



Potential impacts of information disclosure designed to motivate Japanese consumers to reduce carbon dioxide emissions on choice of shopping method for daily foods and drinks



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ARTICLE INFO

Article history:

Received 31 July 2014

Received in revised form

2 April 2015

Accepted 2 April 2015

Available online 11 April 2015

Keywords:

Consumer preference

Environmental information literacy

Environmental awareness

Information disclosure

Daily shopping

ABSTRACT

Information disclosure associated with carbon dioxide emissions of goods or services may be useful for stimulating consumers to make choices to reduce carbon dioxide emissions. The scope of this study was to analyze the potential impact of information disclosure on consumer choices of daily shopping method through an internet survey of Japanese residents (2630 subjects). Japanese consumers were shown to have a preference for low carbon dioxide emissions in their choice of daily shopping method. Awareness of responsibility and intention to act were identified as crucial influences on consumer willingness to reduce carbon dioxide. Supporting information such as comparative presentation of the impacts of well-known everyday carbon dioxide reducing activities effectively made consumers more receptive and sensitive to the meanings and consequences of their choices. The provision of quantitative information on the carbon dioxide emissions associated with different shopping methods may prompt consumers to alter their current choices by comparing the benefits of carbon dioxide reductions and time savings with their preferences for certain shopping methods.

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1. Introduction

Reducing carbon dioxide (CO₂) emissions is regarded as an urgent task in the context of climate change. Still, CO₂ emissions have been increasing steadily in recent years. Japan's CO₂ emissions accounted for 4% of the global total in 2012, making it the fifth largest country in the world for CO₂ emissions (Olivier et al., 2013). Additionally, thermal power plants have come to occupy a larger share of Japan's electricity grid mix since the nuclear power plant accident in 2011, increasing national CO₂ emissions. Thus, Japan can play an important role in reducing global CO₂ emissions. Previous studies (e.g. Takase et al., 2005) have estimated that CO₂ emissions and energy consumption arising from household activities in Japan are the same as in other countries (e.g. Munksgaard et al., 2000;

Munksgaard et al. 2005; Kok et al., 2006; Sánchez-Chóliz et al., 2006; Mäenpää et al., 2007; Girod et al., 2009; Kerkhof et al., 2009; Liu et al., 2009). These studies indicated that large amounts of CO₂ emissions can be attributed to consumer goods or services. Thus, consumers must understand the significance of their choices for reducing CO₂ emissions.

Information disclosure on CO₂ emissions related to goods or services is expected to be relevant to shifting consumers' shopping choices to favor lower carbon emissions (Gadema and Oglethorpe, 2011). Consumers have strong preferences for certain goods or services, for example in relation to performance, design, or safety, as well as environmental performance (Upham et al., 2011; Hartikainen et al., 2014). However, customers may have other options to reduce CO₂ emissions without changing the goods or services they buy. Previous studies revealed that CO₂ emissions related to the retailing and shopping processes comprise a significant share of product related CO₂ emissions (Norris et al., 2002; Motoshita et al., 2008). The reduction of CO₂ emissions by shifting from on-site shopping to delivery services was estimated at around 23% of

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the total emissions related to a purchase (Motoshita et al., 2008). Therefore, a change of shopping method may enable consumers to contribute to CO₂ reduction while maintaining their existing preferences for certain goods or services.

Several studies have examined consumer preferences for CO₂ reductions with regard to goods or services, but have not provided specific information on CO₂ emissions quantities or potential reductions related to consumers' choices (Brouwer et al., 2008; Chalak et al., 2012; van Birgelen et al., 2011). The provision of specific CO₂ emissions values is expected to be more efficient for influencing consumers when choosing goods or services. Achtnicht (2012) evaluated whether CO₂ emissions are relevant attributes in car choices and showed that car emission performance influences consumer choices. The results indicated that CO₂ emissions quantities may be meaningful to consumers when making car choices. However, the effects of information disclosure on consumer preferences with regard to daily shopping method have not been evaluated.

While information on potential CO₂ savings may be useful for decision making in shopping, such information is not conclusive for many consumers. Such information is also hard to convey given the difficult for consumers of grasping the meaning of figures relating to CO₂ reduction (Gadema and Oglethorpe, 2011; Upham et al., 2011). In this context, several studies have shown that additional supporting information improves understanding and promotes consumers' choices of eco-friendly goods (O'Brien et al., 2004; Teisl et al., 2008). Upham et al. (2011) surveyed consumer perceptions of the effectiveness of realizing CO₂ reductions through their choice of daily food products by providing information regarding CO₂ emissions associated with air travel and equivalent figures for low CO₂ food products. However, as indicated by the results of this study, the different magnitudes of the reference values may confuse consumers. The reference values used to help consumers understand and motivate them to seek CO₂ savings need to be surveyed more and differently.

Furthermore, previous studies found that the level of consumers' environmental concerns affected their choice of eco-friendly goods (Loureiro et al., 2005; Teisl et al., 2008). Consumers' environmental concerns may also affect their preferences regarding CO₂ reduction choices in daily shopping. If the environmental concerns of consumers that affect their willingness to reduce CO₂ emissions through daily shopping choices can be identified, further environmental communication and education can be focused on these aspects to increase the number of consumers who alter their method of daily shopping to reduce CO₂ emissions.

Consequently, this study analyzed the disclosure of information on CO₂ reductions intended to prompt consumers to make CO₂ reduction choices in daily shopping. The analysis focused on the following three main perspectives: (1) consumers' preferences on CO₂ reduction choices with regard to shopping methods, (2) the types of supportive information that consumers require to understand the meanings of CO₂ emissions and (3) the effects of consumers' environmental concerns on their preferred CO₂ reduction choice. To represent the decision making process with regard to shopping methods, choice-based conjoint analysis using the results of a questionnaire was applied to verify consumer preferences for reducing CO₂ emissions in comparison with other influential factors. The questionnaire provided different types of information to different respondent groups to identify the preferred information type and promote better understanding of the contribution of consumers to CO₂ reductions. The environmental concerns of consumers were also analyzed by using the result of factor analysis of consumer environmental awareness and considered as influences in the analysis of consumer preferences regarding CO₂ reductions.

2. Methods for analyzing consumer preferences regarding CO₂ reductions

Internet questionnaires were applied to survey Japanese consumer preferences regarding CO₂ reductions. Preferences regarding CO₂ reductions were statistically quantified for three groups of respondents presented with different supporting information on the amount of CO₂ reductions by using conjoint analysis. The effects of consumers' environmental awareness were analyzed by identifying the level of CO₂ reduction preferences of each respondent based on factor analysis. The methods are detailed below.

2.1. Outline of questionnaires

A questionnaire targeting residents of Japan was administered over the internet. Respondents were extracted from a sample registered with a Japanese research company (NetMile, Inc., since renamed Mixi Research, Inc.) and measures were taken to balance the sample with respect to gender (male/female), age band (20s, 30s, 40s, 50, 60s), and representation of various resident areas. All residential areas in Japan were classified into seven regions (Hokkaido/Tohoku, Kanto, Hokuriku/Koushinetsu, Toukai, Kinki, Chugoku/Shikoku, Kyushu/Okinawa), each of which generally includes several major urban areas as well as surrounding suburban and rural areas. Three different questionnaire sheets were distributed to three groups, with each group being provided different supporting information on the meaning of CO₂ reductions (as described in the following section) to estimate the effects of supporting information on decision making. To obtain a representative sample of consumers in Japan (whose population numbered 128 million in 2009 (Ministry of Internal Affairs and Communications, 2009)) then in accordance with the criteria of the margin of error (5%) and confidence level (99%) in this study, the necessary sample size exceeded 666 per group. In case, oversized sample (940 for each group) was set as the initial target of respondents to secure enough numbers of valid answers for the analysis. Each group was randomly selected. Thus, answers from a total of 2630 respondents (after excluding invalid answers as explained in Section 2.6) from the three groups were collected from the website of the research company on January 26–27, 2009. The supplementary material details the demographic information of the survey respondents.

2.2. Analysis method and definition of the general criteria for shopping choices

Conjoint analysis is used for marketing research and is often applied to determine the value of goods not traded on markets, such as environmental quality (Louviere, 1994; Holmes and Adamowicz, 2003). For example, forests possess several valuable attributes, such as carbon storage, capacity to produce commercial goods (e.g., timber), flood control, wildlife habitat, and recreation services. Preferences regarding each of these attributes of forests can be evaluated by applying conjoint analysis based on questionnaire results (details of conjoint analysis are presented in the supplementary material). Similarly, several attributes affect consumers' choices regarding shopping method, such as distance to stores, time required for shopping, costs associated with shopping, available goods, and specific store atmosphere. A principal focus of this study is to quantify consumers' preferences regarding reduction of CO₂ emissions in shopping. Therefore, choice-based conjoint analysis was identified as a suitable method for evaluating consumers' preferences regarding CO₂ reduction given consideration of other attributes related to shopping.

In reality, consumers consider several factors when making shopping decisions. Notably, Solgaard and Hansen (2003)

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