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Biases in consumers' assessment of environmental damage in food chains and how investments in reputation can help

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ABSTRACT

Sustainability is becoming increasingly relevant to consumers in their food choices. However, they may have a limited understanding of the environmental impact of their purchasing decisions and resort to perceptions and heuristics to guide them. In this study, consumers were asked to complete a categorisation task to determine whether they considered a product to have a high or low carbon footprint, with no information besides that contained on the product's front label. The results demonstrated that raw materials (food category), transportation (UK product), and manufacturing (level of processing) influenced the probability that an item would be classified as either having a low or high carbon footprint. These findings are embedded into the supply chain to explore the role of reputation in reducing the categorisation biases observed in the categorisation task.

1. Introduction

Carbon emissions are an increasing concern in many modern economies (e.g., Otto et al., 2015; Paroussos et al., 2015), and environmental regulation is currently paying attention to the role of consumers as agents of change (Boardman, 2008; Perino et al., 2014; Peters, 2010). Changes in consumer behaviour are estimated to have the potential to reduce US carbon emissions by as much as 41%, often with little or no reduction in well-being (Dietz et al., 2009; Bin and Dowlatabadi, 2005). As a result, a growing number of policies targeting changes in consumption emphasise the need to present consumers with information on the environmental impact associated with the production of goods (Boardman, 2008; Clift and Wright, 2000). Carbon labels have attempted to provide consumers with a summary of the environmental information in the form of total carbon emissions, with some questionable results (e.g., Upham et al., 2011). Part of this failure might be driven by a number of factors such as the limited familiarity of consumers with carbon labels, the inability to understanding and differentiate between sustainable (i.e., low-carbon footprint) or unsustainable (i.e., high-carbon footprint) products, and how consumers use the information (see also Beattie, 2012).

This research explores the inferential process consumers use in assessing whether a food product has a high or low carbon footprint. Previous research suggests that consumers have a limited understanding of carbon footprint labelling (Bleda and Valente, 2009; Upham et al., 2011; Beattie, 2012). Additionally, sustainability information provided in the media has been shown to be often unrelated to expenditures in sustainable food categories (Bellotti and Panzone, 2016), suggesting that this type of information might not be very effective in driving behaviour. Nevertheless, in the absence of accurate information on the environmental impact caused by the production and consumption of products, consumers have been shown to rely upon external cues, which are likely to be imprecise and based upon specific (possibly biased) expectations and (possibly faulty) assumptions (e.g., Beattie, 2012; Gifford, 2011; Gifford, 2014; Whitmarsh et al., 2011). An inaccurate inference could lead environmentally-conscious consumers to systematically purchase high-carbon footprint food items whilst believing them to be low-carbon.

When assessing the environmental impact of a product, consumers are also challenged with understanding the supply chain and determining which particular stage is responsible for the environmental damage (Clift and Wright, 2000; Maloni and Brown, 2006). By summarising the environmental impact into one measure, the carbon footprint can mask the contribution of each individual constituent. For instance, farming accounts for a large quota of the carbon footprint of meat production (Nijdam et al., 2012), but this information is not identifiable from the value of the carbon footprint, and consumers might consider other agents in the chain to be the cause of the problem. Similarly, the production process can influence the perceived sustainability of health programs and foods (Vermeer et al., 2013; Verbeke et al., 2007).

Consumers can infer the impact of a food choice by using heuristics that establish a probabilistic relation between different stages of the production process and their respective environmental damage, using

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a mental process similar to covariational thinking (Spellman, 1997). This process would predict that consumers infer whether a good has a low or high carbon footprint by determining the carbon intensity of each stage involved in its supply chain. For example, they may believe that an imported product is high in carbon because transport leads to environmental damage. This heuristic mirrors the 'food miles' paradigm (Weber and Matthews, 2008a; Kemp et al., 2010), in which 'distance' is used as a proxy measure of a product's emissions. Similarly, consumers may perceive that a high carbon footprint is caused by technological intensity, contextualised in terms of the amount of processing required (Monteiro, 2009) and the degree to which technology contributes to the final identity of the product (Palda, 1986). Finally, consumers might attribute the cause of a high carbon footprint to the inherent nature of a product: consumers classify products as either 'vices', which give immediate reward but cause long-term social problems, or 'virtues', which entail delayed gratification but give long-term social benefits (van Doorn and Verhoef, 2011; Gorissen and Weijters, 2016); consumers might then assume that 'vice' products, for instance foods considered unhealthy, have high carbon footprint.

This article discusses the findings of a sustainability categorisation exercise, where a number of consumers were asked to classify a list of foods as 'high carbon' or 'low carbon'. In particular, the article builds upon the current but limited research around food products and environmental quality (Pivato et al., 2008; Bleda and Valente, 2009; Siegrist et al., 2015; Visschers and Siegrist, 2015). In the empirical exercise, the research explores three stages of the food supply chain: the production of raw ingredients versus industrial manufacturing (the level of processing, see Monteiro, 2009), transport (origin, refer to Kemp et al., 2010), as well as the nature of the good (for instance, agriculture or animal farming; see, e.g.,van Doorn and Verhoef, 2011). This exercise allows a comparison between the true carbon footprint of a product and a consumer's perception of the carbon footprint. By presenting a mixture of products that differ in their supply chain, in terms of food category, manufacturing, and origin, it is possible to estimate how each of these three constituents of a supply chain influence the probability of an item being classified as having a high or low carbon footprint. Results indicate that consumers use information on the supply chain in the categorisation task, and while they show no bias in the carbon assessment of manufacturing, there are biases associated to different food categories (with the exception of meat products) and their origin.

This article is organised as follows. The next section discusses the concept of carbon footprint in a food supply chain context. Section 3 is dedicated to consumer behaviour, and explores the potential for biases that influence the perceptions of food products with respect to sustainability. Section 4 documents the finding of the empirical categorisation task, demonstrating that a consumer's perception of sustainability may be influenced by a number of variables. Section 5 presents a model explaining the implications of these results in a supply chain setting, proposing potential corrective measures that could protect members of a supply chain from the negative consequences of the biases. Section 6 discusses the implications of this research, followed by the conclusion in Section 7.

2. The carbon footprint of foods

The environmental sustainability of a product may be estimated using any one of three main measures (Galli et al., 2012): the *carbon footprint*, which measures the amount of greenhouse gases emitted by a product during its life cycle; the *ecological footprint*, which measures the demand for renewable resource production (e.g., land) associated to consumption; and the *water footprint*, which measures the volume of water needed to produce, supply, and consume a product. The concept of the carbon footprint has become a prominent candidate for use as a summary indicator of the environmental damage of a food product to be put on labels (Pandey et al., 2011; Vanclay et al., 2011; Perino et al., 2014; Boardman, 2008). Carbon footprints are measured by observing the amount of greenhouse gas emissions associated to the life of a good along its supply chain, from the production of its raw ingredients, up to its consumption and the disposal of waste (Pandey et al., 2011; Garnett, 2011; Sundarakani et al., 2010) using a life cycle assessment (LCA) approach (Weidema et al., 2008; Currás-Pérez et al., 2009; Lemke and Luzio, 2014). The growing use of LCA increased the availability of carbon footprint data, which aligns with global warming research (e.g., Keeling, 2008) by measuring environmental quality in carbon dioxide equivalents (CO_2e).

The amount of carbon emitted in the atmosphere can vary enormously across different food products, reflecting the heterogeneity that characterises their supply chain (Garnett, 2011; Maloni and Brown, 2006). According to Smedman et al. (2010) there are four main aspects of the supply chain that contribute to the carbon footprint of food: a *production* phase, which captures the emissions related to the production of raw materials (e.g., crops), including agricultural inputs such as fertilisers; a *manufacturing* phase, which refers to the emissions from the actual production of the product (e.g., energy, chemicals, and other industrial inputs); a *packaging* phase, which deals with the emissions associated with packaging; and a *transportation* phase, which refers to the transportation of ingredients and foods from one stage to another (farms to firms, manufacturers to retailers, and retailers to consumers). Because most products offered by UK retailers are packaged, and only certain food categories can be found loose (e.g., fruit and vegetables), the impact of packaging is difficult to identify statistically. Therefore, the remainder of the article will focus on the emissions generated from production, manufacturing, and transportation.

An important element that differentiates the environmental impact of food products is the level of processing required during the manufacturing process (Espinoza-Orias et al., 2011). Monteiro (2009) classified food products into three levels. First, *minimally processed foods* are products that use a minimal amount of technology (e.g., washing, juicing, fermenting, or packaging) that does not substantially change their raw form. Fresh fruit and vegetables, meat, and milk belong to this category. Second, *processed food ingredients* require a level of technology that significantly alters the nature of the original raw product, leading to foods that are used as intermediates to other processed foods. Examples are flours, oils, and sugars. Third, *highly processed foods* apply specific technologies (e.g., baking, frying, curing, and smoking) to minimally processed foods and highly processed ingredients to obtain complex foods. Snacks, biscuits, soft drinks, processed meats, and ready meals are representative examples.[1] Differences in the carbon footprint of processed foods stem from production and processing, which are major contributors of greenhouse gases (Wakeland et al., 2012, pp. 225–226). This is partly due to the additional energy needed for processing (Rizet et al., 2012) as well as the refrigeration of the ingredients and/or the final product (Schmidt rivera et al., 2014). Notably, food preparation and consumption (Espinoza-Orias et al., 2011; Dietz et al., 2009; Weber and Matthews, 2008b) and waste (Scholz et al., 2015) also play a relevant role in the final footprint of foods, but are not captured in this exercise.

Another factor that can account for the differences in the carbon footprint of similar products is the transportation of a product to its destination market (Espinoza-Orias et al., 2011). Products belonging to the same food category have similar production phases and supply chains, and often require comparable inputs and processes, making transportation the delineating factor of their carbon footprint. However, transportation has a rather small influence on the total carbon footprint of

[1] The level of food processing somewhat correlates with the length of the supply chain: minimally processed products will typically only have agricultural producers supplying retailers; processed food ingredients will most likely have a small number of agricultural producers supplying a manufacturer that supplies retailers; while highly processed foods tend to have a much more complex structure with multiple producers and intermediaries supplying a manufacturer who then supplies retailers.