What to Choose? The Value of Label Claims to Produce Consumers

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As a response to shifts in consumer demands towards healthier, more nutritious, and fresher food products, producers and retailers are increasingly engaging in marketing activities that highlight these characteristics. However, there are a variety of means of communicating this information, and often, marketers must choose to highlight a limited set of information from among competing claims on the same or similar attributes, or between alternative attributes. An emerging set of agribusiness market analyses show that marketable characteristics might include intrinsic, verifiable product-based attributes, such as those that contribute to nutrition or health in a specific manner (Baker and Burnham 2000; McCarthy and Henson 2005; Thilmany, Umberger, and Ziehl 2006; Wirthgen 2005). Still other characteristics may be process-based, like organic production, which may (or may not) connote at least a subset of these benefits, but may also provide additional values to consumers (such as perceived environmental stewardship). Furthermore, in practice, consumers do not typically choose these attributes in a separable manner one at a time, but rather choose the available bundle of attributes (including price) communicated on a packaged product that provides the greatest utility in the context of their overall diet, food budget, and purchase motivations.

Three key empirical questions thus present themselves, including: a) How do consumers value alternative claims on product and process-based attributes for fresh produce; b) Are these values additively separable; and c) To what degree is there heterogeneity between consumers on these values? This paper addresses these issues through the use of a hypothetical choice experiment on red leaf lettuce attribute bundles. Using survey responses, several logit models are estimated that provide estimates of marginal utilities (and with the inclusion of varying prices, marginal values) of various attributes related to general health claims, specific nutrition and health claims, certification logos related to health and nutrition currently found in the marketplace, as well as certified organic claims (relative to the conventional reference group).

As the statistical methods used in the paper are fairly well-established, our contribution to the literature comes from a more realistic representation of simultaneous multiple claims of product (health and nutrition) and process (organic production) attributes bundled on a label, some of which may be "certified" from non-producer groups. Doing so in a choice set rather than a traditional contingent valuation framework in which one or multiple attributes is changed at a time allows for reduced hypothetical bias and greater information in a more realistic choice setting. Furthermore, the choice sets are presented using graphically designed labels in an attempt to mimic what information and choices a consumer might have during the actual purchasing experience.

In addition to estimates of the choice probability effects and marginal values of each claim, we concentrate on the heterogeneity of preferences among consumers through a random parameters specification, and compare the results implied by simulating the unconditional and conditional parameter distributions. As this consumer heterogeneity is the basis for market segmentation and the ability to develop niche markets for producers, as well as the key to understanding how populations will respond to greater nutrition and health information and various certification programs, understanding this issue is of considerable significance.

Background

There are a wide variety of nutrient and health claims allowable on the labels of food products, depending on the regulatory constraints placed on such claims by individual nations (Williams 2005). In addition to nutrient content claims that list the qualitative or quantitative level of a particular attribute in a product (e.g., nutrient contest lists or claims such as "sugar free" or "low sodium"), the World Health Organization has characterized three types of health claims: 1) nutrient function claims, which describe the relationship between a nutrient and "normal" body function and development; 2) other function claims, which may "improve or modify" body function or development; and 3) disease risk-reduction claims, which relate food consumption to the probability of illness (Williams 2005; Hawkes 2004). In the United States, the relevant legislation is the 1990 Nutrition Labeling and Education Act (NLEA) and the associated 1994 rules implemented by the U.S. Food and Drug Administration (Roe, Levy, and Derby 1999). In essence, the regulations require packaged foods to display nutrient information in the format of the Nutrition Facts panel, as well as regulating serving size information, health claims, and descriptions of relevant nutrient content (Balasubramanian and Cole 2002).

A number of factors contribute to the relationship between food labels and consumer choice. Individual characteristics (such as socio-demographic traits, product, nutrition, health knowledge and experience, interest in general health issues, and skepticism of advertising claims), interact with the information content of the label and the aggregate information environment (e.g., a recent health scare widely reported in the media), in addition to price, taste, and other variables to influence a purchasing decision

(Wansink, Sonka, and Hasler 2004; Williams 2005; Balasubramanian and Cole 2002; Loureiro, Gracia, and Nayga 2006; Teisl, Bockstael, and Levy 2001). Clearly, these variables and their interactions are likely to result in a great deal of preference heterogeneity across any population of food consumers. Thus, structural models of consumer response to nutrient and health claims that attempt to segment consumers by individual and environmental characteristics are likely to be very data intensive and costly. In the current study, however, we use a less structured approach to test and represent these differences across consumers.

Previous research has investigated a number of specific hypotheses about consumer behavior and nutrition, health, and production process information. In response to NLEA, a considerable number of studies investigated preferences, use, and effectiveness of the Nutrition Facts label in the U.S. and the (potential) impact of similar labeling overseas (Gracia, Loureiro, and Nayga 2007 and citations therein; Loureiro, Gracia, and Nayga 2006; Wansink 2003; Mojduszka and Caswell 2000; Zarkin and Anderson 1992; Padberg 1992; Baltas 2001), with mixed results regarding label use and changes in behavior. Roe, Levy, and Derby (1999) found that front-label health and nutrient claims resulted in a shift of attention away from the back-label Nutrition Facts and towards the claims, resulting in a perception of more health benefits than claimed (termed “halo” effects and/or “magic bullet” effects). Subsequently, Wansink, Sonka, and Hasler (2004) concluded that short health claims on front labels tend to communicate benefits more succinctly and result in greater positive thoughts regarding product attributes than longer claims. Teisl, Bockstael, and Levy (2001) tested the effects of front-label nutrient content claims on grocery purchases of a number of common products, and found that while these claims tended to change behavior, the “healthy” alternative did not always increase market share. However, other studies have contradicted some of these results, suggesting that either the Nutrition Facts label was predominantly used or that front-label health claims did not affect preferences (Williams 2005; Keller et al. 1997; Mitra et al. 1999).

A related literature examines process-related preferences and labeling, with a particular focus on organic or eco-labeled products and genetically modified (GM) foods. With respect to the latter, the labeling issue is particularly important due to significant domestic and international trade issues and perceptions of risk (see, e.g., Carlsson, Frykblom, and Lagerkvist 2007; Gruere 2006; Bond, Carter, and Farzin 2003). Blaine, Kamaldeen, and Powell (2002) provide a recent review of consumer preferences towards labeling and other GM issues, while Roe and Teisl (2007) investigate the effects of the form of the label claim (presence or absence of GM ingredients) and the credibility of certifying agencies (USDA v. FDA) on stated preferences. Interestingly, these authors find that language that admits uncertainty of health or environmental impacts of GM processes on a label does not affect consumer response, which may be of some relevance to this study due to the uncertainty regarding the links between nutrient content and health. Kiesel, Buschena, and Smith (2005) analyze revealed preference data in the fluid milk market, and conclude that a segment of consumers do have preferences for recombinant bovine growth hormone free milk, and that this demand has a positive relationship with voluntary labeling.

While consumer utility has generally been found to be non-increasing in the presence of GM food attributes, organic and other ecolabeled foods tend to have non-negative effects on consumer utility. A number of studies have examined consumer preferences for organic products (see Yiridoe, Bonti-Ankomah, and Martin 2005 for a recent review), most finding at least a subset of consumers willing to pay a premium for organic produce and marginally related process attributes such as local production and GM-free (Loureiro and Hine 2002; Giraud, Bond, and Bond 2005; Thompson and Kidwell 1998; Govindasamy and Italia 1999). Batte, et al. (2007) extend the analysis to multi-ingredient processed organic food labeled under the comparatively new USDA National Organic Program.

This study spans the presented literature by investigating consumers' preferences for various attribute claims on a hypothetical front label for packaged fresh produce; namely, red leaf lettuce. We combine nutrient and health claims (nutrient content, nutrient function, and disease risk-reduction) with government-sponsored program and nonprofit organization labels of varying familiarity, as well as an organic process attribute in an experimentally-designed choice experiment. By including all of these possible claims, we span much of the potential marketing information that could be used to promote a healthy produce product (or even a "functional" food) in a manner consistent with the point of purchase marketing information available to consumers.

Methods

In this study, we perform a choice experiment that varies alternative nutrient, health, government label, and production process attributes on a fresh produce product to assess the preferences of consumers to varying levels of information and/or claims about nutritional health. Choice experiments are emerging as a popular tool to estimate non-market and/or unobservable valuations of goods or product attributes by decomposing relative utility into component, or marginal, effects. Particularly advantageous is the ability to value multiple attributes simultaneously, the consistency of choice experiments with random utility theory, and the similarity of the hypothetical choice posed to each respondent to real-world decisions faced every day (Lusk and Schroeder 2004; Adamowicz, et al. 1998). In addition, there is some evidence that this methodology reduces hypothetical bias relative to contingent valuation, at least in terms of marginal willingness to pay (Lusk and Schroeder 2004; Carlsson and Martinsson 2001). Nevertheless, in many cases, the models rely solely on stated, rather than revealed preference data, and results are conditional on exogenous analyst assumptions regarding error correlations and parameter distributions. Previous choice studies have investigated attribute valuations of a number food products, such as beef (Lusk and Fox 2000; Tonsor, et al. 2005), salmon (Alfnes, et al. 2006), coffee (Arnot, Boxall, and Cash 2006), apples (Kaye-Blake, Bicknell, and Saunders 2005), vegetables (Hearne and Volcan 2002), and ingredients in beer (Burton and Pearse 2002). Choice experiments related to labels have focused on process-based claims such as GM and ecolabeled products (Carlsson, et al. 2007; Harne and Volcan 2002; Matsumoto 2004), though a few have looked at labels relating to other process-based attributes, such as grain-fed veal (West, et al. 2002) and a "quality and safety" label on liver sausages (Enneking 2004). To the authors' knowledge, only Teratanavat (2005) has presented the results of a choice experiment that includes multiple health, nutrient, and process claims on the same label.

Survey

The data used in the choice experiment was collected as part of a larger ongoing research project focusing on the supply of and demand for enhanced nutritional properties of fresh produce through selection of alternative cultivars and production methods. One component of this effort was the administration of a national online survey of produce purchasing habits, contracted to National Family Opinion (NFO) in May, 2006, that included the choice experiment questions used in this analysis. A stratified sampling frame of NFO's database was used to invite 3,170 potential respondents to take the survey, with 1,549 returned for a response rate of 48.9%. Due to the focus of the survey on food purchases, 74% of respondents are female, consistent with the higher probability that females are the primary buyer of produce for a household. The sample is geographically and demographically representative of the U.S. population, with income and household size consistent with U.S. Census data. For more information about the overall survey, the reader is referred to Keeling-Bond, Thilmany, and Bond (2006) and Thilmany, Keeling-Bond, and Bond (2006). A summary of key socioeconomic and demographic data is presented in Table 1.

Experimental Design and Choice Sets

The choice experiment asked respondents to choose between two "New Red Fire" red leaf lettuce products with varying label claims and price levels, informed by comments made in the related project's consumer focus groups (where they looked for nutrition information), science-based results from production studies and the food science literature (for realistic nutrtitional content claims) and current market price levels. In general, our goal was to include the full realm of potential label information that may influence a consumer's fresh produce decision, with specific attention to the attributes that were the focus of the research project (nutritionally superior cultivars, organic production and prices).

Specifically, as detailed in Table 2, we vary two general marketing claims related to nutritional aspects of the product, a nutrient claim regarding Vitamin C content of the lettuce, two claims relating specifically to potential health benefits, two logos that would theoretically certify that the product was endorsed by a government or nonprofit-sponsored health program, and an organic claim. This set of attributes is consistent with the types of issues that came up most frequently in focus group discussions on fresh produce purchasing and consumption decisions. It should be noted that local purchases were also discussed frequently, but not included in the choice sets because of the national coverage of the survey.

Inclusion of a "no claim" option for the Vitamin C attribute and health claims, and a "both" option for the logos, resulted in a total of 72 unique produce labels. Three price levels were included in the final analysis, with the second roughly corresponding to observed read leaf lettuce retail prices in Colorado groceries immediately preceding administration of the survey. With the exception of the price level, all attributes were dummy coded, with a base level of "none" for the Vitamin C and health claims, and "both" or the logos.

Choice sets were designed with two label/price options per decision, with an additional choice of no preference between the two. A software-generated design maximizing the D-efficiency criterion, with main effects and select interactions (organic/Vitamin C, Vitamin C/Health, Health/Logo) was constructed using SAS 9.1 to allow for testing of attribute bundling (see Lusk and Norwood 2005 for a comparison of design alternatives and trade-offs involved with each). As the non-price attributes were informational in nature and not *a priori* directional in terms of utility, clearly dominated alternatives were not an issue. Sample correlations between each attribute were generally low, with most less than 0.2.

Each respondent was randomly offered 8 choices from the 40 constructed choice sets, preceded by the following instructions:

> "In this section, we would like you to consider a hypothetical market choice between New Red Fire lettuce products at different prices. You will be presented with a series of choices, each with three options. Two of the choices include a label describing two differently priced products with similar, but not identical, attributes. This label would appear on a plastic clamshell container holding approximately 4 ounces of the New Red Fire lettuce product. The third choice, Choice C, indicates no preference between Choices A and B. Please indicate which choice you prefer."

As such, respondents at each choice occasion could choose between three alternatives with a total sample of 12,392 choices. The first choice set is displayed in Figure 1. All estimation was performed using NLOGIT 3.0.25.

Econometric Model Specification

Development of the formal choice experiment model has been extensively discussed elsewhere (see, e.g., Louviere, Hensher, and Swait 2000 or Hensher, Rose, and Greene

2005), so we only briefly state the structure of the model here. Assuming each individual i in the sample has full and complete preferences over each potential choice j for each (non-indexed) choice occasion, the utility obtained from j is represented as

$$U_{ij} = V_{ij} + \varepsilon_{ij},$$

where V_{ij} is deterministic utility and ε_{ij} is a random component. An individual chooses j from the set of choices C_i only if $U_{ij} \geq U_{ik} \ \ \forall k \in C_i$, and thus the probability of choosing j can be written $\Pr\left\{ j \text{ chosen} \right\} = \Pr\left\{ V_{ij} + \varepsilon_{ij} \geq V_{ik} + \varepsilon_{ik} \right\}$ for each k. Parameterizing the deterministic portion of utility and assuming the ε_{ij} are distributed Type I extreme value, the probability statement can be rewritten as

$$\text{(1)} \qquad \Pr\left\{ j \text{ chosen} | X_{ij}, \beta \right\} = \frac{e^{V_{ij}(X_{ij},\beta)}}{\sum_{k \in C} e^{V_{ik}(X_{ik},\beta)}},$$

where X_{ij} is a vector of individual characteristics or choice-specific attributes and β is a vector of parameters to be estimated.

In the simplest case, there is no unobserved heterogeneity, the $\varepsilon_{ij}'s$ are independent and identically distributed (*iid*), and (1) is a multinomial logit (MNL) model. However, with the statistical assumption of *iid*, the MNL suffers from the implied independence of irrelevant alternatives (*iia*) behavioral assumption, which if not met results in biased and inconsistent coefficient estimates. An alternative is the mixed logit (ML), also called the random parameters logit (RPL) model, which allows for a relaxation of this assumption (via correlations in the error term between alternatives and choices) by assuming that a subset of the parameter vector varies by individual i

according to an analyst-specified distribution.[1] Most generally, the parameter vector could be decomposed into fixed and random components specified as $\begin{bmatrix} \boldsymbol{\beta}_F \\ \boldsymbol{\beta}_{iR} \end{bmatrix} = \begin{bmatrix} \overline{\boldsymbol{\beta}}_F \\ \overline{\boldsymbol{\beta}}_R + \boldsymbol{\Omega}_R \boldsymbol{\Gamma}_i \end{bmatrix}$, where $\overline{\boldsymbol{\beta}}_F$ and $\overline{\boldsymbol{\beta}}_R$ are parameter means for the fixed and random parameters, respectively, $\boldsymbol{\Gamma}_i$ is a vector of random variables distributed according to the assumption made by the analyst that accounts for heterogeneity across respondents, and $\boldsymbol{\Omega}_R$ represents the structure of the (symmetric) variance-covariance matrix of $\boldsymbol{\beta}_{iR}$. In this case, the left hand side of (1) is conditional on the mean and variance parameters characterizing the random coefficients, as well as the assumed joint distribution of the random parameters. Estimation is carried out via maximum simulated likelihood (see Stern 1997, Hensher, Rose, and Greene 2005, and Train 2003).

As in previous studies (e.g., Lusk, Roosen, and Fox 2003, Hu, Adamowicz, and Veeman 2006), we choose to report results for both the MNL and ML model specifications for several reasons. First, despite its shortcomings, the MNL model is familiar to the majority of practitioners and is still popular due to "ease of computation and the wide variety of software packages capable of estimating" it (Hensher, Rose, and Greene 2005, p. 518). Second, the MNL specification is essentially a restricted ML model that imposes the *iid*/*iia* assumption. Finally, it provides an excellent baseline against which to measure the effects of introducing random parameters and this specification's effect on estimates of willingness to pay (WTP) for each attribute.

Results

[1] Other discrete choice models which relax this assumption include the nested logit model,

Parameter Estimates

Table 3 provides estimation results for the following models: (1) = MNL ignoring interaction effects; (2) = MNL including interaction effects; (3) = ML model ignoring interaction effects; and (4) = ML model including interaction effects. For each of these models, we expect a negative relationship between the probability of choosing an alternative and price *ceteris paribus* (law of demand), and a positive relationship between choice probabilities and the presence of the vitamin C claim (Rosen 1974; Huang 1996; Beatty 2007), either of the two health claims, and the organic claim (Dhar and Foltz 2005; Loureiro et al. 2001). In terms of the government-approved labels, we expect the lack of one of the labels (relative to the baseline of both) to be negatively correlated with the probability of choosing an alternative, but have no prior on which health claim will be most attractive.

Each model is significant at the 99% level and predicts correctly in approximately 49-52% of the choice occasions. In the main effects (no interactions) models, the coefficient on each primary attribute was strongly significantly different from zero, with the expected negative coefficient on the price attribute. Marginal effects of each health claim, the vitamin C claim, and the organic attribute coefficient were positive, with the coefficient of health claim A (focusing on healthy diets and fruits and vegetables in general) significantly greater than that of health claim B (which mentions fiber, vitamin A, and vitamin C), even though both focused on reducing risks of coronary disease and some types of cancer. In fact, the coefficient on health claim A was the largest of the non-price attributes, suggesting that consumers in this sample tended to respond most to a label marketing a generally healthy diet, rather than specific product nutritional or process attributes. This is consistent with findings from the 2007 Food & Health Survey: Consumer Attitudes toward Food, Nutrition & Health study conducted by the International Food Information Council (http://www.ific.org/research/ foodandhealthsurvey.cfm). When asked (without prompting) what changes they are making to improve the healthfulness of their diet, Americans indicated they are both increasing (36 percent in 2007 vs. 23 percent in 2006) and decreasing (29 percent in 2007 vs. 21 percent in 2006) consumption of specific foods and beverages, rather than noting specific vitamins and nutrients they are trying to increase in their diet.

While these results were expected, the signs on each of the nonprofit label variables (a generally familiar “five-a-day” logo from the newly renamed Produce for Better Health Foundation and a new, unexplained antioxidant label) were positive, contrary to expectations. This result suggests that the probability of choosing a product with only one logo is greater than that if both logos appear (or alternatively, the lack of one of the logos is a “good”). The significantly greater sign on *Fiveaday*, however, suggests that unfamiliarity with the *AOX* logo may decrease the probability of choosing a product that displays such a label. Indeed, although more well-known, this may also explain the positive sign on *Aox*, which also describes the effect of the lack of the Five-a-day label.

Turning next to the interaction effects, model (2) in Table 3 reports a model with the experimentally-designed interactions included. Compared to model (1), the joint insignificance of the interactions is rejected via a likelihood ratio test (test statistic = 122, critical $\chi^2(7) = 18.48$ at 1%), suggesting non-linear responses to bundles of alternative product claims. However, these effects tend to be claim/logo specific in terms of direction. Negative coefficients on the health claim and the *AOX* logo interactions indicate a decreased probability of choice in the joint presence of the sole logo and health claim, but an increased probability in the joint presence of the Five-a-day logo and the specific health claim B. Interactions between health claim A and the Five-a-day logo, however, were insignificant (as was the linear effect on the Five-a-day logo). Again, since the five-a-day logo has been more promoted historically, and connected with a health-oriented foundation, it may increase the credibility of any specific nutrient claim.

Interactions between the Vitamin C nutrient claim and each health claim were also negative and significant, likely due in part to the perception of repetition in label information. This explanation is supported by the larger magnitude of the coefficient on the coefficient associated with the more specific health claim B, which also mentions the Vitamin C content of red leaf lettuce. Finally, the interaction coefficient of organic and the Vitamin C claim is positive and significant, with the main effects organic coefficient decreasing in magnitude relative to model (1). In other words, the marginal effect of organic production on choice probability is greater when the Vitamin C claim is present on the label as well. One explanation is that the linear effect of the organic attribute is due to public good aspects of the production process, while the addition of the nutrient claim induces a response to organic production that is both public and private in nature. Alternatively, consumers may still be searching for relevant benefits from organic produce, so that bundling claims conveys information about the lettuce product and a product certification of which the consumer is just becoming aware.

While the MNL model can provide initial information regarding the structure of the choices made be respondents in the sample, the assumed error structure (*iid*) and associated behavioral structure (*iia*) renders coefficients inconsistent if these assumptions are violated. However, *iid*/*iia* can be tested via a Hausman test based on restricted alternatives in each choice set (Hausman and McFadden 1984). In this particular case, we reject the null hypothesis of *iid/iia* with p-values less than 0.0001 for each alternative. As such, a ML specification that accounts for correlations between individuals, alternatives, and choices is appropriate.

Final ML main effect and interaction models with no explicit coefficient covariance parameters are presented in the last two columns of Table 3. To obtain these results, models with all non-price parameters were estimated as normally distributed random variables, and the standard deviation components jointly tested for insignificance. Cases where the standard deviations were not significantly different from zero were interpreted as fixed (i.e., non-random) parameters, and the model re-estimated as such. Final specifications are reported in the table.

For the main effects ML model, mean coefficient estimates display a similar pattern as the MNL model in terms of parameter signs, though magnitudes tend to be between 1.33 and 3.1 times greater. Random parameters include coefficients on the general marketing claim (*Gen*), the vitamin-C nutrient claim (*Nut*), general health claim A (*Health A*), and organically-produced lettuce (*Org*). As shown by the standard deviation estimates on the random parameters, there appears to be significant heterogeneity in respondent behavior, especially with regard to *Gen* and *Org*.

In the interaction model, we reject a non-zero standard deviation for *Health A* and thus estimate it as a fixed parameter. Interestingly, despite a marginally significant standard deviation parameter on *Nut*, the mean estimate is not significant. As such, the parameter estimate suggests the lack of a marginal effect of the vitamin-C nutrient claim on average across the population, but individual responses that are approximately equally split between positive and negative effects on choice probabilities. Furthermore, as a result of the random parameter specification, the vitamin C/health interaction variables and *AOX* logo/health interaction variables are now insignificant, though there are positive and significant interactions with the Five-a-day logo and the health variables.

More details regarding the random parameters are given in Figure 2, which shows the empirical distribution of the unconditional random parameter estimates (simulated by the point estimates of the mean and standard deviation of each random parameter) and conditional common-choice-specific parameter estimates using information provided in the sample (Hensher, Rose, and Greene 2005). In particular, the latter estimates are randomly assigned to each observation with common choices based on the density

$$H\left(\beta_i \mid Y_i, X_i, \Omega\right) = \frac{f(Y_i \mid \beta_i, X_i, \Omega) P(\beta_i \mid \Omega)}{f(Y_i \mid X_i, \Omega)}, \quad (2)$$

where *i* denotes an individual, Ω denotes the underlying moments (parameters) of the random parameters, $f(Y_i \mid \beta_i, X_i, \Omega)$ is the probability of a choice conditioned on the random parameter values, their underlying moments, and the data submatrix

X_i, $P(\beta_i \mid \Omega)$ is the assumed density for the random parameters, and $f(Y_i \mid X_i, \Omega)$ is the unconditional probability distribution of a choice (Hensher, Rose, and Greene 2005). As our sample is representative of the U.S. population and the conditional parameter distributions use all available sample information, we focus on these estimates in the text.

As can be seen in Figure 2, the empirical distributions are slightly skewed (positive for *Gen*, negative for *Org* and *Nut*), with all three admitting a considerably higher kurtosis (more peaked) and fewer extreme values than the unconditional (normal) distributions. In other words, there is relatively *less* heterogeneity than predicted by the unconditional parameters. Based on these distributions, there is a 92.4% probability that the claim "more natural nutrition for a healthy immune system" will increase choice probability over the more general claim "selected for nutritional benefits", a 72.6% chance that the vitamin C claim will increase choice probability for the non-organic product, and a 21.2% probability that organic production would be favored without the additional vitamin C claim. If the Vitamin C claim appears on an organic label, the probability of a positive marginal effect of the organic attribute on choice increases dramatically to 92.2%. Again, this might suggest that the claim is informing the consumer on the potential benefits of an emerging food certification (organic) for which they are still collecting and processing information.

The other striking result from Figure 2 is the large density concentrated over a relatively small portion of the range of the random parameters. The probability of $0 \le \beta_{Gen} \le 0.385 = .713$, $0 \le \beta_{Nut} \le 0.041 = .713$, and $-0.386 \le \beta_{Org} \le 0 = .711$ conditional on the choices made, relative to the corresponding unconditional estimates of 0.074, 0.081, and 0.074, respectively.[2] For the both the marketer and the economic analyst, these results suggest use of unconditional random parameter estimates may, in some cases, considerably overstate the degree of heterogeneity in the sample and/or population, and thus overestimate the likelihood of niche market opportunities. In addition, the means of the conditional parameter estimates are considerably closer to zero in all three cases than the unconditional estimate, suggesting that the latter may overstate marginal impacts of a particular attribute. Table 4 presents the summary stats for the conditional and unconditional estimates.

Willingness to Pay (WTP)

With inclusion of a price attribute in the choice exercise, the dollar value necessary to equate utility levels across choices with different attribute sets can be computed, and thus marginal WTP for a particular attribute can be recovered. In this context, these values could be considered premia (or discounts) that could be charged for alternative red leaf lettuce attributes without materially affecting an individual choice.

Table 5 provides the point estimates of marginal WTP for each attribute, including asymptotic standard errors. Here, we focus on the ML interaction model. Health claim A appears to worth the most of all the attributes at approximately \$0.67, though this increases to almost \$1.00 (\$0.97) when bundled with the "Five-a-day" logo alone. The general nutrition claim and health claim B are similarly valued at \$0.32 and \$0.39, respectively, with the latter also worth more with the lack of the antioxidant label.

[2] These values were chosen based on the bin definitions used by the histogram routine in NLOGIT, fixing the number of bins at 40 and accounting for at least 99.9% of the density implied by the unconditional parameter estimates.

The organic production premium without additional information regarding vitamin C is worth approximately \$0.11, but this increases to \$0.50 when bundled with this claim, suggesting that consumers may believe this validates organics as a higher quality product.

While these point estimates are likely the most familiar to the reader, the random parameters of the model suggest that there is heterogeneity in marginal WTP for each associated attribute, and once again, either the unconditional or conditional parameter values can be used to estimate (Hensher, Rose, and Greene 2005). As the coefficient on the price attribute was estimated as fixed, these distributions mirror those in Figure 2, with the support values divided by the negative of this coefficient (1.505). Thus, mean conditional WTP estimates are $Gen = \$0.11$, $Nut = -\$0.01$, and $Org = \$0.04$ (ignoring interaction effects), though there is still considerable heterogeneity around these means. The major proportion of the random marginal WTP densities are thus defined by $\Pr\left(\$0 \leq WTP_{Gen} \leq \$0.256\right) = .713$, $\Pr\left(\$0 \leq WTP_{Nut} \leq \$0.027\right) = .713$, and $\Pr\left(-\$0.256 \leq WTP_{Org} \leq \$0\right) = .711$. Even with the bundled vitamin C nutrient claim, less than 14% of the sample respondents would be WTP more than the unconditional mean estimate of \$0.50 for organic production.

Conclusions and Implications

Consumers face an ever-increasing set of claims regarding the nutritional content of food products, the associated health effects of a product's nutritional profile, and the private and public good aspects of process-based attributes (like organic production). In addition, food markets typically offer a large number of substitutes which compete via marketing efforts that attempt to highlight the potential positive impact of nutritionally superior cultivars or products. Understanding consumer preferences and responses related to these claims and processes are not only important to producers attempting to capitalize on this information, but increasing health care costs and awareness of the large number of Americans suffering from obesity-related disease provide a public policy motivation for studying consumer behavior in this context.

This paper used a choice experiment to estimate the marginal utilities and WTP for a number of health, nutrition, nonprofit-sponsored logo, and production process attributes for a hypothetical brand of packaged red leaf lettuce. The results showed that consumers do distinguish between competing claims and logos, though the impacts are not always as expected, likely due to the information set used at the time of the choice. In our experiment, general health claims relating a “healthy diet rich in fruits and vegetables” to reduction in coronary heart disease risk proved most effective in attracting consumers (i.e., the greatest marginal utility), though more specific health claims were relatively highly valued as well. We found some evidence of attribute bundling between the health claims and the familiar Five-a-day program logo, and between organic production and a claim regarding vitamin C content. Interestingly, however, neither the logo nor the vitamin C claim was significant on its own in the ML model with interactions, though some multicollinearity was induced through inclusion of these effects.

From a statistical standpoint, the results confirmed previous results that the MNL model (and more specifically, its associated error and behavioral assumptions) can be misleading due to a lack of accounting for preference heterogeneity within the sample.

We further extend this result to empirical estimates of the distribution of the random parameters based on their unconditional and conditional distributions. Specifically, in this application, use of the unconditional distributions (relative to the conditional) overstates the degree of preference heterogeneity across the sample and overstates the magnitude of the marginal effects of the random parameters. This may create misleading impressions regarding the existence and size of specialized niche markets, the response of consumers to varying health, nutrition, or process claims, and/or the response of consumers to the introduction of new products with these (or similar) claims.

Further research is needed in order to assess the potential for generalization of these results to additional choice settings. First, these models were estimated using stated, rather than revealed, preferences, and thus the possibility of hypothetical bias is present. Methods incorporating binding scenarios (such as those in Alfnes, et al. 2006 and Lusk and Schroeder 2004) could be pursued in order to alleviate this problem. Second, while we hypothesize that observed choices are significantly influenced by the information set available to an individual at the time of the response (e.g., the meaning of a logo, the nutritional content of a food, or the relationship between nutritional content and health), more research is needed to understand this relationship. At a minimum, this understanding could help identify the source of the preference heterogeneity represented by the random parameters, and place individuals more precisely on the distribution. Experiments that investigate consumer response to information revelation would be helpful. Third, the product and associated attributes are clearly specific to this application, and additional claims, processes, and logos could be modeled.

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Table 1. Summary Statistics of Socio-Demographic Characteristics (n = 1549)

Category	Description	Mean
Age	In years	51.07
		(14.70)
Gender	1 if female	0.74
		(0.44)
Weekly Grocery Expenditures	1 = < $50,	2.36
	2 = $50 - $99	(1.01)
	3 = $100 - $149	
	4 = $150 - $199	
	5 = $200 - $299	
	6 = $300 or more	
Household Income	1 = < Under $30,000	2.49
	2 = $30,000 - $49,999	(1.17)
	3 = $50,000 - $74,999	
	4 = $75,000 and Over	
Household Size	Actual number in household, range: 1 to 7 members	2.41
		(1.34)
Life Stage	1 if single, no children, 0 otherwise	0.26
		(0.44)
	1 if couple, no children, 0 otherwise	0.40
		(0.49)
	1 if couple, at least one child in household	0.32
		(0.47)
Primary Fresh Produce Source	Supermarket	55.65
(% of sample)	Health Food Store	2.19
	Supercenter	10.39
	Farmers' Market	25.24
	Direct from Producer	4.84
	Specialty Store	1.68

Std. deviation in parentheses.

Table2. Attributes and Levels in the Choice Experiment

Variable	*Value*	***General Marketing Attribute***
	0	Selected for Natural Benefits! (base)
Gen	1	More Natural Nutrition for a Healthy Immune System!
		Nutrient Attribute
	0	None (base)
Nut	1	Excellent source of Vitamin C, an antioxidant nutrient
		Health Attribute
	0	None (base)
Health A	1	Healthy diets rich in fruits and vegetables may reduce the risk of coronary heart disease and some types of cancer.
Health B	1	Vegetables like red leaf lettuce that contain dietary fiber, vitamin A, and vitamin C may reduce the risk of coronary heart disease and some types of cancer.
		Logo Attribute
	0	Both (base)
Fiveaday	1	5-a-Day
AOX	1	AOX
		Organic Attribute
	0	No (base)
Org	1	Yes
		Price (per 4 oz clamshell) Attribute
Price	1.99	1.99
	2.99	2.99
	3.99	3.99

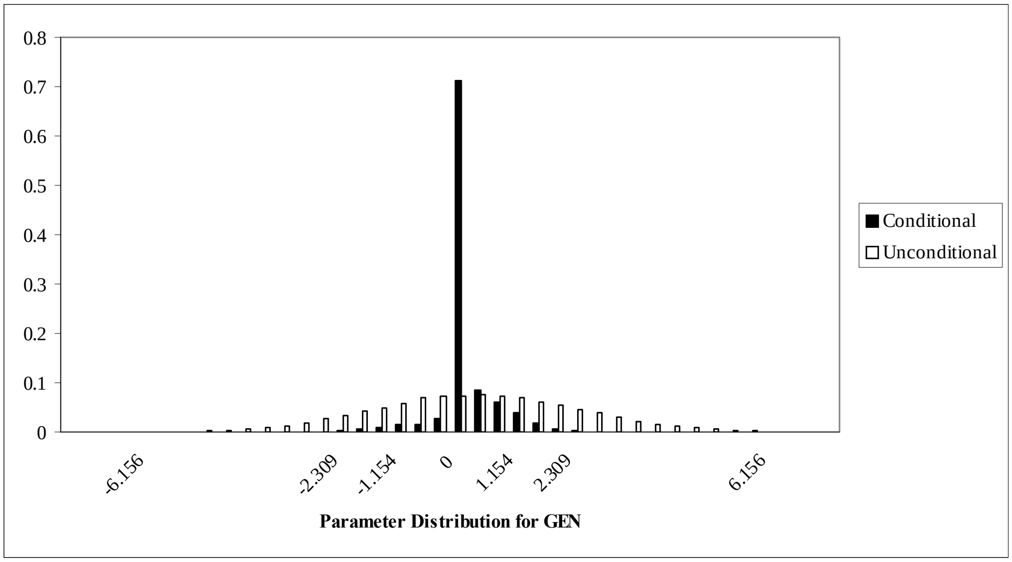
Figure 1. Choice Set #1 as Presented to Respondents (no preference option not shown)

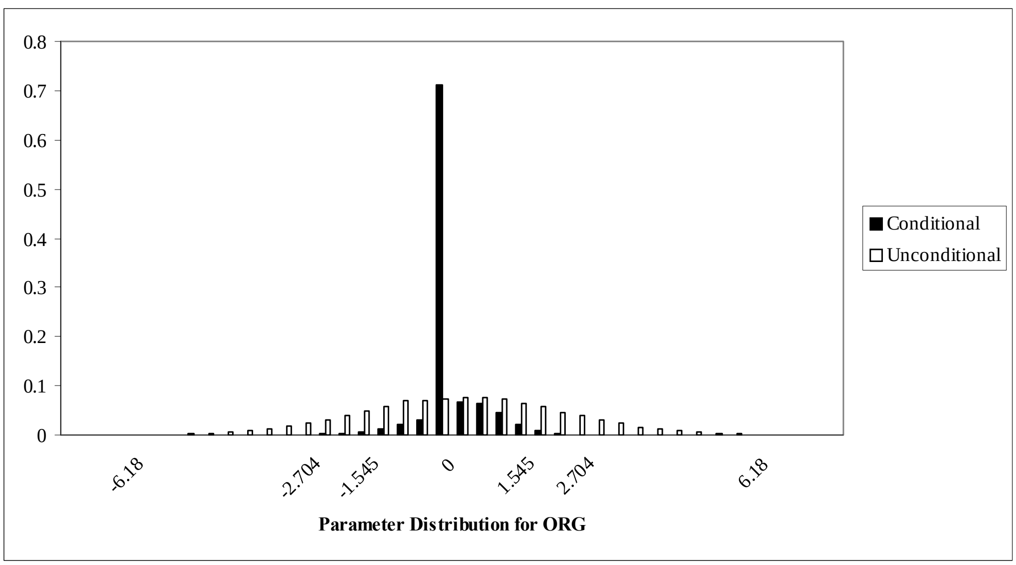
Table 3: Multinomial Logit (MNL) and Mixed Logit (ML) Model Results

	MNL Models		ML Models			
	(1)	(2)	(3)		(4)	
			Mean	Std. Dev	Mean	Std. Dev
Gen	0.264***	0.253***	0.580***	2.423***	0.482***	2.031***
	(0.032)	(0.032)	(0.066)	(0.153)	(0.056)	(0.135)
Nut	0.096***	0.148**	0.144***	0.835***	-0.036	0.200
	(0.029)	(0.070)	(0.044)	(0.196)	(0.091)	(0.132)
Health A	0.885***	1.154***	1.214***	0.659**	1.001***	
	(0.040)	(0.081)	(0.067)	(0.286)	(0.108)	
Health B	0.597***	0.672***	0.856***	--	0.583***	
	(0.039)	(0.079)	(0.061)		(0.111)	
Fiveaday	0.242***	0.111	0.323***	--	-0.111	
	(0.038)	(0.073)	(0.058)		(0.097)	
AOX	0.092**	0.411***	0.290***	--	0.320***	
	(0.038)	(0.071)	(0.064)		(0.105)	
Org	0.296***	0.119***	0.584***	2.330***	0.169***	1.998***
	(0.032)	(0.045)	(0.064)	(0.151)	(0.065)	(0.137)
Price	-1.109***	-1.091***	-1.682***	--	-1.505***	
	(0.019)	(0.019)	(0.061)		(0.037)	0.756***
Constant	-2.843***	-2.764***	-4.285***	--	-4.087***	
	(0.071)	(0.089)	(0.170)		(0.151)	
*Org*Nut*	--	0.297***	--	--	0.587***	
		(0.063)			(0.083)	
*Nut*Health A*	--	-0.196***	--	--	-0.129	
		(0.075)			(0.098)	
*Nut*Health B*	--	-0.280***	--	--	-0.054	
		(0.080)			(0.110)	
*Health A*Fiveaday*	--	-0.089	--	--	0.455***	
		(0.101)			(0.139)	
*Health A*AOX*	--	-0.577***	--	--	-0.136	
		(0.092)			(0.141)	
*Health B*Fiveaday*	--	0.405***	--	--	0.644***	
		(0.094)			(0.127)	
*Health B*AOX*	--	-0.322***	--	--	-0.050	
		(0.092)			(0.130)	
Psuedo-R2	0.181	0.181	0.227		0.227	
n (# of choices)	12392	12392	12392		12392	

Std errors in parentheses.*** denotes significant at 1%, ** denotes significant at 5%.

Figure 2. Empirical Unconditional and Conditional Random Parameter Distributions





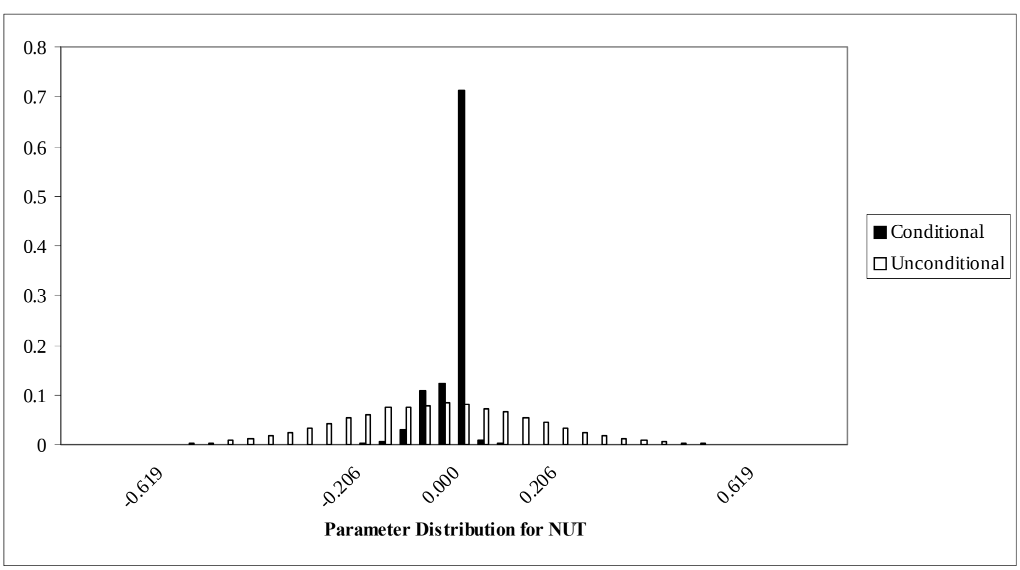


Table 4. Unconditional and Conditional Random Parameter Estimates, ML Model with Interactions

	Mean	Std. Dev.	Skewness	Kurtosis	Min	Max
Unconditional						
Gen	0.482	2.032	-0.023	2.975	-7.325	8.879
Nut	-0.036	0.200	-0.023	2.975	-0.803	0.789
Org	0.169	1.998	-0.023	2.975	-7.507	8.426
Conditional						
Gen	0.162	0.200	0.546	8.954	-4.504	4.778
Nut	-0.012	0.521	-2.135	10.938	-0.501	0.306
Org	0.060	0.571	-0.240	15.957	-3.933	3.973

Table 5: Willingness to Pay (WTP) Results, MNL and ML Models

	MNL Models		ML Models	
	(1)	(2)	(3)	(4)
Gen	0.24***	0.23***	0.34***	0.32***
	(0.029)	(0.029)	(0.037)	(0.036)
Nut	0.09***	0.14**	0.09***	-0.02
	(0.026)	(0.064)	(0.026)	(0.060)
Health A	0.80***	1.06***	0.72***	0.67***
	(0.037)	(0.076)	(0.037)	(0.076)
Health B	0.54***	0.62***	0.51***	0.39***
	(0.036)	(0.073)	(0.036)	(0.076)
Fiveaday	0.22***	0.10	0.19***	-0.07
	(0.034)	(0.067)	(0.035)	(0.064)
AOX	0.08**	0.38***	0.17**	0.21***
	(0.034)	(0.066)	(0.038)	(0.071)
Org	0.27***	0.11***	0.35***	0.11***
	(0.029)	(0.041)	(0.036)	(0.043)
*Org*Nut*	--	0.27***	--	0.39***
		(0.058)		(0.054)
*Nut*Health A*	--	-0.18***	--	-0.09
		(0.069)		(0.065)
*Nut*Health B*	--	-0.26***	--	-0.04
		(0.074)		(0.073)
*Health A*Fiveaday*	--	-0.08	--	0.30***
		(0.093)		(0.090)
*Health A*AOX*	--	-0.53***	--	-0.09
		(0.092)		(0.094)
*Health B*Fiveaday*	--	0.37***	--	0.43***
		(0.086)		(0.084)
*Health B*AOX*	--	-0.30***	--	-0.03
		(0.084)		(0.086)

Asymptotic std errors in parentheses, calc. via delta method.

*** denotes significant at 1%, ** denotes significant at 5%.