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Consumer Preferences for Food Safety Attributes in Fresh Apples: Market Segments, Consumer Characteristics, and Marketing Opportunities

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Past research has yielded conflicting results on consumer valuation of food safety characteristics. In this study, conjoint analysis is used to evaluate consumer responses to hypothetical apple products in a nationwide survey. Product characteristics included price, quality, pesticide use levels and the corresponding cancer risk, and type of government inspection. Consumers expressed a broad preference for reduced pesticide usage. Four market segments were identified corresponding to consumers: (*a*) who had a strong preference for food safety, (*b*) who exhibited a more balanced desire for all product characteristics, (*c*) who were extremely price sensitive, and (*d*) who had a strong preference for product quality. Results suggest that consumers in these segments differ based on demographic and psychographic characteristics. This information should prove useful to produce marketers in marketing produce that better meets consumers' needs.

Key words: conjoint analysis, consumer characteristics, food safety, market segments, pesticides

Introduction

Numerous studies have documented the high degree of perceived risk that American consumers associate with pesticide residues in food (e.g., Misra, Huang, and Ott; Hammonds; Sachs, Blair, and Richter; Zellner and Degner). However, an in-depth understanding of consumer preferences has been hampered by the lack of empirical research concerning consumers' choices regarding pesticide residues in food and inconsistent results relating to consumers' valuation of food safety attributes.

To date, much of the research on consumer food safety preferences has utilized the contingent valuation method, a method that has been widely employed in the resource economics literature to elicit consumer valuation of nonmarket goods. Bishop and Heberlein describe the contingent valuation method as the use of survey techniques to question people about the values they would place on nonmarket goods if markets for these goods did exist. In order to conduct a contingent valuation study, the researcher must determine whose values will be elicited, how the product to be valued will be described, and the method of determining how much respondents are willing to pay for the product being valued.

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Similarly, conjoint analysis has been widely used in the marketing literature to value nonmarket goods. As with contingent valuation, it is necessary to decide whose values will be elicited and how the product to be valued will be described. However, with conjoint analysis, respondents are asked to evaluate alternative products comprised of several attributes, one of which is price. The two methods differ in that with contingent valuation, respondents' valuation of the product is measured directly; with conjoint analysis, respondents' valuation of product attributes must be inferred from their preferences for alternative products.

Studies employing contingent valuation have used several approaches to valuing food safety attributes, including directly asking consumers how much they would be willing to pay for increased food safety and eliciting consumers' responses to hypothetical products. Contingent valuation data typically have been used to estimate a demand function for the product. By including socioeconomic variables in the demand equation, the impact of variables such as income and education is determined.

Contingent valuation studies have shown a wide range in consumers' willingness to pay for food safety attributes. Misra, Huang, and Ott found that 46% of Georgia consumers were willing to pay more for certified residue-free produce. The great majority of those willing to pay more would have paid no more than a 10% premium. The study also suggested that the respondents willing to pay the most for pesticide-free produce were in the higher income and education categories, of European origin, and between the ages of 35 and 60. Van Ravenswaay and Hoehn (1991b) estimated that consumers were willing to pay an additional 31.3¢ per pound to avoid Alar in fresh apples in 1989. In a study of North Carolina shoppers, Eom found that 65% of respondents were willing to pay, on average, $0.35 per pound more for produce that was screened for pesticides than for produce which was grown conventionally and cost between $0.39 and $1.49 per pound. Eom's research also showed that "consumers were willing to pay substantially high price premiums for safer produce, in return for only small reductions in risk" (p. 769).

A major purpose of this study is to employ the conjoint analysis methodology in the study of food safety valuation. This approach has been widely used in the evaluation of nonmarket goods and services as well as hypothetical products in both the private and public sectors (Hair et al.; Acito and Jain; Wittink and Cattin). One of the major advantages of conjoint analysis, vis-à-vis contingent valuation, is the high degree of realism with which consumer choices may be portrayed (Hair et al.). As with contingent valuation, consumers are given detailed descriptions of the products. However, with conjoint analysis, consumers are asked to express their preferences for products that are described as bundles of attributes being offered at various prices, in much the same fashion that consumers have to choose from various products in the marketplace. Individual utility functions are estimated for each consumer, making this method ideal not only for estimating consumer willingness to pay for hypothetical products or attributes, but also for conducting market segment analyses based on consumer preferences for individual or groups of product attributes. This approach has been widely accepted in the marketing literature and in new product development, and should provide additional understanding of consumers' valuation of food safety attributes.

The other major objective of this research is to determine whether consumers belonging to market segments based on food safety preferences differ from one another. Nayga provides some evidence that this may be the case. He reports, "Main meal planners who

are younger, more highly educated, male, those with higher income, or those residing in nonmetro areas are more likely to consider food that has been grown using pesticides at approved levels to be safe than do others" (p. 473). In another study, McGuirk, Preston, and McCormick identified groups of consumers based on similarities in their concern for food safety issues. While they found some interesting differences among groups, there were relatively few differences between the two groups that were most concerned with food safety and the group that was least concerned with food safety.

An understanding of how consumers differ by market segment would be extremely valuable to participants in the food marketing system. Food producers, processors, and retailers require a deeper and more detailed understanding of consumer preferences vis-à-vis their socioeconomic characteristics in order to develop products and marketing strategies that effectively target individual consumer needs. By evaluating consumers in four separately defined market segments, based on both socioeconomic and value characteristics, this study seeks to more clearly identify unique traits and values exhibited by consumers in the different segments.

Theoretical Framework

A number of authors have proposed models to explain consumer product purchases based on the characteristics of the products (Waugh; Theil; Houthakker; Lancaster; Ladd and Zober). This category of models has been referred to as the Lancaster characteristics demand model. The Lancaster characteristics model has important applications in the area of food safety because it assumes that consumers value products for the attributes they contain (Smallwood and Blaylock). This study employs a Lancaster characteristics model similar to that of van Ravenswaay and Hoehn (1991a), as modified by Baker and Crosbie.

Consider a product x_1 offered at price p_1. There are I alternative products represented by vector $\mathbf{x} = (x_2, \ldots, x_I)$ offered at prices corresponding to vector $\mathbf{p} = (p_2, \ldots, p_I)$. The product x_1 contains J attributes, $\mathbf{a}_1 = (a_{11}, \ldots, a_{1J})$; products $\mathbf{x}$ contain a matrix of attributes, $\mathbf{a} = a_{ij}$ ($i = 2, \ldots, I$, and $j = 1, \ldots, J$).

Consumers purchase products because of the attributes they contain. Combinations of these attributes provide consumption services, or value, by satisfying consumers' wants and needs. For example, a food product's attributes may include its ingredients, preparation, packaging, and labeling. However, consumers purchase the product because of the consumption services provided by the attributes, such as taste, satisfaction of appetite, nutritional qualities, and ease of use. Services are expressed as:

$$\mathbf{s} = s_k(x_1, \mathbf{a}_1, \mathbf{x}, \mathbf{a}), \quad k = 1, \ldots, K, \tag{1}$$

where $\mathbf{s}$ is a vector of K consumption services. In this formulation, each product has the same set of potential attributes associated with it. However, the amount of each attribute varies with the specific product, and some attributes may be completely absent in some products.

The consumer's utility function is represented by:

$$U = u(s_1, \ldots, s_k), \tag{2}$$

and is subject to the budget constraint:

$$p_1 x_1 + \mathbf{p}'\mathbf{x} \leq m. \tag{3}$$

Restating the consumer's problem yields the indirect utility function:

$$V = v(p_1, \mathbf{a}_1, \mathbf{p}, \mathbf{a}, m), \tag{4}$$

such that

$$p_1 x_1 + \mathbf{p}'\mathbf{x} = m. \tag{5}$$

V represents the maximum utility achievable for a consumer given product attributes, prices, and income.

Methodology and Model Specification

Conjoint analysis (CA) methodology is based on the premise that consumers value products based on the utility provided by a product's attributes. CA is typically used to evaluate hypothetical products and, as is the case in this research, it can be used to examine how consumers value individual attributes and the tradeoffs consumers make between attributes.

In CA, an individual's total utility for a product or service is defined as some combination of component utilities that are derived from the product's characteristics $(a_j = (a_1, \ldots, a_J))$. The utility function is then specified in terms of a combination rule W and functional forms w_j (one for each characteristic) as $W(w_1(a_1), \ldots, w_J(a_J))$. The combination rule W specifies the relationship between the variables and is typically either additive or interactive. The assumption underlying the additive model is that the effect of each product characteristic on the dependent variable is independent of other product characteristics. The interactive model allows for two-way interaction effects between the independent variables. In practice, it is generally recommended that interaction terms be avoided. This is because any gains due to a more accurate representation of consumer preferences are often offset by the reduction in statistical efficiency (more parameters must be estimated), and because it increases the complexity of the respondent's task (more hypothetical products must be rated) (Hair et al.).

The functional forms, $w_j(a_j)$, specify the relationship between the levels of each variable relative to the utility each variable generates, and are typically one of three types: linear, quadratic, or part-worth. The linear form is $w_j(a_j) = ba_j$, where b represents an estimate of the utility generated per unit of characteristic a_j that is constant over the range of the variable. The part-worth form is estimated as $w_j(a_j) = w_{a_j}$, where dummy variables are used to estimate the level of utility for each level of the variable. The quadratic, or ideal point, form is represented as $w_i(a_j) = c(a^* - a_j)^2$, where a^* is the ideal level of the characteristic for the respondent, and c is a constant of proportionality. The quadratic form allows for a curvilinear relationship between the attributes and utility levels.

The first step in conducting a CA study is to define the hypothetical products by choosing the appropriate attributes and attribute levels. In choosing attributes it is

necessary to balance the need for including the most significant product features against the need to minimize the number of attributes so that the problem faced by survey respondents is manageable. Consumers are then presented with these hypothetical products in the form of detailed product descriptions and asked to express their preferences by rating or ranking them. An indirect utility function is then estimated for each consumer, using the expressed preferences for the hypothetical products as the dependent variable and the attributes as independent variables. (For a more comprehensive description of the CA methodology, see Green and Srinivasan.)

In this study, Red Delicious apples were selected as the experimental product. This particular type of apple was chosen because it is the most commonly produced apple in the U.S., representing about 40% of U.S. production (U.S. Apple Association). The attribute list was developed based on discussions with consumer focus groups, the results of a pilot study (Baker and Crosbie), and follow-up discussions with groups of consumers. The choice of attributes is driven by the need to accomplish several objectives. Typically, the need to adequately and realistically describe the product is balanced against the need to reduce the number of factors so that the resulting survey instrument is relatively simple and brief. In a research project such as this, the factors that are the subject of the research also must be included. Four attributes were chosen for inclusion in the study: (*a*) price, (*b*) level of damage on the fruit, (*c*) pesticide usage policy and the associated cancer risk, and (*d*) assurance of compliance with food safety regulations.

Ultimately, the choice of attributes was heavily influenced by the research objectives. The variables representing pesticide usage and assurance of regulatory compliance were chosen because they were the primary focus of this study. Price and quality characteristics (including size, color, and the absence of damage) were the factors most commonly mentioned by consumers as influencing their purchase decisions. However, only price and the level of damage were included as attributes in this study because it was believed that consumers would be forced to make the greatest tradeoffs with respect to these variables in expressing their food safety preferences.

The levels of the price and damage attributes were chosen to represent the range of options which consumers might realistically face. The price levels were determined based on the range of consumer prices for Red Delicious apples during the previous year, adjusted for a reasonable premium based on the other attributes. The average consumer price in the U.S. for Red Delicious apples for the 1994–95 season was $0.81 per pound, with a range of $0.72 to $0.92 per pound (U.S. Department of Labor). Three price levels were chosen—$0.69, $0.99, and $1.29 per pound. The lowest price was slightly lower than the season low. The highest price represented a 40% premium over the season high and would seem to be a reasonable upper bound since organic food prices are reported to be 25–30% higher than for conventionally grown food (Park and Lohr).

The level of damage was illustrated through the use of pictures. The apples shown in the pictures were of similar size and color, and differed primarily in the level of damage. This was done so as to not introduce any confounding errors based on consumers' preferences for apples of a particular size or color. Damage levels of 0%, 1.6%, and 3.4% of the visible surface area were depicted. The damaged apples had surface imperfections that occurred prior to handling of the apples and which reasonably could have been prevented through the use of pesticides. The range for the damage level was determined by what is typically available in the marketplace. In fact, most apples available in

grocery stores are free from insect damage. The apples that were used in this study were obtained from a supermarket that sold organic food, and the apple with a damage level of 3.4% of the visible surface area represented the highest level of visible damage that could be found.

The third attribute represented the total health risk to consumers resulting from three hypothetical pesticide usage regulations. Previous research has shown that it is difficult for consumers to interpret low probability risks (Magat, Viscusi, and Huber) and technical information on the risks of pesticide exposure (Eom). Because the focus of this research is on understanding the tradeoffs consumers make in expressing food safety preferences, the risk assessments were presented in terms that were as meaningful as possible to consumers. Respondents were told that the apples described in the survey would be produced under three alternative policy scenarios. A policy of conventional pesticide use was described as being associated with an increased lifetime cancer risk of 1 in 1,000 from exposure to pesticides. Similarly, policies of reduced pesticide use and very limited pesticide use were described as being associated with increased lifetime cancer risks of 1 in 10,000 and 1 in 100,000, respectively. The choice of the 1 per 1,000 upper bound on cancer risk was based on estimates by the National Research Council using studies conducted by the Environmental Protection Agency. The reductions in cancer risk by factors of 10 and 100 were arbitrarily chosen because they seemed both reasonable, based on the descriptions of the pesticide policies, and significant enough to be important to consumers. The apples were labeled as "conventional pesticide use/highest cancer risk," "reduced pesticide use/medium cancer risk," and "very limited pesticide use/lowest cancer risk" to reflect the pesticide usage policies under which they were produced. While the labels of highest, medium, and lowest cancer risk were chosen solely to facilitate respondents' understanding of their task, and the product attribute descriptions clearly identified the cancer risk associated with each pesticide policy, it should be noted that the choice of these descriptors may have influenced respondents' perceptions of the risks associated with each pesticide policy.

The last attribute represented the type of food safety compliance program. This attribute was included based on the pilot project, the results of which indicated that for many consumers assurance of compliance with food safety regulations was as important as reducing exposure to pesticides (Baker and Crosbie). Because consumers in this pilot project also exhibited a preference for government rather than private firm inspections, both levels of this attribute described government inspections. The first option described a system of monitoring, similar to the federal inspection system currently in use, whereby approximately 1% of the produce shipments would be tested for compliance with food safety regulations. The second level of this attribute represented a certification system whereby all produce shipments would be inspected and certified prior to shipment to the retailer to ensure that the produce (in this case apples) was produced in compliance with food safety laws.

The model for each individual was specified as:

$$W_i = \beta_{i1} + \beta_{i2}PRICE + \beta_{i3}DAMAGE + \beta_{i4}REDUCED + \beta_{i5}VLIMITED + \beta_{i6}CERT + \epsilon_i, \tag{6}$$

where W is the utility or preference level for the ith individual; *PRICE* is the price per pound of apples; *DAMAGE* represents the level of damage as a percentage of the visible

surface area; *REDUCED* is a dummy variable indicating apples produced with reduced pesticide usage and an increased lifetime cancer risk of 1 in 10,000 associated with this policy (1 if yes, 0 otherwise); *VLIMITED* is a dummy variable signifying apples produced with very limited pesticide usage and an increased lifetime cancer risk of 1 in 100,000 associated with this policy (1 if yes, 0 otherwise); *CERT* is a dummy variable indicating that the apples were inspected and certified as complying with food safety laws (1 if yes, 0 otherwise); and ϵ is a random error term.

The model assumes no interactions between the variables. In other words, it is assumed that the effect of the level of each product characteristic on respondents' preferences is independent of the level of other product characteristics. Because any interaction effects should be incorporated into the model design, it is important to identify any interaction effects before the product descriptions are developed. The procedure used to determine the presence of interaction effects was to conduct a pilot survey as suggested by Bretton-Clark. For each pair of attributes suspected of interacting, respondents were asked to rate their degree of preference for each level of one attribute at each level of the second attribute. A strong interaction effect is indicated when the ratings for different levels of an attribute vary depending on the level of another attribute.

Twenty people were administered a questionnaire in which they were asked to rate all combinations of the attribute levels for three pairs of variables: price and damage, price and pesticide policy, and damage and pesticide policy. Respondents were instructed to rank the various combinations on an 11-point scale, similar to that used in the final survey. For each pair of attributes, group means were calculated for each level of one attribute at each level of the second attribute. No statistically significant differences were found, indicating that there were no interaction effects among the price, damage, and pesticide policy variables.

A fractional factorial design was used to choose the actual product descriptions that respondents evaluated. A full factorial design would have resulted in 54 product descriptions, a number that would have overwhelmed most respondents and, most likely, sharply lowered the response rate. Eleven product descriptions, representing combinations of the attribute levels for each attribute, were generated using the Bretton-Clark Conjoint Designer program (Bretton-Clark). This included two holdout products used to validate the responses. The survey design, including all supporting materials, was pretested on a small sample to ensure that respondents would find the survey clear and easy to complete. Follow-up focus group discussions were held to ensure that respondents clearly understood their task and that their interpretation of the questions was consistent with the researcher's intent.

In early 1996, surveys were mailed to 1,850 individuals randomly selected from a national mailing list. The mailing list was purchased from American Business Lists, a division of a company that maintained a list of over 94 million households in the U.S. The company compiled the mailing list from multiple sources including telephone directories, census data, courthouse records, and credit card records to ensure a broad representation of all types of households.

The survey packet included a letter, an instruction sheet, a page describing the product attributes, a product rating form, a data sheet, a postage-paid return envelope, and a $1 incentive payment to encourage a prompt response. The letter included a brief description of the survey and instructed the recipients to give all of the survey

Table 1. Socioeconomic Characteristics of Survey Respondents and U.S. Population

Characteristic	Survey Sample (1996)[a]	U.S. Population (1995)[b]
Gender (% female)	68.2	51.2
Median Age (years)	47.0	34.3
Average Household Size (no. of persons)	2.66	2.65
Median Household Income ($)	40,000–54,999	35,492[c]
Completed High School (%)	98.0	81.7
Ethnic Composition (%):		
▸ White (non-Hispanic)	86.3[d]	73.7
▸ Black (non-Hispanic)	6.1	12.0
▸ Hispanic	1.8	10.3
▸ American Indian, Asian, or Other	5.9	4.0

[a] Survey sample size = 510.
[b] Source: U.S. Department of Commerce, Bureau of the Census (1996).
[c] Source: U.S. Department of Commerce, Bureau of the Census (1997).
[d] Percentages do not total to 100% due to rounding error.

materials to the person in their household who had the primary responsibility for grocery shopping. Follow-up postcards were mailed to nonrespondents approximately one month and two months after the original mailings.

The product attribute descriptions included narrative descriptions of all attributes, as well as pictures of apples depicting the three levels of damage (0%, 1.6%, and 3.4%). The product rating form asked respondents to rate the 11 hypothetical products on a scale of 1 to 11, with 11 representing the most preferred and 1 denoting the least preferred. Each score could be used more than once.

Respondents were asked to provide information on their socioeconomic status and their attitudes regarding certain values. The information on socioeconomic factors was solicited because several studies have found that consumers with different food safety preferences often have different socioeconomic characteristics (Nayga; McGuirk, Preston, and McCormick). Because attempts at understanding consumer behavior based primarily on the use of demographics have been disappointing (Onkvisit and Shaw), respondents were also requested to provide information on some values they held. Recent research has focused on the use of psychographics, including lifestyles and values, in predicting consumer purchasing behavior. Kahle and Timmer report that some of the best predictive results were found by using the List of Values (LOV), developed by the University of Michigan Survey Research Center, in conjunction with demographic variables.

Of the 1,850 surveys mailed, 173 (or 9.4%) were returned due to incorrect addresses. Of the remaining 1,677 surveys, 557 were returned, yielding a response rate of 33.2%. After eliminating incomplete surveys, there were 510 usable responses.

The socioeconomic characteristics of the sample are presented in table 1. Since the mailing list was comprised primarily of adults, and since individual respondents were

to be the person in the household with the primary responsibility for food shopping, it was expected that many of the sample characteristics would differ from those of the U.S. population as a whole. The finding of a higher average age and higher percentage of women in the sample, as compared to the population as a whole, is consistent with the expectation that grocery shopping is most frequently done by an adult female in the household. The household size of the sample was almost identical to that of the U.S. population. However, the racial composition and the education and income levels of the survey respondents differed from the comparable U.S. population characteristics. While this does not limit the development or analysis of market segments based on these data, it does limit the ability to make generalizations regarding the size of the market segments and to make policy prescriptions.

Results and Discussion

Aggregate Market Results

Estimates of the main effects ANOVA model for equation (6) were obtained for each respondent by using the SAS TRANSREG procedure (SAS Institute, Inc.). The TRANSREG procedure is ideal for performing conjoint analysis because it facilitates the estimation of a model for each individual. The aggregate utility function is then calculated by averaging the coefficient estimates for equation (6) across all individuals. The results are presented in table 2 as part-worth scores, which represent the impact of each level of an attribute on the level of utility. For the continuous variables, price and damage, the averages of the actual coefficient estimates are also presented since they were used to derive the part-worth scores. The part-worth scores for these variables were calculated by multiplying the coefficient estimate by the various price and damage levels.

The relative factor importance scores (table 2) are derived from the part-worth estimates for each attribute by calculating the variation in utility over the range of each attribute as a percentage of total variation due to all factors. The variation in utility for each attribute is calculated as the change in the part-worth score between the least preferred option (lowest part-worth score) and the most preferred option (highest part-worth score). The total variation for all factors is the sum of the absolute value of the variations for all individual factors.

Two measures of goodness of fit were calculated. The average R^2 for the 510 models was 0.88, and indicates a relatively good fit. Furthermore, the average part-worth estimates all have the correct sign. A second method for validating the model is to use the holdout data to generate predicted scores for the preference ratings. The predicted ratings are then compared to the actual holdout ratings, for the two holdout products in this case, and a Pearson correlation coefficient is calculated for each individual. The correlation coefficient between the predicted and actual scores was 0.85. This indicates a high degree of predictive accuracy for the model.[1]

[1] The use of other functional forms was also explored. Logarithmic transformations of the independent variables resulted in no change in the average R^2. When logarithmic transformations were performed on both the independent and dependent variables, the average R^2 declined to 0.86.

Table 2. Survey Respondents' Preferences for Red Delicious Apples, All Respondents

Variable / Measure	Value	Std. Dev.
Intercept:		
Coefficient	7.93	4.27
Price:		
Coefficient	-1.83	3.84
Part-Worth: $0.69	-1.26	2.65
Part-Worth: $0.99	-1.81	3.80
Part-Worth: $1.29	-2.36	4.95
Relative Factor Importance	14.53%[a]	
Damage:		
Coefficient	-0.32	0.68
Part-Worth: 0%	0.00	0.00
Part-Worth: 1.6%	-0.50	1.09
Part-Worth: 3.4%	-1.07	2.31
Relative Factor Importance	14.17%	
Pesticide Policy:		
Part-Worth: Conventional	-2.36	1.83
Part-Worth: Reduced Pesticide	0.09	1.12
Part-Worth: Very Limited Pesticides	2.27	1.79
Relative Factor Importance	61.23%	
Certification Program:		
Part-Worth: Monitoring	-0.38	1.12
Part-Worth: Certification	0.38	1.12
Relative Factor Importance	10.06%	

Note: Sample size = 510.

[a] The sum of the relative factor importance percentages does not equal 100% due to rounding error.

The results of the aggregate market analysis indicate that food safety factors are of great importance to consumers responding to this survey. Food safety factors were responsible for explaining the majority of variation in consumers' utility over the range of attributes studied. It is also clear that consumers in this study do in fact want a real improvement in the level of food safety (and the associated reduction in cancer risk), and not just greater assurance that existing regulations are being followed. The increase in utility resulting from a safer pesticide policy was far greater than the increase in utility associated with a change from a monitoring to a certification system.

This broad consumer preference for reduced pesticide usage is consistent with the findings of other researchers (including Eom; Baker and Crosbie; and van Ravenswaay and Hoehn) who found that consumers were willing to pay substantially more for produce produced with less pesticides than for conventionally produced produce. It is also consistent with the recent direction of U.S. public policy, most notably the passage

of the Food Quality Protection Act of 1996 (which should increase the margin of safety for chemicals in the food supply) and the current development of national standards for organic food.

On the other hand, there is little current evidence in the marketplace that consumers are in fact willing to pay much of a premium for safer produce. The vast majority of all produce is not marketed based on reduced pesticide usage, and most supermarkets sell either no or a limited amount of organic produce. This apparent inconsistency between expressed preferences and observed behavior may be explained by a third possibility that existing enhanced safety produce alternatives do not adequately tap into consumers' concerns. Inadequate advertising and promotion, improper pricing, limited and intermittent supply, and inappropriate product placement may explain why consumers have not exhibited a strong demand for alternatives to conventionally grown produce. If this is the case, the key to successfully marketing safer produce depends on developing a better understanding of consumers.

Market Segment Results

The value of market segment identification lies in understanding the attributes valued by consumers in a particular market segment and developing an understanding of the characteristics of these consumers. In this way, products and services may be developed to meet the segment's unique needs, they may be priced and discounted accordingly, promotion and advertising programs may be designed to target consumers in the segment, and distribution systems appropriate to the segment may be utilized.

In order to develop market segments consisting of consumers with similar preferences, cluster analysis was performed on the relative factor importance scores for each individual using the SAS CLUSTER procedure (SAS Institute, Inc.). The analysis was performed using Ward's minimum-variance method whereby the sum of squared distances between individuals within a cluster is minimized and the squared distance between clusters is maximized. Four clusters corresponding to four distinct market segments were identified based on the pseudo F-statistic (259.92), the pseudo t^2-statistic (144.05), and the author's judgment regarding the most meaningful cluster groupings. The F-statistic and pseudo t^2-statistic are used as a guide in determining the appropriate number of clusters. While the F-statistic peaked at five clusters, the pseudo t^2-statistic peaked at four clusters. Because a four-cluster grouping seemed to be both more meaningful and more consistent with observed consumer behavior than a five-cluster grouping, the four-cluster grouping was chosen. The preference functions for the four market segments are presented in table 3.

The first market segment is designated the "Safety Seekers" because of the overwhelming importance members of this group place on food safety factors. Eighty-three percent of the variation in utility for this group was attributable to the pesticide policy variable, indicating that their product preference was largely determined by the pesticide policy under which fruits and vegetables would be produced and the associated cancer risk. The "Balanced Buyers" segment is comprised of consumers who exhibit a relatively balanced concern for all characteristics, particularly compared to Safety Seekers. Each of the product characteristics has a factor importance score of

Table 3. Survey Respondents' Preferences for Red Delicious Apples, by Market Segment

	VALUE			
Variable / Measure	SEGMENT 1 Safety Seekers (N = 211)[a]	SEGMENT 2 Balanced Buyers (N = 185)	SEGMENT 3 Price Pickers (N = 48)	SEGMENT 4 Perfect Produce (N = 66)
Intercept:				
Coefficient	6.83 (2.32)[b]	7.70 (3.81)	10.48 (8.89)	10.21 (3.63)
Price:				
Coefficient	-0.94 (1.96)	-1.74 (3.29)	-4.25 (8.55)	-3.17 (3.28)
Part-Worth: $0.69	-0.65 (1.35)	-1.20 (2.27)	-2.93 (5.90)	-2.19 (2.26)
Part-Worth: $0.99	-0.93 (1.94)	-1.72 (3.26)	-4.21 (8.47)	-3.14 (3.25)
Part-Worth: $1.29	-1.22 (2.53)	-2.25 (4.24)	-5.48 (11.03)	-4.09 (4.23)
Relative Factor Importance	7.04%	13.74%	49.06%	23.27%
Damage:				
Coefficient	-0.12 (0.34)	-0.27 (0.61)	-0.14 (0.37)	-1.20 (1.07)
Part-Worth: 0%	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Part-Worth: 1.6%	-0.19 (0.54)	-0.43 (0.98)	-0.23 (0.59)	-1.92 (1.71)
Part-Worth: 3.4%	-0.40 (1.15)	-0.91 (2.07)	-0.49 (1.26)	-4.08 (3.62)
Relative Factor Importance	5.02%	12.01%	9.43%	49.88%
Pesticide Policy:				
Part-Worth: Conventional	-3.37 (1.83)	-2.10 (1.44)	-0.67 (1.17)	-1.11 (1.12)
Part-Worth: Reduced Pest.	0.08 (1.26)	0.05 (1.06)	0.09 (0.95)	0.26 (0.91)
Part-Worth: Very Ltd. Pest.	3.29 (1.83)	2.05 (1.36)	0.57 (0.96)	0.85 (0.82)
Relative Factor Importance	83.00%	54.57%	23.93%	23.89%
Certification Program:				
Part-Worth: Monitoring	-0.20 (0.53)	-0.75 (1.58)	-0.46 (1.06)	-0.12 (0.60)
Part-Worth: Certification	0.20 (0.53)	0.75 (1.58)	0.46 (1.06)	0.12 (0.60)
Relative Factor Importance	4.94%	19.68%	17.58%	2.96%

[a]N represents the number of respondents in each segment.

[b]Standard deviations of the coefficients and part-worth scores across all individuals in a segment are shown in parentheses.

at least 10% for respondents in the Balanced Buyers segment. The last two market groups are labeled the "Price Pickers" and the "Perfect Produce" segments. Consumers in these segments are primarily concerned with price and the level of damage, respectively.

The four market segments identified using cluster analysis were analyzed to determine whether the respondents in each market segment differed from respondents in the other three segments. Statistical tests were performed to identify differences in both the socioeconomic makeup and the value preferences of consumers in each market segment. Initially, F-statistics were calculated to determine whether the variable means were different from each other. For those variables where a statistically significant difference was found, the mean of each segment was compared to the mean of each of the other segments, and t-statistics were calculated to determine whether the null hypothesis of no difference between the means could be rejected at the 10% level of significance. For the income variable, the mean of each category was used to calculate the mean income level for each group. The highest income category was assigned a value of $120,000. For the education variable, the number of years of education corresponding to the highest level of education for each category was used to calculate the mean. The highest education category was assigned a value of 18 years. Value preferences were represented by the percentage of respondents in each segment who chose a given value as being their first or second most important value. The results of this analysis are presented in table 4.

The Safety Seekers Segment

The product preferences of consumers in the Safety Seekers segment are primarily determined by type of pesticide policy and the associated cancer risk. Price, level of damage, and the type of certification system were relatively unimportant factors. The differences between consumers in this segment and those in the Balanced Buyers and Price Pickers segments were most notable. Compared to consumers in these groups, Safety Seekers were more likely to be female and white, and placed a greater emphasis on having warm relationships with others. Safety Seekers also had larger households than Balanced Buyers.

This group's profile is that of a family-oriented household. Piner found that individuals who placed a high value on developing warm relationships were more likely than individuals who expressed other value preferences to be female, married, and to gain satisfaction from marriage and parenting. This description accurately depicts the Safety Seekers segment, which includes a higher proportion of females than two of the three other segments and has a larger average household size than that of the other large segment, the Balanced Buyers.

These results are consistent with Nayga's findings that main meal planners who were female were less likely than males to think that conventionally grown produce was safe. These findings are also in agreement with the results of McGuirk, Preston, and McCormick, who reported that those food safety conscious consumers most likely to act on their concerns were more apt to be female, married, and have a greater number of children than consumers in other groups.

Table 4. Socioeconomic and Value Differences Across Market Segments

Variable	VALUE			
	SEGMENT 1 Safety Seekers (N = 211)[a]	SEGMENT 2 Balanced Buyers (N = 185)	SEGMENT 3 Price Pickers (N = 48)	SEGMENT 4 Perfect Produce (N = 66)
Socioeconomic Characteristics:				
Gender (% female)*	73.0 [2,3]	63.2 [1]	60.4 [1]	72.7
Age (years)	49.0	49.3	51.4	47.6
Years of Education	14.2	14.1	14.4	14.5
Ethnicity (% White)*	90.5 [2,3]	84.3 [1,3]	72.9 [1,2,4]	87.9 [3]
Persons in Household (no.)*	2.8 [2]	2.5 [1,4]	2.5	2.8 [2]
Annual Household Income ($)*	47,274 [4]	43,202 [4]	45,208 [4]	57,234 [1,2,3]
Values (% 1st or 2nd choice):				
Being Well-Respected	21.8	19.5	18.8	22.7
Excitement*	3.8	1.6 [3]	8.3 [2,4]	1.5 [3]
Fun and Enjoyment in Life*	11.8 [2,3]	5.9 [1,3,4]	27.1 [1,2,4]	13.6 [2,3]
Security	34.6	41.6	29.2	34.8
Self-fulfillment	18.5	20.0	16.7	19.7
Self-respect*	50.7 [2,3]	66.5 [1,3,4]	35.4 [1,2,4]	51.5 [2,3]
Sense of Accomplishment*	17.5 [3]	17.3 [3]	41.7 [1,2,4]	13.6 [3]
Sense of Belonging	7.8	9.7	8.3	7.6
Warm Relationships w/Others*	33.6 [2,3]	17.8 [1,4]	14.6 [1,4]	34.8 [2,3]

Notes: *F*-statistics were calculated for all variables to determine whether the group means were significantly different from each other. An *F*-statistic that is significant at the 10% level of probability is indicated by an asterisk (*) after the variable name. When a statistically significant *F*-statistic was identified, pairwise *t*-statistics were calculated to determine whether there were statistically significant differences between individual group means. Statistically significant differences between the means of two groups, at the 10% probability level, are indicated by the numbers in brackets. For example, the [2] following the mean of 2.8 people per household in the Segment 1 column indicates that there is a statistically significant difference between the means for Segments 1 and 2 for this variable.

[a] N represents the number of respondents in each segment.

The Balanced Buyers Segment

The Balanced Buyers segment is comprised of consumers who tended to exhibit a much more balanced concern for price, quality, and food safety attributes than consumers in the other three market segments. While Balanced Buyers were more likely to be male, non-white, and have smaller households (particularly compared to the other large segment, the Safety Seekers), their most distinguishing characteristic is that they value self-respect much more highly than consumers in all other segments.

The profile and purchasing preferences of the Balanced Buyers segment are consistent with the description of the conventional American. According to Piner, self-respect is the value most frequently selected as most important by Americans. He describes the people holding this value as being the "average, typical American who resembles the

conventional stereotype" (p. 261). Members of this group are also unlikely to see themselves as being different from the average American. It is therefore not surprising that Balanced Buyers would express more traditional product preferences, i.e., a desire for produce that is safe, of high quality, and reasonably priced.

The Price Pickers Segment

The Price Pickers segment is characterized by consumers who were very sensitive to price, with the price factor accounting for approximately 48% of the variation in utility. The most distinguishing demographic characteristic of Price Pickers is that they were more likely than respondents in all other segments to be non-white. However, Price Pickers, like consumers in other segments, are most easily distinguished by the values they hold. Price Pickers were more likely to indicate that a sense of accomplishment or fun and enjoyment in life is one of their most important values, and they were more likely than consumers in both the Balanced Buyers and Perfect Produce segments to choose excitement as one of their top values. Conversely, Price Pickers were the least likely to rate self-respect as a value that is important to them.

An examination of the value groups with which Price Pickers are most similar (sense of accomplishment, fun and enjoyment in life, and excitement) reveals several interesting characteristics. Compared to the other value groups, these groups tend to be male-oriented, are very independent, unbothered by stress, and very healthy (Piner). These descriptions yield some insight as to the possible motivations underlying the Price Pickers' product preferences. One hypothesis is that Price Pickers, since they are generally healthy and they tend not to worry, are less concerned with the effects of pesticides—both because it is their nature and because of the sense of control they have over their lives. One would expect such consumers to be much more concerned with factors such as price, which affect them immediately, than with factors that have long-term effects such as pesticide usage.

The Perfect Produce Segment

Consumers in the Perfect Produce segment were most concerned with the level-of-damage attribute. This segment tended to be most like the Safety Seekers segment, with the only statistically significant difference between the two groups being the higher income level of members of the Perfect Produce group. In fact, the high income level of the Perfect Produce segment, relative to all other segments, was the most distinguishing characteristic of this group. Members of the Perfect Produce segment also can be distinguished by several of the values they hold. Like the Safety Seekers, they were much more likely to indicate that having warm relationships with others is one of their most important values. With respect to two other important values, they tended to occupy intermediate positions relative to the Balanced Buyers and Price Pickers segments. Members of the Perfect Produce segment were more likely to choose fun and enjoyment in life as one of their most important values compared to the Balanced Buyers group, and less likely to choose this value compared to the Price Pickers. They were more likely to select self-respect as an important value than Price Pickers, but less likely than Balanced Buyers to pick this value.

The Perfect Produce market segment is the most difficult to understand. The values these consumers hold give no clear indication as to the motivation behind their product preferences. The only clear distinction between individuals in this group and those in all other segments is their high level of income. It is likely that their preference for undamaged produce is due to the high quality standards to which they have become accustomed because of their status as high income earners.

Summary and Conclusions

Conjoint analysis is used to examine the tradeoffs consumers make with respect to food safety attributes. Respondents to a mail survey were asked to rate Red Delicious apple products with different levels of four attributes: price, level of damage, pesticide usage policies and the associated cancer risk, and type of certification program for compliance with food safety regulations.

The major contribution of this research is the clear delineation of market segments based on consumers' preferences for price, quality, and food safety attributes. Cluster analysis yielded four well-defined market segments with substantial differences in the socioeconomic and value characteristics of consumers in each segment.

Consumers in the first market segment, labeled Safety Seekers, place a high value on food safety as defined by their strong preference for a reduction in the use of pesticides. Their family-oriented profile indicates that their concern for food safety may be motivated by a desire to protect their families. Balanced Buyers, the second market segment, are consumers who have a demographic and value profile matching that of the typical American, and exhibit a more balanced preference for price, level of damage, and food safety factors. Segment 3, the Price Pickers, is defined by consumers who place a high emphasis on price in making their purchase decision. Members of this segment tend to be non-white and are much more likely to hold either fun and enjoyment in life or a sense of accomplishment as one of their most important values. Finally, consumers in the Perfect Produce segment differed from members of the other three segments based on their strong preference for undamaged produce and their higher income levels.

The results of this research have important implications for produce marketers. The first is that produce consumers may be grouped into several distinct market segments based not only on their preferences for product attributes, but also on demographic and psychographic characteristics. It is also notable that consumers' preferences for food safety attributes are an important component of the segmentation structure identified by this research. This raises some interesting questions regarding produce marketing in the U.S. From a systemwide perspective, do the current options available to most consumers adequately meet the diverse set of needs described in this research? More specifically, are consumers given sufficient choices regarding food safety attributes? Are attributes bundled in such a way as to satisfy the preferences of the distinct market segments? Have alternatives to conventional produce been widely distributed through the appropriate channels so that they are conveniently available to consumers who have an interest in purchasing them? Have alternatives to conventional produce been adequately promoted and advertised so that potential consumers understand the benefits of such produce and know where it is available?

Future research should provide additional insight into some of the areas explored in this study. For example, collecting more detailed information relating to respondent characteristics and purchasing behavior would be useful in conducting an economic analysis to predict changes in the quantity or quality of purchases and in estimating substitution effects in response to product or policy changes. Subsequent conjoint analysis studies might include additional factors important to consumers. It would be particularly interesting to include quality factors such as color or taste in the analysis. Finally, other methodologies that take a different approach may provide further insight into the relationship between consumer behavior and food safety attributes.

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