The Design of an Eco-Marketing and Labeling Program for Vehicles in Maine[1]

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1 Introduction

The widespread use of eco-labels suggests they are perceived by some as an effective method of altering consumer behavior. Indeed, several stated-preference studies (Anderson 2003; Donovan and Nicholls 2003; Ozanne and Vlosky 2003; O'Brien and Teisl 2004) and a number of market-based studies have documented the potential for eco-labels (Blamey and Bennett 2001; Teisl et al. 2002; Bjørner et al. 2004). Although some industry sectors have adopted eco-labeling to take advantage of specialized product markets and potential product premiums, others have been sceptical about the touted environmental and economic benefits of these approaches.

Given that eco-labeling is not costless[2], certification and labeling programs may not achieve their objectives unless consumers are willing to pay for the underlying improvements in the production practices specified by the program. However, in addition to being willing to pay for eco-labeled products, consumers must also notice, understand and believe the information presented to them by the product manufacturer. Thus, the success of labeling is contingent upon both the characteristics of the consumer and of the labeling program. Here we provide a review of the literature demonstrating some of the individual and label program characteristics that have been hypothesized, or shown, to influence the effectiveness of eco-information. We then present results from a current study testing some of the individual and label program factors as applied to environmentally preferred passenger vehicles.

We focus on the light-duty vehicle market because light-duty vehicles are one of the major sources of carbon dioxide, nitrogen oxide, carbon monoxide, and volatile organic compound emissions in the United States

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[2] The costs of labeling are not generally related to the costs of providing the information, per se; it is the costs associated with changes in production practices needed to meet the label standards and the costs needed to directly link production changes to end-products (e.g., chain-of-custody agreements).

(EPA 2004), and because traditional command and control approaches have been difficult to apply.[3] In addition, although there are several studies (e.g., Brownstone et al. 1996a, b; Bunch et al. 1996; Gould and Golob 1998) indicating a demand for 'greener' vehicles, no one has studied whether an eco-information program is effective in altering consumers' attitudes toward, or purchases of, environmentally preferred vehicles.[4] It is, thus, an open question whether informed customer choice in the light-duty market will lead to these outcomes.

2 Literature Review

The purpose here is to contribute to an understanding of how eco-labels and other types of eco-information work. The specific objectives are first, to develop and test a model explaining a person's propensity to buy an environmentally preferred vehicle as a function of their personal characteristics. The second objective is to extend current research efforts looking at the characteristics of the label and how it influences several metrics known to be important to an eco-label's success. In turn, this section reviews the literature related to the specific individual and label factors studied later in the paper.

2.1 Individual Factors Influencing Eco-Buying

Economic theory suggests that demand for a good is a function of a number of factors; one of these being tastes and preferences. Psychologists have developed a more nuanced delineation of what constitutes tastes and preferences; some of these include a person's level of environmental concern, their perceptions of their effectiveness as an eco-consumer, their faith in the eco-behavior of others and their perception that eco-buying entails compromise.

Environmental Concern - The literature suggests a person's general view of the environment will be a significant factor in promoting eco-purchases, but that concerns more specific to the environmental issues related

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[3] For example, Congress's recent inability to increase fuel efficiency standards.

[4] The research presented within this article will focus on the effects that eco-information programs may have on traditional fueled passenger vehicles, and will not address the case of hybrid vehicles. Throughout this article we will refer to 'greener' vehicles or 'environmentally preferred vehicles'. These terms refer to gasoline-powered vehicles classified as low emission by the USEPA.

to the product under consideration will have a greater impact (Grankvist and Biel 2001; Thøgersen 1999). As air pollution is the primary environmental consequence associated with passenger vehicles, one can imagine a high level of concern regarding air pollution may influence a consumer's choice of vehicle. This possibility is strengthened by the work of Henry and Gordon (2003) in studying the affect of a public information campaign on driving behavior. They recognize that an awareness of the link between driving and poor air quality was needed in order to "influence target behaviors", in this case driving.

Perceived Consumer Effectiveness - Thøgersen (1999, 2000a, b) indicates a consumer's attention to eco-labels is influenced by the belief that a consumer, through their purchase choices, is an important part of the solution to environmental problems.[5] Studies also suggest a positive relationship between perceived consumer effectiveness and willingness to purchase environmentally friendly products (Balderjahn 1988; Lee and Holden 1999; Thøgersen 2000a).

Faith in Others - Another component of environmental concern, recently recognized as a separate construct, is faith in others. Bamberg (2003) points to Ajzens's theory of planned behavior where normative expectations of others may be a factor in an individual's behavior. Gould and Golob (1998) indicate the behaviors of others influenced the participants in their study; drivers often felt no personal responsibility for vehicle air pollution because they noted worse offenders (i.e., observing free-ridership leads to a decreased faith in others and to a decrease in own socially beneficial behavior). Stern (2000) suggests that information, such as provided on an eco-label, may activate consumer's environmental norms by highlighting the benefits to self and others.

Perceived Compromise - While the above-mentioned constructs positively influence one's environmental behavior, there are also barriers to environmentally friendly consumption. One such barrier is when individuals hold beliefs that purchasing environmentally preferred goods entails some increased inconvenience, cost or risk, or entails accepting a decrease in product quality (Stern 1999). Thøgersen (2000b) notes that consumers purchase goods for the perceived utility they will obtain and are unlikely to substitute a good they perceive as providing lower utility merely because it is eco-labeled. Additionally, consumers may see buying an eco-labeled item as a risky behavior if they are unfamiliar with the product or the eco-labeling program (Thøgersen 2000a). As vehicles are a relatively large capital expense, the risk associated with an incorrect decision is clearly

[5] This construct is also frequently referred to as 'Ascription of Responsibility to Self' (Stern 2000).

high. Thøgersen (2000a) indicates that eco-labeled products become more difficult to sell when the perceived compromise gets larger. In addition, previous studies also indicate that if other characteristics of a good monopolize a consumer's attention, the role of environmental concern in the decision will be lessened (Thøgersen 1999). One can imagine that *perceived* inferiority may monopolize a consumer's attention and thus decrease the likelihood of buying green.

2.2 Information Program Factors Influencing Eco-Buying

This sub-section focuses on several program attributes that appear to be important in affecting the impact of information policies: the degree to which all firms are required to provide product information (compulsoriness), the degree of information detail presented to consumers (explicitness), the degree to which information is required to appear in a format that is uniform across products (standardization) and the organization that is seen as providing the information (source).

Compulsoriness - At the extremes, labeling restrictions are either mandatory or voluntary; most eco-labeling programs fall into this latter category. Voluntary policies often yield an information environment in which consumers lack data concerning key product attributes. As a result, attention has been devoted to the process by which consumers infer a value for missing information or the process by which missing information affects choice (see Lee and Olshavsky 1997 for a recent review of this literature). This research suggests that consumers look at equivalent attributes from other brands (Jacard and Wood 1988; Ross and Creyer 1992), or other attributes of the same product (Johnson and Levin 1985; Ford and Smith 1987). Others suggest that consumers may not infer missing values at all, but merely pay less attention to a product with missing information (Simmons and Lynch 1991). Teisl (2003) finds that a move from voluntary to compulsory labeling does not significantly alter choice behavior as respondents are able to correctly infer the lack of environmental information on a product signals the product performed relatively poorly on this characteristic.

A related issue is that the availability of labels in the marketplace seems to play a key role in consumers' use of labels (Thøgersen 2000a). As labeled products become more common they are more likely to be noticed, appear credible, be useful in making cross-product comparisons and may influence some consumers' perceived consumer effectiveness (Thøgersen 2000a). By definition, a compulsory labeling program increases the availability of eco-labeled products.

Explicitness - Here we define two types of labels differentiated by the level of information detail. Eco-seals, such as seals of approval issued by certification programs, communicate little detail concerning attribute values. Only consumers who are intimately familiar with the certification agency and its standards understand the full meaning of the symbol. At the other extreme are disclosure labels that provide the most detailed information including product attributes, and the disclosure typically involves continuous or categorical information about each element.

Consumer scientists have long understood that more information is not always better because of the possibility of information overload (Scammon 1977) and of distraction from more authoritative information sources (Roe et al. 1999). However, increasing the amount of information on an eco-label can significantly increase the credibility of the label (Teisl 2003; Teisl and Roe 2005) and respondents' ability to correctly identify an environmentally friendly product (Teisl and Roe 2005; Teisl, 2003). One measure of the effectiveness of an information disclosure policy is if consumers can adequately rank competing products by key attributes, as such rankings can be an important input into the consumer choice process (Lee and Geistfeld 1998).

Bei and Widdows (1999) explore how disclosure of simple (summary ratings) versus complex (attribute-level ratings) information differentially affects consumers with different levels of experience and involvement in the product decision-making. They find that both simple and more detailed information improved respondent efficiency, but respondents with previous knowledge of the product category benefit more from the more complex information. However, adding summary eco-ratings can actually backfire, leading to *decreases* in the perceived credibility of the label (Teisl 2003). It seems summary ratings can increase the respondents' level of scepticism about the overall information; this type of response has also been observed in other contexts (Levy et al. 1996; Teisl et al. 1999).

Standardization - At one extreme, a labeling policy can require a specific format, where the firm has no discretion over the presentation. Alternatively, the content of the information may be regulated but the firm has discretion over how the information is presented. Studies suggest that standardized displays provide the largest benefit to consumers (Schkade and Kleinmuntz 1994) because they increase the number of products or attributes considered during choice, allowing for more accurate choice decisions (Coupey 1994). However, standardization can also mask differences. For example, Teisl and Roe (2005) found that when respondents view multiple products bearing a standard eco-seal and different prices they assume the eco-characteristics of the products are similar and are not willing to pay a price differential between the two certified products.

However, when respondents view a similar situation with non-standard eco-seals they assume the environmental characteristics of the higher-priced product are better, and at least some of them are willing to pay the higher price.

Source - Thøgersen (2000c) suggests that the success of an eco-labeling program depends on the credibility of the label. The Angus Reid Group (1991) indicates individuals have very different views about the credibility of different sources of environmental information and a number of studies have found that consumers are sceptical of eco-claims on products (see Peattie 1995). Many other studies find that labels provided by independent sources are trusted more than information provided by business/industry (MacKenzie 1991; Enger and Lavik 1995; Schlegelmilch et al. 1996; Ozanne and Vlosky 2003). However, Teisl et al. (2001b) find that most U.S. survey respondents prefer a federal agency to administer and enforce an eco-labeling program. Differences in the perceived credibility of certifying organizations may be due to differences in respondents' familiarity with the organizations (Teisl 2003; Brown et al. 2002; Thøgersen 2000c).

3 Theoretical Model

To provide a modeling framework to measure changes in consumer choice behavior due to changes in eco-labeled product, one first needs to know how perceptions of environmental quality enter an individual's utility function (here defined in terms of a purchase occasion or decision). The utility evaluation can be represented by the indirect utility function[6]

$$V = \nu \{ E , p, M, I\} \qquad (1)$$

where E denotes a vector of perceived environmentally related assessments for J products (i.e., $E = [E^S_1,...E^S_J]$), p is a corresponding vector of prices and M denotes income. I denotes a vector of individual characteristics (such as environmental perceptions and perceived consumer effectiveness).

The method that extracts and translates environmental information into an assessment of a product's environmental impact can be viewed as a 'household production' process by which an individual combines her prior environmental knowledge (K), cognitive abilities (A), time (T) and the environmental information (S) presented during the evaluation phase of the

[6] This model is similar to those used by Teisl, Bockstael and Levy (2001a) and Teisl, Roe and Hicks (2002)

purchase decision. Thus, we could model the assessment process during the purchase decision as:

$$E_j = f(S_j, K, A, T|\ \theta) \quad (2)$$

where E_j denotes the (subjectively) assessed environmental impact of purchasing good j given information set S, S_j is the environmental information displayed about product j at the point of purchase (e.g., an eco-label). The objective level of the environmental impact characteristics represented by the information variable S is denoted by θ. For example, if S represents a 'Low Emissions' claim made on a vehicle label, then θ denotes that the driving of that vehicle produces emissions lower than some preset definition. θ is separate from the assessment function because the individual does not observe it at the time of purchase except through the variable S. Although θ may be unobservable to the consumer at the time of the purchase decision, we include it within the discussion to distinguish between the factor that affects consumer decisions, S, and the one that ultimately determines the environmental impact of production, θ.

We can model the individual's utility[7], once a choice is made as:

$$V_1 = \nu\ (E_1(S_1, K, A, T), M\text{-}p_1, I) \text{ if } y_1 \text{ is chosen} \quad (3)$$

where E_1 is the assessed environmental impact of product y_1, S_1 represents the environmental information presented on y_1's label and p_1 is the price of y_1. Typically, the researcher cannot observe E_1, or many of its components, directly necessitating use of the reduced form of (3):

$$V_1 = \nu\ (S_1, M\text{-}p_1, I) \text{ if } y_1 \text{ is chosen} \quad (4)$$

The reduced form is not unduly limiting given the policy-relevant variable, S_1, is retained.

Under a random-utility framework, there are unobservable components of the utility function; the individual's utility function is treated as random with a given distribution:

$$V_j = \nu\ \{S_j, M\text{-}p_j, I\} + \varepsilon_j \quad (5)$$

where ε_i is the unobservable component of the individual's utility function. Therefore, the choice of product y_1 by an individual indicates that the utility associated with y_1 is greater than any of the other alternatives within a choice set. The probability that the individual will choose y_1 is equal to

[7] The utility function is quasi-linear allowing for aggregation across consumers as the marginal utility of money is held constant. It further assumes only one item is purchased during the purchase occasion (a reasonable assumption for vehicle purchases).

the probability that the utility associated with y_1 is greater than the utility of the alternative:

$$\Pr(y_1) = \Pr[\nu_1\{S_1, M\text{-}p_1, I\} + \varepsilon_1 > \nu_j\{S_j, M\text{-}p_j, I\} + \varepsilon_j] \quad \text{for all } j \neq 1 \tag{6}$$

The probability of choosing an alternative can then be estimated using one of various dependent variable modeling techniques.

4 Methods

The analysis is based upon a nineteen-page survey used to gather baseline data on the willingness of Maine citizens to purchase environmentally friendly passenger vehicles. This section clarifies the methods employed in collecting the data.

4.1 Sampling and Survey Administration

In May of 2004, we obtained 1,382,735 records from the Maine Bureau of Motor Vehicles; the records represent everyone who registered a vehicle in Maine within the past 12 months. A random sample of 2,000 was generated from the frame with approximately 800 records removed because they were inappropriate or contained incomplete information.[8] The survey was administered as a three-round modified Dillman between June and August. The total number of respondents was 620, with 169 undeliverable, for a response rate of 60 percent. Our respondents are similar to the characteristics of the Maine adult population as measured by the recent U.S census, except in terms of gender. Although our survey respondents are more likely to be male, the proportion of males correctly reflects the underlying percent of males in the vehicle registration data.

[8] Records were rejected if the: primary address was outside the state, vehicle was listed as homemade, registration was for a non-passenger vehicle (e.g., utility trailers, snowmobiles, boats) or records did not have a valid vehicle identification number (VIN). Multiple registrations were also removed, as were records of vehicles older than 1985 (these individuals were assumed to be not in the new car market).

4.2 Survey Design

The survey instrument consisted of seven sections with 41 questions. Sections I and II solicited respondents' opinions on air quality in Maine, the relationship between motor vehicles and air pollution and environmental protection in general. Section III asked respondents about their current vehicle, including the type of vehicle and the importance of various attributes considered during the purchase decision; in Section IV respondents were asked about their search and use of environmental information in the vehicle purchase decision. Sections V and VI incorporated an experimental label test (Experiment I) and a vehicle choice experiment (Experiment II), respectively. These two experiments are analyzed in the paper and their design will be discussed separately (below). The final section of the survey, Section VII, collected demographic characteristics.

Experiment I - Respondents were presented with an eco-label with differing formats and information levels (Figure 1). Five different versions of the survey were created and randomly assigned across respondents. This includes a) the base case where only the State of Maine Clean Car label was presented with no additional text or information; b) the State of Maine Clean Car label with a sliding scale comparing the vehicle to the average of all vehicles in the same class of vehicle; c) the State of Maine Clean Car label with a sliding scale comparing the vehicle to the average of all personal vehicles; d) the State of Maine Clean Car label with a sliding scale comparing the vehicle to the average of all vehicles in the same class of vehicle *and* all personal vehicles; and e) the State of Maine Clean Car label with a thermometer scale comparing the vehicle to the average of all personal vehicles. These diverse label systems allow the analysis to look at two factors that affect a label's effectiveness: the amount of information presented and the consistency of presentation.[9]

Respondents were then asked to rate the label on credibility, perceived environmental friendliness of the vehicle, satisfaction with, and importance of, information. All questions concerning the labels used Likert-type ratings scales. For the credibility question the scale runs from 1, which denotes the label was 'not credible', to 5, which denotes the label was 'very credible'. For the environmental ratings question the scale ran from 1, 'not eco-friendly, to 5, 'very eco-friendly'. In the information load equation 1 denotes 'not enough information, 3 denotes 'just enough information' and 5 denotes 'too much information'. In the information importance equation, 1

[9] Note that the information actually provided to respondents was hypothetical; the vehicle ratings in Figure 1 do not necessarily represent an actual vehicle.

denotes 'not at all important', 3 denotes 'somewhat important' and 5 denotes 'very important'.

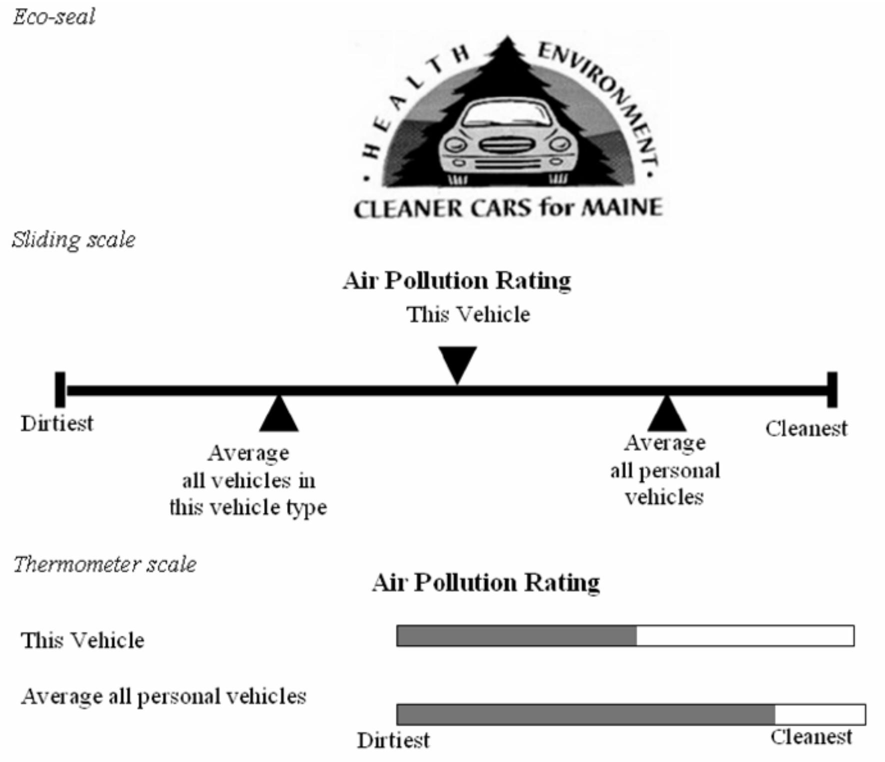

Fig. 1. Information treatments used in eco-label test experiment

Experiment II - Respondents were asked to respond to a two-stage choice scenario; the two stages are designed to reflect the two-stage process of vehicle purchasing (Figure 2) as indicated by focus group participants (Teisl et al. 2004). In the first stage (SI) participants choose a vehicle class (car, van, SUV or truck). After choosing a vehicle class in SI, respondents were then directed to the SII scenario, where they then selected one of three vehicles within their chosen class. Respondents were asked to assume that all vehicles were exactly the same except for the information presented.

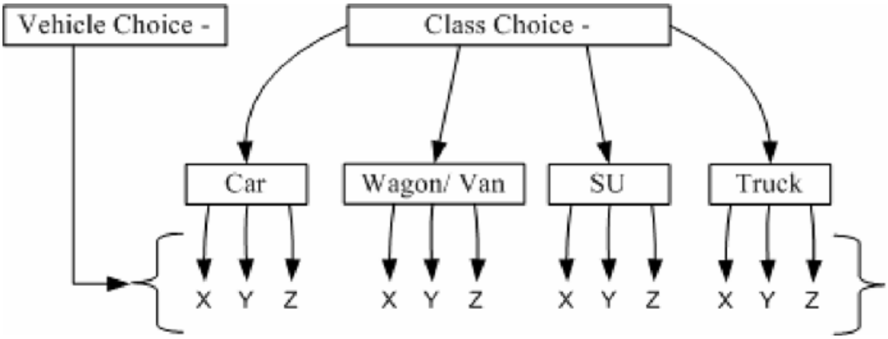

Fig. 2. Two-stage vehicle choice scenario

In SI, respondents are provided with average prices, miles per gallon and scores for criteria pollutants and global warming gases for each of the four classes. The class-level values were generated from two primary sources. Prices for each class were calculated from the National Auto Dealers Association's 'NADA Guides' (NADA.com 2004). The range of class-level fuel efficiency and pollutant scores was calculated based on U.S. EPA's 'Green Vehicle Guide' (EPA 2004). The class-level prices are positively correlated with the criteria pollutant scores (i.e. higher prices are associated with better pollutant scores). Miles per gallon ratings were positively correlated with the global warming scores. The standard deviations of data used to calculate the class averages were used to generate ranges of prices and eco-scores which were randomly assigned to respondents.

In SII, respondents are provided with prices, miles per gallon and scores for criteria pollutants and global warming gases for each of three vehicles. The vehicle-level values were generated from the same sources, and employed the same procedures used to generate the class level values. Respondents were asked to select one of the three vehicles; however respondents were also presented the option of not choosing any of the vehicles presented.[10] If rejection of the choice set was selected, information was then collected on the reason for rejection.

[10] Few individuals chose the 'do not choose' option; these observations are not used in the analysis.

5 Data Analysis

5.1 Experiment I

Here we are interested in estimating whether the individuals' eco-assessments of the product differ across the eco-labeling treatments (Equation 2). In turn we estimated the following equation:

$$E_j = \Sigma\alpha_j INT_i + \Sigma\beta_k TREAT_k + \rho_1 CRED + \rho_2 SATIS + \rho_3 IMP + \delta_1 GENDER + \delta_2 AGE + \delta_3 EDUC + e \quad (7)$$

where E_j is the response to the question measuring the individual's assessment of the product's eco-friendliness. INT_j denotes the vector of intercepts (j = 1 – 3). $TREAT_k$ denotes the eco-label permutation the respondent viewed (k = A- E). CRED denotes the response to the question measuring the label's perceived credibility. SATIS denotes the response to the question measuring the respondent's level of satisfaction with the information. IMP denotes the response to the question measuring the label's importance. GENDER, AGE and EDUC denote the respondents' gender (1= male; 0 = female), age (in years) and education level (in years). Given the dependent variable is ordered we use ordered-logit techniques. The sign and significance of the β_k provides information on how the reactions of respondents' differed across labels; we test the equivalence of individual pairs of parameters (e.g., $\beta_A = \beta_B$), to determine if the impact of the eco-label are significantly different across the various information treatments.

5.2 Experiment II

In order for eco-labeling initiatives to meet the greatest level of success (i.e. result in the largest number of consumers choosing eco-labeled vehicles), a concrete understanding of the individual characteristics that influence a consumer's reaction to eco-labeling must be established. Here we consider the effect that the personal characteristics of a consumer may have in promoting environmentally responsible purchase behavior in response to eco-labels. Thus, the primary goal of this section is to develop an appropriate empirical model that identifies the variables that influence consumer purchase decisions. The empirical model for any one individual's choice is:

$$\text{Class Choice } [C_j] = \Sigma_j\alpha_j + \Sigma_j\gamma_{1j}USE_1 + \Sigma_j\gamma_{2j}USE_2 + \gamma_3(INC - APP_j - ACD_j) + CRITj^*(\gamma_5 + \rho_1 VSUB + \rho_2 FIO + \rho_3 PCE + \quad (8)$$

ρ_4KNOW + ρ_5CON) + GWG_j*(γ_6 + κ_1VSUB + κ_2FIO + κ_3PCE + κ_4KNOW + κ_5CON)

Vehicle Choice [$C_{k/j}$] = β_1(INC – APP_k – ACD_k) + $CRIT_k$ *(β_2 + λ_1VSUB + λ_2FIO + λ_3PCE + λ_4KNOW + λ_5CON) + GWG_k *(β_3 + τ_1VSUB + τ_2FIO + τ_3PCE + τ_4KNOW + τ_5CON) (9)

where Cj and Ck are discrete choice variables indicating an individual's choice of the jth class (either CAR/VAN,[11] SUV or TRUCK) and the kth vehicle (vehicle X, Y or Z), respectively. The class-level intercept terms (α_j) are employed as a means of capturing unobserved class-specific characteristics. USE_1 and USE_2 are constructed to measure the importance that respondents place on specific vehicle-related uses. Specifically, USE_1 measures the average importance (1 = not at all important; 5 = very important) a respondent places on using their vehicle to commute to work and to transport family. USE_2 is a similar measure to quantify the average importance a respondent places on using their vehicle for recreational or work-related hauling. A positive γ_{1CAR} is expected because people who require a vehicle for commuter uses are more likely to choose the CAR/VAN class. We hypothesize respondents who require their vehicle for hauling purposes will most likely choose a TRUCK over a CAR/VAN; this would indicate a negative γ_{2CAR}. We do not hold strong priors on the γ_{jSUV} parameters since SUV's have characteristics that fall in between those of cars and trucks.

Willingness to pay is a function of both price and income. In turn, we create the joint variable (INC – APP_j – ACD_j), where INC denotes the respondents' annual household income.[12] APP denotes the annual cost of purchasing the vehicle and ACD denotes the annual cost of driving. We calculated an annual purchase price for each vehicle provided in the choice scenario (using an interest rate of 6 % and a payment period of five-years). In addition, the annualized vehicle price was adjusted upward by 10 percent to include insurance and tax costs. The annual cost of driving (ACD) variable was created utilizing the formula: ACD = [1/MPG * MILES*

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[11] Testing indicates the original nesting structure (Figure 1.2) created instability in the parameter estimates and that it was not appropriate to have VAN as a separate nest. Once VAN was combined with the CAR nest, the model became stable.

[12] Since the utility evaluation is at the *individual* level, it is unfortunate we collected *household* income and did not collect household size. As income will be larger, on average, than it should be, the parameter on the joint variable may be underestimated.

CPG* 1.93], where MPG is the miles per gallon stated in the choice scenario for the vehicle, MILES denotes the annual number of miles driven by respondents, CPG is equal to $1.95 - the average cost per gallon of gasoline noted during the time of the survey administration. The last term (1.93) weights the annual gasoline costs to include the annual costs of maintenance.

APP and ACD is intended to capture how ownership and driving costs affect the purchase decision; however, since ACD uses MILES in its construction, ACD could be (at least partially) measuring the individual's need for a vehicle, or need for a larger (more comfortable) vehicle. If true, then one could expect that willingness to pay for a vehicle would increase with increased ACD. We expect this latter effect to be small and anticipate that as a vehicle/class becomes more expensive to own or drive, a respondent will be less likely to choose that vehicle/class. The reasoning behind our assumption is that Maine has a relatively poor public transportation infrastructure and poor weather for much of the year. Thus, we assume most of our respondents need a vehicle due to the lack of substitute means of transportation (i.e., few public transportation alternatives and walking would be uncomfortable for much of the year). Regarding the second possibility for ACD (need for a larger vehicle), we feel that the two USE variables are likely to capture much of this effect.

The parameter estimates on the monetary variables (γ_3 and β_1) should be positive; this would indicate that individuals would be less likely to purchase a vehicle/class with higher relative prices (note: as the annual purchase and driving costs increase, the monetary variable decreases)

CRIT and GWG denote the criteria pollution scores and the global warming scores presented to respondents for each class and vehicle. Both eco-scores were presented on a scale of 1 to 10, where 10 represented the cleanest emission record. It is expected that the coefficients on CRIT and GWG will be positive indicating that higher scores will increase likelihood of purchase.

The interaction variables were created to test whether various personal characteristics influence the importance the respondent places on the eco-information. VSUB, FIO and PCE are variables constructed by using factor analysis on the answers to nine perception questions.[13] The factor analysis indicates that individuals have three underlying factors influencing their responses to these nine questions. Factor one (FIO) reflects a *faith in*

[13] Responses to the questions are from a five-point Likert scale where 1 = strongly disagree, 3 = neutral, and 5 = strongly agree. For simplicity we will not fully discuss the factor analysis procedures here - details are available from first author.

*other*s; Factor 2 (PCE) relates to a persons *perceived consumer effectiveness* and Factor 3 (VSUB) measures a person's *perceived compromise* needed when buying a greener vehicles. We hypothesize the parameters on VSUB, FIO and PCE are negative, indeterminate and positive, respectively. If a consumer perceives that an eco-labeled vehicle is not an apt substitute for their normal vehicle, they will be less likely to purchase an eco-labeled vehicle. Consumers with a higher faith in others may be more likely to purchase an eco-labeled vehicle as they feel their pro-environmental choice may be part of a larger effort; however there may also exist an incentive to free-ride and thus the sign on FIO is ambiguous. Consumers with greater perceived consumer effectiveness will be more likely to purchase an eco-labeled vehicle.

KNOW is meant to measure a person's knowledge of vehicles' contribution to air quality; specifically KNOW is a dummy variable where 1 denotes the person feels that all vehicles pollute about the same when driven; 0 otherwise. We hypothesize that the coefficient on the KNOW variable will be negative; individuals who think that all vehicles pollute about the same should place less value on the environmental scores. CON is meant to measure the individuals' general level of concern about the amount of air pollution in Maine (where 1 = not at all concerned and 5 = very concerned). We hypothesize that the coefficient on the CON variable will be positive; individuals who have greater concerns about air quality should place more value on the environmental scores.

Given the two-stage nature of the choice, a nested logit is the most appropriate technique in estimating the results for this data set (Hensher & Greene 2002). Nested-logit models allow for the variances of the random error to be different across groups of alternatives in the utility expressions; this requires scale parameters to be introduced explicitly into the utility expressions (Hensher & Greene 2002). Consistent with the literature, the two scale parameters here are labeled λ (the parameter associated with the class-level utility) and μ (the parameter associated with the vehicle-level utility). To provide consistency with utility maximization, one of the scale parameters must by fixed (typically at 1). Here we estimate the nested-logit model with $\lambda = 1$; this allows the μ's to be free. Give our model contains alternative-specific variables this specification is consistent with utility maximization (Hensher & Greene 2002).

While the existing economic and psychology literatures provide guidance on what explanatory variables should be included in the model, they provide little guidance on whether the variables are important in the class-choice level, at the vehicle-choice level or at both levels in the nesting structure. Given our interest in identifying the form of the model we performed the following analysis on a subset of the data. We first estimated the full model (as presented in equations 8 and 9), then re-estimated the model 1) without any interaction terms; 2) without interaction terms at the class level only; and 3) without interaction terms at the vehicle level only. Using likelihood ratio tests we can then determine whether inclusion of the additional interaction variables is useful in explaining respondent choices. We also wanted to determine whether the interaction terms were important in explaining differences in individuals' reactions to the criteria pollution scores, the global warming scores or both. Again we used likelihood ratio tests. We find from these analyses that interaction terms are only important at the vehicle level and they are only important in explaining differences in reaction to the criteria pollution scores.[14] The final estimated model is discussed in the results section.

6 Results

6.1 Experiment I

As expected, an increase in the perceived label credibility and in the individuals' satisfaction with the amount of information leads to an increase in the eco-rating (Table 1). Because the regression equation contains the information treatment variables, the impact of information quantity on the information credibility and satisfaction ratings is already included. As a result, the label credibility and satisfaction parameters indicate how eco-ratings differ across individuals with different tastes and preferences for, or perceptions of, information, *holding information content constant*. Thus, individuals who are more trusting of, or satisfied with, a given level of information are more likely to view the product as eco-friendly, *ceteris paribus*. Interestingly, individuals with more education provided significantly lower eco-ratings. Gender, age and the stated importance of the information were not significant factors in explaining a respondent's product eco-rating.

In all cases, providing additional quantitative information to the eco-seal leads to *decreases* in the eco-rating of the product; this is consistent with individuals having incorrect priors of a vehicle's cleanliness. One potential measure of the effectiveness of an information policy is if consumers can adequately rank competing products by key attributes when faced with incomplete or imperfect information (see Lee and Olshavsky 1997, for a

[14] For brevity we will not fully discuss the analyses here - details available from first author

recent review of this literature). Here, the eco-seal does not provide any explicit environmental score; however, respondents must form some expectation of what the eco-seal means in terms of such a score. The eco-seal by itself apparently led respondents to incorrectly assess the vehicle as being environmentally better than when they were faced with more quantitative information.

Table 1. Regression results for experiment I

Parameter estimates	
Variable name	Coefficient
Intercept	1.825***
Intercept	5.042***
Intercept	6.530***
Treatment A	-4.039***
Treatment B	-4.727***
Treatment C	-5.317***
Treatment D	-4.800***
Treatment E	-5.027***
Perceived credibility	0.403***
Satisfaction with the amount of information	0.483***
Importance of the information	-0.036
Gender	0.093
Age	-0.001
Education	-0.076**

** significant at the five percent level;*** significant at the one percent level

A) only exhibits a State of Maine Clean Car logo with no additional text or information;

B) exhibits a State of Maine Clean Car label with a sliding scale comparing the vehicle to the average of all vehicles in the same class of vehicle;

C) exhibits a State of Maine Clean Car label with a sliding scale comparing the vehicle to the average of all personal vehicles;

D) exhibits a State of Maine Clean Car label with a sliding scale comparing the vehicle to the average of all vehicles in the same class of vehicle and all personal vehicles; and

E) exhibits a State of Maine Clean Car label with a thermometer scale comparing the vehicle to the average of all personal vehicles.

Respondent reactions across label treatments B and C seems to be in the ‘correct’ direction. That is, respondents gave significantly higher eco-ratings to vehicles environmentally better than a baseline rating (treatment B) compared to those worse than a baseline rating (treatment C). Comparing respondent reactions to treatments C and E indicate the display format of the label (sliding versus thermometer scales) did not impact a respondent’s eco-rating of the product.

Comparing treatments B and C with D provides some indication of the importance that respondents place on the different comparative baselines (the same class of vehicle or all vehicles). There is no difference in respondent reactions when they are presented only baseline information about the same vehicle class (treatment B) and when they are presented both the class baseline and the all-vehicle baseline (treatment D). However, there is a significant difference in respondent reactions when they only receive baseline information about all vehicles (treatment C) and when they receive both the class baseline and the all-vehicle baseline (treatment D). This suggests respondents' eco-ratings of vehicle are primarily driven by comparisons between a vehicle and vehicles within the same class. This conforms to previous focus group results (Teisl et al. 2004) where participants indicated that information about the environ-mental friendliness of vehicle should be relative to other vehicles in the same class. Participants reasoned most people shop for a particular class of vehicle because the vehicles within that class better meets their driving needs. They thought it unlikely an eco-label would induce someone to buy a vehicle from different vehicle class but could induce someone to buy a different vehicle from the same vehicle class.

6.2 Experiment II

The estimated scale parameters (the μ's) lead to Inclusive Values (IV) parameters ($1/\mu$) that are in the appropriate range ($0 \leq IV \leq 1$) for a utility maximizing individual (Hunt 2000). Further, the correlation-of-utilities coefficients ($1 - IV^2$) are relatively close to one (CAR = 0.85; SUV = 0.65 and TRUCK = 0.81) indicating the vehicle alternatives in each class segment are similar to each other (i.e., the nesting structure seems appropriate since the alternatives appear to be reasonable substitutes).

The CAR and SUV-specific variables indicate an individual's use of a vehicle is an important determinant of class choice (Table 2). As commuting becomes more important, respondents are more likely to choose the CAR or SUV class relative to choosing the TRUCK class. Conversely, as hauling becomes more important, respondents are more likely to choose the TRUCK class. The class specific attributes provided in the scenarios had no significant impact on class choice; this may indicate the use characteristics of the class are the primary driver of this choice or that respondents' priors of the different classes are more important than the class-level information we provided them (i.e., the respondent basically ignored the class-level information presented to them).

Table 2. Regression results for experiment II

Variable	Coefficient
Scale parameter (μ)	
CAR	2.610*
SUV	1.613
TRUCK	2.347*
Class choice	
Car-specific variables	
Intercept	-0.315
Importance of commuting (USE1)	0.928***
Importance of hauling (USE2)	-0.988***
SUV-specific variables	
Intercept	-1.513*
Importance of commuting (USE1)	0.692***
Importance of hauling (USE2)	-0.581***
Income – annualized price – annual driving cost (INC-APP-ACD)	-0.096
Criteria pollution score (CRIT)	0.041
Global warming pollution score (GWG)	-0.116
Vehicle Choice	
Income – annualized price – annual driving cost (INC-APP-ACD)	0.165*
Criteria pollution score (CRIT)	-0.006
Global warming pollution score (GWG)	0.098*
Green vehicles are poor substitutes (VSUB * GWG)	-0.005
Faith in others (FIO * GWG)	-0.006
Perceived consumer effectiveness (PCE * GWG)	0.019
All vehicle pollute the same (KNOW * GWG)	-0.014
Concern over air quality (CON * GWG)	0.018

Vehicle choice is positively impacted by the monetary variable; this indicates respondents are less likely to choose a vehicle as the costs of ownership or driving increases. Further, as income increases respondents are less sensitive to the negative price impact. The criteria pollution score is not significant except when its impact is jointly tested with the KNOW variable. The jointly significant negative sign indicates individuals who believe all vehicles pollute about the same when driven are less likely to choose a vehicle having better criteria pollution scores. Although not significant, the signs of the other perception and concern variables are as hypothesized.[15] The positive significant sign on the global warming pollution score indicates individuals are more likely to choose a vehicle displaying a better global warming score. Given all of the GWG interaction terms were deemed unimportant implies that, unlike respondent reactions to the criteria pollutant information, there is no heterogeneity in respondent reactions.

7 Conclusions

In debates surrounding eco-labeling programs, some have argued the lack of consumer response to these products may indicate that consumers do not really care about, or at least are not willing to pay more for, such products. Although this explanation may be valid, it is not necessarily true. One alternative explanation is that consumers do care about and are willing to pay for more environmentally benign products, but the current state of labeling these products is slowing the development of this market. Research in other markets has indicated that well-designed environmental (Bennett and Blamey 2001; Blamey et al. 2001; Teisl et al. 2002; Bjørner et al. 2004) labeling can significantly alter consumer and producer behavior. Experiment II suggests that consumers do value the environmental benefits of more environmentally benign vehicles (at least with respect to global warming gases).[16] Thus, consumer-driven purchases could potentially support an eco-labeled market. A further implication is that consumers who are willing to purchase vehicles with better environmental profiles face a welfare loss (a cost-of-ignorance) when this information is not available (see Teisl et al. 2001a for presentation of this issue).

Experiment I indicates an eco-seal with no other information gave respondents a greener view of the vehicle relative to more quantitative information. This sets up a potential conflict between market dynamics and environmental improvement. A policy of using eco-seals alone would presumeably increase the likelihood of an individual purchasing a labeled vehicle relative to the case of more complete eco-information. This can be seen as follows. Define demand as a function of price (P), income (M) and

[15] Given that KNOW is the only interaction term that leads to a significant impact of the CRIT score we used a likelihood ratio test to see whether dropping all of the other interaction terms was indicated. We find that the combination of interaction terms is a significant addition to the model.

[16] Note that the reactions to emissions labeling is directly at odds with current policy reality; in the US most vehicles display criteria emissions labels but no vehicles display global warming gas emissions.

assessed environmental quality (E); where E is a function of the underlying objective level of environmental improvement θ and the label used (S = eco-seal, L = more detailed label). Define θ^1 as a better environmental quality relative to θ^0. Experiment I indicates $D(p_1, M, E(S \mid \theta^0)) > D(p_1, M, E(L \mid \theta^0))$.

This, in turn, should increase the likelihood of changes in producer behaviors; firms develop new marketing strategies, new eco-products and/or alter the attributes of current products. This would imply the eco-seal alone would lead to a more rapid transition to a more eco-labeled *market*[17] situation (more rapid shifts in demand for, and supply of, eco-friendlier vehicles). However, it is unclear whether the eco-seal alone leads to a more rapid transition to a more eco-friendly *environmental* situation. To see this observe that: $D(p_1, M, E(L \mid \theta^1)) > D(p_1, M, E(L \mid \theta^0))$.

Hence the relevant comparison is between $D(p_1, M, E(S \mid \theta^0))$ and $D(p_1, M, E(L \mid \theta^1))$. Clearly, if $D(S \mid \theta^0) \leq D(L \mid \theta^1)$ then the more detailed label leads to a more eco-friendly *environmental* situation; however, when $D(S \mid \theta^0) > D(L \mid \theta^1)$ then the result is unclear because it depends upon the differences in vehicle demands and the differences in the θ's. One thing is clear though, consumers who are willing to purchase vehicles with better environmental profiles face a higher welfare loss (a cost-of-ignorance) when this information is provided through the use of eco-seals relative to the label situation (Teisl et al. 2001a).

In reviewing the above conclusions, one should also be mindful of the hypothetical nature of the experiments. First, the market-share dynamics of disclosure policies will be very sensitive to the number of firms in the market and the relative strengths of each firm (see Roe and Sheldon 2002 for an exploration of firm dynamics after the introduction of labeling). Second, using a survey approach may have allowed respondents to evaluate the labels more fully, and with potentially fewer distractions, than they would in an actual purchase setting (see Russell and Clark 1999, for an overview of instances when eco-labels may be less effective in a market setting). Finally, externally validated experiments indicate that when respondents do not face a real budget constraint they are not as sensitive to price differences as they are in real markets.

[17] Note we are using a very restrictive definition of market effect. Here we are taking the perspective of someone who defines market success solely in terms of increasing the demand for a labeled product.

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