Title: What Do Carbon Labels Signal? The Role of Biospheric Values on Perceptions of 'Green' Food Consumers

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Abstract

Costly signalling theory suggests that individuals might be more likely to consume sustainable food products if doing so signals an underlying prosocial value to others. However, it is unclear whether prosocial signals are equally interpreted by others. We study whether consumers of carbon-labelled (vs. non carbon-labelled) products are perceived more positively and if observers' biospheric values and product prices influence such perceptions. An experimental study ($N = 229$) assessed participants' perceptions of consumers of carbon and non-carbon labelled food products described as being either cheaper or more-expensive-than-average. Results indicated that consumers of carbon-labelled products were perceived more positively and that such perceptions were accentuated when observers strongly endorsed biospheric values. Further, positive perceptions of consumers occurred regardless of a product's price, although effects were strongest amongst observers with high biospheric value endorsement when products were cheap and carbon-labelled. Implications for carbon labelling initiatives and food marketing more generally are discussed.

Keywords: costly signaling theory; carbon-labels; food products; sustainable consumption; sustainable food marketing

1. Introduction

The food industry currently accounts for more than a quarter of the world's greenhouse gas (GHG) emissions (IPCC, 2019; Poore & Nemecek, 2018), with some estimates suggesting that the figure might even be over a third (Crippa et al., 2021). The farm stage of food production emits 61% of the food chain's emissions (81% when deforestation is also included; Poore & Nemecek, 2018), and distribution contributes around 30% (a figure that is expected to grow considerably as globalisation increases; Crippa et al., 2021). Food-based emissions are growing rapidly, becoming increasingly energy-intensive in both industrialised and economically developing countries (IPCC, 2019). The intensity of GHG emissions varies significantly between food products in terms of production, packaging, and transportation impacts (Crippa et al., 2021). Rethinking and transforming production methods towards a more sustainable food system will thus be an important step in the mitigation of climate change effects (Bajželj et al., 2014).

Whilst food producers should focus on reducing their environmental impacts, changes in consumer behaviour could help to drive change in production systems (Poore & Nemecek, 2018). The potential to curb food-related emissions by targeting individual behaviours is especially notable in industrialised societies such as North America and Europe, where consumption of high-emission foods (e.g., animal-based foods) is largest (Scarborough et al., 2014). In fact, changing diets has been described as one of the most impactful behaviour changes an individual can make (alongside having fewer children, avoiding air travel, and living without a car; Wynes & Nicholas, 2018). Moreover, the Intergovernmental Panel on Climate Change (IPCC) produced a special report in 2019 identifying dietary shift as a major opportunity to substantially cut back on GHG emissions (IPCC, 2019; Schiermeir, 2019).

Despite the need for a widespread shift in individual food consumption, research has shown that people rarely consider dietary choices when faced with questions about what they

can do for the environment (Joyce et al., 2008), and generally underestimate the environmental impact of their food (Macdiarmid et al., 2016; Truelove & Parks, 2012). Although recent times have seen increased trends towards more sustainable diets such as veganism (Wright, 2020), research suggests that a widespread lack of awareness of the environmental impacts caused by dietary choices remains a significant obstacle to reduction in food-related GHG emissions (Camilleri et al., 2019). These findings highlight the importance of increasing public awareness of the environmental impacts of food choices in order to encourage widespread changes in individual food consumption. The question, however, is how an increase in public awareness and shift towards more sustainable eating can be achieved. In the present work we explore one possible solution: harnessing the communicative value of purchases of 'eco' labelled food products.

The current paper is structured as follows: First, we present a theoretical framework that highlights the potential benefits of purchases of 'eco' labelled food products as signals of prosociality, and how such signals might be interpreted differently based on what observers find personally important. Secondly, we introduce and describe an online experiment designed to test these ideas, that is, whether purchasers of 'eco' labelled food products are indeed perceived more positively than purchasers of conventional food products, and whether such perceptions vary depending on what observers care for. Finally, we present the results of the study and discuss their theoretical and practical implications for 'eco' labelling initiatives and food marketing more generally.

Encouraging Sustainable Food Consumption: The Potential of Carbon Labelling

One potential approach to raising consumer awareness of the environmental impacts of food, thus encouraging a transition to more sustainable food consumption, is through the addition of 'eco' labelling on food products (Cohen & Vandenbergh, 2012; Onozaka et al., 2015). Many different types of environmental or ecological labels currently exist,

communicating environmental impacts such as water use, resource efficiency, biodegradability, and farming methods (Hallez et al., 2021). While labels have the potential to convey a variety of environmental impacts, the current research explores the possible value of carbon labels as a simple and effective way to inform consumers of the carbon emissions of a product (Cohen & Vandenbergh, 2012; Vandenbergh et al., 2011).

Carbon labels vary from simply stating a commitment to reducing GHG emissions, displaying a traffic light system specifying different levels of GHG emissions caused by producing a product, or providing a specific numerical estimate of carbon dioxide equivalent per kilogram from production to purchase ('cradle to gate') or to use and disposal ('cradle to grave') (Camilleri et al., 2019; Liu et al., 2016). Most carbon labels tend to display a product's 'carbon footprint', which is the total amount of GHG emissions caused both directly and indirectly by the product, taking into account every stage of its lifecycle (Carbon Trust, 2012). By communicating representative environmental impacts of food products, carbon labels could motivate individuals to avoid high-impact options and consequently incentivise food producers to reduce emissions (Camilleri et al., 2019; Vandenbergh et al., 2011). Indeed, some research has already indicated that carbon labels can successfully increase knowledge regarding the emissions of more environmentally harmful foods, and subsequently can help to shift choices to more sustainable food options (Camilleri et al., 2019; Hallez et al., 2021).

Many food companies already utilise carbon labels (e.g., Swedish-based oat milk brand Oatly and UK-based vegetarian brand Quorn), and research suggests that widespread carbon labelling would be accepted by the general public (Carbon Trust, 2020). Indeed, one experimental study (Vanclay et al., 2011) tested the effects of implementing carbon footprint labels on six different types of food products in an Australian supermarket, either described as having below, near, or above average carbon footprints. While there was considerable

variation due to product cost, products labelled as having above average carbon footprints lost 6% of sales, whilst products described as having below average carbon footprints experienced a 4% increase in sales, which grew to a 20% increase for cheaper products. These findings indicate that not only would carbon labels effectively convey the environmental impacts of foods but would notably decrease sales in less sustainable food options. That being said, the reasons why consumers might choose to purchase carbon-labelled food products is an outstanding question that needs to be addressed in order to gain insight to the circumstances under which carbon labels might be most effective at encouraging sustainable food consumption. Thus, a more thorough understanding of the motives underlying food consumption choices would be beneficial for informing and promoting future carbon labelling initiatives.

Motives Underlying Sustainable Food Consumption

Environmental behaviour usually involves a conflict between individual interests such as comfort, convenience, and pleasure, and collective interests of environmental sustainability (Steg, 2015); for example, eating meat and dairy might be considerably more convenient than eating a plant-based diet, though the cost to the environment in terms of greenhouse gas emissions is considerably higher for an omnivore (Scarborough et al., 2014). Indeed, pro-environmental behaviour has been argued to represent a social dilemma in which the problem of climate change can only be addressed if individuals support collective interests rather than short-term, self-oriented interests (Naderi & Strutton, 2015).

To date, the most dominant approach to addressing this social dilemma has been the environmental concern perspective, which aims to promote pro-environmental behaviour by highlighting its ecological benefits (e.g., Bamberg, 2003; Thøgersen, 2010). Research findings do indicate that when individuals hold values – that is, relatively stable, object-unspecific, and chronically-activated general goals (Hitlin & Piliavin, 2004; Schwartz &

Bilsky, 1987) – that prioritise the environment and nature (referred to as biospheric values; Schwartz, 1992), they are more motivated to consume sustainably (Steg, 2015). However, this implies that developing policies or campaigns which emphasise the environmental benefits of sustainable consumption might only be effective for those who are already environmentally conscious and driven by pro-environmental motives (Bolderdijk et al., 2013; Steg & De Groot, 2012).

Although most people tend to generally endorse biospheric values relatively strongly (Bouman & Steg, 2019; European Social Survey, 2016), it is likely that there is variability in levels of environmental concern, with some people caring about the environment to a lesser degree, or even some caring mostly when certain contextual conditions are met (e.g., living in a wealthy country; Franzen & Vogl, 2013). Some research, for instance, has indicated that whether or not biospheric value endorsement translates to pro-environmental behaviour may depend on contextual characteristics (e.g., Ling & Xu, 2020) or on cultural factors (e.g., Milfont et al., 2006). Moreover, even among people who care about the environment, it is likely that such level of environmental concern varies throughout their lives. Indeed, longitudinal data suggests that there can be substantial changes in value orientations over time, subsequently leading to changes in attitudes and beliefs regarding climate action (Ignell et al., 2019). Furthermore, when behaviours are deemed costly enough (e.g., financially costly, time-demanding, or requiring substantial effort), even individuals who strongly endorse biospheric values might refrain, perhaps opting for an alternative, less sustainable, behaviour (Steg et al., 2014). These findings suggest that to encourage more widespread sustainable consumption, we need to target motives other than environmental concern in order to successfully promote more sustainable food options to a wider audience, thus also targeting those who care about the environment to a lesser degree.

Motivating Non-Environmentalists: Communicative Functions of Sustainable Food

If appealing to biospheric values does not encourage the consumption of more sustainable food products to everyone equally, a critical question is how to motivate those with lower levels of environmental concern. One way to motivate such individuals to engage in sustainable food consumption is through promoting the personal benefits that 'green' consumption can incur, and thus appealing to self-interest motives. Whereas some previous research suggests that egoistic, self-interested orientations are negatively related to pro-environmental behaviour and sustainable consumption (e.g., Steg & De Groot, 2012), sustainable consumption choices have in fact also been found to follow from a variety of non-environmental concerns, such as a desire for financial gain, comfort, or pleasure (Lindenberg & Steg, 2007; Steg, 2015). The Inclusion Model of Environmental Concern (IMEC) outlines how both environmental concern and self-interest motives can lead to sustainable behaviour (De Dominicis et al., 2017). Specifically, the IMEC states that individuals with higher levels of self-concern are more likely to engage in sustainable behaviour when self-enhancing motives have been made salient. Indeed, some research has highlighted the importance of utilising self-interest motives in encouraging sustainable consumer choices (e.g., Griskevicius, Tybur, & Van den Burgh, 2010). In some cases, self-oriented motives for sustainable consumption, such as how 'green' purchases can symbolise a positive self-image, might even be more effective at encouraging such behaviour compared to other motives (Noppers et al., 2014).

Costly signalling theory, a framework originally developed in the field of biological ethology, posits that organisms develop costly traits to signal qualities that are not directly observable in order to attract mates and/or to increase social ranking (Zahavi, 1975, Zahavi & Zahavi, 1977). Applying the theory to humans, people may therefore engage in behaviours that incur personal costs (e.g., financial, time, effort), but are beneficial to the collective interest, as a way to send a communicative signal to others about their underlying qualities or

resources (Miller, 2000, 2010). As previously mentioned, pro-environmental behaviour can be considered as 'costly' to an individual because it involves refraining from taking advantage of environmental resources and from engaging in 'easier' or 'more convenient' activities which are environmentally harmful (Barclay & Barker, 2020). Environmentally-friendly products may also have other costs, often being perceived as more expensive and poorer quality than less sustainable alternatives (Naderi & Strutton, 2015). Thus, giving up less sustainable products, which may be (or at least perceived as) more convenient, cheaper, and more enjoyable can be considered a 'sacrifice' (Ottman et al., 2006), especially to those who care less about the environment. Due to a willingness to undergo this personal cost, some studies drawing on costly signalling theory have therefore explained one motive for purchasing sustainable products to be a way to signal social status to others (e.g., Puska et al., 2016).

In support of this, experimental data suggests that people are more likely to display pro-environmental behaviour when they are being observed by other people, both in laboratory settings (e.g., Griskevicius et al., 2010) and in field experiment settings (Kraft-Todd et al., 2015). For example, one study found that participants were more likely to donate to an environmental charity when they were being observed by others, and especially so when they were 'competing' to be chosen as a partner by an observer (Barclay & Barker, 2020). The possible communicative function of sustainable consumption behaviour might therefore explain why, for example, sales of more obviously hybrid cars are higher compared to hybrid cars which look more like conventional vehicles (Sexton & Sexton, 2014), or why installations of home solar panels increase as the density of other, nearby home solar panels also increases (Bollinger & Gillingham, 2012). The desire to gain social benefit from consuming more sustainably may thus encourage those with lower levels of environmental

concern to ‘keep up’ with the behaviour of environmentalists in order to reap some social reward for themselves (Palomo-Vélez & Van Vugt, 2021).

Whilst many studies argue that pro-environmental behaviour can be explained by a desire for signalling social status to others, much of this research has often centred its focus on the financial cost of products (e.g., Griskevicius et al., 2010). However, it has also been posited that sustainable consumption should be considered a specific case of *prosocial* signalling (i.e. showing cooperativeness and concern for others) rather than *social status* signalling (Berger, 2017, 2019). By relying on wealth displays (e.g., driving an expensive car, wearing ‘luxury’ clothing), behaviours commonly considered to signal social status may actually result in a perception that the signaller is not trustworthy (Berger, 2017, 2019). In contrast, signalling a willingness to undergo a personal cost to produce a benefit for the ‘greater good’ (i.e., the environment) by consuming food more sustainably (e.g., choosing to cut back on meat-based foods), implies an underlying prosocial value (Whitfield, 2011). Hence, it is possible that people who are less environmentally concerned could be persuaded to engage in sustainable food consumption, specifically purchasing food products labelled as having low carbon footprints, in order to signal their prosociality to others.

Social Benefits of Prosocial Signalling

In order for the signalling of prosociality to be considered a functional explanation for sustainable food consumption, individuals must experience some social benefit from their behaviour being observed by others (Barclay & Barker, 2020). Indeed, research suggests that people who successfully signal prosociality have been found to be perceived as more moral (Olson et al., 2016), trustworthy (Barclay, 2004), altruistic and honest (Luomala et al., 2019), and as a result more often chosen as allies (Gintis, Smith, & Bowles, 2001). For example, in one social dilemma experiment (Vesely et al., 2019), it was found that individuals who acted in an environmentally friendly way were perceived as more cooperative and were more often

chosen as partners. Individuals signalling prosociality are also generally perceived to be better long-term romantic partners (Borau et al., 2020) and less willing to engage in uncommitted sexual relationships (Palomo-Vélez et al., 2021), perhaps due to being perceived as more competent and intelligent (DiDonato & Jakubiak, 2016). Sustainable consumption behaviour therefore has signalling value that could result in numerous social benefits and preferable social treatment (Luomala et al., 2019).

Taken together, these findings suggest that those who might only weakly endorse biospheric values or have only low-to-moderate levels of environmental concern, could become motivated to consume in a more sustainable way if they believe that they might as a result be perceived by others as a prosocial individual. More specifically, by purchasing food products with carbon labels, people could be trying to signal their prosociality to observers to reap the social benefits discussed above.

Are Signals of Prosociality Always Perceived in the Same Way?

The assumption that signalling sustainable consumption behaviour will yield social benefits requires that observers perceive the behaviour to be prosocial. However, it could be possible that specific characteristics of observers might influence the interpretation of and thus the eventual consequences of the signalling behaviour; more specifically, whether the behaviour results in the previously discussed social benefits or instead leads to disadvantages due to misinterpretation of the behaviour (e.g., purchasing a food item which could be considered ‘luxurious’ resulting in being seen as a selfish rather than prosocial). Indeed, it has been previously argued that observer characteristics might influence the extent to which the social meanings of signals are fully, partially, or not at all transferred (Luomala, et al., 2019). Thus, considering the important role that an audience may play in an actor’s signalling behaviour, calls have been made for research to be conducted exploring how such characteristics might influence signal interpretations (Berger, 2017; Brick & Sherman, 2021;

Griskevicius et al., 2010). One study found that perceptions of others were moderated by certain characteristics of the observers (i.e., socioeconomic background), with people wearing 'green-labelled' clothing being perceived as less prosocial and less trustworthy by those of a lower socioeconomic background (Berger, 2017).

Further, research has indicated that individual differences in people's values can influence our evaluations of others (Puska, 2018; Schwartz, 1992, 2006). It has been widely documented that people have a tendency to judge others from the viewpoint of their in-group, preferring others who express similar values to themselves (Schwartz & Struch, 1989; Wright et al., 2013). One study explored through an online survey whether participants' self-reported values influenced how prosocial they perceived regular consumers of organic and non-organic food products (Puska, 2018). Results suggested that people who more strongly endorsed ethical values perceived the consumers of organic food products more positively, specifically by perceiving them to be more prosocial. Some aspects of organic food that are considered to be prosocial, namely animal welfare and environmental benefits, are more likely to be preferred by people who endorse values involving concern for other people and the environment (Aertsens et al., 2009). Further research has supported these findings, indicating that stronger perceptions of prosociality from some audiences may indeed also lead to more preferable social treatment (Luomala et al., 2019).

These previous findings highlight the importance of observers' individual differences on the interplay between consumer and observer; if an observer of the purchase behaviour finds the person to be more prosocial as a result of their personal values, the subsequent benefits resulting from this could lead to a reinforcing effect whereby the consumer engages in this kind of sustainable consumption behaviour more often in the future. While organic food represents specific prosocial characteristics as described above, food which is labelled as having a low- or zero-carbon footprint may also represent environmental benefits and

purchasing these kinds of food products could be seen as equally prosocial. To the authors' knowledge, however, no previous work has explored the role of values on how consumers of carbon-labelled food products are perceived.

The Current Research

This research aims to explore the potential of carbon labels as prosociality signals, and whether observers' characteristics influence how such signals are interpreted. Regarding observers' characteristics, research has highlighted the importance of biospheric values on sustainable consumption, with strong endorsement being more predictive (Steg et al., 2014; Steg & De Groot, 2012). The proposition that carbon labels can signal prosociality to others relies on the assumption that observers value the environment, so it follows that those with stronger biospheric value endorsement might interpret sustainable consumption behaviour as more prosocial. This study therefore considers whether the extent to which one endorses biospheric values influences one's perceptions of consumers of carbon-labelled food products (detailing a low carbon footprint). In other words, this study aims to investigate to what extent does one's biospheric value endorsement predict perceptions of consumers of carbon-labelled food products? Specifically, based on relevant consumer perceptions which have been identified in previous literature (Barclay, 2004; DiDonato & Jakubiak, 2016; Luomala et al., 2019; Olson et al., 2016; Puska, 2018), here we ask people how prosocial, moral, trustworthy, and intelligent they perceive consumers of carbon-labelled food products to be. We hypothesize that consumers of carbon-labelled food products, relative to consumers of non-labelled food products, will be perceived more positively, and that this effect will be greater when observers more strongly endorse biospheric values.

Moreover, as previously mentioned, whether or not the signalling behaviour also symbolises wealth may additionally influence interpretations of the behaviour. Some previous research suggests that a higher financial cost attributed to the signalling behaviour

results in a perception of low trustworthiness from an observer (Berger, 2017, 2019). In other research, however, the benefits achieved from prosocial signalling (i.e., being considered as more moral, trustworthy, intelligent) have been found to occur regardless of financial cost (Kohlová & Urban, 2020). As such, as an exploratory endeavour, the current research also examines the possible role that the financial cost of a food product might have on subsequent perceptions of its consumer, by considering whether price further moderates the hypothesised interaction between label type and biospheric values.

2. Method

Participants

Assuming an effect size for the interaction between biospheric values and perceptions of $f = 0.28$ (based on Puska, 2018) and a power of 90%, it was calculated that at least 138 participants were needed. A minimum of 160 participants was aimed for in order to account for incomplete responses. Participants were recruited both through a convenience sample via social networks and through the SONA system (a cloud-based research and participant management software) of a Dutch University, where first year psychology students receive course credits for partaking in research. After combining both participants recruited through social networks and through SONA, the final sample size was $N = 229$.[1] Participants' ages varied from 18 to 85 years old ($M = 28.87$ years, $SD = 13.00$), and 59.8% of identifying as female, 33.2% as male, and 1.7% as non-binary/third gender (5.3% did not report their sex). Most participants reported residing in Europe (81.7%), followed by North America (6.6%), Asia (6.1%), and Africa and Oceania (both 0.4%; 4.8% did not report their country of residence). The data for this study is available publicly available here: 10.17605/OSF.IO/PHAFB.

Design and Procedure

The current study employed a mixed 2 (Product price: higher-than-average vs. lower-than-average –between subjects) x 2 (Label: carbon-label vs. no carbon label –within-subjects) design and included biospheric values as a continuous predictor. First, participants were presented with information about the study, and invited to participate in an investigation about the 'public appeal of different food products on the market'. Once participants confirmed that they consented to partake in the research, they were firstly asked to complete a values measure. Next, participants were introduced to a distraction task, designed to mask the intent of the study and to distract participants from the connection between their values and the final section of the study. The distraction task asked participants to identify and select the areas of images of food magazines which appealed to them the most; this was chosen as a task because it was relevant to the described goal of the research being food marketing.

After completing the distraction task, participants were told that they would be shown images of different food products and instructed participants to imagine that they were out shopping and observed someone purchasing the products that would be presented. The participants were asked to look at each product closely before responding to questions. Following this, all 14 images of the seven food products (shown both with and without a carbon label) were presented in a random order to participants, with the food products shown either being described as 'cheaper than the average cost' for that type of product ($N = 105$), or as 'more expensive than the average cost' for that type of product ($N = 124$). Whether or not participants were in the lower-than-average or higher-than-average product price condition was completely random. For each food image, participants were asked to rate the extent to which they perceived the imagined consumer of that food product as moral, trustworthy, prosocial, intelligent, healthy, wealthy, outgoing, and family-oriented. These perceptions were also presented in a random order. Once participants had responded to all of the questions for each food product image, some demographic questions were presented (i.e.,

sex, age, highest level of completed education and current country of residence). Following this, participants were debriefed and thanked for participating in the study.

Materials and Measures

Images of Carbon-Labelled Food Products

Images of seven different food products were selected (see Appendix A for images provided to participants). Images were of real food products (from UK supermarket chain Sainsbury's) which people could come across on a normal shopping trip. Food images were of a high visual quality and shown on a large enough scale to ensure that participants could clearly read the label text. Basic, every-day food products were chosen, with similar, simple branding. Each food product image was duplicated with the addition of a carbon label (see Appendix A), adapted from the labels produced by Carbon Trust (Carbon Trust, n.d.), which produces many different types of carbon labels for food and material products. The label used on the food product images stated that the product carbon footprint was '3 times lower than the market standard'. This wording replicates that used by Carbon Trust, and obviously identifies a 'lower' carbon footprint, making it clear that the labelled product has lower environmental impact than the average for that product. Every label applied to the food products used the '3 times lower' comparison; this was to ensure standardisation of the perception of environmental friendliness of the labelled products. Each food product was presented to participants both with and without a carbon label.

Values

The extent to which participants endorsed biospheric values was measured using a shortened version of Schwartz's values scale developed by De Groot and Steg (2008), which has been validated in previous research (e.g., Van der Werff & Lurvink, 2014). Although the present study was only interested in the degree of biospheric value endorsement, all four values in the scale (biospheric, hedonic, altruistic, and egoistic) were provided to participants

to mask the fact that only information pertaining to biospheric values was desired. The biospheric values scale showed good internal consistency (α = .91), however the scales for the other values showed a somewhat lower but still adequate internal consistency (egoistic values α = .67, altruistic values α = .74, and hedonic values α = .65). The scale presents 16 values (e.g., "respecting the earth", "unity with nature") and ask participants to rate the extent to which each are important 'as guiding principles in their life' on a nine-point scale (-1 = *opposed to my principles,* 0 = *not important at all,* to 7 = *of supreme importance*).

Perceptions of Consumers

Perceptions of consumers, namely prosociality, trustworthiness, morality, and intelligence, were presented as single-items (e.g., To what extent do you think that a person buying this product is prosocial?; 1 = *not at all, 5 =extremely*) for each of the 14 food images (seven foods shown both with and without carbon labels). All four perceptions showed high internal consistency (prosociality α = .91, morality α = .91, trustworthiness α = .93, and intelligence α = .91). In addition to these four perceptions, participants were also asked to rate the extent to which they believed the purchaser of the shown food product was healthy, wealthy, family-oriented, and outgoing. This was done in order to mask the intent of the study.

3. Results

Analytic Approach

To assess whether participants perceived consumers of carbon-labelled food products more positively than consumers of non-labelled food products, and whether participants' biospheric values moderated this effect, a linear mixed model approach was adopted. For each of the four separate linear mixed models (one for each of the consumer perceptions: prosociality, trustworthiness, morality, and intelligence), perception scores were regressed on biospheric values (centred), label type (carbon-labelled vs. no label), product cost (lower than

average vs. higher than average), and on the possible interactions between these factors.[2] All models were fitted by restricted maximum likelihood (REML) using the Mixed Model function of the GAMLj package (Gallucci, 2019) for JAMOVI (The Jamovi Project, 2021). Random intercepts for participants and products were included as random terms in the model to control for the possibility of the different food products themselves resulting in differences in consumer perceptions. A summary of random intercept variances of each model is presented in Appendix C.

Perceptions of Carbon-Labelled Food Product Consumers

Perceived Prosociality

It was predicted that consumers of carbon-labelled food products would be perceived more positively than consumers of non-labelled food products, and that this effect would be stronger when observers more strongly endorsed biospheric values. Indeed, results showed a main effect indicating that consumers of carbon-labelled food products were rated as more prosocial than consumers of non-labelled ones, $F(1, 2858) = 122.94$, $p < .001$. Moreover, as predicted, this main effect was further qualified by an interaction with biospheric values, $F(1, 2857) = 5.10$, $p = .024$. Simple effects tests revealed that, among people with stronger biospheric values (+1 *SD* above the mean; here and during the following perceptions), consumers of carbon-labelled food products were viewed as more prosocial than those of non-labelled food products, $\beta = .32$, $t(2857) = 9.44$, $p < .001$. Among people with weaker biospheric values (-1 *SD* below the mean; here and during the following perceptions), however, this effect also emerged, with consumers of carbon-labelled food products being rated as more prosocial than those of non-labelled food products $\beta = .21$, $t(2859) = 6.24$, $p < .001$. In other words, the prosocial perception associated with the carbon label appeared among both those with strong and weak biospheric values, although the effect was stronger among the former (see Figure 1).

[Figure 1 near here].

Perceived Trustworthiness

Results for trustworthiness showed a similar pattern as seen with perceptions of prosociality. Indeed, results again showed a main effect of the carbon label, $F(1,2858) = 73.20$, $p < .001$, which was further qualified by an interaction with observers' biospheric values, $F(1, 2858) = 5.31$, $p = .021$. However, this time, the two-way interaction between the carbon label and biospheric values was further moderated by product price, $F(1, 2858) = 3.92$, $p = .048$. This three-way interaction was broken down to test how the carbon label and observers' biospheric values influenced trustworthiness ratings when product price was described as either lower-than-the-average or higher-than-the average. This way, simple effects tests showed that when the prices of the food products were described as lower-than-average, observers with strong biospheric values rated consumers of carbon-labelled food products as more trustworthy than those of non-labelled food products, $\beta = .26$, $t(2857) = 6.10$, $p < .001$. Among observers with weak biospheric values though, ratings of consumers of carbon-labelled food products and non-labelled food products did not significantly differ, $\beta = .08$, $t(2858) = 1.93$, $p = .053$. However, when food product prices were described as higher-than-average, the positive influence of strong biospheric values tended to disappear. Indeed, among both observers with weak, $\beta = .018$, $t(2860) = 4.28$, $p < .001$, and strong, $\beta = .19$, $t(2857) = 4.75$, $p < .001$ biospheric values, consumers who bought carbon-labelled food products were rated as more trustworthy than consumers who bought non-labelled food products (see Figure 2).

[Figure 2 near here].

Perceived Morality

Regarding perceived morality of consumers, results showed a main effect of the carbon label condition, indicating that consumers of carbon-labelled food products were

perceived as more moral than consumers of non-labelled food products, $F(1, 2859) = 344.26$, $p < .001$. Moreover, and again in line with the main prediction, this main effect was further qualified by an interaction with biospheric values, $F(1, 2858) = 6.07$, $p = .014$. No other significant interactions were observed. Simple effects tests indicated that among people who strongly endorsed biospheric values, consumers of carbon-labelled food products were perceived as more moral than those who bought non-labelled food products, $\beta = .50$, $t(2858) = 14.9$, $p < .001$. Further, similar to what was observed with prosociality perceptions, this effect also emerged among those with weak biospheric values, $\beta = .38$, $t(2860) = 11.4$, $p < .001$, but it was smaller (see Figure 3).

[Figure 3 near here].

Perceived Intelligence

Finally, results regarding perceptions of intelligence again indicated a main effect of the carbon label, with consumers of carbon-labelled food products being perceived as more intelligent than consumers of non-labelled food products, $F(1, 2857) = 70.44$, $p < .001$. Moreover, and supporting the main prediction, this main effect interacted with biospheric values, $F(1, 2856) = 10.57$, $p = .001$. Such two-way interaction, however, was further qualified by product price, $F(1, 2856) = 5.06$, $p = .025$. Thus, and following the analytical strategy used to interpret results regarding perceptions of trustworthiness, the three-way interaction was broken down to evaluate the effects of the carbon label and observers' biospheric values on intelligence perceptions, both when food products were described as lower-than-average in price and when they were described as higher-than-average in price. When food product prices were described as being lower-than-average, observers who strongly endorsed biospheric values tended to rate consumers of carbon-labelled food products as more intelligent than those who bought non-labelled food products, $\beta = .34$, $t(2856) = 7.33$, $p < .001$. This pattern also emerged among observers with weak biospheric

values, but as with previous perceptions, the effect was smaller, β=.09, t(2856) = 1.97, p =.049. However, when food product prices were described as higher-than-average, the pattern just described tends to fade. Indeed, among both observers with strong, β=.19, t(2856) = 4.27, p <.001, and weak biospheric values, β=.15, t(2859) = 3.15, p = .002, consumers of carbon-labelled food products were perceived as more intelligent than consumers of non-labelled food products, and these effects were more similar to each other than when products were described as being cheaper than average (see Figure 4).

[Figure 4 near here].

4. Discussion

Drawing from previous literature on prosocial signalling, the current research aimed to investigate whether carbon labels on food products act as a communicative signal of prosociality to others. To this end, an experimental study tested whether consumers of carbon-labelled food products were perceived by observers as more prosocial, as well as more trustworthy, moral, and intelligent, than consumers of non-labelled food products (H1). Further, the present study also measured whether observers' individual differences in biospheric values predicted the extent to which a carbon label acted as a prosocial signal to these observers (H2). Moreover, as an exploratory endeavour, the role of food product price was also assessed, in order to understand whether or not the food product being cheaper or more expensive than average influenced its signalling effect on observers. Overall, findings supported predictions, indicating that not only are consumers of carbon-labelled foods perceived more positively by all observers, but that observer characteristics can in fact influence the degree of signalling value of a carbon label, with higher biospheric value endorsement leading to more positive perceptions. Furthermore, the current study indicated that positive perceptions of carbon-labelled food consumers occur regardless of product price, but that a cheaper price strengthened some effects. Next, these findings will be discussed in

further detail, followed by their theoretical and practical implications, limitations of the current study, and directions for future research.

The Role of Carbon Labels

As predicted, observers found consumers of carbon-labelled food products to be more prosocial than consumers of non-labelled ones. Similarly, results also supported the prediction that observers would perceive consumers of carbon-labelled food products, relative to consumers of non-labelled food products, as more trustworthy, moral, and intelligent. These results together support the first hypothesis and are consistent with findings from previous research that products with positive environmental messaging and their consumers are evaluated more preferably by observers (Borin et al., 2011; Luomala et al., 2019; Puska, 2018). More specifically, the current findings indicate that carbon labels on food products can indeed signal to others underlying prosocial traits in their consumers.

The Role of Biospheric Values

The current results further supported the prediction that observers who reported higher levels of biospheric value endorsement perceived consumers of carbon-labelled foods more positively on all perceptions, compared to observers with low biospheric value endorsement (supporting the second hypothesis). Again, these results reflect previous findings indicating that observer characteristics may result in differences in the way prosocial signals are received (e.g., Puska, 2018, Luomala et al., 2019). The fact that those with higher biospheric value endorsement felt more positive about carbon label consumers may have been due to the perception that carbon labels represent compatibility with their own ecological motives (Hahnel et al., 2015). Indeed, as previously mentioned, observers might be more likely to positively judge actors when they consider them to be a member of an in-group due to expressing similar values to themselves (e.g., Wright et al., 2013).

Moreover, while the present findings contribute further support to research indicating that ecologically motivated people hold stronger preferences for sustainable consumption behaviour (Hahnel et al., 2015), it was also found that even those with lower levels of biospheric value endorsement perceived carbon-labelled food consumers more positively than non-labelled food consumers (although the effect was weaker than for those with stronger endorsement). These findings give insight to the strength of carbon labels as a signal of prosociality even to people who care about the environment less. One explanation for this finding may have been upwards social comparisons (Argo et al., 2006). More specifically, if a non-environmentalist observes another person behaving in a way which symbolises pro-environmental intention, then an upwards social comparison may occur (i.e., perceiving the other person as superior), due to prominent social norms describing pro-environmental behaviour as desirable (Luomala et al., 2019). Thus, it could be possible that observers with differing levels of endorsement of biospheric values viewed carbon-labelled food consumers positively for different reasons, with in-group compatibility playing a more significant role for those with higher biospheric value endorsement, and upwards social comparisons playing more of a role for those with lower biospheric value endorsement.

The Role of Product Price

Given conflicting findings in previous literature on the role of a product's cost on its signalling effects, the current findings can be argued to advance current understanding in this regard. In the present study, and in line with previous findings indicating that social benefits achieved from prosocial signalling occur regardless of product price (Kohlová & Urban, 2020), the price of food products was found not to influence the effect that carbon labels had on perceptions of prosociality or morality. Again, these findings reveal the strength of carbon labels as a prosocial signal; the perception that carbon label consumers were more prosocial and moral remained even when product price changed.

Interestingly, the price of the product did influence perceptions of trustworthiness. Specifically, when food products were described as cheap, observers who cared more about the environment found carbon-labelled food consumers to be significantly more trustworthy than did observers who cared less about the environment. This finding may have resulted from environmentally-minded observers having a stronger belief that consumers of cheap carbon-labelled foods are purchasing these foods due to genuine prosociality rather than as a display of status (since the products do not also convey wealth); observers with lower biospheric values may not have cared as much whether the consumer had true pro-environmental intentions. Indeed, previous findings have indicated that observer perceptions may partially depend on the belief that the consumer really does intend to behave pro-environmentally and thus puts effort into their consumer decisions (Costa et al., 2014; Uren et al., 2019). There was, however, no difference between observers with different levels of biospheric value endorsement on their trustworthiness perceptions of consumers of more expensive products. These findings contrast with previous research findings that products with higher financial costs result in lower levels of perceived trustworthiness (Berger, 2017, 2019). Instead, the current findings revealed that perceptions of trustworthiness prevailed even when products were described as more expensive (similar to Kohlová & Urban, 2020).

Furthermore, whether the food products were described as cheaper or more expensive than average also had an effect on perceptions of consumer intelligence. Similar to perceptions of trustworthiness, when food products were expensive, observers with both weak and strong biospheric values perceived carbon label consumers similarly intelligent. However, when food products were cheaper, observers with strong biospheric value endorsement found carbon label consumers significantly more intelligent than did observers with low biospheric value endorsement. Again, one possible explanation for these results may be that cheaper products which are also carbon-labelled are more likely to signal genuine pro-

environmental intention (due to an absence of wealth signalling) to environmentally-minded observers. These observers might therefore be more likely to consider these consumers as part of their in-group, and thus consider such consumers as more intelligent. Indeed, research drawing on self-verification theory (Swann, 2012) suggests that people are more likely to attribute positive characteristics to people who reaffirm their positive self-image (Zell et al., 2019). Nonetheless, the effects of carbon labels on perceptions of intelligence were present for all observers, regardless of product price, indicating again the strength of the positive effect of carbon labels.

Overall, perceptions of prosociality, morality, trustworthiness, and intelligence of carbon-labelled food consumers did not decrease as a result of different product prices. However, trustworthiness and intelligence perceptions were magnified amongst observers who were environmentally concerned when products were cheap and carbon-labelled.

Practical Implications for food marketing

The findings from the current study may have implications for practical purposes in the context of food marketing. First, due to the positive associations made with consumers of carbon-labelled food products, more food-based companies and brands could be encouraged to adopt carbon labels on their product packaging. More specifically, the prosociality signalling value of carbon labels could result in carbon-labelled food products being approached more by consumers due to what they represent, and consequently how they as consumers might symbolically present themselves to others. Indeed, it has been argued that an ‘unconscious benevolent behavioural tendency’ can be evoked from such positive perceptions of ‘green’ foods (Luomala et al., 2019), meaning that favourable opinions of products lead to their subsequent consumption. Thus, the current findings could be applied to inform and promote carbon labelling initiatives and help to increase the likelihood of more sustainable food choices being consumed.

Second, the current study's findings have implications for how non-environmentalists can be encouraged to purchase sustainable food products. Carbon labels and other 'conspicuous' signals of prosociality, such as stickers, signage in supermarkets, and other packaging design, could be utilised for the marketing of more sustainable food options. This would allow for non-environmentalists to more easily signal prosociality to others, and would thus could encourage these consumers to purchase more sustainable food items (cf. van der Wal et al., 2016). Moreover, given that in the current findings those with higher levels of biospheric value endorsement were more positively receptive of carbon-labelled food product consumers, a consideration of who the audience is might lead consumers to produce different displays of such signalling behaviour. If consumers are aware of the potential heightened receptiveness of their audience, and the possible social benefit they may receive, actors may psychologically adapt to how their displays are received by others. Specifically, they could be more persuaded to display prosocial signalling behaviour through consuming carbon-labelled foods. As such, the current findings have implications for how social interactions might reinforce sustainable consumption behaviour, and how food markets could perhaps design their environmental features not only to encourage signalling behaviour, but also in ways that appeal to those with high biospheric values.

Limitations and Directions for Future Research

The present research is not without its limitations. First, the majority of participants in the current study were female, well educated, and Western. As such, the present findings may not be fully generalisable considering that symbolic meanings of food are often shaped by the sociocultural context in which consumption occurs (e.g., Luomala et al., 2009). Future research should examine the present findings in a wider cross-cultural context, as well as across both urban and rural environments, where attitudes towards food may also differ (e.g., Puska et al., 2016).

Moreover, although the current study presented images of real day-to-day food products which reflect real-world choices (taken from UK supermarket Sainsbury's), all of the products chosen had relatively low environmental impact (to make the carbon labels more believable). Results may have differed if a wider variety of food items had been selected, representing the full spectrum of environmental impact. For example, it would be interesting in future research to assess whether the signalling effects of carbon labels persist when applied to food items generally known or believed to be environmentally harmful, such as animal-based food products, or products which require many air miles or intensive resource use (e.g., avocados, almonds). Alternatively, it is possible that differences in perceptions might occur due to a wider variability in environmentally friendliness of food products; for example, strongly environmentally-minded individuals might consider a 'low carbon' labelled meat product or heavily packaged product as 'greenwashing' (Aji & Sutikno, 2015), and thus lose trust in the label and its symbolic value. Perhaps comparisons could therefore be made between low- and high-impact foods to assess whether there are differences in the effectiveness of carbon labels.

Further, this study used an online experiment to test the effects of prosocial signalling in the context of purchasing carbon-labelled food products. While we emulated the effects of label type and price, many other factors may play a role in real supermarket settings. As such, future research could take advantage of field studies to evaluate additional potential moderating variables. For example, the level of visibility of the consumption behaviour in a real-world setting may be important. While much previous research suggests that increased visibility of behaviour increases the likelihood of pro-environmental behaviour (e.g., Barclay & Barker, 2020; Yoeli et al., 2013), other research findings have also indicated that being watched by others does not affect 'green' behaviour (Brick & Sherman, 2021). As argued by Brick and Sherman (2021), it might be possible that signalling behaviour might be more or

less prominent depending on who consumers want to signal to, and for what reasons. For example, people might be more motivated to choose more sustainable food options if they are shopping in an environment where a lot of people are present, or if they are in an environment in which many members of their community also shop. Thus, it is possible that more 'meaningful' audiences who might observe the consumer repeatedly could induce prosocial displays more often. Thus, future research administered in field settings could examine in more detail the roles which level of visibility of purchasing behaviour and the 'meaningfulness' of audiences play in prosocial signalling behaviour.

Conclusion

The current research aimed to shed light on how carbon labels can act as signals of prosociality, and how observers' level of biospheric value endorsement might influence interpretations. The findings indicate that carbon labels successfully signal prosociality, morality, trustworthiness, and intelligence to all observers, but especially to observers with higher levels of biospheric value endorsement. Moreover, findings suggest that these positive social perceptions can be achieved regardless of a product's price, although effects might be strongest amongst observers with high biospheric value endorsement when products are cheap (for perceptions of trustworthiness and intelligence) and display a carbon label. Taken together, these findings contribute novel insights to the literature on prosocial signalling and can be applied to the promotion of carbon labelling initiatives as a way to encourage widespread behaviour change in food-related consumption patterns.

Ethics Statement:

The research protocol of the present research has been approved by the Ethical Committee of Psychology at the Heymans Institute for Psychological Research of the University of Groningen (PSY-2021-S-0204).

Disclosure Statement:

We declare that none of the authors have any financial or non-financial competing interests

Footnotes

[1] A total of 178 participants were recruited through social networks and 52 through SONA, resulting in a total sample size $N = 230$. However, one response had been submitted by a participant who had already used their SONA ID to complete a previous response, and so the later response was removed.

[2] Because of way that variance is partitioned in linear mixed models, there is currently no agreement on how standardized effect sizes for individual model terms (main effects and interactions) should be calculated (Rights & Sterba, 2019). Therefore, following general recommendations for reporting effect sizes (Pek & Flora, 2018), we report the unstandardized effect sizes (i.e., unstandardized beta coefficients) for all the models.

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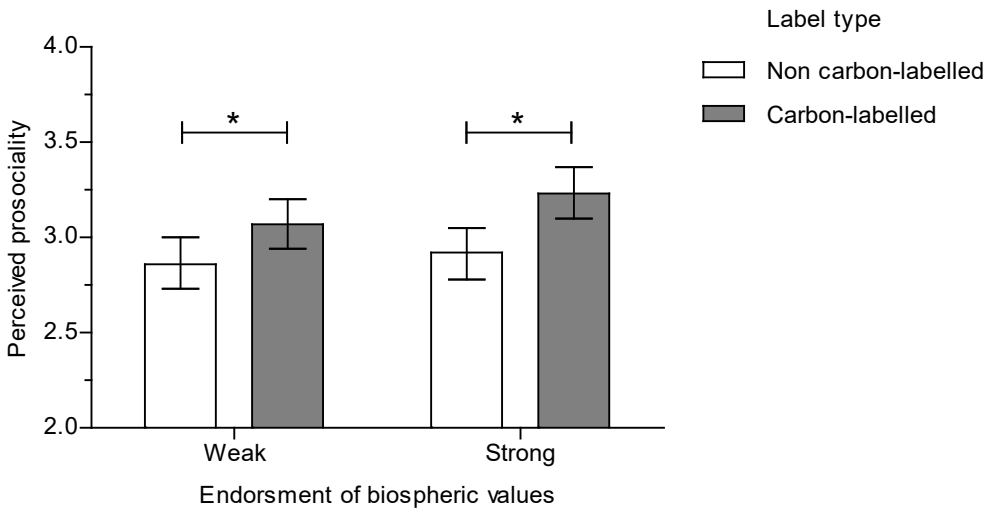


Figure 1. Means and 95% confidence interval bars for perceived prosociality depending on observers' endorsement of biospheric values and label type. * Indicates that the simple effect is significant at the $p < .05$ level.

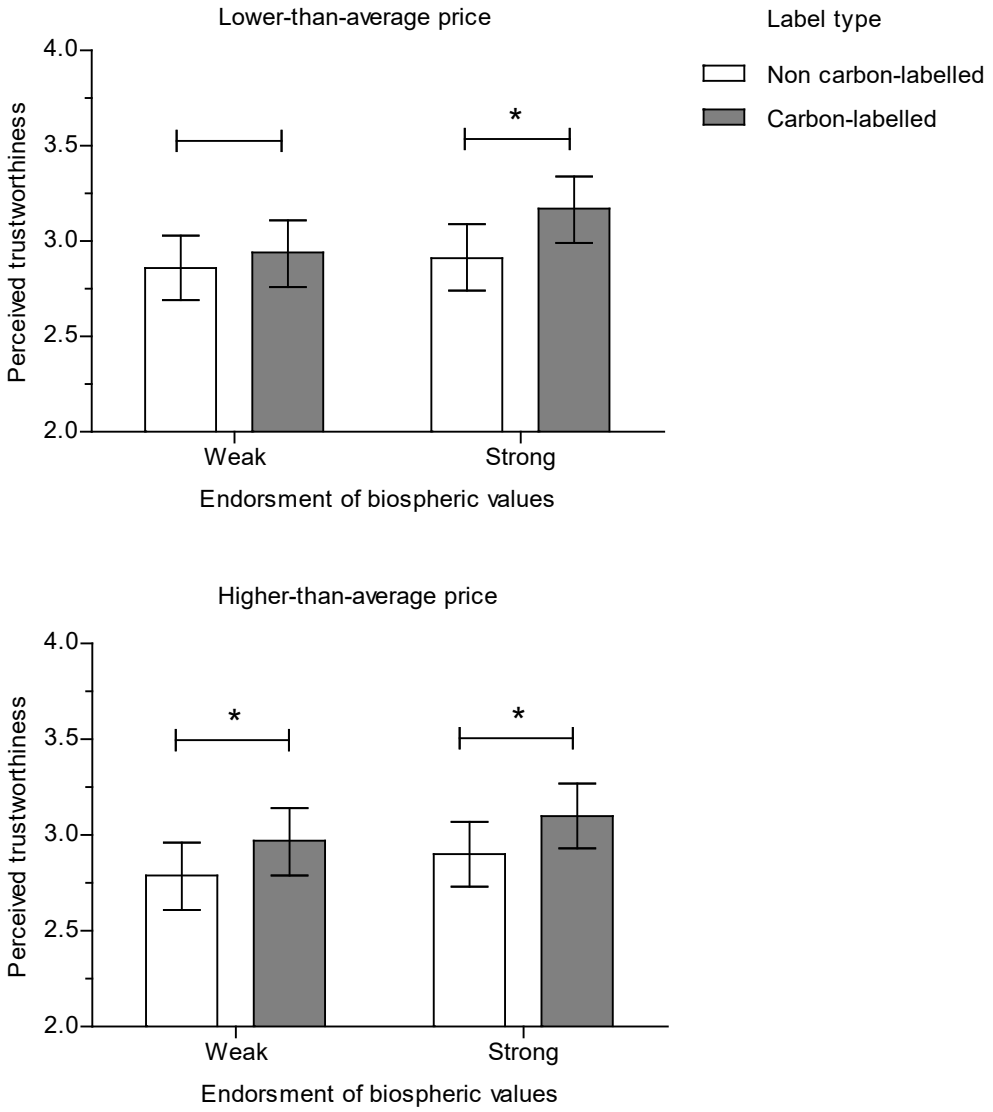


Figure 2. Means and 95% confidence interval bars for perceived trustworthiness depending on observers' endorsement of biospheric values and label type when products where described as being lower-than-average and higher-than-average in price. * Indicates that the simple effect is significant at the $p < .05$ level.

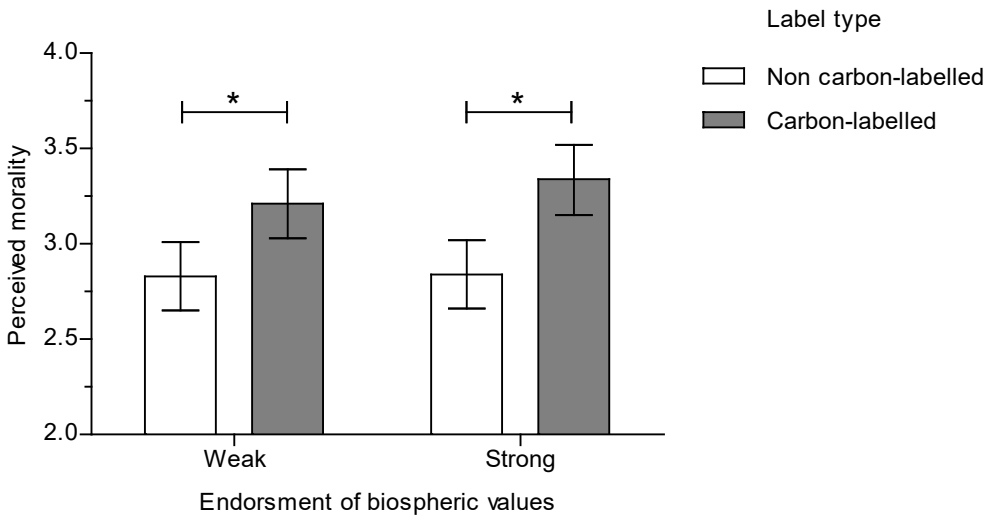


Figure 3. Means and 95% confidence interval bars for perceived morality depending on observers' endorsement of biospheric values and label type. * Indicates that the simple effect is significant at the $p < .05$ level.

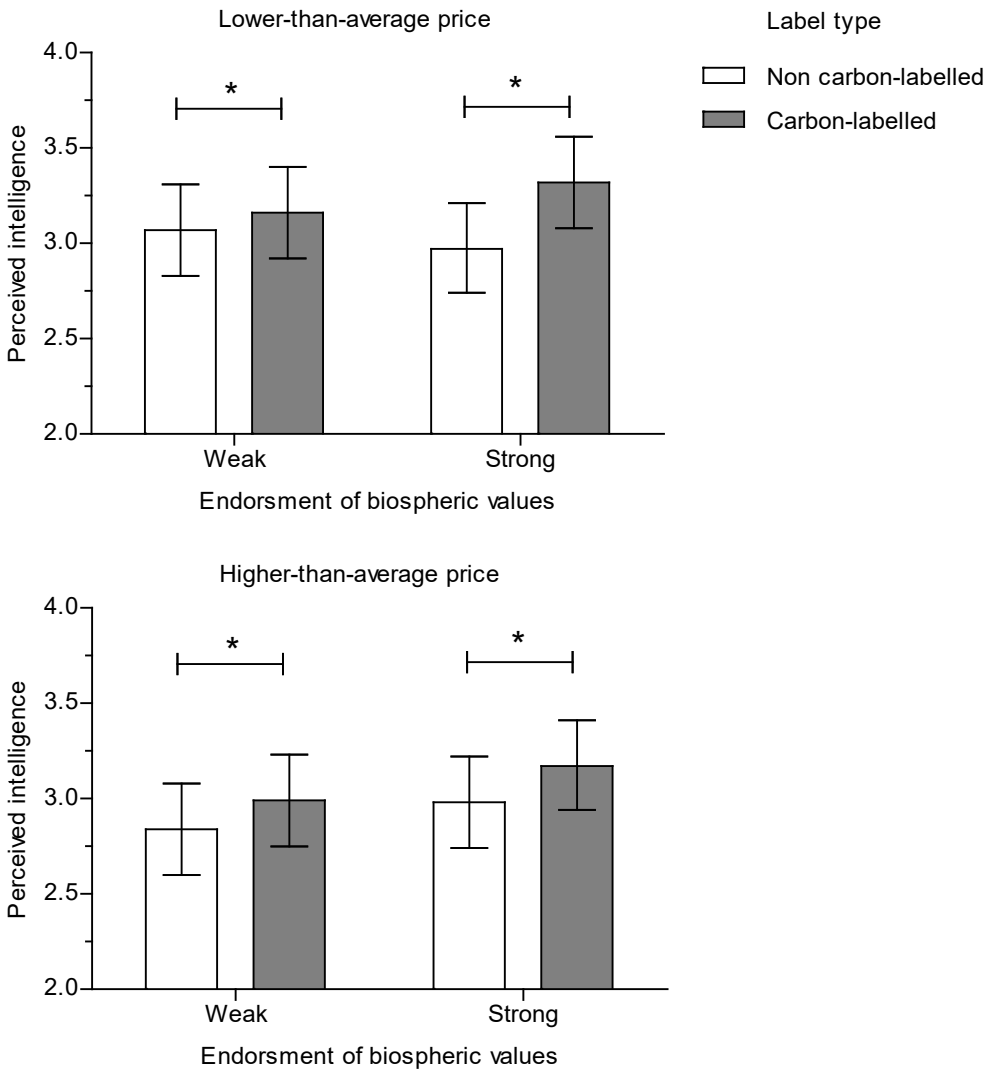
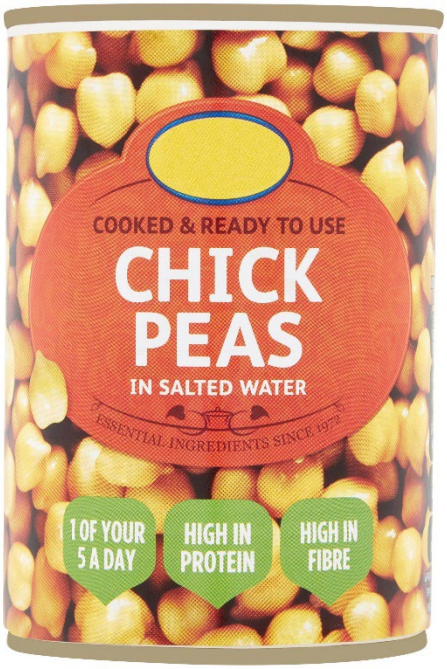
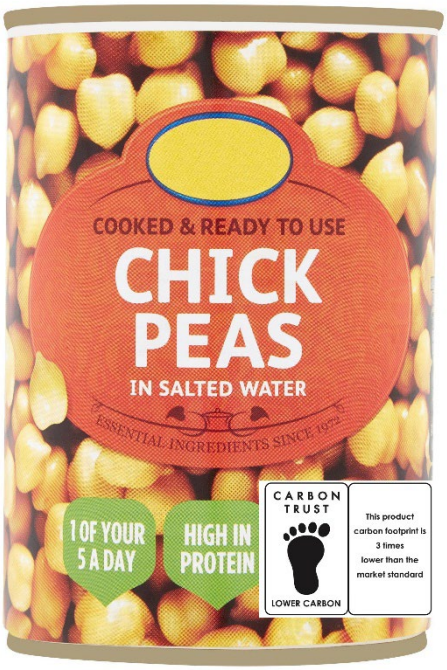


Figure 4. Means and 95% confidence interval bars for perceived intelligence depending on observers' endorsement of biospheric values and label type. * Indicates that the simple effect is significant at the $p < .05$ level.

Appendices

Appendix A: Food products images






LASAGNE
Serving suggestion
Keep refrigerated
Use by
Serves 2. Per 1/2 pack (microwaved)
ENERGY 1973kJ 471kcal 23%
FAT 18.6g 27%
SATURATES 8.5g 43%
SUGARS 9.4g 10%
SALT 1.29g 22%
% of the Reference Intakes
Typical values per 100g: Energy 576kJ/137kcal
BEEF


LASAGNE
Serving suggestion
Keep refrigerated
Use by
Serves 2. Per 1/2 pack (microwaved)
ENERGY 1973kJ 471kcal 23%
FAT 18.6g 27%
SATURATES 8.5g 43%
SUGARS 9.4g 10%
SALT 1.29g 22%
% of the Reference Intakes
Typical values per 100g: Energy 576kJ/137kcal
BEEF
CARBON TRUST
LOWER CARBON
This product carbon footprint is 3 times lower than the market standard

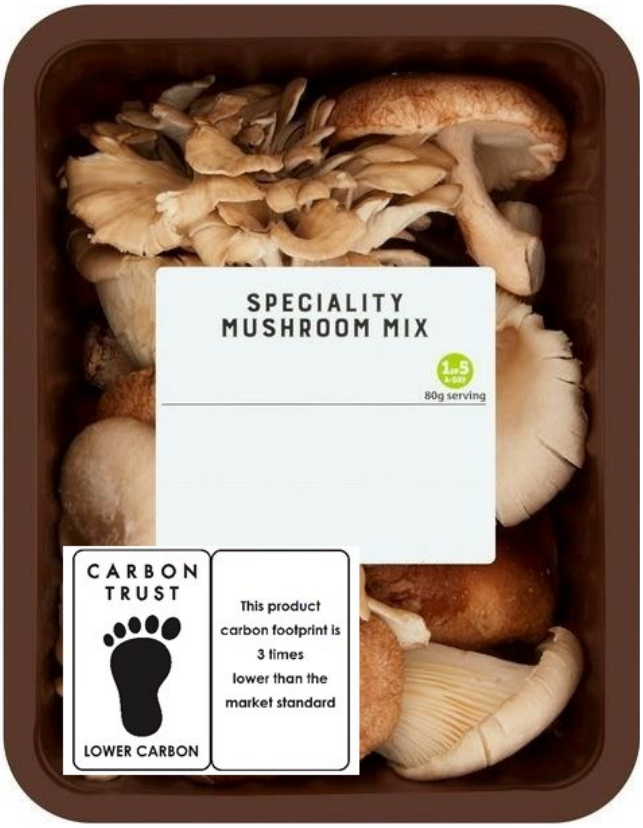

British
leeks
great steamed or sautéed


British
leeks
great steamed or sautéed
CARBON
TRUST
LOWER CARBON
This product
carbon footprint is
3 times
lower than the
market standard


Pure
Peppermint
All natural ingredients*
20
SINGLE
TEA BAGS


Pure
Peppermint
All natural ingredients*
CARBON
TRUST
LOWER CARBON
This product
carbon footprint is
3 times
lower than the
market standard
20
SINGLE
TEA BAGS


SPECIALITY
MUSHROOM MIX
80g serving


SPECIALITY
MUSHROOM MIX
80g serving
CARBON
TRUST
LOWER CARBON
This product
carbon footprint is
3 times
lower than the
market standard


Suitable for freezing
– 8 –
PLAIN
TORTILLA WRAPS
Once opened enjoy within 48 hours
Serving suggestion
PEEL & RESEAL
TAMPER SEAL
Best before
WHEAT FLOUR


Suitable for freezing
– 8 –
PLAIN
TORTILLA WRAPS
Once opened enjoy within 48 hours
Serving suggestion
PEEL & RESEAL
TAMPER SEAL
CARBON TRUST
This product carbon footprint is 3 times lower than the market standard
LOWER CARBON
Best before
WHEAT FLOUR

Appendix B: Distribution of participants' characteristics

Table B1.
Distribution of gender and age across groups.

Group: Price	*N*	Gender			Age			
		Male (%)	Female (%)	Other (%)	Min. (years)	Max. (years)	Mean age (years)	SD (years)
Low	104	32.4	66.7	0	18	85	28.14	12.57
High	115	34.4	53.6	3.2	18	76	29.43	13.39
Total	219	33.5	59.6	1.7	18	85	28.82	12.99

Table B2.
Distribution of educational attainment across groups.

Group: Price	*N*	Up to 16 (%)	Up to 18 (%)	Undergraduate (%)	Postgraduate (%)	PhD (%)
Low	104	1.9	37.1	35.2	21	3.8
High	115	1.6	24	44.8	16.8	4
Total	219	1.7	30	40.4	18.7	3.9

Table B3.
Distribution of participant residence across groups.

Group: Price	*N*	Africa (%)	Asia (%)	Europe (%)	North America (%)	Oceania (%)	South America (%)
Low	104	0	4.8	87.6	6.7	0	0
High	115	0.8	7.2	76.8	6.4	0.8	0
Total	219	0.4	6.1	81.7	6.5	0.4	0

Appendix C: Summary of Random Intercept Variances of Linear Models

Table C1.
Random intercepts, standard deviations, and intraclass correlations (ICCs) of fitted models.

Model	Groups	Random component	SD	σ^2	ICC
Perceived trustworthiness	Participants	Intercept	.56	.32	.49
	Products	Intercept	.08	.01	.02
Perceived morality	Participants	Intercept	.55	.30	.41
	Products	Intercept	.17	.03	.06
Perceived prosociality	Participants	Intercept	.56	.31	.42
	Products	Intercept	.09	.01	.02
Perceived intelligence	Participants	Intercept	.56	.31	.43
	Products	Intercept	.21	.05	.10