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SOCIO-DEMOGRAPHICS, IMPLICIT ATTITUDES, EXPLICIT ATTITUDES, AND SUSTAINABLE CONSUMPTION IN SUPERMARKET SHOPPING

Luca Panzone[1*], Denis Hilton[2], Laura Sale[3], Doron Cohen[4]

[1]Newcastle University, Newcastle-upon-Tyne (UK); [2]University of Toulouse, Toulouse (France); [3]Diva Creative, Sheffield (UK); [4]University of Manchester, Manchester (UK)

*Correspondence to: Luca Panzone, School of Agriculture, Food and Rural Development, Newcastle University, NE1 7RU, Newcastle-upon-Tyne, UK. E-mail: luca.panzone@newcastle.ac.uk

Abstract

The aim of this research is to examine whether socio-demographics, implicit and explicit attitudes towards the environment predict sustainable consumer behaviour, measured using supermarket loyalty card data. The article uses an Implicit Association Test (IAT) and Likert scales to gauge implicit and explicit attitudes towards sustainable consumption in a real consumer sample, and measures demographic characteristics of participants. Results indicate that level of education is a key predictor of an aggregate measure of sustainable consumption, with a small part of this influence mediated by level of explicit environmental concern for climate change. Econometric modelling shows that explicit and implicit attitudes influence consumer decisions differently in specific food categories. Results, obtained with real consumer data, call into question the accepted socio-demographic profile of the green consumer and help identify conditions under which pro-environmental attitudes predict sustainable consumption.

Keywords: sustainable consumption, implicit and explicit attitudes, grocery shopping, mediation analysis, almost ideal demand system

EconLit codes: D12; Q18; Q59

PsycInfo codes: 3900; 3920; 4070

1. INTRODUCTION

In recent years, there has been increasing attention to the environmental impact of consumer behaviour. Evidence suggests that current consumption patterns in modern societies are unsustainable (Arrow *et al*., 2004; Daly *et al*., 2007), and policies are required to ensure that future generations have access to the same quantity and quality of consumption as present generations (Peattie, 2010; Vermeir and Verbeke, 2006). Sustainable consumption requires large-scale changes in consumer behaviour (Adger *et al*., 2009; Dietz *et al.*, 2009), which in turn will be favoured by a change in the underlying set of attitudes driving behaviour (Bohner and Dickel, 2011), i.e. how individuals feel about the environment. Although attitudes have often been shown to predict behaviour (Ajzen & Fishbein, 1977), research has frequently found that pro-environmental attitudes do not always translate into pro-environmental behaviour (Prothero *et al*., 2011; Steg and Vlek, 2009). In the case of food, in 2012 only 6% of UK consumers state that "buying organic products is not important", with 80% of them claiming to purchase organic food; yet organic sales only account for a 1% share of the market (Soil Association, 2013).

This article tests whether measures of implicit and explicit attitudes predict environmentally-friendly food consumption using actual supermarket shopping data. The behavioural economics literature often explores the relation between attitudes and behaviour by using measures of *explicit attitudes* (see e.g. Costa and Kahn, 2013) in the form of self-reported ratings that may be expected to reflect a conscious thought process (Hofmann *et al*., 2007). Implicitly, these models attribute the failure to convert attitudes into behaviour to cognitive barriers (e.g. ignorance, or distrust in information; see Gifford, 2011), or external constraints (e.g. income; see Schor, 2005). However, there is

growing awareness that consumer decision-making is also driven by an automatic (i.e. non-deliberate) component (Alòs-Ferrer and Strack, 2014; Samson and Voyer, 2012), with heuristics and habits[1] also influencing behaviour (Gifford, 2011). As a result, the relation between consumer decision-making and attitudes should also include measures of *implicit attitudes*, which capture automatic cognition (e.g. Bohner and Dickel, 2011; Gawronski, 2013), and which have been shown to predict environmentally-friendly behaviours under time pressure in laboratory settings (Beattie and Sale, 2011).

Models of behaviour that account for both deliberate and automatic cognition are known as dual-system models (see Alòs-Ferrer and Strack, 2014; Brocas and Carrillo, 2014; Dhar and Gorlin, 2013; Samson and Voyer, 2012). Evidence on the link between implicit attitudes and behaviour is mostly based on research conducted in experimental settings rather than on real-life data. An innovation of the present research is the measurement of the impact of both implicit and explicit attitudes to the environment on actual consumer behaviour. The focus of the article is on food choices, which account for a large component of the carbon footprint of UK households (e.g. Panzone *et al*., 2013).

The next section reviews the links between socio-demographics, attitudes, and consumer behaviour with relation to sustainable consumption. Section 3 describes the dataset used in the empirical analysis, which contains demographic characteristics, explicit and implicit attitudes, and actual expenditures for a sample of consumers at Tesco, the largest UK food retailer. The first set of analyses reported in Section 4 explores the role of demographic variables, and measures of implicit and explicit

[1] Habits are the only type of automatic behaviour occasionally used in economic modelling, where they are modelled as lagged consumption (e.g. Browning and Collado, 2007; Blanciforti and Green, 1983).

attitudes to predict an index developed to measure the aggregated sustainability of a shopping basket (ESS, Panzone *et al*., 2013), as well as aggregate basket expenditures. A second set of analyses uses these same demographic and attitude variables to predict sustainable choices within four product categories, using an econometric model of demand, the Linear Almost Ideal Demand System (LAIDS) (Deaton and Muellbauer, 1980), which identifies structural demand parameters. Section 5 discusses the implications of the results, while section 6 concludes.

2. PRO-ENVIRONMENTAL ATTITUDE, DEMOGRAPHICS AND SUSTAINABLE CONSUMER BEHAVIOUR

2.1. Pro-Environmental Attitudes and Sustainable Consumption

Pro-environmental behaviour change requires consumers to develop more positive pro-environmental attitudes over time to make consumption more sustainable (Steg and Vlek, 2009). An influential perspective on the relation between attitudes and behaviour comes from expectancy-value models (e.g. Ajzen, 1991), which view consumers as forming attitudes through active cognition: they gather information on the attributes forming an object (e.g. carbon footprint and calorific content of foods), weight each attribute on the basis of prior beliefs, and derive the final perceived value of the good (e.g. Cohen *et al*., 1972; Bentler and Speckart, 1979). Once formed, these attitudes are stored in memory, revised if new relevant information becomes available (e.g. Petty, 2006; Fazio, 2007; Jacoby *et al*., 2002; Sanbonmatsu and Fazio, 1990), and used anytime they are activated (Fazio, 2001). This deliberate cognitive process leads to evaluations called ***explicit attitudes***, which are measured by asking individuals to report their agreement to statements on tailored metrics (e.g. Likert scales).

Research in economics on has incorporated measures of explicit environmental attitudes to predict explain behaviour (e.g. energy consumption in Costa and Kahn, 2013). This perspective presupposes that attitudes to the environment are formed by a calculative individual who determines his utility for each option in a choice set after accurately considering his attitude toward all alternatives, an idea that seems to correctly depict food consumption only in information-intensive markets (e.g. wine, see Hamlin, 2010). Whilst easy to measure, however, explicit attitudes may not measure the underlying attitude constructs, but the understanding the individual has of his own relation with the object, as they incorporate cognitive and motivational stimuli unrelated to attitudes (Gawronski *et al*., 2006). Moreover, most choices in retail environments are made under time pressure, with a median estimated choice time of 1 second (Moorman, 1996, page 36), suggesting that automatic cognition should prevail in supermarket grocery shopping (Beattie & Sale, 2011). This point is supported by research that occasionally finds a gap between self-reported attitude to the environment and consequent behaviour (e.g. organic purchasing in Hughner *et al.*, 2007).

2.2. Implicit Attitudes and Consumer Behaviour

Consumer behaviour is often associated with a high degree of automaticity (Bargh, 2002), and deliberate cognition is often considered suitable to account for only a part of the evaluation process (Friese *et al.*, 2008, 2006; Gibson, 2008; Hofmann and Friese, 2008; Maison *et al.*, 2004; Olson and Fazio, 2004; Scarabis *et al.*, 2006). Specifically, consumers are likely to make automatic (i.e. fast and efficient) evaluations of objects, based on ***implicit attitudes*** (Eagly and Chaiken, 2007). Implicit attitudes can be measured using indirect methods that quantify mental associations between objects and specific evaluative parameters of which respondents may not be necessarily aware

of [2] (Gawronski *et al*., 2006; Greenwald *et al.*, 1998): the Affective Priming Test (Fazio *et al*., 1986); the Implicit Association Test (IAT) (Greenwald *et al.*, 1998); and the Affect Misattribution Procedure (AMP) (Payne *et al.*, 2008). Experimental research consistently finds a positive relation between implicit attitudes and decisions affecting health (e.g. Payne *et al*., 2008; Prestwich *et al*., 2011) or brand choices (e.g. Friese *et al.*, 2006; Messner and Vosgerau, 2010; Brunel *et al.*, 2004), as well as environmentally-friendly food shopping (Beattie and Sale, 2011).

Both implicit and explicit attitudes refer to a consumer's evaluations towards an attitude object (Bohner and Dickel, 2011), which are assumed to influence behaviour when active, drawing from memory or responding to external stimuli (Schwarz, 2007), and which both require accessibility of congruent information during the decision task to translate into behaviour (Gawronski, 2013). Moreover, both implicit and explicit attitudes tend to be sensitive to changes in the context where they are measured (Gawronski et al., 2006; Gawronski and Cesario, 2013). Notably, implicit and explicit attitudes can result in different evaluations of the same object (Fitzsimons *et al.*, 2007): for example, a consumer who "instinctively" dislikes soy burgers (negative implicit attitudes) may feel she ought to prefer them to beef burgers to protect the environment (positive explicit attitudes). This conflict is relevant to public goods like environmental sustainability, because the benefits of a change in behaviour (e.g. the carbon footprint saved by switching from beef to soy burger) are shared with the whole society, while the cost of the change (e.g. the possible price premium to pay and the perceived loss in taste) is borne entirely on the decision-maker.

[2] See Gregg and Klymowsky (2013), Dimofte (2010), and Fitzsimons et al. (2002) for a review.

2.3. Implicit and Explicit Attitudes in Dual-System Models of Behaviour

Dual-system models of behaviour provide a framework that combines deliberate (i.e. rational) and automatic thinking in consumer decision-making (Alòs-Ferrer and Strack, 2014; Brocas and Carrillo, 2014; Dhar and Gorlin, 2013; Samson and Voyer, 2012). According to this framework, decisions require both automatic and deliberate cognition, although environmental and personal factors influence the relative importance of each component. Specifically, implicit and explicit attitudes can be seen as two different (but correlated) constructs (Greenwald *et al*., 2009; Greenwald and Banaji, 1995), which target different behaviours: implicit attitudes are stronger predictor than explicit counterpart when dealing with socially sensitive behaviours, while the correlation between explicit and implicit attitudes is highest for political preferences and consumer behaviours (Greenwald *et al.*, 2009). Moreover, automatic and deliberate cognition cooperate proficiently in guiding eating and drinking behaviours under normal cognitive loads; however, implicit cognition dominates under high cognitive load (Friese *et al*., 2008), and in low self-control individuals when implicit attitudes conflict with explicit attitudes (Fitzsimons *et al.*, 2007).

Research on the simultaneous impact of both explicit and implicit attitudes and food purchase is generally limited, with currently no research on their relevance in a real supermarket setting. However, grocery shopping is a relevant case study for studying both implicit and explicit attitudes, because it combines deliberate economic thinking from a budget constraint with implicit cognition from habitual consumption and time pressure (Hoyer, 1984; Milosavljevic *et al*., 2011). Specifically, "desirable" options often require consumers to consciously apply some effort (Friese *et al.*, 2008; Fitzsimons *et al*., 2007), for instance by giving up on certain preferences (e.g. taste) or

by paying a price premium; equally, the time pressure consumers experience during grocery shopping may facilitate the prioritising of automatic thinking (e.g. Jabs and Devine, 2006). As a result, dual-system models might be relevant in studying food consumption, particularly when implicit and explicit attitudes might conflict or be weakly correlated.

2.4. Socio-demographic characteristics and Sustainable Consumption

Previous research has highlighted possible relationships between the socio-demographic profile of consumers and pro-environmental behaviour, in particular sustainable consumption patterns, but providing mixed evidence on their relation (e.g. Peattie, 2001) that questions the utility of consumer segmentation in environmental marketing. In part, difficulties in finding clear results may be caused by the use of self-reported measures of behaviour, as well as the use of relatively small survey samples. Verbally expressed attitudes to environmental labels have been found to be more favourable in high income groups, and in retired and part-time employees, but are unrelated to gender (D'Souza *et al*., 2006). Environmentalists defined over multiple self-reported behaviours are more likely to be older, richer, liberal in political thinking, owner-occupiers, and females (Gilg *et al.*, 2005). However, another study found that education, occupational level, employment status, and income appear unrelated to self-reported pro-environmental behaviours in Swiss consumers (Tanner and Wölfing Kast, 2003). In contrast, studies on actual expenditures on organic food show consistent effects of education, along with ethnicity and income (Dettmann and Dimitri, 2009), while age and education predict both the purchase intention and frequency of purchasing organic foods (Magnusson *et al*., 2003).

3. DATA

This article uses a subsample of the 110,000 Tesco customers enrolled into Dunnhumby's Shopper Thoughts panel[3]. Every year, a subset (circa 30,000 individuals) of this consumer panel responds to a wide range of questions on their habits and preferences, including attitudes towards the environment, which inform strategic marketing decision-making. A random sample of 4,759 panel members who were contacted by Dunnhumby to answer questions on their attitudes for the environment in 2013 were asked to take part in the IAT survey in exchange for Clubcard points (useable in Tesco stores) or "Shopper Thoughts" points (which can be exchanged for high street vouchers). The survey was open for 36 days between March and April 2013, collecting information on 916 participants. The data matched attitudes to expenditures from Tesco Clubcards in the previous 12 months on: total food and drink except alcoholic drinks (F&D); all meat products; red meat products; bottled water; all fruit and vegetables (F&V); organic fruit and vegetables; and total F&D purchased online (see Panzone *et al*., 2013 for the relevant bibliography on these food categories).

The first stage of the survey collected a respondent's implicit attitudes towards sustainability measured using an online ***Sustainability IAT*** (e.g. Greenwald *et al*., 1998). The IAT requires the rapid categorization of various stimuli (typically words and images) and operates on the underlying assumption that individuals respond more quickly and accurately when instructed to categorize two concepts that are closely associated and congruous in memory (i.e., "sustainable" and "good"), while responding more slowly and making a greater number of errors when categorizing concepts that are not closely associated (e.g., "sustainable" and "bad"). In this specific IAT, respondents

[3] see https://www.shopperthoughts.com/.

were asked to associate a number of words with positive or negative valence to a number of "sustainable" or "unsustainable" images. Respondents were presented with images located in the middle of the screen, one word (e.g. bad or good) visible on the top left hand side of the screen and another one (the opposite of the first one, e.g. good or bad) on the top right hand side of the screen. Participants were instructed to use a key on the left hand side of the keyboard to classify stimuli as belonging to the category on the top left, and to use a key on the right hand side of the keyboard to categorise stimuli as belonging to the category on the top right. Whenever participants made a categorisation error, a red cross appeared in the centre of the screen and the participants were required to self-correct by reclassifying the target stimuli.

The choice of target images followed a three-stage procedure. Firstly, target stimuli that reflected the typical supermarket environment were selected using the carbon footprint of a good from CCaLC[4] to determine their sustainability. This resulted in a total of 30 sustainable images, e.g. organic vegetables, and 30 unsustainable images, e.g. bottled water. Secondly, a sample of 30 participants rated how representative each of the target products was of the categories "sustainable" and "unsustainable". Finally, the average level of agreement was calculated, and only images with an agreement rating of above 70% qualified for inclusion in the IAT. This process resulted in 12 images, 6 sustainable and 6 unsustainable, which are presented in table 2. The target category labels of "sustainable" and "unsustainable" were employed along with the attribute categories "good", which contained words with a positive valence (e.g. pleasant), and "bad", which used words with a negative valence (e.g. unpleasant).

[4] See http://www.ccalc.org.uk/ccalctool.php. We thank Adisa Azapagic and Harish Jeswani for support.

In line with the literature (Greenwald *et al*., 2003), the Sustainable-Unsustainable IAT consists of the 7 Blocks presented in table 1. The positions of Blocks 1, 3 and 4 are reversed with those of Blocks 5, 6 and 7 for half the sample to avoid order effects. IAT effects are calculated from an individual summary measure of the latency, i.e. the response time for each word-image combination, of Blocks 4 and 7. The preferred central tendency measure is a *D* score (the "difference score"), which is the ratio of the difference between the mean response and the standard deviation of a Block (Greenwald *et al*., 2003): it rescales the average difference in latency by the within-respondent variability, removing potential biases due to the task (i.e. larger variability in the more complex incongruent image-word task), and to individual differences (Cai et al., 2004). Specifically, the procedure to calculate IAT effects is as follows (Lane et al., 2007, table 3.3): a) estimate the standard deviation of the trials in Blocks 3 and 6, and the trials in Blocks 4 and 7; b) estimate the mean latency for Blocks 3, 4, 6, and 7; c) estimate the differences in the mean of (Block 6 – Block 3) and (Block 7 – Block 4), and divide them by the respective standard deviations of point a); d) calculate the final IAT score as the average of the two resulting ratios. Positive and negative IAT effects represent, respectively, preferences for Sustainable and Unsustainable products.

In phase two, participants were presented with an ***explicit attitude survey***, which measured a respondent's agreement to a set of 13 statements capturing explicit attitudes towards sustainability, along the lines of Milfont and Duckitt's (2010) environmental attitudes inventory (see Table 3). These questions were not collected specifically for this study, but are part of the set of questions the retailers collect from their customer base. Participants had to rate their level of agreement with each statements on a 5-point Likert scale going from 1 ('I strongly disagree') to 5 ('I strongly agree'), and each statement

was presented in a random order. Roughly half of the participants (473 individuals) were asked the same questions in 2011, and had their explicit attitudes collected twice. It is worth noticing that these measures include items sampling general attitudes to sustainability and in some cases refer to behaviours. In contrast, the IAT items all reflect evaluations of specific objects (e.g., landfill, bottled water)[5]. After these steps, respondents reported their socio-demographic characteristics (gender, age, income, education and occupation), and the store brand where they shopped most frequently.

4. RESULTS

This section analyses the relationships between socio-demographics, attitudes, and consumption. In the analyses that follow, gender is a dummy variable equal to 1 if the respondent was male; while education uses two dummies, equal to 1 if the respondent had attained graduate or postgraduate University education respectively (no university education is the baseline). Income and age were collected in bands (e.g. £17,500-£29,999 for income; and 20-24 for age; see table 3); in the analyses these variables were recoded by assigning to each respondent the median of the interval selected (e.g. 22 years for the 20-24 year band). Some respondents had missing values for age and income: these missing values were recoded as before using information panellists reported in 2011 (if the panellist was already there); 35 further missing income values were replaced with the mean income of the sample. Finally, a dummy variable identified whether the respondent indicates Tesco as the main store for the household's grocery shopping. Summary statistics on demographics are reported in Table 3, while attitudes are reported in Table 4.

[5] We thank an anonymous referee for highlighting the need for this clarification.

Of the 916 respondents who completed the online IAT, 21 (2.29%) were removed from the dataset due to excessively fast responses (<300ms) (as indicated in Greenwald *et al.*, 2003; and Lane *et al*., 2007), reducing the sample to 895 participants. For the remaining respondents, the IAT score was calculated according to the improved scoring algorithm developed by Greenwald *et al.* (2003), where a positive score reflects an implicit preference for sustainability whereas a negative score indicates a preference for unsustainability. The resulting IAT scores ranges from -0.5 to 1.5, with an overall mean implicit attitude score of 0.72 (SD = 0.29). Statistical conventions for effect size (Cohen's *d*, see Cohen, 1988) indicate a moderate-strong implicit preference for sustainability in this sample[6]. A paired-sample t-test indicates that the mean response time for those who did the association "Pleasant Words + Sustainable Images" first (M = 1156.4, SD = 78.5) and those who did the "Unpleasant Words + Unsustainable Images" association first (M = 1173.8, SD = 63.0) did not differ significantly (t(5) = -0.446, $p = 0.674$), providing no evidence for an order effect.

The 13 explicit statements have been aggregated using a Principal Component Analysis (PCA). Negatively-phrased explicit statements (items 1, 2, 8 and 13 in table 3) were reverse-coded to have scales going from low to high environmental preferences. To determine factor memberships, factor loadings were transformed using an oblique Oblimin rotation, which allows for correlated factors. Table 5 reports the rotated coefficients (setting gamma equal to 0), which yield three components: *Green Consumer Action* (GCA) (34.3% of the variance) measures the degree to which respondents are personally motivated to behave sustainably; *Environmental Concern*

[6] This convention classifies effects as small, medium and large for values of ±0.2, ±0.5 and ±0.8 respectively (i.e. scores between -0.2 and +0.2 are considered neutral).

(EC) (22.2% of the variance) captures the extent to which consumers worry about climate change; and *Sustainable Food Preference* (SFP) (14.2% of the variance) measures preferences for organic and non-genetically-modified foods. One statement ("I am willing to pay extra for environmentally friendly products") does not manifest clear membership (table 3), but the coefficient of GCA is above 0.5 for values of gamma lower than -3.2 [7]. The resulting factors GCA and EC have reasonable internal consistency, with a Cronbach's α equal to 0.86 and 0.68, respectively; SFP has lower internal consistency, with α = 0.23, suggesting that preferences for organic and GM foods only weakly reflect the same underlying psychological construct.

4.1. Correlations between Attitudes and Socio-demographics Characteristics

A first analysis assesses the correlation between socio-demographics, attitudes, and behaviour. Table 6 highlights the existence of a number of significant correlations between demographic variables and attitudes. Specifically, males have significantly lower pro-environmental attitudes on all the three explicit attitude factors; while age is negatively correlated with environmental concern and positively related to green environmental action. Both undergraduate and postgraduate education are positively related to ESS index and environmental concern, while undergraduate education only correlates significantly with the IAT score. Finally, income is unrelated to explicit and implicit attitudes and sustainable consumption, while total food and drink sales correlate negatively with the ESS index.

Pearson correlations in Table 4 reveal that ten of the thirteen explicit attitude questions are significantly positively correlated with the IAT score, and only attitudes towards GMO consumption, beliefs on climate change, and monitoring one's carbon

[7] The value of the correlation equals 0.5 if gamma equals -3.2. Note that gamma should always be below 0 when using oblique rotations (see Jennrich, 1979).

footprint show non-significant correlations. Non-parametric Kruskal-Wallis correlations show equivalent results, although three further items have a correlation that is not significantly different from zero. The IAT also shows low but strongly significant correlations with the three resulting Bartlett's factors (Table 6): the correlation is 0.1093 ($p = 0.0011$) for Green Consumer Action; 0.0890 ($p = 0.0077$) for Environmental Concern; and 0.0747 ($p = 0.0253$) for Sustainable Food Preference. These correlations are depicted in figure 1: data points are narrowly dispersed, and suggest the existence of a linear relationship between variables.

Further analyses compared attitudes measured in 2013 and in 2011 on the subset of 473 individuals who had the information in both years. A test-retest analysis (table 4) indicates that attitudes across the two years correlate significantly ($p<0.0001$ for all the 13 items), with coefficients in the range 0.43-0.71. High IAT scores in 2013 could be also correlated to positive changes in explicit attitudes across the two years; results (available on request) indicate that IAT scores are unrelated to changes in explicit attitudes from 2011 to 2013, with the exception of a significantly positive correlation with changes in the intention to consume organic products ($\rho = 0.1123$, $p = 0.0146$).

4.2. Socio-demographics, Attitudes, and Consumer Behaviour: a Mediation Analysis

After observing the univariate correlation between implicit and explicit attitudes, this section evaluates the relation between the measures of implicit and explicit attitudes and actual consumer behaviour using a multivariate statistical approach. Moreover, the section explores whether the effects of demographics on consumer behaviour are mediated by implicit and explicit attitudes. Figure 2 shows the expected path where socio-demographics (e.g. gender, income, education) affect attitudes (both implicit and

explicit), which in turn affect behaviour. The hypothesis that attitudes mediate the impact of demographics on behaviour is tested using a Structural Equation Model (SEM), where demographics are exogenous variables, and implicit and explicit attitudes simultaneously determine behaviour, as portrayed in figure 2.

Referring to behaviour as *B*, demographics as *D*, and attitudes as *A*, the path of figure 2 can be described by the system of equations

$$B_i = \alpha D_i + \gamma A_i + \nu_i \qquad (1)$$

$$A_i = \beta D_i + \upsilon_i$$

From system (1), the direct effect of demographics on behaviour corresponds to α, while $\beta \cdot \gamma$ is the indirect effect of demographics on behaviour. Finally, γ refers to the direct effect of attitudes on behaviour. A variable is a candidate mediator when three conditions hold simultaneously (Baron and Kenny, 1986): (1) the suspected mediator (in this case, attitude) is significantly correlated to the dependent variable (behaviour) when regressed alone; (2) the independent variable (demographics) is significantly correlated to the suspected mediator (attitudes); and (3) the independent variable (demographics) is significantly correlated to the dependent variable (ESS index) when regressed alone. Tables 7a and 7b presents the regressions testing these three conditions, showing that environmental concern is a possible mediator of demographics.

Sustainable consumption is observed using the Environmentally Sensitive Shopper (ESS) index of Panzone *et al*. (2013), which is an aggregate indicator measuring sustainable consumption that concentrates six categories with high carbon implications (both in terms of carbon reduction associated to decreased consumption, e.g. red meat, and in terms of low carbon footprint, e.g. fruit and vegetables) into a

single indicator. This article uses the binary version of the Environmentally Sensitive Shopper (ESS) index (Panzone *et al*., 2013), which identifies sustainable consumption patterns relative to the modal consumption level in selected food and drink (F&D) categories. In the index, consumption is defined as the ratio of expenditure in a subcategory (e.g. organic fruit and vegetables) over expenditure in a total category (e.g. total fruit and vegetables), as in Deaton and Muellbauer (1980). For each category, the index assigns a 1 to consumers who consume sustainable options above the mode of the population, or consume unsustainable options below the mode of the population (zero otherwise). The values of all categories are then summed into an index that goes from 0 to 6 (average ESS score in the sample: 2.372). Qualitatively similar results to those presented below are obtained aggregating the ratios of expenditure directly, as well as from the other versions of the index reported by Panzone *et al.* (2013).

As in Panzone *et al.* (2013), the ESS index includes three sustainable categories (fruit and vegetables over total food expenditure; organic fruit and vegetables (F&V) over total F&V[8]; and online F&D over total F&D[9]) and three unsustainable categories (meat over total F&D; red meat over total meat[10]; and bottled water[11] over total F&D). Notably, this indicator does not base its validity on consumer expectations, but on the true carbon footprint of a food category (see Panzone *et al*., 2013, for a full discussion on the construct validity of this index): F&V (total and organic) and meat (total and red) appear because of their carbon footprint, which is high for meats and low for F&V

[8] These two categories include fresh and processed F&V, excluding juices.
[9] Total food and drink expenditures includes all food products purchased in-store independently on their sustainability. These values exclude alcoholic drinks and non-food items.
[10] These two categories include fresh, frozen, canned, or cooked meat products.
[11] This category refers to all water products, flavoured and plain. Note that for drinks the relevant substitute is other food, as people substitute away from other food purchases, not necessarily other drinks, in order to be sustainable.

(Williams et al., 2006); bottled water and online shopping instead appear because of the large difference in carbon footprint compared to their closest substitutes (tap water has a lower footprint than bottled water, see Botto et al., 2011; while store shopping has a higher footprint than online shopping, e.g. Edwards et al., 2010). The use of consumer perception of what constitutes sustainable behaviour can lead to situations where behaviour is consistent with underlying attitudes because the behaviour performed corresponds to personal beliefs that the behaviour is sustainable, even if it is actually not the case. The use of an objective measure of behaviour determines whether attitudes match true rather than imagined environmental performance.

For comparison, table 8 reports the same mediation analysis using total F&D sales (in logarithmic form) in 2013, as previous research suggests that environmentally-friendly consumption requires the payment of a price premium (see e.g. Lusk *et al*., 2007), enabling aggregated sales to serve as a proxy measure of sustainable consumption. The dataset contains total sales purchased in the 12 months leading up to the survey. This variable allows for the possibility that environmental attitudes increase expenditures on food to pay for a higher environmental quality, with or without reducing quantity consumed (Kotchen and Moore, 2008).

Table 7a reports the restricted equations that follow Baron and Kenny (1986), using standardised coefficients. These equations show that Environmental Concern is the only explicit attitude factor predicting aggregated sustainable consumption as measured by the ESS index; concern also predicts lower total F&D sales, while green consumer action predicts higher sales. Undergraduate and postgraduate educations predict higher sustainable consumption, while undergraduate education predicts lower total F&D sales. Income is inversely related to the ESS index, but positively related to

total F&D expenditures, while age is negatively associated to total F&D sales. Finally, respondents who shop primarily at Tesco spend more on F&D in this store, but have a lower ESS index. Results of the full structural model (table 7b) indicate that Environmental Concern continues to significantly predict the ESS index and Green Consumer Action continues to predict F&D sales after controlling for socio-demographics. Similarly, education still predicts higher ESS scores, whereas income and shopping primarily in Tesco predict lower scores; while undergraduate education predicts lower F&D sales, and income and loyalty to Tesco predict higher F&D sales.

Only environmental concern seems to have the potential of mediating the effect of socio-demographic factors on the ESS index, as it is the only variable significantly predicting behaviour in table 7b. Green consumer action and environmental concern are potential mediators of the effect of demographics on total F&D sales. The Baron and Kenny criteria in tables 7a and 7b suggest that only education (undergraduate and postgraduate) might be mediated by concern in driving the ESS index and sales, while age and gender on F&D sales might be mediated by green consumer action. In both case, these variables could have a direct and indirect effect on behaviour. For completeness, table 8 shows the estimated effects of all demographics on sustainable consumption as measured by the ESS index and total F&D sales with bootstrapped standard errors (1,000 replications). Results indicate that 90% of the impact of education on the ESS is direct, while around 10% is indirect. The standardised impact is very similar for both levels of education. As expected, the remaining demographics (male and age) present no effect on the ESS index. Conversely, males spend more on F&D because of higher green consumer action, while age and undergraduate education only have a direct effect on sales of F&D.

4.3. Attitudes and Consumer Behaviour: a Linear AIDS model

The previous section examined the relationship between demographic and attitude measures and aggregate measures of sustainable consumption. This approach is limited because significance at basket level might be driven by a specific item rather than by all products in a basket. Moreover, a failure to identify a significant relationship between attitude measures and behaviour may have been due to mismatch in the level of specificity of the attitude and behavioural measures (e.g. Ajzen and Fishbein, 1977; Weigel et al., 1974). For example, the items used in the IAT test are quite specific and may not be able to capture generic pro-environmental attitudes well enough to predict aggregate measures of sustainable consumption. Conversely, general explicit attitude measures might fail to capture direct relationships between attitudes to specific behaviours, as the analysis only used aggregate measures of sustainable consumption (Bamberg, 2003). Moreover, both total F&D sales and the ESS index aggregate items without considering the carbon footprint of the basket explicitly, but £1 of meat is likely to emit more CO_2 than £1 of F&V. This section tests attitude-behaviour relations within specific food-category levels (e.g. purchasing organic vs. standard fruit and vegetables).

A disaggregated analysis adds the benefit of observing how consumers use their attitudes in making more specific decisions, for instance on the purchase of foods with specific labels (e.g. organic), or in products with a potentially bad environmental reputation (e.g. bottled water, red meat). In fact, consumers might perceive some goods to be "greener" than others (van Doorn and Verhoef, 2011), and these expectations might activate specific attitudes (see Bamberg, 2003). Finally, the analysis in the previous section does not estimate structural demand parameters as defined by the

econometric literature (e.g. Deaton and Muellbauer, 1980; Meghir and Robin, 1992; Tiffin and Arnoult, 2010), a point treated in this section.

To explore the role of attitudes and demographics in an econometric model of demand, this section estimates demand parameters using a linear AIDS (LAIDS) model (Deaton and Muellbauer, 1980). In a market with $i = 1,\ldots,N$ different categories, the demand equation for products in class *i* by consumer *h* corresponds to

$$w_{ih} = \alpha_i + \delta_i c_i + \sum_j \gamma_{ij} \log\left(p_{jh}\right) + \beta_i \ln\left(\frac{X_h}{P^*}\right) + e_{ih} \qquad (2)$$

where w indicates the amount of expenditure consumers allocate to a specific subcategory (e.g. organic F&V; red meat) given a certain budget spent on the overall category (e.g. total F&V; total meat), so that $\sum_i w_{ih} = 1$, p is the average transaction price, and $e_{ih} \sim \mathrm{N}(0,\sigma^2)$ are the residuals. The term $\left(X_h / P^*\right)$ refers to total expenditures normalised by average price, precisely a Stone price index $P^* = \exp\left[\sum_i w_i \ln(p_i)\right]$. Finally, c_h are demographics and attitudes, which enter linearly as in Blanciforti and Green (1983). Identification of demand parameters is achieved imposing the adding-up condition, $\sum_{i=1}^{N} \alpha_{\mathrm{i}} = 1$, $\sum_{i=1}^{N} \gamma_{\mathrm{ij}} = 0$, $\sum_{i=1}^{N} \beta_{\mathrm{i}} = 0$, and $\sum_{i=1}^{N} \delta_{\mathrm{i}} = 0$, the symmetry condition $\gamma_{\mathrm{ij}} = \gamma_{\mathrm{ji}}$, and *the homogeneity condition* $\sum_j \gamma_{\mathrm{ij}} = 0$. In the use of individual data, w_{ih} is truncated: some individuals may make no purchase during the course of a year (Meghir and Robin, 1992; Blundell and Meghir, 1987), and the demand model corresponds to a Tobit model (Solon, 2010).

Importantly, both price and income are as expected correlated with the residual *e* in equation (2), because unobservable tastes are correlated with prices *p* (Dhar *et al*., 2003) and expenditures *X* (Meghir and Robin, 1992). The analysis uses a control function approach to endogeneity correction (Wooldridge, 2014), which starts with the usual first-stage regression of the endogenous variable over a set of instruments *k* and the exogenous regressors *c*, using the regressions

$$p_{ih} = \pi_0^p + \pi_1^p c_i + \pi_2^p k_{ih} + u_{ih}^p \qquad (3')$$

for price and

$$X_h = \pi_0^X + \pi_1^X c_i + \pi_2^X k_{ih} + u_{ih}^X \qquad (3'')$$

for total expenditures. The regression in equation (1) is then augmented with the residuals of both equations u_{ih}^p and u_{ih}^X, whose coefficients test the null hypothesis of no endogeneity. In the analysis, the set of variables *k* includes income (a set of dummies corresponding to the selected income band) in the expenditures equation (3'); and transaction prices paid by the same individual in the same category in 2011 in the price equation (3') as a proxy for the retailer's cost of supplying products in the category. Because the 2011 expenditures is only available for 669 of the 763 respondents, this regression obtains the parameters of equations (3') and (3'') from the individuals whose information is available, while estimating the residuals for the whole sample, as in a two-sample 2SLS regression method (see Inoue and Solon, 2010).

The empirical analysis estimates four independent two-equation demand systems: organic vs conventionally-grown fruit and vegetables; red vs non-red meat; and bottled water vs other drinks; and the demand for food purchased online versus in-store. Organic foods are often seen as a sustainable options (Seufert *et al*., 2012; Pretty *et al*.,

2005; Pimentel *et al*., 2005), and are commonly sold with certified labels. Red meat has a high carbon footprint, particularly compared to white meat: UK estimates (Audsley *et al*., 2009) show that 1 Kg of chicken meat (white) produces 2.84 kg of CO_2e, compared to 12.14 kg for beef, 14.61 for lamb, and 4.45 for pork Bottled water is often considered unsustainable because of the low carbon footprint of tap water (Gleick and Cooley, 2009; Botto *et al.*, 2011); while food purchased online is less carbon-intensive than food bought in-store (Edwards *et al.*, 2010; Rizet *et al.*, 2010). Survey evidence from 42 consumers collected before this study (Sale, 2013) suggests that the above differences may not have fully translated into consumer perceptions at the time of this exercise. Table A1 in the Appendix shows that respondents viewed white meat as slightly more sustainable than red meat, and considered bottled water as unsustainable. Fruit and vegetables were also viewed as sustainable when organic[12] or autochthonous (apples, parsnips, and lettuce), but were not differentiated from meats when assumed foreign (e.g. bananas and oranges were perceived as less sustainable than some meat products).

As indicated in equation (2), the market share of a subcategory (e.g. organic fruit and vegetables when purchasing fruit and vegetables) depends on total expenditures in the category (e.g. total individual spend on fruit and vegetables) and the average price paid for each of the subcategories. For individuals making no purchase in a sub-category (e.g. purchasing fruit and vegetables but no organic alternatives), price is missing, and price corresponds to the average price paid in the sample in the same region of the respondent (as in Tiffin and Arnoult, 2010). Finally, vector c_h contains: the implicit attitude score; the three explicit factors (Green Consumer Action,

[12] In particular, 74% of respondents considered blueberries as high carbon, but the value drops to 26% when these are organic.

Environmental Concern, and Sustainable Food Preference); gender; age (in linear form); university education (one dummy for undergraduate degree, and one for postgraduate studies); and a dummy equal to one if the consumer primarily shops in Tesco. The strength of the instruments varies (table 9): own-price instruments are strong (Wald test > 10) in all equations; cross-price instruments are strong for all categories, with the exception of meat; while income dummies are jointly significant, but relatively weak (Wald test > 3.8).

Results of the demand estimates (Table 10) indicate that the IAT score only predicts bottled water consumption. Conversely, explicit measures of green consumer action and preferences for sustainable food influence the demand for organic fruit and vegetables, while explicit environmental concern predicts shopping online. Demographics significantly predict a number of behaviours: females buy more bottled water and are less likely to shop online; individuals educated at postgraduate level buy more food online and more organic fruit and vegetables; and consumers who indicate that they primarily shop in Tesco buy less food online. Prices and expenditure are very relevant drivers of behaviour: the price of organic and non-organic F&V, red and white meat, and online food shopping are strong predictors of behaviour in the respective category; similarly, total expenditures in a category are positively related to the consumption of organic F&V, bottled water, and online shopping. Prices and expenditures but not attitudes appear important in driving the demand for meat.

Taken together, these results indicate that the predictive power of attitudes on sustainable consumption may depend on the specificity of behavioural measures, as.attitudes predict behaviour better when both attitudes and behaviours are measured at the same levels of specificity (e.g. Weigel *et al.*, 1974; Ajzen & Fishbein, 1977). In line

with this reasoning, the data show that the explicit attitude measures which measure abstract values like environmental concern successfully predict an aggregate measure of sustainable consumption (the ESS index). Conversely, specific attitude measures may be necessary to successfully predict behaviour within a specific product category. For instance, measuring specific attitudes towards the sustainability of bottled water would be expected to be more effective in explaining the demand for bottled water, rather than a general measure of sustainability. The finding that purchase of bottled water was predicted by the IAT may have been facilitated by the widely shared perception (measured in pre-test, see also appendix 1) that bottled water is unsustainable.

5. DISCUSSION

The objective of this article is to contribute to the current literature on sustainable consumption by understanding how consumers make decisions that have environmental implications in the marketplace. The study benefitted from information about real expenditures in a supermarket taken from a loyalty card scheme to test the predictive power of implicit and explicit attitudes towards sustainability taken from two surveys on the same set of consumers. This data was analysed using methods from both econometrics and social psychology to explore the existence and the nature of the relation between attitudes and actual consumption behaviour, and suggests that the relationship between them in this sample of shoppers is fairly limited. In fact, only generic Environmental Concern predicts our aggregate measure of sustainable food shopping behaviour, while demand in single categories is driven by more specific attitudes (IAT scores for bottled water; the Sustainable Food Preferences factor for bottled water and fruit and vegetables; Environmental Concern for online shopping).

This section discusses how these results contribute to the current knowledge on sustainable consumption.

5.1. Attitudes and Sustainable Consumption

Results indicate that implicit attitudes towards environmentally-friendly food are not always related to sustainable consumption. Specifically, the IAT score does not significantly predict sustainability of food baskets, and does not mediate the effect of socio-demographic characteristics. Moreover, demand estimates show that implicit attitudes towards sustainable grocery products only predict the share of expenditures allocated to bottled water, with no significant impact on other categories. The role of implicit attitudes might be expected to be much stronger in food markets, which are characterised by significant time pressure and automaticity (Wood and Neal, 2009; Verplanken and Aarts, 1999). Consistent with the literature on implicit attitudes (Greenwald *et al.*, 2009), results indicate that IAT scores and explicit attitudes are significantly correlated in this domain. However, the IAT score does not predict consumer demand in other categories than bottled water, suggesting that implicit attitudes may not be activated in all consumer choices that have sustainability implications.

Conversely, results suggest that explicit attitudes play a more prominent role than implicit attitudes in predicting aggregate measures of consumer behaviour, supporting earlier research showing that explicit environmental motives are important drivers of behaviour change (Thøgersen, 2013). Specifically, the mediation analysis shows that environmental concern significantly influences the sustainability of a basket, both directly and partly mediating the effect of education. Conversely, two other generic explicit constructs, Green Consumer Attitude and Sustainable Food Preference, did not

predict aggregate consumer behaviour. The role of environmental concern on environmental behaviours and intentions has already been documented both experimentally (Minton and Rose, 1997) and using psychometric methods (Bamberg, 2003), and the results of this article support its role as an important motivator of specific food categories. At a more specific level, Sustainable Food Preferences increase the demand for organic fruit and vegetables and bottled water (despite this being relatively high carbon); Environmental Concern motivates online food expenditures; while Green Consumer Action is only associated the consumption of organic fruit and vegetables.

The mixed results observed in the attitudinal variables might be caused by problems of behaviour specificity, as attitudes towards generic concepts correlate poorly with specific behaviours (e.g. Weigel *et al.*, 1974), leading to the poor observed link between attitudes and behaviour. As a result, the link between attitude and behaviour might have been considerably stronger if the empirical exercise had collected one specific IAT for each of the categories under consideration, specifically preferences for the environmental impact of red meat, organic fruit and vegetables, bottled water and online shopping. On the other hand, the general preferences for the environment collected in this exercise might only operate indirectly via more specific concerns and preferences for the environment (as explained in Bamberg, 2003), and the relation might not appear directly. The same argument applies to the IAT, which measures implicit attitudes to specific grocery products, which may explain why it predicts purchase of specific products that featured in the IAT such as bottled water.

A second explanation for these results is that pro-environmental attitudes might have been inactive when consumers in this sample shopped for food. Attitude research indicates that consumers make goal-congruent choices only if relevant attitudes are

activated (Fazio, 2001). For example, Demarque et al. (2015) found that shoppers in an experimental online store bought more eco-labelled products when relevant social norm information was given, consistent with Cialdini's (2003) norm activation model. The failure to activate relevant attitudes might also be driven by a perceived dissociation between the behaviour and the goal, for instance people with pro-environmental attitudes may still buy meat if they perceive their own meat consumption to have no actual impact on the environment. Similarly, attitudes might not be activated because consumers willingly ignore relevant information available to them on the basis of their own feelings towards the object (Gawronski and Lebel, 2008), for instance refusing to accept the environmental impact of a red meat because they like eating it.

Notably, retailers typically base their micro-management strategies based on the answers to explicit attitude and belief measures like the one used in our study, e.g. tailoring promotions of environmental goods to consumers who report positive explicit attitudes. It is worth noting that the sample of respondents in this study holds relatively positive implicit attitudes for sustainable food, and consumers who reported not shopping primarily in the store brand who supplied the data had even more pro-environmental IAT scores compared to loyal customers. As a result, the insignificant IAT-behaviour relation might be caused by these consumers using their implicit pro-environmental attitudes primarily in retail channels with a positive reputation for environmental quality, such as farmers market (see Sommer *et al*., 1981). Finally, this study defines demand as expenditure shares; however, explicit attitudes and IAT effects might be more important drivers of specific choices (e.g. between standard and organic fruit) rather than aggregate behaviour (see Friese *et al.*, 2006; Friese *et al.*, 2008; Brunel *et al*., 2004), a point that should be considered in future research.

5.2. Demographic Variables and Sustainable Consumption

The statistical analysis confirmed that socio-demographic characteristics are important determinants of actual sustainable consumption. In an aggregate basket, education operates by increasing environmental concern, as well as influencing behaviour directly. Other demographic measures predict pro-environmental attitudes without predicting sustainable consumption. For example, women tend to express higher explicit (but not implicit) pro-environmental attitudes than men, despite having a comparable ESS index and total F&D sales. This may reflect a tendency for women to express more socially desirable attitudes when questioned about the environment than men (Felonneau & Becker, 2008). Young consumers are more concerned about the environment, but older consumers score higher in Green Consumer Action. Similarly, university education predicts higher Environmental Concern, while postgraduate education is negatively associated to Sustainable Food Preferences (at 10% level of significance). Level of income is negatively correlated to the ESS index, but shows a positive relation to Sustainable Food Preferences and income.

Previous research exploring the link between demographics and organic food consumption in scanner data identified education, ethnicity and age as determinants of behaviour (Dettmann and Dimitri, 2009). This article presents similar results with a more complete picture. Specifically, education is a fundamental driver of aggregate sustainability whereas age, gender and education appear to moderately influence aspects of the intra-category budget allocation. Socio-demographics operate by influencing both deliberate and automatic cognition, but only explicit concern towards climate change mediates part of this influence on behaviour.

The relevant role of education in explaining behaviour may be linked to the concept of attitude activation discussed in the previous section. Specifically, people may have a very unclear idea of what is sustainable and what is unsustainable. The decision-making task is complicated by the absence of environmental information in stores, which limits the ability to access relevant information during the choice task. For instance, at the time of testing a number of consumers might have believed that meat was not as unsustainable as claimed in the media. Failure to understand the environmental implications of a choice prevents consumers from acting on goal-congruent attitudes. Education might help consumers in this assessment, providing relevant prior information that they can use in their shopping decisions, and facilitating the search and acquisition of information on the environmental impact of choices and decisions (e.g. Whitmarsh *et al.*, 2011).

5.3. Attitude change and behaviour change

A final point is relevant to understand the present results with the objective of improving the environmental impact of current consumption patterns. In fact, attitudes and attitude change are generally considered a key element in changing behaviours (see e.g. Bohner and Dickel, 2011). However, the results in this article indicate only moderate relations between attitudes into behaviour. A key point in this respect is that the fact that attitudes do not translate into behaviour in the present sample does not necessarily reflect a value-action gap. It may be that consumers believe that they are actually behaving sustainably, so that their attitudes drive purchases of items that they believe to be sustainable (e.g., organic meat), but which would have a negative impact on the sustainability index used in this research (the ESS). This point is well known in the attitude literature, as actual environmental attitude-behaviour consistency is to be

expected not only when pro-attitudes are activated (Fazio, 2001), but also when consumers hold correct beliefs about the nature of the behaviour (Bohner and Dickel, 2011). To this extent, the influence of education observed in the mediation analysis might be due to an improved ability to correctly estimate the "environmental quality" of behaviour, a point that should receive more attention in future research.

5.4. Limitations of this study

While the present study presents a novel approach to the study of the economic psychology of sustainable food consumption using actual supermarket expenditures jointly with intrinsic and extrinsic attitudes, it has some limitations. Firstly, the analysis focuses on a small subset of products that make the basket sustainable. Secondly, consumption is only measured in terms of consumer expenditure in only one retailer. The analysis tries to account for these problems by adjusting for whether consumers primarily shop in Tesco, and disaggregating sales in subcategories to reach progressively smaller units of analysis. As a result, whilst the data refers to the largest UK retailer, results might not be fully generalizable to the UK population. This exercise contributes to the literature on sustainable consumption by observing the role of attitudes and demographics outside the laboratory, and at different stages of the demand formation process. Future research can be built around these findings to see, for instance, how personalised intervention based on attitudes and demographics can be used to target individuals to improve the overall sustainability of food consumption.

6. CONCLUSION

In sum, this study contributes to previous research on sustainable consumer behaviour by linking actual consumer purchasing behaviour over an entire year to socio-demographics and implicit and explicit attitude measures. The benefit of this broader

focus is that results provide a much more detailed insight into the patterns of sustainable consumption. Results indicate that the relationship between implicit attitudes and consumer behaviour might not be as strong as previously conjectured. Importantly, the nature of the study opens the door to further analyses on more disaggregated data, in order to better specify the possible influence of implicit and explicit cognition on specific choices and behaviours.

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Table 1: Example of the Sustainable–Unsustainable IAT

Block	# of Trials	Function	Items Assigned to Left Key Response	Item Assigned to Right Key response
1	20	Practice	Sustainable Images	Unsustainable Images
2	20	Practice	Pleasant Words	Unpleasant Words
3	20	Practice	Pleasant Words + Sustainable Images	Unpleasant Words + Unsustainable Images
4	40	Critical	Pleasant Words + Sustainable Images	Unpleasant Words + Unsustainable Images
5	20	Practice	Unsustainable Images	Sustainable Images
6	20	Practice	Pleasant Words + Unsustainable Images	Unpleasant Words + Sustainable Images
7	40	Critical	Pleasant Words + Unsustainable Images	Unpleasant Words + Sustainable Images

Table 2: Figures used in the IAT

"Sustainable" images




"Unsustainable" images

Table 3. Socio-demographic data frequencies and percentages.

	Variable	N	Mean	S. D.	Min	Max
Demographics	Male	895	0.45	0.50	0	1
	Age	895	49.75	14.15	18.50	72.00
	18-19	*4*				
	20-24	*22*				
	25-29	*63*				
	30-34	*70*				
	35-39	*86*				
	40-44	*128*				
	45-49	*38*				
	50-54	*95*				
	55-59	*112*				
	60-64	*134*				
	65 and over	*134*				
	Income	868	38.47	19.44	4.75	85.00
	Up to £9,499	*31*				
	£17,500 - £29,999	*174*				
	£30,000 - £39,999	*120*				
	£40,000 - £49,999	*100*				

	£50,000 - £74,999	*110*				
	£75,000 or more	*63*				
	£9,500 - £17,499	*84*				
	£-Decline to answer	*196*				
	University Education	895	0.39	0.49	0	1
	Buys grocery and food primarily in Tesco	895	0.73	0.44	0	1
Expenditures	Total Food	763	3080.94	2479.61	1.84	15930.96
	Total Meat	895	358.44	418.30	0	2783.95
	Red Meat	895	134.34	180.48	0	1751.33
	Bottled Water	895	21.76	50.45	0	499.95
	Fruit and Vegetables	895	485.96	538.19	0	3665.61
	Organic Fruit and Vegetables	895	9.90	45.77	0	761.45
	Total Drinks	895	136.92	196.64	0	1758.25
	Total Food Online	895	152.57	653.99	0	6424.70

Table 4. Descriptive statistics and explicit and implicit correlations.

Variable	**N**	**Mean**	**S. D.**	**Test-retest**	**IAT score correlation**	
					Pearson ρ	**Kruskal-Wallis**
IAT score	895	0.72	0.29	-	1.00	
I feel pressured to be environmentally friendly†	895	2.91	1.11	0.4468***	0.0650*	9.670**
Concerns about the environment are exaggerated†	895	3.37	1.18	0.6431***	0.1024***	17.655***
Global warming is a serious threat to society	895	3.64	1.14	0.6407***	0.0448	5.394
I am willing to pay extra for environmentally friendly products	895	2.99	1.06	0.5736***	0.0849**	5.791
I am willing to pay extra for products with a reduced carbon footprint	895	2.77	1.03	0.5606***	0.0972***	7.946*
I would like to see a product's carbon footprint on its label	895	3.21	1.03	0.5506***	0.1042***	12.287**
I try to buy products that have the minimal amount of packaging	895	3.79	0.95	0.5319***	0.1240***	13.504***
I have no desire to try organic products†	895	3.48	1.16	0.4383***	0.0852**	7.633
I am concerned about what I can personally do to help protect the environment	895	3.65	0.92	0.4898***	0.0865***	11.367**
It is important for the food I buy to display the carbon footprint	895	2.83	1.07	0.5373***	0.0703**	6.288
I monitor my carbon footprint	895	2.41	1.11	0.4801***	0.0454	4.874

I am taking steps to address my carbon footprint	895	3.20	1.08	0.4484***	0.1003***	12.459**
I would be happy to eat genetically modified products†	895	3.34	1.19	0.7113***	0.0185	0.786

Significance is as follows: * = 0.1; ** = 0.05; *** = 0.01. †: reverse-coded variable (5 indicates high sustainability, and 1 indicates low-sustainability). Note: IAT = Implicit Association Test

Table 5. Standardised factor loading from a PCA with oblique Oblimin rotation

Variable	Green Consumer Action (GCA)	Environmental Concern (EC)	Sustainable Food Preference (SFP)	Unique variances
I feel pressured to be environmentally friendly†	-0.2107	**0.7127**	0.1543	0.5181
Concerns about the environment are exaggerated†	0.1282	**0.7837**	-0.0551	0.3064
Global warming is a serious threat to society	0.2050	**0.7098**	-0.0706	0.3597
I am willing to pay extra for environmentally friendly products	**0.4084[a]**	0.1784	0.4470	0.4191
I am willing to pay extra for products with a reduced carbon footprint	**0.5645**	0.1303	0.3453	0.3692
I would like to see a product's carbon footprint on its label	**0.7077**	0.1645	-0.0163	0.3858
I try to buy products that have the minimal amount of packaging	**0.6323**	-0.1883	0.0667	0.6387
I have no desire to try organic products†	-0.0254	0.2450	**0.648**	0.4716
I am concerned about what I can personally do to help protect the environment	**0.5593**	0.1401	0.0801	0.5713
It is important for the food I buy to display the carbon footprint	**0.7230**	0.1159	0.0611	0.3678
I monitor my carbon footprint	**0.7999**	-0.0891	-0.0321	0.4202
I am taking steps to address my carbon footprint	**0.8153**	-0.0118	-0.1018	0.3744
I would be happy to eat genetically modified products†	0.0241	-0.2601	**0.7035**	0.5038

Values in bold refer to factor membership. Note: the values refer for oblique rotations with gamma set equal to 0. †: reverse-coded variable (5 indicates high sustainability, and 1 indicates low-sustainability).

[a]: the value of this correlation becomes greater than 0.5 for values of gamma lower than -3.2.

Table 6. Correlation between socio-demographic variables, factors, and IAT score

	IAT score	**ESS**	**GCA**	**EC**	**SFP**
IAT	1	0.0675**	0.1093***	0.0890***	0.0747***
Male	-0.0375	0.0339	-0.1366***	-0.0819**	-0.1002***
Age	0.0282	-0.0367	0.0711**	-0.1988***	-0.0520
Postgraduate Education	-0.0531	0.0635*	0.0285	0.0711**	-0.0465
Graduate Education	0.0948***	0.0852**	0.0127	0.1166***	0.0082
Total Food Sales	-0.0302	-0.0777**	0.0446	-0.0169	0.0382
Total Drinks Sales	-0.0468	-0.1347***	-0.0000	0.0170	0.0354
Income	0.0041	-0.0553	-0.0349	0.0379	0.0497

Significance is as follows: * = 0.01; ** = 0.05; *** = 0.01. Note: IAT = Implicit Association Test; EC = Environmental Concern; GCA = Green Consumer Action; SFP = Sustainable Food Preference.

Table 7a: Structural Equation Model of Attitudes and Behaviour – restricted regressions

Dependent variable	ESS		ESS		Total F&D sales		Total F&D sales	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
Intercept	-0.1168***	0.0375	-0.1096***	0.0377	0.0016	0.0360		
Green Consumer Action	0.0095	0.0419			0.0767*	0.0411		
Environmental Concern	0.1122***	0.0403			-0.0757*	0.0391		
Sustainable Food Preferences	-0.0054	0.0385			-0.0020	0.0361		
IAT score	0.0527	0.0367			-0.0345	0.0355		
Male			0.0268	0.0389			-0.0084	0.0327
Age (linear)			0.0265	0.0380			0.0815**	0.0369
Undergraduate education			0.1215***	0.0375			-0.1177***	0.0369
Postgraduate education			0.0983**	0.0401			-0.0326	0.0370
Income (linear)			-0.1217***	0.0387			0.1561***	0.0365
Tesco main store			-0.0942**	0.0412			0.3875***	0.0389
Observations	763		763		763		763	
F statistic	3.0449**		4.1738***		1.4342		24.2381***	
Log-likelihood	-1107.06		-1099.85		-1079.10		-1005.32	
R^2	0.0159		0.0343		0.0080		0.1824	

Note: The variable "Total food sales" is used in logarithmic form.

Table 7b: Structural Equation Model of Attitudes and Behaviour – Full Models

Dependent variable	ESS		Total F&D sales		GCA		EC		SFP		IAT score	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
Intercept	-0.1134***	0.0370	-0.0318	0.0328	-0.0003	0.0353	0.0249	0.0352	0.0111	0.0355	0.0200	0.0357
GCA	-0.0064	0.0426	0.0810**	0.0378	-		-		-		-	
EC	0.1105***	0.0419	-0.0434	0.0371	-		-		-		-	
SFP	0.0173	0.0391	-0.0069	0.0347	-		-		-		-	
IAT score	0.0437	0.0378	0.0003	0.0335	-		-		-		-	
Male	0.0374	0.0381	-0.0011	0.0338	-0.1358***	0.0359	-0.0666*	0.0358	-0.1130***	0.0361	-0.0502	0.0363
Age (linear)	0.0471	0.0399	0.0663*	0.0354	0.0856**	0.0369	-0.1821***	0.0369	-0.0517	0.0372	0.0219	0.0374
UG education	0.1070***	0.0388	-0.1178***	0.0344	0.0573	0.0367	0.1091***	0.0367	-0.0229	0.0370	0.0737**	0.0371
PG education	0.0906**	0.0386	-0.0331	0.0342	0.0535	0.0365	0.0984***	0.0364	-0.0684*	0.0367	-0.0368	0.0369
Income (linear)	-0.1246***	0.0390	0.1593***	0.0346	-0.0296	0.0370	0.0056	0.0370	0.0928**	0.0373	0.0110	0.0374
Tesco main store	-0.0889**	0.0391	0.3892***	0.0347	-0.0302	0.0372	-0.0127	0.0372	-0.0294	0.0375	-0.0827**	0.0376
Observations	763		763									
chi2	38.23***		176.07***		22.18***		50.49***		21.40***		13.19**	
Log likelihood	-5239.48		-5147.90									
R^2	0.0477		0.1875		0.0283		0.0621		0.0273		0.0170	

Significance is as follows: * = 0.1; ** = 0.05; *** = 0.01. LR test of model vs. saturated: $\chi^2(6) = 430.77$ (Prob > $\chi^2 = 0.0000$). Note: IAT = Implicit Association Test; EC = Environmental Concern; GCA = Green Consumer Action; SFP = Sustainable Food Preference; ESS= Environmentally-Sensitive Shopper index. The variable "Total food sales" is used in logarithmic form.

Table 8: Estimated mediation effects of environmental concern

		Male	UG Education	PG Education	Age

		Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
ESS	**Direct effect**	0.0374	0.0383	0.1070***	0.0378	0.0906**	0.0393	0.0471	0.0403
	Indirect effect via EC	-0.0074	0.0048	0.0121*	0.0063	0.0109*	0.0060	-0.0201**	0.0081
Total sales	**Direct effect**	-0.0011	0.0332	-0.1178***	0.0371	-0.0331	0.0388	0.0663*	0.0386
	Indirect effect via GCA	-0.0110*	0.0058	0.0046	0.0036	0.0043	0.0041	0.0069	0.0046
	Indirect effect via EC	0.0029	0.0032	-0.0047	0.0049	-0.0043	0.0046	0.0079	0.0066

Significance is as follows: * = 0.1; ** = 0.05; *** = 0.01. S.E. refers to Bootstrapped Standard Errors (1,000 replications). Note: EC = Environmental Concern; PG = Postgraduate; UG = Undergraduate.

Table 9: Estimated strength of instruments in first-stage regressions

	Organic F&V	Red meat	Bottled water	Online shopping
Income	F(7, 733) = 7.24***	F(7, 723) = 4.58***	F(7, 713) = 3.67***	F(7, 745) = 4.83***
Own price	F(1, 733) = 32.03***	F(1, 723) = 188.70***	F(1, 713) = 54.99***	F(1, 745) = 35.85***
Cross-price	F(1, 733) = 23.84***	F(1, 723) = 2.12	F(1, 713) = 27.17***	F(1, 745) = 10.68***

Significance is as follows: * = 0.1; ** = 0.05; *** = 0.01. Note: F&V = Fruit and Vegetables

Table 10: Estimated parameters of the LAIDS model, instrumental variable Tobit regression

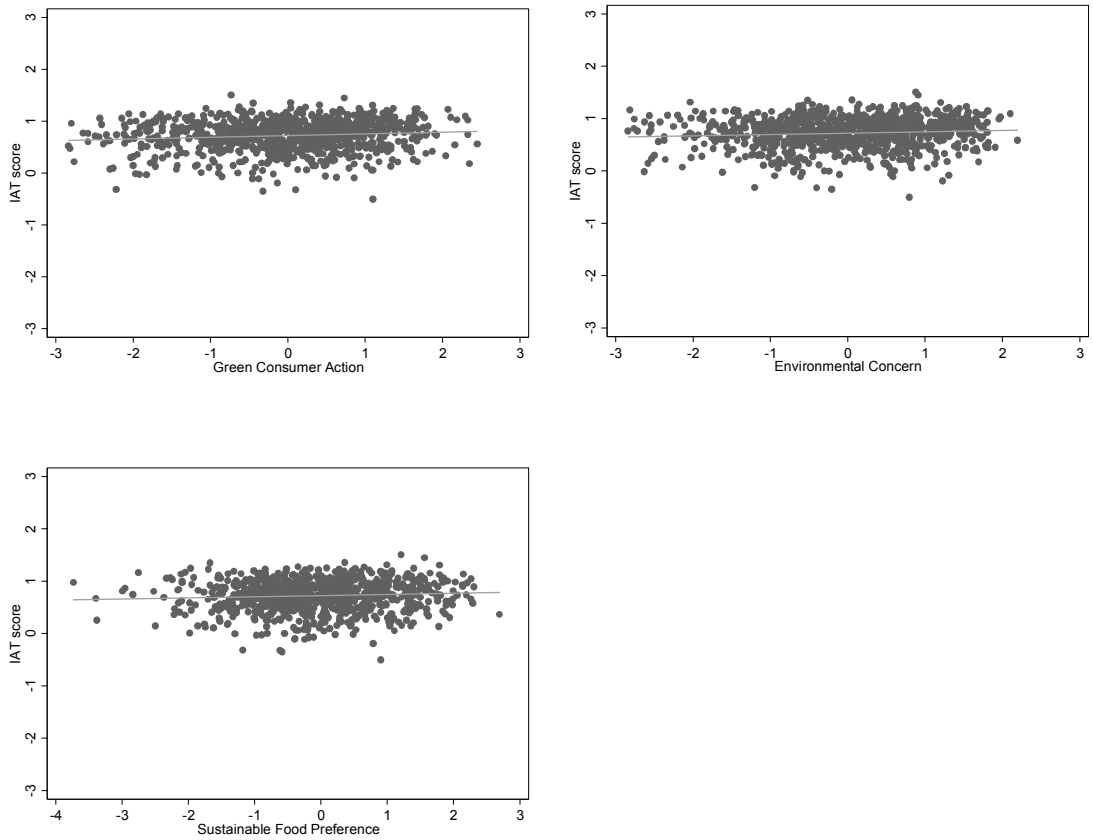
	Organic F&V	Red meat	Bottled water	Online shopping
Basket with	**Standard F&V**	**White meat**	**Other drinks**	**In-store shopping**

	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
Intercept	0.0049	0.0526	0.1345	0.1338	-0.0406**	0.0204	-5.9454***	1.3948
Own price	0.0586***	0.0182	-0.2133***	0.0597	0.0013	0.0021	-1.7029***	0.4336
Cross price	-0.0586***	0.0182	0.2133***	0.0597	-0.0013	0.0021	1.7029***	0.4336
Total expenditures	-0.0084	0.0127	0.0664**	0.0329	0.0079**	0.0034	0.9095***	0.2344
IAT score	-0.0026	0.0120	0.0265	0.0230	-0.0085***	0.0027	0.1514	0.1102
GCA	0.0061**	0.0029	0.0018	0.0086	-0.0004	0.0009	-0.0557	0.0355
EC	0.0013	0.0034	-0.0072	0.0079	-0.0005	0.0008	0.0888**	0.0419
SFP	0.0086**	0.0041	-0.0002	0.0069	0.0013*	0.0007	0.0112	0.0341
Age	0.0002	0.0003	0.0010	0.0006	-0.0001	0.0001	-0.0016	0.0030
UG Education	-0.0019	0.0068	0.0034	0.0218	0.0030*	0.0018	0.1683	0.1060
PG Education	0.0290*	0.0151	0.0263	0.0235	0.0027	0.0030	0.3491***	0.1228
Male	0.0065	0.0066	0.0005	0.0149	-0.0016	0.0014	0.1526**	0.0762
Tesco main store	0.0244	0.0208	-0.0726	0.0518	-0.0031	0.0051	-1.1538***	0.3315
u_{ih}^{X}	0.0376**	0.0150	-0.0625	0.0396	-0.0038	0.0033	-0.8762***	0.2499
u_{ih}^{p-own}	0.0574***	0.0190	-0.0583	0.0783	0.0014	0.0023	-1.9378***	0.4760
$u_{ih}^{p-cross}$	-0.0873***	0.0322	0.1236***	0.0476	0.0037	0.0045	2.5927***	0.5976
Sigma	0.0742***	0.0123	0.1883***	0.0093	0.0181***	0.0014	0.5833***	0.0515
Observations	752		742		763		763	
Left-censored (y<=0)	312		41		252		628	
Uncensored	440		689		511		130	
Right-censored (y=1)	0		12		0		5	
Wald chi2(14)	33.89***		377.86***		61.19***		45.66***	
Log likelihood	366.1145		102.5341		1160.004		-314.9386	

Pseudo R^2	-0.2087	4.5324	-0.0303631	0.0842

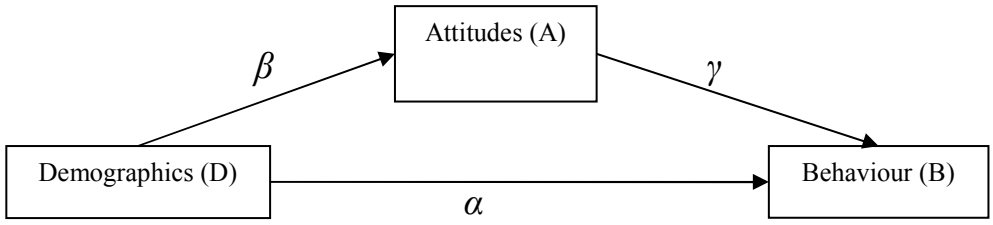
Significance is as follows: * = 0.1; ** = 0.05; *** = 0.01. S.E. refers to Bootstrapped Standard Errors (1,000 replications). Note: F&V = Fruit and Vegetables; IAT = Implicit Association Test; EC = Environmental Concern; GCA = Green Consumer Action; SFP = Sustainable Food Preference.

Figure 1: Scatter diagram plots of IAT and explicit attitude Bartlett factors



Note: Factors refer to Bartlett factors.

Figure 2: Path Analysis of Demographics and Consumer Behaviour



APPENDIX

Table A1: Consumer categorisation of a list of food products as high or low carbon

		High carbon	Don't know	Low carbon
Fruit and vegetables	**Apples**	7%	10%	83%
	Asparagus	69%	10%	21%
	Beans	40%	29%	31%
	Blueberries	74%	7%	19%
	Chopped tomatoes	50%	21%	29%
	Fair trade bananas	67%	5%	29%
	Fair trade oranges	48%	19%	33%
	Frozen raspberries	26%	31%	43%
	Innocent smoothie	48%	7%	45%
	Lemons	45%	14%	40%
	Lettuce	5%	5%	90%
	Mushrooms	21%	5%	74%
	Organic blueberries	26%	14%	60%
	Parsnips	14%	5%	81%
	Peas	31%	12%	57%
	Pineapple	57%	0%	43%
	Soya	36%	33%	31%
	Strawberries	17%	7%	76%
	Tomatoes	21%	7%	71%
	Tropicana juice	52%	29%	19%
Meat	**British beef steak**	48%	7%	45%
	Chicken breast fillets	33%	17%	50%
	New Zealand lamb	88%	7%	5%
	Organic beef mince	45%	7%	48%
	Organic chicken	36%	10%	55%
	Turkey breast slice	40%	14%	45%
	Turkey drummers	43%	10%	48%
Water	**Evian**	74%	7%	19%
	One water	48%	14%	38%

Note: responses are based on 42 participants.