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Buying Your Way into a Healthier Lifestyle: A Latent Class Analysis of Healthy Food Purchases

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ABSTRACT

A non-hypothetical second-price Vickrey auction was conducted to elicit consumer preferences and willingness to pay for vegetable attributes, including production technique, origin, taste, and health benefits. Using a Latent Class Analysis (LCA) we segmented participants based on health-driven motivations, willingness to pay estimates, and socio-economic characteristics. Two latent classes were found and characterized as: "Health Conscious", and "Health Redeemers". In particular, the "Health Conscious" consumers presented healthy lifestyle habits, expressed price premiums for domestic and local-specialty food products after a blind tasting treatment, but they did not have price premiums for health benefits of the products. On the contrary, the "Health Redeemers" presented unhealthy lifestyles but they were willing to pay more for healthy food products, perhaps in an attempt to make up for their unhealthy habits.

Key words: credence attributes; functional foods; health behaviors.

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1. Introduction

The prevalence of obesity in the United States has continued to grow to a point where it is becoming a public health crisis (Ogden et al. 2014; Wang, Monteiro, and Popkin 2002). The spending on national health care costs was $2.5 trillion in 2009 (Truffer et al. 2010), with direct costs of obesity estimated to be as high as $147 billion (Finkelstein et al. 2009). Body mass index (BMI), defined as weight/height^2 (in units kg/m^2), is generally used to classified overweight (BMI ≥ 25) and obesity (BMI ≥ 30) among adults. According to the 2009-2010 National Health and Nutrition Examination Survey (NHANES), approximately 33% of adults are overweight, 35.7% are obese, and 6.3% are extremely obese (Fryar, Carroll and Ogden 2012). The principal causes of obesity growth are excess calorie consumption and physical inactivity (WHO 2014). The Dietary Guidelines for Americans (DGA) 2010 recommends a reduction in the amount of meat, poultry and eggs, refined grains, solid fats and added sugars, and promotes the consumption of fruits, vegetables, seafood, dairy, and whole grains (DGA 2010). An analysis of food consumption in the U.S. shows that the typical American diet is not consistent with the DGA recommended intake levels. On average, Americans exceed the optimal intake levels of meat, poultry, and eggs by 10%, solid fats and added sugars by 180%, refined grains by 100%, and saturated fat but 10%. In contrast, they fall short of the optimal intake levels of fruits by 58%, vegetables by 41%, wholegrains by 85%, dairy by 48%, and seafood by 56% (DGA 2010).

There exist several health risks associated with overweight and obesity, including cardiovascular diseases, type 2 diabetes mellitus, certain cancers, and morbidity disabilities (Etilé 2007). Due to the impact of obesity on morbidity and the tremendous costs associated with overweight and obesity, government agencies and industries started to incorporate strategies into health promotion programs in order to reduce obesity by encouraging healthful diets and

physical activity (Philipson 2001). This health awareness movement and the publicity given to healthful eating habits as a measure to prevent obesity and chronic diseases have pushed consumer's attention towards differentiated healthy food products.

Experimental economics provides a framework to analyze consumer acceptance and willingness to pay regarding different food products and product attributes. In the case of differentiated food products, experimental economics methods help researchers evaluate other non-price factors that affect consumer choice in the food marketplace, such as heterogeneity in food quality and in consumer preferences, nutrition, and health (Unnevehr et al. 2010). Many of the differentiated food products, such as those with environmental, local, and healthy and quality claims, are categorized as credence goods. Credence attributes, such as nutritional characteristics, are unobserved by consumers even after consumption, making the use of information crucial for marketing the product quality (Lusk 2013). Even though consumers can get an indication of the nutritional content of food products, the cost of verification of such claims is high. Although the main focus of this article concerns the effect of health-related factors on consumer's food choices, a brief review of how other factors, such as origin and taste, influence individuals' WTP is necessary to fully understand their motivations towards healthy foods.

Organic foods are among the credence goods that have been extensively researched for potential health benefits, especially due to their high vitamin C levels and polyphenolic content (Caris-Veyrat et al. 2004). In the U.S., about 65% of the population has consumed organic foods and beverages (Bernard and Bernard 2010). Americans consider food safety, freshness, health benefits, nutritional value, effect on environment, and support for small and local farmers as the most important reasons for buying organic foods. Consumers are willing to pay 10% to 40%

price premium for organic food products (Shepherd, Magnusson and Sjoden 2005; Dhar and Foltz 2005; Lusk and Briggeman 2009; Bernard and Bernard 2009; Winter and Davis 2006). At the same time, consumer's desire to support local producers became an important factor in organic food purchases, with consumers associating locally grown products to be tastier and fresher than other foods (Bruhn et al. 1992; Darby et al. 2008; Onozaka and Thilmany 2011). However, the availability of local food products is limited by weather and other growing conditions (Curhan 1974). This study was conducted during an off-season period in the United States; hence, local food availability was limited, and the quality was lower than usual during this season. Several studies show significant price premiums for local food products (James, Rickard and Rossman 2009; Hu, Woods, and Bastin 2009; Loureiro and Hines 2002; Wang and Sun 2013). One of the contributions of this study is to test how far would consumers go to support local food products, especially during off-season periods when supply is limited and quality is lower.

Tomatoes were selected to be used in the experiment for several reasons: 1) they are the second most consumed vegetable after potatoes, and hence are commonplace and familiar to most consumers (USDA 2013); 2) they contain many health benefits including high content of vitamin C and antioxidants (Freeman and Reimers 2010); and 3) they are grown in almost every state in the U.S. (Love and Lucier 1996).

Tomatoes are functional foods that combine both credence and experience attributes. Functional foods refer to food products that provide health benefits beyond basic nutritional value or reduce the risk of chronic disease when consumed on a regular basis (Maynard and Franklin 2003; Robinson 2013). Credence characteristics in tomatoes include its location of origin, production method, nutritional content, etc. Perhaps the most important credence

attributes in tomatoes relates to human health benefits (Ames, Shigenaga and Hagen 1993). Because of their high frequency in the diet, tomatoes are an important source of carotenoids (antioxidants), particularly lycopene (Heber 2000). In the United States, about 80% of the intake of dietary lycopene comes from the consumption of tomato and tomato products (Clinton 1998). Several studies have reported a negative correlation between lycopene and prostate cancer (Giovannucci 1999), cardiovascular disease (Arab and Steck 2000), and atherosclerosis (McQuillan et al. 2001). If consumers displayed positive attitudes towards these health benefits, tomato producers could greatly benefit by including this information in their promotional campaigns.

The experience characteristic is the element of taste where the consumer's uncertainty can only be resolved through sensory analysis. Consumption of fresh-market tomatoes has likely increased over time due to the introduction of improved tomato varieties and the expanding national emphasis on health and nutrition. For example, a USDA breeding program developed tomato varieties with higher beta-carotene content than conventional varieties (Stommel 2001). Research programs have been making efforts to produce high-value, specialty tomatoes with added health benefits and improved flavor (Phillips 2011). Domestic producers have recognized opportunities in this market niche and, as a result, specialty tomato production began in several States. Similar programs have been implemented to many fruits and vegetables to a point where many are considered to be "superfoods" (Seeram 2008).

The main objective of this article is to determine the influence of the sensory tasting and credence attributes on consumer's healthy food choices and how they are affected by individuals' health-related behavior. Specifically, this article will 1) examine the impact of location of origin, production technique, taste, and health information on consumer valuation of

specialty tomatoes; and 2) identify and characterize participants based on observed indicators of health-related lifestyle habits and BMI status, and investigate differences in willingness to pay by each latent class. To achieve this purpose, we combined methodologies from two disciplines, Food Science and Economics, to help us set up a rigid taste panel and to develop the models necessary for estimating WTP for flavor and health benefits.

Our experimental results suggest that individuals' purchasing decisions regarding food products are influenced by health driven motivations. While "Health Conscious" consumers are willing to pay price premiums for domestic and local-specialty varieties after tasting, they do not express price premiums for health benefits of the products. In contrast, "Health Redeemers" are willing to pay more for healthy products, perhaps in order to compensate for their unhealthy lifestyles.

2. Experimental Procedures and Data

A total of 157 general population participants (nonstudents) were recruited in a mid-size city at a large University campus to participate in one of the eight sessions that were conducted over the course of three days. The assignment of participants to different sessions was done in a way that mimicked the overall grocery-shopper demographics in the region. In order to participate in the study, subjects had to be the primary grocery shopper of their household, be at least 18 years old, and have no tomato allergies. The demographic and behavioral characteristics of participants are shown in table 1.

Upon arriving at their assigned session, participants were asked to sign a consent form and were randomly assigned an identification number to be used throughout the entire session to maintain anonymity. Then, they were provided with an instructional packet and bid sheets. Half of the participants proceeded to a station to take their height and weight measures in order to

calculate their BMI. The other half had the measures taken at the end of the experiment before payment. All instructions were read loudly from a script by a session monitor, who explicitly clarified that the auction was non-hypothetical in nature and that any participant who purchased any good during the session would have to pay real money. To better clarify the specific details of the incentive-compatible sealed-bid second-price Vickrey auction (Vickrey 1961)[1], subjects were taken through two verbal and numerical examples. Then, they participated in two practice rounds. While the market price (2nd –highest bid) for the first practice round was posted, participants completed a short knowledge quiz on the auction procedures, and the answers to the quiz were discussed. Next, they participated in the second practice round. Following the completion of the practice rounds, subjects were given instructions on the procedures for the vegetable product portion of the session. Six vegetable products, which are close substitutes, were chosen for this study: 1) conventionally grown tomatoes produced in the U.S.; 2) conventionally grown tomatoes produced in Mexico; 3) organic tomatoes produced in the U.S.; 4) organic tomatoes produced in Mexico; 5) local-specialty tomatoes; and 6) a yellow squash as a control product. The locally grown specialty variety was produced using breeding techniques, thus, it presented improved taste and additional health benefits compared to the other tomato products (Phillips 2011). Moreover, since the study was conducted during an off-season period in the United States, the local tomato varieties were limited in availability, smaller, and their quality was lower than usual during this season. This can help us test how far would consumers go to support local food products during off-season periods.

[1] In a sealed-bid second price auction, the subject who submits the highest bid wins the auction but pays an amount equal to the second highest bid for the good. This procedure ensures that the mechanism is incentive-compatible.

Four non-hypothetical vegetable auction rounds were conducted. The first round was the "baseline round", and no information was provided to the participants. Following the "baseline round", subjects were provided with three randomized within- subject information treatments. These treatments were as follows: 1) Blind Tasting, in which subjects had the opportunity to taste small, equally sized samples for each of the vegetable products, 2) Health Information Treatment, in which subjects were provided with information about the health benefits of consuming tomatoes in general, and 3) Product Information Treatment, in which participants were provided with information regarding the location of origin and production system of each vegetable variety. At the time of bidding, subjects had the opportunity to closely examine each of the products up for auction. After bids were collected for all rounds, one round and one product were randomly chosen by a session monitor to be binding. Market prices between rounds were not posted for the tomato products in order to reduce bid affiliation (List and Shogren 1999). While the buyers and the market price of the auction were determined, participants were asked to fill out a consumer survey regarding their purchasing habits, health-related behavior, and demographic characteristics. Finally, subjects received a compensation fee of $30 and signed a receipt of payment form for the compensation received. The complete packet of instructions that was given to the participants is available upon request.

3. Experimental Auction Models

The experimental auction data consists of multiple bids submitted for several goods in multiple bidding rounds. Because several bids are submitted by each participant, those bids tend to be strongly correlated (Lusk, Feldkamp, and Schroeder 2004). A Random Parameters Tobit model can be specified to address unobserved individual heterogeneity in the data and to account

for potential bid-censoring at zero. First, the censoring aspect is modeled following a Tobit specification:

$$WTP^*_{isj} = f\left(x_{isj}\ ,\eta\ ,\beta,\theta,\varepsilon_{isj}\right)$$

(1)

$$WTP_{isj} = \max\ \left(0, y^*_{isj}\right),$$

where y^*_{isj} is the latent value of individual i's bid in round s for product j, y_{isj} is the observed value, x_{isj} is a set of socio-economic characteristics, product characteristics, and treatment indicators, η is a vector of random intercepts, β is a vector of random coefficients, θ is a vector of constant coefficients, and ε_{isj} is a random error term.

The Random Parameters Tobit model allows individual-specific parameter set β to vary around a common mean-coefficient vector, which translate into the assumption that treatments or product features have different effects on individuals. A Random Parameters Tobit model for a given individual i can be specified as follows:

(2)

$$WTP^*_{isj} = a\eta_i + x_{1,i}\beta_i + x_{2,i}\,\theta + \varepsilon_i$$

$$\eta_i = \bar{\eta} + \mu_i \text{ and } \beta_i = \bar{\beta} + \alpha_i$$

where y^*_{isj} is a ($S\ X\ J$) X 1 column vector of latent variable values associated with each observation, α is a ($S\ X\ J$) X 1 column vector of 1s, η_i represents the mean intercept for the group of observations submitted by individual i, $\bar{\eta}$ is a scalar that represents the grand mean, and μ_i denotes the deviation of the mean intercept from the grand mean, that is, it captures the variation in intercepts between individuals. It is assumed that the random intercepts are distributed with a zero mean and variance σ^2_μ. The coefficients vector β_i is the sum of the grand mean coefficient

vector, $\bar{\beta}$, and the respondent deviation, α_i, which captures variation in coefficients between individuals, and the $x_{1,i}$ is a (S X J) X K matrix of K random covariates. Within the same individual, these deviations are distributed with a zero mean vector and a variance-covariance matrix Δ. Consequently, the random coefficients follow a multivariate normal distribution, so that $\beta_i \sim mvn(\bar{\beta}, \Delta)$ and $\mu_i \sim N(0, \sigma_\mu^2)$ if $i = j$. In addition, $x_{2,i}$ represents a (S X J) X L matrix of L fixed covariates, θ is a vector of constant coefficients across individuals, and the term ε_i is a normally distributed random vector with mean zero and common variance matrix σ_e^2. Finally, it is assumed that α, μ, e, and x are uncorrelated within and across individuals (Moeltner and Layton 2002; Swamy 1970).

In our application, WTP bids are modeled as a function of socio-demographic characteristics, behavioral characteristics, product characteristics, and treatment indicators. Product characteristics include the tomato variety (conventional, organic, domestic, or local-specialty), while treatment variables include dummy indicators identifying blind tasting, health, and product information treatments. In this article, the Random Parameters Tobit models were estimated using NLOGIT5 (500 Halton draws).

4. Latent Class Analysis

Besides consumers' preferences for the category of products being investigated, it is also likely that other interrelated factors might influence their bidding behavior. For example, health-related behaviors including exercising, tobacco use, and BMI status, among other potential factors might be affecting consumers' valuations for selected food products and/or treatments. All of these factors could result in unobserved individual heterogeneity, which in turn may affect individuals' WTP.

The latent class analysis offers a discrete way of identifying heterogeneity in preferences where the n consumers are classified into a number of C latent classes. The latent class model, which is described in detail by Collins and Lanza (2010), can be summarized as follows. Suppose there are $c = 1,\ldots,k,\ldots C$ latent classes that must be inferred from a set of $j = 1,\ldots, J$ observed categorical indicators, and that variable j contains R_j possible outcomes, for individuals $i = 1,\ldots, n$. Let $X_i = \left(X_{i1}, \ldots, X_{ij}\right)$ represent the vector of a particular individual i's observed responses to the J variables, where the r possible outcomes of X_{ij} are $r = 1, \ldots, R_j$. Let $I(x_{ij} = r)$ be an indicator function that equals 1 when the response to the variable $j = r$, and 0 otherwise. The probability density function of observing a particular response pattern is

$$X_i \sim f_i(x_i; \varphi) = \Sigma_{c=1}^{C} \pi_c f_{i|c}\,(x_i; \theta_c) \tag{3}$$

$$= \Sigma_{c=1}^{C} \pi_c \Pi_{j=1}^{J} \Pi_{r=1}^{R_j} \left(\theta_{jr|c}\right)^{I(x_{ij}=r)}$$

where $\pi = (\pi_1, \ldots, \pi_K)$ represents the probability of membership in the latent class c and the conditional probability density functions $f_{i|k}(.)$ represents the probability of response r_j to item j given the membership in latent class c. The parameters of the component densities, $\theta = (\theta_1, \ldots, \theta_c)$, correspond to vectors of indicator-response probabilities for each class. The objective of the LCA is to estimate the parameters $\varphi = (\pi, \theta)$ given realized values of X and a value of C provided by the analyst. The likelihood function for φ is defined as

$$\mathcal{L}(\varphi|X) = \Pi_{i=1}^{n} f_i(x_i; \varphi). \tag{4}$$

When the corresponding parameters φ that maximized the log-likelihood function have been estimated, the n individuals are classifying into the C classes by assigning each individual to the class with the highest probability (Collart and Palma 2013).

5. Results and Discussion

In analyzing the demographics of the population sample (table 1), about 86% of recruited subjects reported to be the primary grocery shopper of their household. The mean reported household spending on all food purchases was $113 per week, of which $28 was spent on fruits and vegetables. Additionally, participants reported that, on average, fruits and vegetables comprise 34% of their full stock of food at home. To test for any relationship between health-related factors and the information treatments included in the study, participants were surveyed on their health-related behaviors. From all participants, about 21% reported having a serious health issue and 9% reported to be smokers. The average percentage days exercised per year was 40%. Moreover, from the female group about 3% were classified as underweight, 58% as normal, and 39% as overweight and obese[2] based on the BMI estimates. Similarly, from the male group about 57% were classified as normal and 43% as overweight and obese. Participants were also asked to state their "perceived" BMI category. When comparing these weight categories with those based on actual BMI estimates, few differences were found between categories. These differences were not statistically significant ($P < 0.01$), which implies that participants in the sample were self-aware of their BMI state.

5.1. Statistical Analysis

The experimental auction bids were pooled for all treatments, which resulted in 3,140 observations (5 products x 4 rounds x 157 participants). With bids ranging from $0.00 to $6.00

[2] The obese category also includes the severely obese and very severely obese categories.

for one pound of tomatoes, the average price that consumers were willing to pay for all tomato varieties across all rounds was $1.37 per pound. This price was significantly higher than the retail price ($1.26 per pound) for conventional tomatoes at the time of the study; however, it was statistically lower than the retail price ($2.99 per pound) for organic tomatoes in the U.S. (USDA 2014).

Table 2 shows the estimation results of the experimental auction data using a Random Parameters Tobit model. The standard deviations of the random parameters, which represent the dispersion in intercepts and coefficients between individuals, are constructed as unobserved individual heterogeneity (Rickard et al. 2011, McAdams et al. 2013). Results indicate that almost all standard deviations in the random parameters model were statistically significant, meaning there was variation in the effect that any particular information treatment and product variety might have had on an individual.

The Random Parameters model provided a better fit to the data than the Constant Parameters Tobit and Random Effects Tobit models. A likelihood ratio test (Prob > 0.01) rejected the null hypothesis of a constant parameters Tobit model in favor of a Random Parameters Tobit specification. The Random Parameters Tobit regression also provided a better fit than a Random Effects Tobit model, based on a likelihood ratio test (Prob > 0.01).

5.2. Information Effects on Consumers' Valuation

The marginal effects of the Random Parameters Tobit model are presented in table 2. All estimates are expressed in dollars per pound, with their respective percentage shown in parentheses. Results show that knowledge of location of origin of tomatoes does have an impact on consumer valuation. The same holds true for the blind taste attribute (experience) and the health attribute (credence). In particular, consumer's WTP for tomatoes increases $0.06 (4.2%)

after they receive the health information treatment. It is hypothesized that health information will increase consumer WTP because it is unlikely that a consumer will place a negative value on positive health attributes. This result shows that providing health-related information when advertising a product can increase the demand for that product.

However, consumer's WTP decreased $0.14 (2.6%) after the blind tasting treatment. That is, although the added information of health benefits did cause a statistically significant increase in valuation, that amount was not enough to offset the amount the consumer discounted the tomatoes from its initial bid after it was tasted. In previous studies, significant decreases in WTP were observed when the products did not meet consumer expectations. For example, Chern, Kaneko, and Tarakcioglu (2003) found consumer's WTP for orange juice processed by a novel pulsed electric field technique declined by 17% after the tasting treatment. Similarly, Combris et al. (2009) reported a significant decreased for bid prices for wine with the label indicating "Appellation of Origin". However, the price discount expressed by consumers after tasting the tomatoes doesn't necessarily mean the consumers did not like the taste of the products. It could simply be viewed as a decrease in the original bid under imperfect information. It must also be noted that the manner in which the tomatoes were prepared for tasting (no lime and no salt) may not be the typical preparation method used by consumers. Thus, they may have discounted the taste due to a preconceived notion of how a tomato is "supposed" to taste. Since all tomato products were tasted in the same manner, comparison among products was still valid. In particular, consumers' WTP for domestic and local-specialty tomatoes increased after the blind tasting treatment; however, the valuation of organic tomatoes decreased after the blind tasting treatment. Furthermore, marginal effects suggest that consumers are willing to pay more for domestic tomatoes than imported tomatoes, after they knew the origin of those tomatoes. These

results support those of Mabiso et al. (2005), who reported that on average consumers are willing to pay a price premium of $0.48 for U.S. grown tomatoes if they are labeled as "U.S. grown".

Differences in product varieties were also analyzed. Estimates show that consumers are willing to pay a price premium of around $0.14 (10.4%) for organic tomatoes and a price premium of around $0.20 (14.9%) for locally grown tomatoes, compared to conventionally grown tomatoes produced in Mexico, whose average price was $1.34. These results can be explained by the increase in consumers' attention towards healthy diets and the rise in consumers' concerns and awareness over the quality of the food they purchase. However, consumers expressed a price discount of $0.10 (7.5%) for the conventional tomato produced in the United States. This can be explained by the lower quality and small size of this variety at the time of the study, as it was conducted during an off-season period. Several studies have shown that people tend to make quality judgments based on the exterior appearance of the food products, some of which may be inaccurate (Schechter 2010). Yue, Alfnes, and Jensen (2009) conducted a study to analyze consumers' WTP for organic and conventional apples with different levels of cosmetic damages. The authors reported that 75% of subjects were willing to pay more for organic than for conventional apples given identical appearance. However, when the organic apples presented any imperfection in their appearance, the price premium consumers were willing to pay for those products was significantly reduced.

5.3. Latent Class Analysis-Results

A latent class approach was used to classify participants into unobserved latent classes based on observed indicators of lifestyle habits and health status[3,4]. The LCA was set up using the following procedure: 1) select the number of latent classes, 2) characterize the latent classes, and 3) measure consumers' WTP for products and treatments for each latent class.

First, in order to select the correct number of latent classes, a sequence of latent class models with the number of classes ranging from 2 to 9 was estimated. When comparing the models, the minimum Bayesian Information Criterion (BIC) statistic favored a two-class model, whereas the minimum Akaike's Information Criterion (AIC) and Adjusted BIC statistics favored a three-class model. When the results of the different Information Criteria (ICs) are contradictory, the question often arises as to which is best to use in practice. Dziak et al. (2012) states that there is a risk in using AIC criteria as it often tends to choose a large model (i.e. overfitting), while BIC and similar criteria often risk choosing too small a model (i.e. underfitting). Nylund et al. (2007) presented simulations on the performance of various ICs and tests for choosing the number of classes in a LCA. The authors reported that in general the BIC performed much better than the AIC, as the latter had a much smaller accuracy due to its overestimating tendency. Furthermore, although the three-class model was preferred based on two selection criteria, the estimated class-membership probabilities for that model were 3.18%, 51.59%, and 45.22%. As discussed by Lanza et al. (2007) the size difference between classes should be significant in order for them to be easily distinguishable based on their probabilities.

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[3] Random Parameters models using the pooled data were also estimated which tested the effects of "health awareness levels". While "highly aware" consumers were not willing to pay price premiums for health benefits, "relatively unaware" consumers expressed a willingness to pay for such premiums. However, there are still other important differences that can be captured using a LCA. The results of these random parameters models are available from the authors on request.

[4] Implied differences models were also estimated using an Instrumental Variable (IV) approach to deal with possible endogeneity in the model due to omitted variables. This approach was not sufficient in solving the problem as it was noticed that almost all the socio-demographic and behavioral indicators were also endogenous. The results of these implied differences models are available from the authors on request.

Thus, given the estimated values of the Information Criteria and the estimated class-membership probabilities, a two-class model was chosen.

After the appropriate number of classes was chosen, each class was characterized. Table 3 shows the estimated class membership probabilities and indicator-response probabilities. Based on the class-membership probabilities, 51.59% of individuals were members of Class 1 and 48.41% of individuals were members of Class 2. The indicator response probabilities represent the probability of observing each health indicator variable in the different latent classes. That is, there is a 100% probability that consumers in Class 1 had a BMI between 18.5 kg/m^2 and 24.9 kg/m^2, which is considered a normal weight. Consumers in this class were not likely to smoke cigarettes or have a serious health issue. Moreover, 37% of the individuals in Class 1 exercise on a regular basis and 14% of them had high weekly fruit and vegetable expenditures of $50 or more.

On the other hand, individuals in Class 2 had a 7% probability of being underweight and a 93% probability of being obese. They were also more likely to be smokers and to have a serious health issue relative to consumers in Class 1. Similar to Class 1, there was a 13% probability that consumers in Class 2 had a high weekly fruit and vegetable expenditure. However, there was only a 20% probability that individuals in Class 2 exercise on a regular basis, which is almost half the probability in Class 1.

Table 1 also shows a description of demographic and behavioral characteristics of the participants by latent class. Class 1 was composed mainly of young individuals (67% aged 18 to 34 years old), while about 53% of the individuals in Class 2 were older than 34 years old.

Household size and income were two variables that differed in a similar manner between the two classes; that is, households in Class 2 were larger on average than households in Class 1,

and yearly income in Class 1 and Class 2 were $44,312 and $51,849, respectively. Regarding education level, participants in Class 1 were the most educated as this class included the highest percentage of participants with graduate education and the lowest percentage of participants with only a high school education. Classes 1 and 2 were mainly composed by Caucasian individuals (about 47% and 53%, respectively) and certain Hispanic individuals (around 37% and 26%, respectively). Even though the probability that consumers in Class 1 and Class 2 had a high weekly fruit and vegetable expenditure was similar, participants in Class 1 had a higher amount of fresh produce on hand as percentage of their full stock compared to Class 2.

After characterizing the different latent classes, the willingness to pay for each class was calculated. Table 2 contains parameter estimates from the Random Parameters Tobit models per class.

Consumers in Class 1 (51.6% of participants) are willing to pay higher price premiums of $0.11 and $0.15 for organic and local-specialty tomatoes, respectively. However, they expressed price discounts for the domestic variety. In general, consumers in Class 1 had no statistically significant price premiums for any of the additional information treatments. However, when analyzing the information treatments for each specific product, consumers expressed significant price premiums for the domestic variety after blind tasting it and after knowing it was produced in the U.S. The average consumer in Class 1 is willing to pay $1.42 per pound of tomato product. Recall Class 1 is composed of individuals who had a normal weight and were less likely to have a serious health illness. Moreover, they were more likely to be nonsmokers and exercise frequently. This leads us to refer to the first latent class of consumers as “Health Conscious”.

In contrast, consumers in Class 2 (48.4% of participants) expressed a positive effect on the health information treatment. In particular, their WTP increased by $0.08 after receiving

information about the potential health benefits of consuming tomatoes. Even though consumers in Class 1 are also willing to pay price premiums for the organic and local-specialty varieties, the price premiums consumers in Class 2 expressed for those products were significantly higher than those of Class 1. Moreover, consumers in this class increased their WTP for the domestic and local-specialty tomatoes after tasting them. The average consumer in Class 2 is willing to pay $1.33 per pound of tomato product, which is lower than the estimate of Class 1. Recall Class 2 is represented by individuals who were underweight or obese, had a serious health issue, and were more likely to be smokers. Moreover, they were less likely to exercise on a regular basis. Since this class of consumers present unhealthy lifestyles, but are willing to pay a price premium for health benefits in food products in order to make up for their unhealthy habits, we refer to them as the "Health Redeemers."

It can be inferred from this discussion that although the "Health Conscious" consumers expressed price premiums for certain varieties after the blind tasting and information treatments, they had no statistically significant premiums for the health information set. This can be explained by the fact that they already have a healthy lifestyle and are content with their current health status so they do not feel the need to pay a premium for any added health benefits. On the contrary, the "Health Redeemers" expressed a significant price premium for added health benefits. We propose that this price premium is driven, at least in part, by a feeling of guilt urging this type of consumers to compensate for their unhealthy behavior.

6. Implications

This article has confirmed that consumers have different perceptions towards differentiated healthy food products and identified which consumers are willing to pay price premiums for those products. In particular, when analyzing consumers' reactions to the blind

tasting for each tomato product, it was found that they were willing to pay price premiums after tasting the local-specialty and domestic varieties. Producers can take advantage of this fact, while marketing their products, by giving samples at point of purchase. Even tough, consumers had price discounts for the organic variety after blind tasting; their bids for this product increased after they learned about its production system. This confirmed consumers' purchases decisions might be influenced by their perceptions towards specific attributes in differentiated food products. It should also be noticed that the way tomatoes were prepared for the sensory analysis might differ from the standard way consumers prepare their tomatoes at home. This could result in the consumer discounting the taste due to a prejudiced view of how the tomato should taste.

The product information set was another treatment that significantly impacted WTP. Here, consumers revised their bids in favor of locally grown and domestic tomato varieties. This could be viewed as a benefit to producers who can boost their sales by emphasizing product origins to their advantage. Furthermore, the positive impact of the health treatment in WTP shows that health advertising can be effective. This suggests that policy makers can promote the consumption of fruits and vegetables by providing a higher awareness about the nutritional benefits of those products. To this end, consideration might be given to including labels that carry specific nutritional information about the particular products being marketed.

7. Summary and Conclusions

Although certain socio-economic and behavioral characteristics (like education, race, and income level) are helpful in explaining WTP, it is also likely that other interrelated factors, such as health-related behaviors, might influence their bidding behavior for selected food products and/treatments. All of these factors could result in unobserved individual heterogeneity, which in turn may affect individuals' WTP. In this article, a Latent Class Analysis was used to segment

participants based on observed indicators of lifestyle habits and health status, and to analyze the differences in the valuation of differentiated food products and information treatments among those classes.

Using data collected in a non-hypothetical second price Vickrey auction to elicit consumer preferences and willingness to pay for tomato attributes, including production technique, origin, health benefits, and taste, two latent classes were identified. Based on observed indicators of willingness to pay estimates, socio-economic characteristics, and health-driven motivations, two classes were found and characterized as: “Health Conscious” (52% of participants), and “Health Redeemers” (48% of participants). In particular, the “Health Conscious” consumers presented healthy lifestyle habits, expressed price premiums for domestic and local-specialty tomatoes after blind tasting but they did not expressed preferences for health benefits of the products. On the contrary, the “Health Redeemers” presented unhealthy lifestyles but they were willing to pay more for healthy products, perhaps as a compensatory attempt to make up for their unhealthy habits. Overlooking these differences between classes might lead researchers to make erroneous inferences regarding healthy food product valuations.

Finally, some of the limitations of this study include the relatively small sample size and using the BMI as an indicator of health status. Although care was taken to ensure that the participants correctly represented the demographics of U.S grocery shoppers, the results were limited to 157 participants due to budget constraints. On the other hand, BMI measures were used in this study since information needed to calculate them is relatively common in social science databases and easy to collect.

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Table 1. Demographic and Behavioral Characteristics of Experiment Participants by Latent Class

Variable	Abbreviation	Category	All Participants		Class 1		Class 2		Texas Population[a]	
			Mean	Percent	Mean	Percent	Mean	Percent	Mean	Percent
Age (years)	DAGE1[b]	18-34		57.33		66.67		47.37		51.50
	DAGE2	35-44		26.75		22.22		31.58		13.70
	DAGE3	55 and over		15.92		11.11		21.05		34.80
Household Size (Individuals)	HHSIZE		2.57		2.49		2.65		2.83	
Education	DEDU1[b]	High School Diploma or Less		7.01		6.17		7.89		43.80
	DEDU2	Bachelor's Degree or at least some College		47.77		41.98		53.95		47.20
	DEDU3	Graduate Courses or more		45.22		51.85		38.16		9.00
Race	DRACE1[b]	Caucasian/Native American		50.30		46.91		52.63		44.50
	DRACE2	Hispanic		31.21		37.04		26.32		38.20
	DRACE3	Asian/African American		18.49		16.05		21.05		17.30
Gender	FEMALE	Female		61.51		62.96		57.89		50.30
		Male		39.49		37.04		42.11		49.70
Marital Status	DMAR	Married		48.08		43.21		53.33		49.70
		Not Married		51.92		56.79		46.67		50.30
Yearly Household Income ($)[c]			47,908		44,312		51,849		71,651	
Primary Shopper		Primary Shopper		85.99		86.41		85.52		
		Secondary Shopper		14.01		13.59		14.48		
Vegetables on Hand (% of full stock)			34.31		37.88		30.49			
Household Spending on Food ($/week)	SPENDFV		113.35							
Household Spending on Fruits and Vegetables($/week)[d]			27.61							
Have a Serious Health Issue[d]	ILLNESS	Yes		21.28						
		No		78.72						
Tobacco Use[d]	SMOKE	Yes		8.51						
		No		91.49						
Exercise (%of days per year exercised)[d]	EXERCISE			39.52						

[a]Source: U.S. Census Bureau, 2012 American Community Survey.

[b]Used as dummy variables base levels.

[c]The income categories used in the estimation are: DINC1(less than $50,000), DINC2($50,000-$99,999), DINC3($100,000 or more).

[d]Used to characterize the latent classes.

Table 2. Random Parameters Tobit Estimates for WTP for Tomato Products by Latent Classes

	All Participants			Class 1 Health Councious			Class 2 Health Redeemers		
E[y]	1.377			1.421			1.329		
	Parameter	S.E.	∂y/∂x	Parameter	S.E.	∂y/∂x	Parameter	S.E.	∂y/∂x
Means of Random Parameters									
Intercept	2.118 ***	0.069		1.667 ***	0.083		1.022 ***	0.066	
Organic	0.143 ***	0.042	0.142	0.112 *	0.067	0.111	0.170 ***	0.048	0.169
U.S.	-0.103 ***	0.030	-0.103	-0.172 ***	0.048	-0.169	-0.270 ***	0.048	-0.269
Local-Specialty tomato	0.204 ***	0.053	0.204	0.155 *	0.083	0.152	0.372 ***	0.073	0.371
Tasting	-0.139 **	0.067	-0.139	-0.162	0.111	-0.159	-0.100	0.084	-0.100
Health	0.062 **	0.025	0.062	0.043	0.044	0.042	0.079 **	0.031	0.079
Product Information	-0.083	0.079	-0.083	-0.097	0.131	-0.096	-0.072	0.092	-0.072
Tasting x Organic	-0.239 ***	0.075	-0.239	-0.271 **	0.126	-0.267	-0.194 **	0.087	-0.194
Tasting x U.S.	0.345 ***	0.059	0.344	0.403 ***	0.103	0.397	0.289 ***	0.081	0.288
Tasting x Local	0.202 **	0.096	0.201	0.181	0.156	0.179	0.244 **	0.122	0.243
Info x Org	0.090	0.088	0.090	0.036	0.149	0.035	0.153	0.095	0.152
Info x U.S.	0.212 ***	0.068	0.211	0.246 **	0.098	0.242	0.178	0.116	0.177
Info x Local	0.145	0.108	0.144	0.123	0.179	0.122	0.184	0.151	0.183
Demographics/Behaviors									
DAGE2	-0.089 ***	0.029	-0.088	-0.260 ***	0.047	-0.256	-0.145 ***	0.041	-0.145
DAGE3	-0.271 ***	0.038	-0.270	-0.788 ***	0.079	-0.777	-0.401 ***	0.043	-0.400
DEDU2	-0.528 ***	0.048	-0.526	0.332 ***	0.039	0.328	0.346 ***	0.029	0.345
DEDU3	-0.896 ***	0.049	-0.893	-0.111 **	0.049	-0.109	-0.102 **	0.052	-0.101
HHSIZE	0.013	0.009	0.013	-0.335 ***	0.022	-0.331	0.052 ***	0.010	0.052
FEMALE	-0.284 ***	0.022	-0.283	-0.336 ***	0.038	-0.331	-0.498 ***	0.032	-0.496
DMAR	-0.014	0.026	-0.014	0.513 ***	0.044	0.505	0.248 ***	0.037	0.248
DINC2	-0.138 ***	0.031	-0.138	0.057	0.048	0.057	-0.152 ***	0.041	-0.152
DINC3	0.600 ***	0.037	0.598	0.706 ***	0.064	0.695	0.335 ***	0.045	0.334
DRACE2	0.236 ***	0.026	0.235	0.885 ***	0.045	0.872	0.437 ***	0.037	0.436
DRACE3	-0.532 ***	0.029	-0.529	0.090 *	0.054	0.088	-0.267 ***	0.035	-0.267
SPENDFV	0.001 **	0.001	0.001						
ILLNESS	-0.089 ***	0.027	-0.089						
TOBACCO	-0.301 ***	0.041	-0.299						
EXERCISE	0.001 ***	0.000	0.001						
Standard Deviations for Random Parameters									
Intercept	0.587 ***	0.011		0.665 ***	0.024		0.567 ***	0.014	
Organic	0.325 ***	0.014		0.527 ***	0.030		0.237 ***	0.024	
U.S.	0.451 ***	0.019		0.552 ***	0.030		0.407 ***	0.028	
Local-Specialty tomato	0.581 ***	0.021		0.651 ***	0.036		0.492 ***	0.032	
Tasting	0.180 ***	0.020		0.148 ***	0.026		0.12 ***	0.026	
Health	0.050 **	0.019		0.157 ***	0.032		0.006	0.027	
Product Information	0.023	0.021		0.055	0.035		0.047	0.029	
Tasting x Organic	0.141 ***	0.034		0.089	0.056		0.176 ***	0.040	
Tasting x U.S.	0.042	0.036		0.005	0.063		0.072	0.048	
Tasting x Local	0.038	0.048		0.019	0.062		0.128 **	0.054	
Info x Organic	0.045	0.029		0.166 ***	0.052		0.21 ***	0.039	
Info x U.S.	0.085 **	0.036		0.041	0.056		0.076 *	0.045	
Info x Local	0.089 *	0.048		0.193 ***	0.090		0.145 **	0.058	
σ(e)	0.522 ***	0.003		0.575 ***	0.005		0.424 ***	0.005	
Log-Likelihood	-2856.624			-1684.523			-1106.124		
Likelihood ratio test	1833.274 *** [a]								
Likelihood ratio test	384.342 *** [b]								

Note: *,**,***, indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

[a] Likelihood ratio test of Random Parameters Tobit vs. Constant Parameters Tobit Regression.

[b] Likelihood ratio test of Random Parameters Tobit vs. Random Effects Tobit Regression.

Table 3. Latent Class Parameter Estimates for Two-Class Model

		Class 1	Class 2
		Latent class membership probabilities (π)	
		51.59%	48.41%
Variable	Definition	Indicator-response probabilities (θ)	
UNDERWEIGHT	Had a BMI < 18.5 kg/m^2	0.000	0.066
NORMAL	Had a BMI between 18.5 kg/m^2 and 24.9 kg/m^2	1.000	0.000
OBESE[a]	Had a BMI > 25.0 kg/m^2	0.000	0.934
SMOKE	Smoked cigarrettes	0.062	0.118
HEALTHISS	Had a serious health issue	0.136	0.289
WFV	Had a high weekly fruit and vegetable expenditures (more than $ 50)	0.136	0.132
EXERCISE	Exercised on a regular basis (4 times per week or more)	0.370	0.197

[a]The obese variable include the overweight, obese, severely obese, and very severely obese categories.