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Talking green and acting green are two different things:
An experimental investigation of the relationship between implicit and explicit attitudes and low carbon consumer choice.

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Abstract:

One major assumption in the climate change debate is that because respondents report positive attitudes to the environment and to low carbon lifestyles that they will subsequently engage in environmentally friendly/low carbon behaviours given the right guidance or information. Many governmental agencies have based their climate change strategy on this basic assumption, despite some anxiety about the value-action gap in psychology more generally. Here we test this assumption. We investigated the relationship between explicit and implicit attitudes to carbon footprint, and both self-reports of environmental behaviour and low carbon behavioural choices. We found that self-reported attitudes to carbon footprint were significantly associated only with *self-reported* environmental and *self-reported* low-carbon behaviours. They were not significantly associated with the choice of low carbon alternatives in a

simulated shopping task. Given that the vast majority of studies on attitudes and behaviour in the environmental domain use self-report measures of behaviour, this may mean that we are generating research findings that may be making policy makers overly complacent about our readiness for actual behaviour change. Implicit attitudes were not significantly associated with either measure in terms of group comparisons, but those with a strong positive implicit attitude towards low carbon did choose more low carbon items, but only under time pressure. The opposite trend was found for explicit attitudes – this increased only when participants were not under time pressure. These results suggest that Kahneman's hypothesis about contrasting systems of human cognition might be highly relevant to the domain of climate change and behavioural adaptation.

Key words: implicit attitudes, explicit attitudes, low carbon consumer choice, carbon footprint, brand.

Introduction

The evidence is now clear that our climate is changing - according to the IPCC (2015), global warming is 'unequivocal' and 'unprecedented'. More people are witnessing the devastating effects of climate change first-hand, with increased adverse weather conditions such as frequent flooding, stronger hurricanes, longer heatwaves, more tsunamis and periods of drought (IPCC, 2015; UK Climate Change Risk Assessment, 2016). The World Health Organisation

(WHO) warns that with temperatures rising and the increase in rainfall we need to be prepared for more illnesses resulting from climate change, including mosquito borne infections like malaria, dengue and the Zika virus. The WHO report that 'Climate change already claims tens of thousands of lives a year from diseases, heat and extreme weather', and they say it is 'the greatest threat to global health in the 21st century.' Indeed, the World Economic Forum identified climate change as *the* top global risk facing humanity, a greater risk than weapons of mass destruction and severe water shortages (Global Risk Report, 2016).

Human beings are the most significant contributor to climate change through energy use, population growth, land use and patterns of consumption (IPCC, 2015). Currently, CO_2 emissions from human activity are at their highest ever level and continue to rise. Global CO_2 emissions in 2011 were reported as being '150 times higher than they were in 1850' (World Resource Institute, 2014, see also IPCC 2015). Although we cannot undo the damage already done with regards to climate change (Clark et al., 2016; Sadler-Smith, 2015; Sunstein, 2015) we do have the power to adapt our behaviour to ameliorate any future effects (Hayles and Dean, 2015).

There have been a number of government policies to encourage the reduction of CO_2 emissions in both domestic households and in the workplace with a target of an 80% reduction by 2050 (see GOV.UK, 2015; DECC, 2016; DEFRA, 2016). There have also been campaigns from a variety of

organisations aimed at promoting awareness, and encouraging a more sustainable lifestyle, amongst the general public. These campaigns have used a variety of media, including television commercials (Act on CO_2), magazine advertisements (sponsored by the WWF) and social media (The Climate Coalition). But with groceries accounting for, on average, one third of household CO_2 emissions (Sharp and Wheeler, 2013; Moser, 2015; Fisher et al., 2013) it is important to assist consumers to identify low carbon alternatives in everyday purchases. Carbon labelling, the practice of communicating the greenhouse gas emissions associated with the life cycle of a product or service, was one major initiative designed to help in this regard. Consumers are informed of the environmental impact of the products through a simple labelling scheme, thus enabling them to reduce the CO_2 emissions of their household by making simple and relatively small changes to their lifestyle.

In 2006, the Carbon Trust introduced the 'Carbon Reduction' label scheme to show that the carbon emissions of a particular product had been measured and that the manufacturers using these labels were committed to reducing carbon emissions. These labels were used on many food items in the U.K. including Kingsmill Bread, Walkers Crisps and Quaker Oats and also on domestic appliances such as Dyson cleaners. The Carbon Trust explicitly stated that 'It is consumption activity and consumer behaviour that drives carbon emissions on a wider scale. In order to meet the long-term emission reduction

targets it will be necessary to change cultural patterns of consumption and the way in which products and services are produced for the final consumer' (Vision 21, 2008). These labels are assessed every two years and if the manufacturers of these products do not successfully reduce the carbon footprint of the item, then they no longer have the right to use the label. The carbon reduction label has also been used internationally. Aldi was the first retailer in Australia to introduce a Carbon Reduction label on their 'Everyday Olive Oil' range. The labels also became popular in Japan, Korea and France and are now used in over 26 countries worldwide (Carbon Trust, 2011).

In 2007, the Carbon Trust teamed up with the multinational retailer 'Tesco' and developed the 'Carbon Measured' label. The Carbon Measured label provided consumers with an accurate measure of CO_2 emissions of the lifecycle of selected products, thus enabling consumers to make more informed choices in terms of exact environmental impact (see Figure 1).

Figure 1: An example of a carbon footprint label used on a bottle of Tesco non-biological washing liquid.

Tesco began measuring the carbon footprint of a number of its own store-branded products, including orange juice, detergent, toilet roll and energy saving lightbulbs with the intention to include carbon labels on all of its 70,000 own brand products within a few years. The then CEO of Tesco, Sir Terry Leahy, stated that we needed a mass movement in green consumption and pledged that Tesco would be 'a leader in helping to create a low-carbon economy.' Leahy was optimistic about the possible impact of carbon labelling, saying that this could be the start of 'a green revolution'. On the basis of existing market research, which had measured consumer attitudes to consumption and climate change, he was confident that the public were ready for this green revolution and willing to adapt their behaviour accordingly 'with the right information'. The background market research on consumer attitude seemed unambiguous. According to an IPSOS MORI poll 78% of people

reported that they would change their behaviour to help reduce climate change (Downing and Ballantyne, 2007). Forum for the Future reported that 85% of people *reported* that they wanted more information about the associated environmental impacts of their purchases (Berry et al., 2008). Leahy concluded from this that 'Customers want to do more in the fight against climate change if only we can make it easier and more affordable'. This view was shared with the Department for Environment, Food and Rural Affairs (DEFRA) in the U.K. who asserted that 'Many people are willing to do more to limit their environmental impact, they have a much lower level of understanding about what they can do and what would make a difference' (2008: 28).

But not all researchers were so optimistic. Upham et al. (2011) used focus groups to gain more insight into consumers' understanding of carbon labels. They found that that there was little understanding of the values on the carbon labels. Some consumers wanted a recommended daily allowance for carbon (Upham et al., 2011; Beattie, 2012a). Gadema and Oglethorpe (2011) asked 428 participants if they thought that it would be an advantage to have carbon footprint information labels on products. Whilst 72% of respondents reported that the labels would be useful, 81% of respondents found that such labels were difficult to understand and that the comparison of carbon footprint values across the various products was confusing. Participants in this particular study ranked carbon footprint information 13th on the list of important attributes

of a product (out of a total of 14). Hartikainen et al. (2014) found that, although 90% of their respondents reported that a carbon label would influence their purchasing decisions, price and taste would be a priority before they even considered the carbon footprint information.

But it was not just that consumers did not understand carbon labels or prioritise the information, it was found that consumers paid little visual attention to them. Beattie et al. (2010) found that in an experimental setting where participants viewed images of products the carbon label was the focus of the first visual fixation of participants in only 7% of cases suggesting that the carbon label was not of immediate concern to most participants (Beattie, 2012a). They also found that participants showed little visual attention overall to the carbon label in the first five seconds which is a critical finding considering that this is close to the average time taken to make a selection in a supermarket (Louw and Kimber 2007, Young, 2004).

But there is another potentially even more serious issue here. The assumption guiding government agencies (including DEFRA) and multi-nationals like Tesco are that self-report measures of attitudes are good predictors of actual consumer *behaviour*. There does *appear* to be a significant relationship between attitudes and behaviour in the sustainable consumption domain. Schlegelmilch et al. reported that 'attitudes are the most consistent predictor of pro-environmental purchasing behaviour' (1996: 51). Honkanene

et al. reported ‘a significant relation between attitude and intention to consume organic food’ (2006: 426). Dahm et al. reported that ‘attitudes were significant predictors of consumption behaviors and practices…Positive attitudes toward organic foods and other environmentally friendly practices significantly predicted similar behaviors’ (2009: 195). Barber et al. reported ‘a strong and significant relationship between attitude and willingness to purchase environmentally friendly wine’ (2009: 69). But none of these studies examined actual behaviour, rather the focus was on self-reports of behaviour, reported intentions, or willingness to consume environmentally friendly products. Baumeister et al. have commented that although psychology may call itself the science of *behaviour* ‘some psychological sub-disciplines have never directly studied behaviour’ (2007: 396). They also noted that ‘a remarkable amount of ‘behaviour’ turns out to be really just marks on a self-report questionnaire. Sometimes these questionnaires ask people to report what they have done, will do, or would do. More often, they ask people to report what they think, how they feel, or why they do what they do.’ (2007: 397). When it comes to issues regarding the environment and climate change, any such responses may well be overshadowed by social desirability and reporting biases.

The relationship between actual environmental behaviour and self-reports of such behaviour is often problematic. For example, Tsakiridou et al. (2008) explored the relationship between attitudes and behaviours towards organic

products. They found that 50% of participants *reported* that they preferred to buy organic products but this was contradicted by actual consumption data, in that only a small proportion of those who expressed a positive attitude towards organic products actually purchased organic products. Corral-Verdugo (1997) randomly selected 100 families in Mexico who were required to report the amount of glass, aluminium, newspapers, etc. they reused and recycled. These reports of behaviour were then compared with direct observations of reuse or recycled items of the household. The researchers found that 'beliefs (assessed verbally) only predicted the self-reported conservation, while competencies (assessed nonverbally) were only related to observed behavior' (1997: 135). Similarity, Fielding et al. (2016) measured self-reported household recycling, self-reported water conservation behaviour as well as actual recycling and actual water use. Their results showed a 'weak relationship between self-reported household recycling and objective measure of recycling.' They also found a 'weak relationship between self-reported water conservation behaviour and objective household water use' (2016: 90). Kormos and Gifford (2014) performed a meta-analysis of the validity of self-report measures of pro-environmental behaviour and concluded that 'self-reports are only weakly associated with actual behaviour' (2014: 360). They identified some of the factors responsible for this weak relationship including the fact that self-report measures may be 'prone to exaggeration' and that because self-report measures are 'subjective by nature; descriptors such as "*Often*," may mean different

things to different participants' (2014: 360). In addition to this, self-reports of behaviour may 'reflect individuals' perceptions of their behaviour (Olson, 1981), behavioural intentions (Lee, 1993), or other – sometimes false – beliefs and attitudes (Rathje, 1989), rather than objective behaviour.' (2014: 360). They also say that 'limited memory or knowledge may also reduce the accuracy of self-reports (e.g. see Warriner, McDougal and Claxon, 1984)' (2014: 360).

One alternative approach to this issue of the potentially weak relationship between self-report measures of attitudes and actual behaviour, is to measure 'implicit' attitudes, where reporting biases may not be so prevalent. These implicit attitudes are underlying evaluations, which appear to be fast and automatic (Kahneman, 2011), often operating below the level of conscious awareness (Beattie, 2010; Greenwald and Banaji, 1995; Wilson et al., 2000). Greenwald et al. (1998) have defined implicit attitudes as 'actions or judgments that are under the control of automatically activated evaluation, without the performer's awareness of that causation' (1998: 1464). Research has shown that in *some* domains implicit attitudes (measured using the Implicit Association Test, or IAT) and self-reported attitudes show little or no correlation. This seems to be the case in the environmental domain (Beattie, 2010: Beattie and Sale, 2009, 2011; Brunel et al., 2004; Friese et al., 2006; Hofmann et al., 2005), and other 'sensitive' domains like race (Beattie, 2012b; Beattie et al., 2013). The IAT has been acknowledged as a reliable and valid measure of implicit

attitudes towards given target concepts with a test-retest reliability of .60 (Greenwald et al., 2002) and a consistency measure with a Cronbach's alpha > 0.80 (see Friese et al., 2006; but see Blanton et al., 2009). The basic premise behind the IAT is that when categorising items into two sets of paired concepts, if the paired concepts are strongly associated, then participants should be able to categorise the items faster into these sets (and with fewer errors) than if they are not strongly associated.

A number of studies have examined whether implicit attitudes predict 'behaviour' in the environmental domain. But again there has been a bias here in using self-reports of behaviour rather than actual behaviour and again with potentially misleading conclusions (see Friese et al., 2006; Levine and Strube, 2012). Perhaps typical is Vantomme et al., (2006) who reported that 'the IAT effects for buyers and non-buyers of fair trade products were significantly different' and also that 'the logistic regression analysis demonstrated that IAT effects partially predicted ethical consumer behaviour even when the influence of the explicit measure was controlled for' (2006: 702). But the experimenters (again) did not analyse actual consumer choice, they based their conclusions on people reporting their behaviour.

However, a few studies in the environmental domain have measured implicit attitudes and *actual* behaviour, although the behaviour in questions is often not about consumer choice but visual attention (Beattie and McGuire,

2012, 2015), or somewhat incidental like the choice of a goody bag at the end of the study (Beattie and Sale, 2009, 2011), or the choice of a plastic carrier bag (Geng et al., 2015). Geng et al. (2015), for example, measured students' connectedness to nature using a 14 item 'Connectedness to Nature' Scale (CNS) – an explicit measure designed to measure participants' emotional and cognitive connectedness to nature, and implicit attitudes to nature using an IAT. They also asked participants to complete a 'College Students' Environmental Behaviours Questionnaire' which required students to *report* their behaviours to seven different domains including energy conservation, waste avoidance, recycling and purchasing behaviour. Participants also completed a simulation task whereby they chose four packs of wafers at the end of the task. Each participant was then asked if they needed a free plastic bag. Geng et al. (2015) found that reported CNS measures correlated with reported environmental behaviours and implicit measures correlated with spontaneous environmental behaviours. However, 'spontaneous environmental behaviours' was solely based on those who chose or did not choose a carrier bag at the end of the study. Similarly, Beattie and Sale (2011) reported that only implicit attitude, under time pressure, predicted behavioural choice in their study, but the behavioural choice in question was merely the selection of a low carbon goody bag as a reward for taking part.

Given the importance of consumer behaviour to climate change, we clearly need to understand more fully the relationship between both self-reported and implicit attitudes of consumers to environmental features of products such as carbon footprint, and their self-reports of behaviour versus actual behavioural choices. Given the emphasis in both governmental and commercial circles on carbon labelling, it is important to evaluate the potential effectiveness of this scheme in guiding behavioural choice.

The aim of the present study is thus to investigate experimentally the relationships between explicit and implicit attitudes to carbon footprint, reported environmental and carbon behaviour, and actual product choice in an experimental setting. By studying consumer choice in an experimental situation, we are able to carefully control for a range of variables that could affect the selection of certain everyday products, including brand, price and carbon footprint in a simulated 'shopping' task. We can also consider the impact of variables such as time pressure on product selection. Following Kahneman (2011) and Beattie (2010) one prediction might be that positive implicit attitudes to low carbon should be more closely associated with low carbon behaviour but only under time pressure as responses become more automatic.

Method

Participants

There were fifty participants (19 males, 31 female) ranging in age from 18 to 67. With a moderate effect size of 0.40, an N of 50 gives a power analysis of 0.803. Each participant received £5.00 for taking part in the experiment. Ethical approval was obtained from Edge Hill Department of Psychology Research Ethics Committee (DREC).

Self-reported environmental behaviour questionnaire

Participants were asked to complete a 30 item self-report sustainability behaviour questionnaire - 10 items measuring reported pro-environmental behaviour (e.g. 'I avoid using toxic detergents', 'I avoid using aerosols' and 'I buy organic products'), 20 items measuring carbon efficient behaviour (e.g. 'I buy high efficiency lightbulbs', 'I buy locally produced foods', and 'I turn the heat off in unused rooms'). Participants reported their behaviour on a 5-point scale of 1 = 'never' to 5 = 'always.

Attitude measures

Explicit (self-report) measure

Likert scale

A Likert scale was used to assess explicit preference towards high/low carbon footprint products (see Greenwald et al., 2003; Beattie, 2010). Participants reported their attitudes on a 5-point scale (from 1 = 'I strongly prefer products with a high carbon footprint to a low carbon footprint' to 5 = 'I strongly prefer products with a low carbon footprint to a high carbon footprint').

Implicit measure

IAT

There were two target categories (low/high carbon footprint) and two attribute categories (good/bad) displayed in the top right/left side of the screen. Exemplars of low carbon items (e.g. bicycle, local apples, energy saving lightbulb etc.) and high carbon items (e.g. luxury car, standard lightbulb, bottled water etc.) appeared in the middle of the screen. Participants had to sort the exemplars into their respective categories using the key 'Z' for the category on the left side and 'M' for the category on the right. There were seven blocks in total - blocks 3, 4, 6 and 7 were the critical trials - participants who associate low carbon footprint products with 'good' and high carbon footprint products with 'bad' should respond faster on trials where the pairs are good/low carbon

footprint and bad/high carbon footprint and slower on trials where the pairs are good/high carbon footprint and bad/low carbon footprint. The IAT measures differences in speed of response (with a penalty for errors) and yields a difference or 'D' score (Greenwald et al. 2003).

Simulated shopping task

Stimuli

There were 10 items in total: breakfast cereal, bread, cheese, coffee, fabric conditioner, ice cream, orange juice, soup, toilet roll, and washing up liquid (see also Beattie & McGuire, 2016). The images were modified photographs of actual products. Each product had 4 variations – luxury brand (the most expensive), organic/Eco brand, well-known brand (e.g. Heinz, Hovis, Kellogg's), and value brand (the cheapest and usually the supermarket's own brand). The price and the carbon footprint of the item were superimposed onto the front of the image. The price of the product was always the actual price (always highest for 'luxury' and then 'organic/Eco', followed by 'well-known brand' then 'value'). Prices were represented in white numbers on a black circular sticker and was always placed in the same position on the four individual items within the set, but this varied from set to set. The carbon footprint was colour coded in green (low carbon) and black (high carbon). The carbon footprint value was represented in white numbers which were clearly

visible on the representative footprint. See figure 2. In order to assign a carbon footprint value to the products we started with the actual carbon footprint value of the particular product (e.g. Branflakes = 80g). For scoring purposes we regarded this as 'H' and placed it on a black footprint to represent a high carbon footprint value. This figure was then halved to generate a lower carbon footprint (in this case 40g). For scoring purposes we regarded this as 'L' and placed the carbon value on a green footprint to represent low carbon footprint. We then subtracted 10% from this value and regarded this as 'LL' (representing the lowest carbon footprint value and placed it on a green footprint representing low carbon footprint). Finally, 10% was added to the starting carbon footprint value and was regarded this as 'HH' and placed it on a black footprint to represent the highest carbon footprint value of this particular product set. The carbon footprint was assigned to products using the following criteria: each product had two high and two low carbon footprint labels, and each brand had five high and five low carbon labels. Once the price and carbon footprint was attached to each product the images were then placed on a white background and laminated thus creating a series of flash cards.

Figure 2: An example of the 'Heinz Classic Cream of Tomato Soup' with a price sticker at the bottom right corner and a low carbon footprint in the top left corner (from Beattie and McGuire, 2016).

Procedure

Participants were asked to complete a self-report questionnaire about their carbon and environmental behaviours. They also completed the computerised Likert scale, the carbon IAT and participated in a simulated shopping task. The experimenter laid out forty laminated flash cards in ten rows, with each row having 4 alternatives. Each participant was asked to choose ten items (one from each row) under one of two conditions – time pressure and no time pressure. After each condition was complete, there was a two-minute break whilst the experimenter reset the cards. There were 20 choices per participant. The order of the time pressure/no time pressure conditions was randomised. When participants were in the time pressure condition they were told to imagine that they were in a 'real hurry' and were told to choose an item as quickly as they could, whereas under no time pressure they were told that they had as much

time as they needed to make the selection of an item. The average time spent choosing a product under time pressure was 2.7 seconds (with a range from 1.2 to 5.5 seconds) as opposed to 7.3 seconds (range from 2.0 to 27.8 seconds) under no time pressure. The time spent choosing under time pressure was significantly shorter (Wilcoxon Matched-Pairs Signed-Ranks Test, T=0, n=49, $p<0.001$, 2-tailed test).

Results

Self-reported attitudes and self-reported behaviours.

There were 3 categories of self-reported behaviour: reported carbon behaviour (20 items), reported environmental behaviour (10 items), and all reported sustainable behaviours (both categories together) with 30 items. A scale was produced for each of these categories by multiplying frequency of response by 'value' (where 'always'=5, 'often'=4, 'sometimes'=3, 'rarely'=2 and 'never' =1). For each participant, the score in each of these 3 categories could range between 20 and 100 for reported carbon behaviour, 10 and 50 for reported environmental behaviour and 30 and 150 for all reported sustainable behaviour. The actual ranges for each of these 3 categories were: 40 to 94 (carbon), 10 to 45 (environmental) and 50 to 136 (all sustainable behaviours). The overall mean for the Likert score was 3.6, which represents a slight explicit preference for low carbon. We dichotomised the data as follows: 4 =

('moderately prefer low carbon') or 5 ('strongly prefer low carbon') were categorised as having a positive explicit attitude towards low carbon (PEA), n=30. 1, 2, 3 on the Likert were categorised as non-positive towards low carbon, in effect either neutral or preferring high carbon (NPEA), n=20. We did it this way in order to create two groups of more similar size (Ns of 30 for PEA and 20 for NPEA). A focus on just a Likert score of 5 would have produced a comparison of 10 and 40 participants. We compared the reported behaviour in each of the 3 categories with participants falling within the PEA or NPEA groups using a series of t tests. The analyses revealed that in each case the results were significant at the two-tailed level. For reported carbon behaviour: $t=2.16$ ($n_1=30$, $n_2=20$), $p<0.05$ (effect size $r = 0.30$; Cohen's $d = 0.62$). For reported environmental behaviour: $t=2.53$ ($n_1=30$, $n_2=20$), $p<0.02$ (effect size $r = 0.34$; Cohen's $d = 0.71$). For all reported sustainable behaviours: $t=2.49$ ($n_1=30$, $n_2=20$), $p<0.02$ (effect size $r = 0.34$; Cohen's $d = 0.73$). The means are displayed in Table 1. In other words, there is a significant relationship between self-reported attitudes and self-reported behaviours, and this is found not just with respect to the category of carbon behaviours, but seems to apply to other environmental behaviours and therefore sustainable behaviours more generally.

Table 1: Relationship between self-reported attitude to carbon footprint and self-reported carbon/environmental/sustainable behaviour (mean scores reported; high scores indicate more reported sustainable choices).

	Carbon behaviour	Environmental behaviour	Sustainable behaviour
Positive explicit attitude towards low carbon	70.37	30.27	100.64
Non-positive explicit attitude towards low carbon	62.10	24.95	87.05

Self-reported attitudes and actual choice behaviour.

In terms of behavioural choice, we tabulated for each participant the number and nature of the carbon choices they actually made. We then multiplied the frequency of choice by the carbon value of the particular product with choice of an LL product scoring 4, choice of an L product scoring 3, choice of an H product scoring 2 and choice of an HH product scoring 1. This generated a score between 10 and 40 for each participant (as there were 10 choices), for each of the 2 conditions (time pressure and no time pressure). We compared the actual choice behaviour of our PEA and NPEA groups using a two factor ANOVA (with factor 1: explicit attitude, high or low, and factor 2: time pressure). The ANOVA revealed that there was no significant main effect for explicit attitude to low carbon on carbon choice behaviour ($F=3.31$, $df=1$, n.s.), no significant effect for time pressure ($F=0.67$, $df=1$, n.s.) and no

significant interaction effect between explicit attitude and time pressure (F=0.96, df=1, n.s.). The means are displayed in Table 2 below.

Table 2: Relationship between self-reported attitude to carbon footprint and actual carbon behaviour, with or without time pressure (mean scores; high scores indicate more low carbon choices).

	No time pressure	Time pressure	Overall mean
Positive explicit attitude towards low carbon	27.23	26.17	26.70
Non-positive explicit attitude towards low carbon	25.35	25.60	25.48
Overall mean	26.48	25.94	26.21

Of course, there could be an argument that because carbon footprint was colour coded with green covering both L and LL, and black for H and HH, that this may have minimised the effects of the variation within each of the two categories (H versus HH, for example). Therefore, we also analysed the data in terms of frequency of low (L or LL) versus high (H or HH) carbon choices when under time pressure versus no time pressure (see Tables 3 and 4). It is worth noting that there were more low carbon choices overall than high carbon choices. There was also a tendency for people with a positive explicit attitude towards low carbon to select more low carbon items when not under time pressure. However, this fails to reach significance ($X^2 = 3.71$, df=1, n.s.).

Table 3: Relationship between self-reported attitude to carbon footprint and number of low carbon and high carbon choices (no time pressure).

	Number of low carbon choices	Number of high carbon choices
Positive explicit attitude towards low carbon	185	115
Non-positive explicit attitude towards low carbon	106	94

The next analysis (Table 4) focused on behavioural choice under time pressure. Here we found that those with a positive explicit attitude to low carbon were again more likely to choose low carbon products under time pressure, but again this result was not significant (X^2=0.05, df=1, n.s.).

Table 4: Relationship between self-reported attitude to carbon footprint and number of low carbon and high carbon choices (time pressure).

	Number of low carbon choices	Number of high carbon choices
Positive explicit attitude towards low carbon	168	132
Non-positive explicit attitude towards low carbon	110	90

In summary, self-reported attitudes to low carbon might be significantly associated with self-reported carbon/environmental/sustainable behaviour but it was not significantly associated with low carbon choices in our experimental paradigm.

Implicit attitude and self-reported behaviours

Implicit attitudes were dichotomised with a strong positive implicit attitude towards low carbon operationalised as a D score of 0.8 and above (SPIA), n=26; and a weaker implicit attitude as anything less than 0.8 (WIA), n=24, which in terms of number are broadly comparable to the explicit categorisation. The behavioural self-report measures were dichotomised as before. The mean D score in our sample was 0.99, which represents a strong pro-low carbon preference (for the particular set of high and low carbon items represented in our IAT). We compared the reported frequency of behaviour in each of the 3 categories (reported carbon behaviour, reported environmental behaviour, and reported sustainable behaviour) with participants falling within the SPIA or WIA groups using a series of t tests. The analyses revealed that in each case the results were not significant at the two-tailed level. For reported carbon behaviour: $t=1.21$ ($n_1=26$, $n_2=24$), n.s. For reported environmental behaviour: $t=0.31$ ($n_1=26$, $n_2=24$), n.s. For all reported sustainable behaviours: $t=0.95$ ($n_1=26$, $n_2=24$), n.s.). The means are displayed in Table 5. In other

words, there does not appear to be a significant relationship between implicit attitudes and self-reported carbon/environmental/sustainable behaviours.

Table 5: Relationship between self-reported carbon/environmental/sustainable behaviours and implicit attitude to carbon footprint (mean scores).

	Carbon behaviour	Environmental behaviour	Sustainable behaviour
Strong positive implicit attitude towards low carbon	69.31	28.46	97.77
Weaker implicit attitude towards low carbon	64.62	27.79	92.42

Implicit attitudes and actual choice behaviour.

We then compared the actual choice behaviour of our SPIA and WIA groups using a two factor ANOVA (factor 1: implicit attitude, high or low; factor 2: time pressure). The ANOVA revealed that there was no significant main effect for implicit attitude to carbon footprint on carbon choice ($F=2.46$, $df=1$, n.s.), no significant effect for time pressure ($F=0.66$, $df=1$, n.s.) and no significant interaction effect between implicit attitude and time pressure ($F=0.03$, $df=1$, n.s.). The means are displayed in Table 6 below.

Table 6: Relationship between implicit attitude to carbon footprint and actual carbon behaviour, with or without time pressure (mean scores).

	No time pressure	Time pressure	Overall mean
Strong positive implicit attitude towards low carbon	26.92	26.50	26.71
Weaker implicit attitude towards low carbon	26.00	25.33	25.67
Overall mean	26.48	25.94	26.21

Again, we analysed the data in terms of frequency of low (L or LL) versus high (H or HH) carbon choices in our two conditions (TP versus no TP). See Tables 7 and 8. There was a tendency for people with a positive implicit attitude towards low carbon to select more low carbon items, however, this fails to reach significance either not under time pressure (X^2 = 0.96, df=1, n.s.), or under time pressure (X^2=0.24, df=1, n.s.) when compared in this way.

A further consideration of the patterns in the relationship between explicit/implicit attitude to carbon and actual carbon behavioural choice.

Despite the non-significant effects in the 2x2 chi square tests when those with a positive explicit attitude were compared with those with a non-positive attitude, and when those with a strong positive implicit attitude to low carbon were compared with those with a weaker implicit attitude, there is clearly

something interesting in the underlying pattern of the data. In the case of choice *under no time pressure* for *explicit* attitude (see Table 3), those with a positive explicit attitude to low carbon (4 or 5 on the Likert scale) were 60.9% more likely to choose low carbon items than high carbon items, compared with 23.4% more for those with a non-positive attitude to low carbon (1, 2 or 3 on the Likert scale). The observed frequency for the PEA group was significantly different from the expected frequency under chance (X^2 (1) = 8.28, $p < 0.002$, two tailed). This was not significant for those with a non-positive explicit attitude (NPEA group) to low carbon (X^2 (1) = 0.36, n.s., two tailed). When there was time pressure (see Table 4), both groups varied much less in terms of an increase in number of low carbon choices expressed as a percentage over high carbon choices (rises of 27.3% and 22.2% respectively), and neither observed frequency was significantly different from chance. For the PEA group - (X^2 (1) = 2.15, n.s., two tailed); for the NPEA group (X^2 (1) = 1.00, n.s., two tailed).

In the case of choice under time pressure for *implicit* attitude (see Table 8), those with a strong positive implicit attitude to low carbon (a D score of 0.8 or higher on the IAT) were 36.4% more likely to choose low carbon items than high carbon items, compared with only 14.3% more for those with a weaker implicit attitude to low carbon (less than 0.8 in terms of D score). When there was no time pressure (see Table 7), the percentages were 45.3% and 33.0% respectively.

It is important to recall that there was an overall tendency to select more low carbon items generally in this consumer choice task. When there *was no time pressure* the figures were 291 low carbon choices versus 209 high carbon choices (in other words, 58.2% of the overall choices were low carbon; 41.8% were high carbon, representing an average rise of 39.2% from high carbon to low carbon choices). See Table 7. When there was *time pressure*, the figures were 278 versus 222 (in other words, 55.6% and 44.4% of the overall choices respectively, representing an average rise of 25.2% from high carbon to low carbon choices). See Table 8.

So what stands out from these figures is the 60.9% rise in percentage of low carbon choices (from the high carbon choice baseline) for those with a positive *explicit* attitude towards low carbon when *not under time pressure* and the 36.4% rise in percentage of low carbon choices for those with a strong positive *implicit* attitude towards low carbon when *under time pressure*. The relationship between implicit attitude and low carbon choice under no time pressure might also look interesting at first sight with the 45.3% rise (see Table 7), but it is clear that both groups in this table, irrespective of the nature or strength of the implicit attitude towards low carbon, reflect a major shift upwards.

If you statistically compare the observed frequency of the group with the strong pro-low carbon implicit attitude under time pressure the observed frequency does differ significantly from chance (X^2 (1) = 6.16, $p < 0.02$, two

tailed), but this is not the case for those with a weaker implicit attitude (X^2 (1) = 1.06, n.s.). When there is no time pressure, *both groups* (strong and weaker implicit attitude) show a significant deviation from the expected frequency under chance (X^2 (1) = 8.86, $p < 0.01$, two tailed; X^2 (1) = 4.82, $p < 0.05$, two tailed), and therefore the nature of the attitude, as measured, does not discriminate behavioural choice. See also Beattie and McGuire (2016).

In other words, when participants/consumers are under time pressure (as they are in many everyday consumer situations) those with a strong implicit attitude to low carbon are more likely to choose low carbon items when considering observed frequency versus expected frequency for that group. Those with a positive explicit attitude to low carbon seem more likely to choose low carbon items *when not under time pressure* using again the comparison with expected frequency, hinting at the difference in operation of two systems of human cognition – the fast and automatic implicit system (system 1) and the slower, more reflective and deliberative explicit system (system 2) (see Beattie, 2017; Kahneman, 2011).

Table 7: Relationship between implicit attitude to carbon footprint and number of low and high carbon choices (no time pressure).

	Number of low carbon choices	Number of high carbon choices
Strong positive implicit attitude towards low carbon	154	106
Weaker implicit attitude towards low carbon	137	103

Table 8: Relationship between implicit attitude to carbon footprint and number of low and high carbon choices (time pressure).

	Number of low carbon choices	Number of high carbon choices
Strong positive implicit attitude towards low carbon	150	110
Weaker implicit attitude towards low carbon	128	112

Finally, Figures 3 a and b display the relationship between explicit and implicit scores and mean carbon choices. There have been arguments in the literature that when explicit and implicit attitudes are both positive towards an object, then together they have more predictive power (Maison et al., 2004). Although the mean low carbon score is highest when explicit and implicit attitudes are both positive and lowest when implicit and explicit attitudes are

both non-positive, none of the specific comparisons were significant when t-tests were applied.

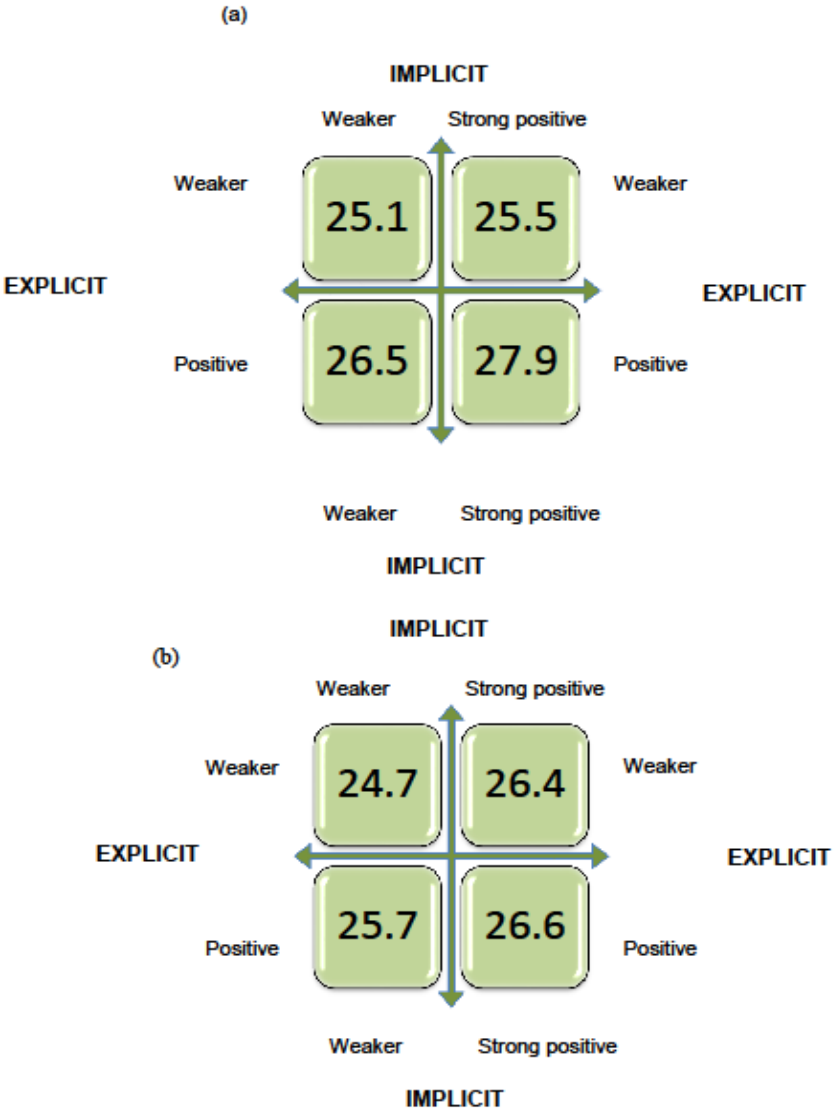

Figure 3: Overall means for actual carbon behaviour varying with explicit and implicit attitude under no time pressure (a), and under time pressure (b).

Discussion

This study has demonstrated that self-reported attitudes to carbon are significantly associated with self-reported carbon behaviours (e.g. 'I buy high efficiency lightbulbs'), self-reported environmental behaviours (e.g. 'I avoid using toxic detergents') as well as the generic category of sustainable behaviours (the two categories combined). This finding is in line with much of the published literature on this topic (Barber et al., 2009; Corral-Verdugo, 1997; Honkanene et al., 2006; Schlegelmilch et al., 1996). There are many government agencies and NGO's who would see this, and have seen similar data in the past, as very optimistic results in the battle against climate change. Indeed, those researchers who have successfully modified (exclusively) self-reported cognitions with persuasive messages, including film, have drawn equally optimistic conclusions. The present researchers, unfortunately, are no exception (see, for example, Beattie et al., 2011; Beattie 2011). But, following the exhortations of Baumeister et al. (2007) and others this study attempted to move beyond self-reports of carbon behaviour to consider the carbon value of consumer choice in a simulated shopping task. Here it was found that positive pro-low carbon self-reported attitudes were not reliably associated with the actual choice of low carbon alternatives in the shopping task under either condition (time pressure or no time pressure). This contrast between self-reported environmental behaviour and actual behaviour is unfortunately

consonant with previous research. Corral-Verdugo (1997) found that 'beliefs (assessed verbally) only predicted the self-reported conservation, while competencies (assessed nonverbally) were only related to observed behavior' (1997: 135). Fielding et al. (2016) reported a 'weak, relationship between self-reported household recycling and objective measure of recycling' (2016: 90). Our findings are also in line with the conclusions of the meta-analysis of Kormos and Gifford (2014) which were that 'self-reports are only weakly associated with actual behaviour' (2014: 360).

There was an interesting trend in the present study in terms of the pattern of results with an increase in the proportion of low carbon choices for those with positive explicit attitudes to low carbon but only when not under time pressure. But this was only a trend marked by a significant change from expected frequency but not significant in terms of a between-groups comparison. Of course, one might also want to consider here which of these sorts of carbon choices in everyday life are not made under time pressure. It has been argued in the past by many consumer psychologists that a high proportion of everyday choices with carbon implications are made quickly and under considerable time pressure. This is especially true for supermarket shopping (see Beattie, 2010).

The problem that we are faced with is that climate change requires urgent action not mere self-reports of action. Given that the vast majority of studies in

the attitude-behaviour environmental domain (and elsewhere) use self-report measures of behaviour, this may mean that we are generating research findings that may be making policy makers, both in government and elsewhere, overly optimistic (and perhaps even complacent) about our readiness for actual behaviour change (and our ability to predict it). This study may give us all pause to reflect on this.

Our study also found the implicit attitudes to low carbon, measured using the Implicit Association Test, were not significantly associated with either self-reports of behaviour or actual low carbon choices either under time pressure, or not, when we use a between-groups comparison, comparing those with a strong pro-low carbon implicit attitude and those with a weaker pro-low implicit attitude. Although, what is interesting here is that there was a tendency for those with a strong pro-low carbon implicit attitude to choose a higher proportion of low carbon items in a way not found with those with a weaker implicit attitude, *but only under time pressure*.

These trends in our data with explicit attitudes seemingly having more of an effect on behaviour when the participant is not under time pressure, and implicit attitudes more of an effect when the participant is under time pressure, might again suggest that Kahneman's (2011) description of two systems of human cognition, with one system being fast, automatic and non-reflective, and the other being slower, more deliberative and more available to conscious

reflection might be indeed plausible. But, of course, these were just interesting trends, representing a deviation from expected frequency under chance, and clearly these results need to be examined preferably in larger data sets.

It is also perhaps worth remembering that the colour-coded carbon labels in this study were competing with a whole series of other product features such as brand and price, as would happen in any supermarket. These other features were very significant in guiding the choice of our experimental participants. Our more detailed analyses (see Beattie and McGuire, 2016) revealed, for example, that well-known brands were chosen 38.0% of the time, followed by value brands (32.4%) then organic/Eco brands at 17.0% of the time and finally luxury brands at 12.6% of the time. We know that these other factors – brand, price, luxury, value will be exerting very powerful implicit pressures on individuals and it might be worth remembering that implicit attitudes to low carbon might not have been sufficiently powerful to override the others powerful implicit forces attracting us to these other features of products (Friese et al., 2006; see also McGuire and Beattie, 2016).

In is also interesting that we did find that the choice of the low carbon alternatives (green carbon footprint) were more frequent than the choice of the high carbon alternatives (black carbon footprint). This might be an important result for those concerned with representing carbon footprint on products. In the U.K. there has been a good deal of misunderstanding about how to interpret

carbon labels when numerical values were used to represent the carbon footprint (Upham et al., 2011). Perhaps other approaches, including colour coding with more thought about the essential iconicity of the image and perhaps some understanding of the importance of iconic images for quick and effortless processing in everyday communication and cognition (Beattie, 2003; 2016; Beattie and Sale, 2012; Beattie and Shovelton, 1999a, b; Beattie and Shovelton, 2006) should have been tried first before many started to abandon this particular project. Colour-coded carbon labels might actually have a role to play in guiding consumer behaviour.

This study is clearly in need of further elaboration and extension. We used an experimental approach to investigate consumer choice to give us more control over features that might influence this, including brand, carbon label, colour coding of carbon footprint, price etc. There is nevertheless the opportunity to extend this research on implicit and explicit attitudes to carbon footprint to consider real consumer behaviour rather than simulated behaviour. Panzone et al. (2016) used 900 panel members of the Dunhumby Shopper Thoughts Panel from the Tesco consumer data base, and the Tesco Club Card data (which record all purchases at Tesco), to examine people's actual shopping preferences. They considered the relationship between such shopping habits and measures of both implicit and explicit attitudes. They found that the sustainability IAT score did not significantly predict the sustainability of the

food baskets, although it did predict the share of expenditure allocated to bottled water – those with a positive implicit attitude to sustainability bought less. Their measures of explicit attitude also produced mixed results. Measure of 'Green Consumer Attitude' and 'Sustainable Food Preference' 'did not predict aggregate consumer behaviour' (Panzone et al., 2016: 15). Panzone et al.'s finding that implicit attitude did significantly predict the consumption of bottled water suggests that there may be predictive value of implicit attitudes with regards to product choice. Bottled water was one of the images included in their IAT, so it suggests that the selection of items in the IAT is a critical one for behavioural prediction. It may be very naïve to assume that a sample of images in the IAT will predict *any* sample of behaviours (because the images in the IAT essentially construct the concept of 'high' and 'low' carbon for the participants). So a degree of stimulus and behaviour specificity (and mapping) may need to be carefully thought out in future.

In conclusion, climate change is the most pressing global problem we face, and psychology and semiotics have a major role to play in trying to understand the drivers behind consumer behaviour, given that the consumer is a very significant instrumental factor in climate change. But if we are to do anything significant about climate change then we have to follow the recommendations of Baumeister and study behaviour and behavioural choice per se rather than just questionnaire responses about intentions to act,

willingness to act, or reports of past behaviour. Questionnaire responses might be easier to obtain but they can encourage false (and overly) optimistic conclusions about how we can predict actual consumer choice, and therefore how things might change in the future. There are clearly new research possibilities for a focus on carbon attitudes and actual consumer carbon behaviour in this digital age (using supermarket data sets). We just need the impetus to change our focus and begin some new lines of enquiry if we are to shed any light on this most pressing of issues. This study offered some tantalising glimpses of how we might proceed in this regard.

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