy Milk	○	○	○
Salt, Sugar	○	○	○
Tea, Coffee	○	○	○
Sauces (e.g. mustard, ketchup)	○	○	○
Honey and Jam	○	○	○
Flour	○	○	○

_____-page break _____

Self-control scale (Tangney, Baumeister, and Boone 2004)

Using the scale provided, please indicate how much each of the following statements reflects how you typically are.

	Not at all 1	2	3	4	Very much 5
I am good at resisting temptation.	○	○	○	○	○
I have a hard time breaking bad habits.	○	○	○	○	○
I am lazy.	○	○	○	○	○
I say inappropriate things.	○	○	○	○	○
I do certain things that are bad for me, if they are fun.	○	○	○	○	○
I refuse things that are bad for me.	○	○	○	○	○
I wish I had more self-discipline.	○	○	○	○	○
People would say that I have iron self- discipline.	○	○	○	○	○
Pleasure and fun sometimes keep me from getting work done.	○	○	○	○	○
I have trouble concentrating.	○	○	○	○	○
I am able to work effectively toward long-term goals.	○	○	○	○	○
Sometimes I can't stop myself from doing something, even if I know it is wrong.	○	○	○	○	○
I often act without thinking through all the alternatives.	○	○	○	○	○

Moral self-image scale (Jordan, Leliveld, and Tenbrunsel, 2011)

Compared to the intelligent person I want to be, I am:

1	2	3	4	5	6	7	8	9
Much less than the person I want to be				*Exactly as much as the person I want to be*				*Much more than the person I want to be*

Compared to the environmentally-friendly person I want to be, I am:

1	2	3	4	5	6	7	8	9
Much less than the person I want to be				*Exactly as much as the person I want to be*				*Much more than the person I want to be*

Compared to the healthy person I want to be, I am:

1	2	3	4	5	6	7	8	9
Much less than the person I want to be				*Exactly as much as the person I want to be*				*Much more than the person I want to be*

Compared to the wealthy person I want to be, I am:

1	2	3	4	5	6	7	8	9
Much less than the person I want to be				*Exactly as much as the person I want to be*				*Much more than the person I want to be*

_____-page break _____

What gender to you identify with?

☐ Male ☐ Female ☐ Other

Your age

_____

What is your postcode? _____

Please choose your highest qualification of education

☐ Postgraduate university degree
☐ Undergraduate university degree
☐ Further education (HNC/HND)
☐ Secondary education
☐ Others

Please choose your annual income range

☐ Up to £12,999
☐ £13,000-£18,999
☐ £19,000-25,999
☐ £26,000-£31,999
☐ £32,000-£47,999
☐ £48,000-£64,999
☐ Above £65,000
☐ Prefer not to say

Who else do you buy food and drink for in your household?

Type zero (0) in each box if you only buy food and drink for yourself.

	Number
Young children (0-5 years)	
Children (6-10 years)	
Teenagers (11-17 years)	
Adults (18 years or older)	

Week 2

Would you characterise the shopping trip you have just made

- A top-up shopping trip (you purchased a little just to increase the stock of a few items in your kitchen)
- Part of a typical shopping trip (you purchased some items that you need stocking up at home)
- A full-size typical weekly shopping trip (you purchased as much as you could of what you need stocking up at home)
- An atypical weekly shopping trip (you bought some things you need, but also made several unplanned purchases)

What were the main objectives of this shopping trip? Please tick any relevant objectives, ranking them for the most important to the least important to you. [adapted from (Steptoe et al 1995)]

		Rank
Buy food that **is easy to prepare**	○	
Buy food that **contains no additives**	○	
Buy food that **is low in calories**	○	
Buy food that **is familiar**	○	
Buy food that **keeps me healthy**	○	
Buy food that **I like**	○	
Buy food that **helps me with cope with stress**	○	
Buy food that **is not expensive**	○	
Buy food that **is friendly to the environment**	○	
Buy food that **protects the welfare of animals**	○	
Buy a **wide variety** of foods	○	
Buy food that is **the best possible quality**	○	
Buy food that is **produced in Britain**	○	

How much did you spend last week on food? (please consider only supermarkets, corner shops, and other retailer, not cafés, restaurants, and bars).

Are there any products you had not expected to purchase today?

Thinking about today's shopping, would you say that you bought enough of what you needed?

	I never buy this product	I bought enough of this product in this NU-food shop today	I may buy more of this outside of the NU-food shop
Beans, peas, and lentils	○	○	○
Bottled Water, Fruit Juice, and Soft Drinks	○	○	○
Oil, margarine, and butter	○	○	○
Cheese, milk, and other dairy products	○	○	○
Fish (fresh, frozen, or processed)	○	○	○
Bread and bakery products	○	○	○
Meat (fresh, frozen, or processed)	○	○	○
Vegetables (fresh, frozen, or processed)	○	○	○
Fruit (fresh, frozen, or processed)	○	○	○
Rice and Pasta	○	○	○
Breakfast Cereal	○	○	○
Eggs	○	○	○
Non-Dairy Milk	○	○	○
Salt, Sugar	○	○	○
Tea, Coffee	○	○	○
Sauces (e.g. mustard, ketchup)	○	○	○
Honey and Jam	○	○	○
Flour	○	○	○

_____-page break _____

(1=totally don't agree, 7=totally agree)

		1	2	3	4	5	6	7
Attitudes	It is important to be environmentally-friendly.	○	○	○	○	○	○	○
	It is important to perform environmental behaviours	○	○	○	○	○	○	○
	It is important to be in an healthy.	○	○	○	○	○	○	○
	It is important to perform healthy behaviours	○	○	○	○	○	○	○
Self-perception scale	I think my behaviour is environmentally responsible	○	○	○	○	○	○	○
	When I buy a product, I take environmental considerations into account.	○	○	○	○	○	○	○
	I think my behaviour is healthy	○	○	○	○	○	○	○
	When I buy a product, I take health considerations into account.	○	○	○	○	○	○	○
Self-signalling scale	The purchase of a food basket with a low carbon footprint is an accurate reflection of how much I care for the environment.	○	○	○	○	○	○	○
	Purchasing a food basket with a low carbon footprint tells **me** that I am a person who cares for the environment	○	○	○	○	○	○	○
	Purchasing a food basket with a low carbon footprint tells **people close to me** that I am a person who cares for the environment.	○	○	○	○	○	○	○
	The purchase of a food basket that is low in kilocalories is an accurate reflection of how much I care for my health.	○	○	○	○	○	○	○

Purchasing a food basket that is low in kilocalories tells **me** that I am a person who cares for my health.	○	○	○	○	○	○	○
Purchasing a food basket that is low in kilocalories tells **people close to me** that I am a person who cares for my own health.	○	○	○	○	○	○	○

_____-page break _____

Environmental identity (Aquino and Reed, 2002) (1=totally don't agree, 7=totally agree)

1. Caring for the environment is an important part of who I am.
2. I often buy products that communicate the fact that I care for the environment
3. The types of things I do in my spare time (e.g., hobbies) clearly identify me as caring for the environment.
4. The kinds of books and magazines that I read identify me as caring for the environment.
5. I am actively involved in activities that communicate to others that I care for the environment.
6. It would make me feel good to be a person who cares for the environment.
7. A big part of my emotional well-being is tied up in caring for the environment.
8. I would be ashamed to be a person who cares for the environment. (R)
9. Caring for the environment is not really important to me. (R)
10. Caring for the environment is an important part of my sense of self.
11. I strongly desire to care for the environment.
12. I often wear clothes that identify me as caring for the environment.
13. The fact that I care for the environment is communicated to others by my membership in certain organizations.

Health identity (Aquino and Reed, 2002) (1=totally don't agree, 7=totally agree)

1. Caring for my health is an important part of who I am.
2. I often buy products that communicate the fact that I care for my health
3. The types of things I do in my spare time (e.g., hobbies) clearly identify me as healthy.
4. The kinds of books and magazines that I read identify me as healthy.
5. I am actively involved in activities that communicate to others that I care for my health.
6. It would make me feel good to be a person who cares for my health.
7. A big part of my emotional well-being is tied up in being healthy.
8. I would be ashamed to be a person who cares for his/her own health. (R)
9. Caring for my health is not really important to me. (R)
10. Caring for my health is an important part of my sense of self.
11. I strongly desire to care for my health.
12. I often wear clothes that identify me as caring for my health.
13. The fact that I care for my health is communicated to others by my membership in certain organizations.

_____-page break _____

Self-control scale (Tangney, Baumeister, and Boone 2004)

Using the scale provided, please indicate how much each of the following statements reflects how you typically are.

	Not at all 1	2	3	4	Very much 5
I am good at resisting temptation.	○	○	○	○	○
I have a hard time breaking bad habits.	○	○	○	○	○
I am lazy.	○	○	○	○	○
I say inappropriate things.	○	○	○	○	○
I do certain things that are bad for me, if they are fun.	○	○	○	○	○
I refuse things that are bad for me.	○	○	○	○	○
I wish I had more self-discipline.	○	○	○	○	○
People would say that I have iron self- discipline.	○	○	○	○	○
Pleasure and fun sometimes keep me from getting work done.	○	○	○	○	○
I have trouble concentrating.	○	○	○	○	○
I am able to work effectively toward long-term goals.	○	○	○	○	○
Sometimes I can't stop myself from doing something, even if I know it is wrong.	○	○	○	○	○
I often act without thinking through all the alternatives.	○	○	○	○	○

Moral self-image scale (Jordan, Leliveld, and Tenbrunsel, 2011)

Compared to the intelligent person I want to be, I am:

1	2	3	4	5	6	7	8	9
Much less than the person I want to be				*Exactly as much as the person I want to be*				*Much more than the person I want to be*

Compared to the environmentally-friendly person I want to be, I am:

1	2	3	4	5	6	7	8	9
Much less than the person I want to be				*Exactly as much as the person I want to be*				*Much more than the person I want to be*

Compared to the healthy person I want to be, I am:

1	2	3	4	5	6	7	8	9
Much less than the person I want to be				*Exactly as much as the person I want to be*				*Much more than the person I want to be*

Compared to the wealthy person I want to be, I am:

1	2	3	4	5	6	7	8	9
Much less than the person I want to be				*Exactly as much as the person I want to be*				*Much more than the person I want to be*

_____-page break _____

Trolley problem

Imagine the following situation:

A runaway trolley is headed for five railway workmen who will be killed if it proceeds on its present course. The only way to save these people is to hit a switch that will turn the trolley onto a side-track where it will run over and kill one workman instead of five. Ignoring legal concerns, is it ethically okay to turn the trolley in order to save five people at the expense of one?

- **Yes.**
- **No.**

Trolley problem 2

A runaway trolley threatens to kill five people. You are standing on a footbridge spanning the tracks between the oncoming trolley and the five people. Next to you is a railway worker who is wearing a large backpack. The only way to save the five people is to push this worker off the bridge and onto the tracks below. The man will die as a result, but his body will stop the trolley from reaching the others. You cannot jump yourself because you do not have enough weight on you to stop the trolley, and there is no time to put the backpack on Ignoring legal concerns, is it okay to save the five people by pushing this stranger to his death?

- **Yes.**
- **No.**

Environmental Literacy

- Which of these products do you think is **higher** in carbon footprint? (not in store)

  (A 500g portion of Chicken Biryani; A 500g portion of Shepherd's Pie; both the same; Not sure/Don't know)
- Which of these products do you think is **higher** in carbon footprint? (not in store)

  (One Thin Crust Cheese Feast Pizza; One Thin Crust Pepperoni Pizza; Both the same; Not sure/Don't know)
- Which of these products do you think is **higher** in carbon footprint? (not in store)

  (1 litre of lager beer in two 500ml cans; 1 litre of lager beer in four 250ml bottles; both the same; Not sure/Don't know)
- Which of these products do you think is **higher** in carbon footprint? (not in store)

  (A standard 250-ml cup of latte; A standard 250-ml cup of cappuccino; Both the same; Not sure/Don't know)