CONJOINT ANALYSIS OF BREADED CATFISH NUGGETS: CONSUMER

PREFERENCES FOR PRICE, PRODUCT COLOR, COOKING METHOD,

AND COUNTRY OF ORIGIN

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THESIS ABSTRACT

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The catfish nugget is the residual product that results when the belly flap is cut away the fillet to produce the shank fillet. Nuggets are a lower-valued portion of the catfish because of their high fat content, higher potential for an off-flavor, and the black membrane covering one side of the nugget. A new product, marinated, breaded catfish nuggets, was developed to ameliorate these negative attributes. This conjoint study was designed to evaluate consumers' preferences for four attributes of catfish nuggets: price ($1.49/lb., $4.59/lb., and $7.49/lb.); color of breading (light, medium, and dark); country of origin (U.S. and China); and cooking method (oven baked and deep fried).

An in-store survey was conducted in grocery stores in eight cities in three states: Alabama, Georgia, and Florida that included using a 7-point intention-to-buy scale. Participants evaluated 12 different photographs of catfish nuggets that included information about various levels of the attributes. 614 usable surveys were collected. The data was analyzed to determine individual preferences using conjoint analysis. Cluster analysis, based on similar preferences, was used to group respondents into the following three segments: the price sensitive segment preferring the low price, country of origin being U.S. as preferred country, and color of breading being dark as the preferred color. A multinomial logit model was used to identify significant demographic variables that influenced membership in the segments. These included age, ethnicity, and education.

Journal of Agricultural and Applied Economics

Microsoft Word 2007; Microsoft Excel; Conjoint Designer; Conjoint Analyzer; SAS; Limdep; Adobe Photoshop

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Introduction

The nugget portion of the catfish has not been a popular product among

consumers. The nugget has a negative image among consumers which contribute to a

low profit margin for catfish processors. The nugget has several drawbacks that

contribute to the negative image perceived by consumers. The nugget is made from the

belly flap that is cut away from the fillet of the catfish.   It has a higher concentration of

fat than other forms of the catfish (fillets, steaks, and whole dressed) and therefore is

more likely to retain off-flavors. There is also a black membrane covering one side of the

nugget that gives it an unappetizing appearance. The membrane, high fat content and

potential for off-flavor have all contributed to the unappealing image with consumers.

To offset these drawbacks, a new product was developed to improve the nugget:

a marinated, breaded catfish nugget that comes in four distinct flavors (Szechwan,

Poblano, Buffalo, and Lemon Pepper). A test taste was done to evaluate participants'

preference for the four different samples of nuggets in terms of flavor, appearance,

texture, off-flavor perception and overall acceptability (Woods-Williams et al., 2007).

The taste test, as well as meetings and phone conversations with catfish processors, suggested that information on additional attributes would be needed to successfully market this product. Several attributes were determined to be important for evaluation: price, color of breading, country of origin, and cooking method. There were several additional attributes identified as well. Flavor was considered as an attribute to include in the survey, with four levels: Lemon Pepper, Szechwan, Poblano, and Buffalo. However, a taste test provided information on flavor preferences, so there was no need to include this attribute. Size was considered, which would include three levels: small, medium, and large. However, size was not included in the survey because the food technologist, Woods-Williams' standard size for the nuggets is one to one and half ounce. Also, it takes additional processing on both the food technologist and processors to vary the size. Labeling was also an attribute considered. Some fish contain omega-3 fatty acids which are considered a good fat that contributes to healthy hearts. There were two levels: with labeling indicating high in omega-3 fatty acids or no label. However, after discussions with food technologists, it was discovered that catfish have low omega-3 fatty acids and to get a substantial amount, catfish would have to be fed omega-3 fatty acids. Another labeling considered was farm-raised or wild caught. However, conversations with processors revealed that they only processed farm-raised catfish. The objective of this study was to determine consumers' preferences for various levels of these attributes for catfish nuggets and to identify any segments that might differentiate the market. This information would add value to the nugget and help processors improve the marketability of the nugget.

Literature Review

        Numerous conjoint studies have been conducted on food products in the past several years. One of the more recent studies involved of analysis consumer preferences for mandarin attributes (Campbell et. al, 2006). Conjoint analysis was used to determine the variety of mandarin and other attributes that consumers prefer when purchasing the fruit. Attributes considered were price, packaging, and type of mandarin, shelf life, and Vitamin C labeling. An in-store survey was conducted in several grocery stores and participants were asked to rate pictures of the fruit on a 7-point intention-to-buy scale. This study made use of cluster analysis and multinomial logit modeling. In the study six segments were identified.

        Another study similar to the mandarin study was about the fruit quality characteristics for Satsumas that are important to consumers (Campbell et al., 2004). A conjoint study was developed to determine preferences for price, color, size, blemishes, seediness, production region label and organic production. In this study there was a price-sensitive segment characterized by strongly preferring the lowest price. The study also examined color as an attribute.

        Two studies on consumer preferences for peanut products were conducted in Haiti. The first one dealt with the preferences for roasted peanut products. Nelson et al. (2005) conducted a conjoint analysis to determine consumer preferences for roasted peanuts, including the processed form, country of origin, and price. In this study, all of the segments placed the highest relative importance on price, but in Segment II second highest relative importance was placed on country of origin. The other study was done on peanut butter products in Haiti (Nelson, et al, 2003) to determine consumer

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preferences for form, country of origin, and price. Again, price was the most important attribute to the consumers. However, in Segment II, there was again a clear indication that origin plays a role in consumer preferences, with 27% relative importance.

There are two methods used to code consumer preferences: rank order and interval rating. The rank order method allows respondents to ambiguously rank all hypothetical product choices, which provides a non-metric ordering of a respondent's preferences (Harrison et al., 2002). The interval rating method allows respondents to express order, indifference, and intensity, a feature that allows both metric and non-metric properties of utility to be expressed (Harrison et al., 2002). If rank order is the method of choice than the dependent variable is ordinal, and models such as logit or probit are appropriate to use. However, other researchers argue that the ordered probit or logit model is best suited for conjoint estimations because interval rating are measured as discrete variables (Harrison et al., 2002). In Harrison, Stringer, and Prinyawiwatkul's (2002) study on added-value products from crawfish, a two-limit probit model and ordered probit model were used to determine the part-worth estimates (or preference coefficients) and address the methodological issues.

In a study of consumer preferences for added-value products from crawfish an exploratory survey conducted in 10 grocery stores in south Louisiana discovered that common product forms were breaded nuggets, fish and crab patties and shrimp poppers (Harrison et al., 2002). The authors discovered four attributes that were important, including price, product form, packaging, and reheating method.   They also discovered that there was little estimation differences between the two-limit probit model and the ordered probit model. All the part-worths' estimates in both models were significant

except for microwave reheating and package size, and all the signs were consistent in both models (Harrison et al., 2002). The magnitudes of the standardized two-limit probit model were also very similar to the ordered probit models. This indicates that the partial effects on the estimated utility functions are consistent across both models (Harrison et al., 2002).Ward's method was used for the cluster analysis revealing three segments. Segments I and II preferred the nugget form baked. In Segment III, they preferred the nugget form microwave.

A conjoint analysis was conducted by Alberto Manalo (1990) on the importance of apple attributes. The research was to determine the attributes that consumers desire when purchasing apples. Manalo took a random sample of 208 respondents that were interviewed in a shopping mall. Respondents were asked to evaluate the following attributes of apples during the survey: size, color, flavor, crispiness, and price. The conjoint study consisted of 18 stimulus cards where each card displayed a combination of the attributes. The respondents were asked to rank the cards from 1 to 18, indicating highest and lowest preference. Effects coding was used to code the attributes' levels. Manalo states that using effects coding allows for easier explanation of the part-worths and interpretation of the conjoint analysis results. Ordinary Least Squares was used to estimate the part-worths. The study revealed that consumers placed the highest importance on crispiness, followed by size, color, flavor, and finally price per pound.

Methodology and Materials

Conjoint analysis is a multivariate technique developed specifically to understand how respondents develop preferences for any type of product (Hair et al., 2006). It is

based on the simple premise that consumers evaluate the value of a product by combining the separate amounts of value provided by each attribute (Hair et al., 2006). By evaluating the respondent's rating for the combined features (attributes) for the product, the individual preference scores for each feature can be deduced.

Conjoint analysis is a technique widely used to measure consumers' trade-offs between competing products. It has been very useful in the marketing world to determine consumers' preferences for products. The advances made in conjoint analysis have created a powerful tool to predict consumers' preferences for product features.

The first step in a conjoint study is to determine the design. In a conjoint analysis, the features that are most important to the evaluation of the product must be determined. When determining the number of features to include in the conjoint analysis, it is important to keep in mind that respondents will only devote a limited time to the process, so it is important to select the fewest features that are critical to the product, while still being able to obtain the information needed to estimate the respondents' utility functions. In this conjoint study of catfish nuggets, the features evaluated were price, color of breading, country of origin, and cooking method. From information received from food technologists, catfish processors, and past conjoint studies, these four factors were identified as the key characteristics that consumers would use to evaluate this product. Each feature will have two or more levels.

When the features and their levels are determined, the information is entered into the Bretton-Clark (1990) Conjoint Designer program. Conjoint Designer will produce a set of designs with a certain number of cards in each design. Each design will consist of cards displaying at least one of every feature identified and at least one of its levels for

that feature. Therefore, there would be a set number of cards with the features: price and one of its specified levels, color of breading and one of its specified levels, country of origin and one of its specified levels, and cooking method and one of its specified levels. Conjoint Designer will randomize the cards to reduce any bias in the study. When choosing one of the designs produced by Conjoint Designer, it is best to choose the smallest complete design, which is the design with the least number of cards.

As stated, there were four features to be evaluated in this conjoint study of catfish nuggets. One of the features is price. Price is a factor included in many conjoint studies because it represents a distinct component of value for many products or services being studied (Hair et al., 2006). Price is an important factor to a consumer's decision making process. There were three price levels determined for this study: $1.49/lb., $4.59/lb., and $7.49/lb.

The color of the breading may also be a determining factor for consumers. A taste test for catfish nuggets was conducted by Kristin Woods-Williams, food technologist with the Alabama Cooperative Extension System. The test suggested that respondents associated the color of the breading with cooking quality. Some respondents believed that the darker color nuggets suggested over-cooking, while others thought the lighter color nuggets suggested undercooking. Therefore, three color levels were included in the conjoint study; medium to golden brown, dark brown and light brown.

Following several recent food-related scares over products from other countries, there has been an increasing concern among consumers to know where their food products originated. The recent food scare from China has highlighted this issue among catfish consumers. After several conversations with catfish processors, it was discovered

that some processors deal with imported catfish products. Therefore, country of origin was determined to be an important factor to be evaluated in this study. There are two levels: imported products from China and domestic products from United States. China was chosen as the source of imported product because channel catfish are raised there. This decision was made before the reports of tainted food products being imported from China.

The fourth and final feature is cooking method. In the past several years there has been a push by the food industry to provide healthier alternatives for certain food products because of consumers' increasing concern with healthier eating. Also, because if the product was introduced into the Alabama's school system, it would have to be in the baked form because the schools no longer fry. That is why two different cooking methods, oven baked and deep fried, are included in the study to be evaluated by respondents.

Experimental Design and Data Collection

There were four attributes, two with three levels and two with two levels, so the required combinations to be evaluated would have been 36 combinations (3 x 3 x 2 x 2). However, to minimize participants' fatigue, Conjoint Designer was used to reduce that number of combinations to nine. There were three more combinations added to the design as holdout cards, increasing the total number of combinations to 12, and increasing the degrees of freedom in the model to be estimated. Conjoint Designer does this by using orthogonal rays, which is a highly efficient technique that reduces the size of the task necessary to estimate the respondent's preference (utility) function (Bretton-Clark, 1990).

Several photographs of cooked, breaded catfish nuggets were taken with a digital camera. The photographs were examined to determine which batch of nuggets best represented the medium to golden brown color desired. This photograph was chosen as the archetypal batch of nuggets.

Once the archetypal nugget photograph was chosen, the photograph was copied into Adobe's Photoshop 7 (Adobe Systems Inc., Seattle, Washington). After the archetypal ('medium color") photograph was copied into Adobe's Photoshop, the hue, saturation, and light values were adjusted to achieve the light and dark extremes of the medium color. The "light color" was achieved by adjusting the hue to +7, the saturation to +9, and the light to +15 of the original photo which were all normalized to zero. The "dark color" was achieved by adjusting the hue to -5, the saturation to -15 and the light to -15 of the original photo which were all normalized to zero.

There were 12 panels, each displaying a picture with three lines of text describing attributes' levels. There were 3 sets of posters that were rotated as displays for the in-store surveys. Each poster had two sides, the front side displayed panels A through F and the back side displayed panels G through L. The attributes' levels were randomized three times using Conjoint Designer to reduce order bias, thus creating the three sets of posters. These kinds of props make the task more interesting to the respondent, provide easier and potentially less ambiguous ways of conveying information, and hence allow a greater number of attributes to be included in the full-profile method (Green and Srinivasan, 1990).

The in-store surveys were administered in 12 grocery stores in eight cities in Alabama, Georgia, and Florida. The eight cities included were Opelika, Auburn,

Luverne, Troy, Montgomery, and Prattville, all located in Alabama, as well as,

Columbus, Georgia and Apalachicola, Florida. The grocery store chains visited were The

Kroger Company (3), Bruno's (1), Piggly Wiggly (5), Southern Family Foods (2), and

Food World (1).

A display was set up in each store either near the frozen meat section or near the

entrance. There was a different set of posters taken to each store on different days with

the time spent in each store ranging from four to eight hours. Several grocery stores were

revisited, at a different date and with a different set of posters. Dummy coding was used

to code the grocery stores. The posters were set up on a table six feet in length. Panels A

through F stood on one side and Panels G through L stood on the opposite side, with the

backs facing each other or on occasion the posters were standing side by side with the

edges touching. Either way, respondents were allowed to take the survey starting at any

panel of their choosing as long as the panel they were evaluating corresponded to the

panel they marked on the survey. The respondents were asked to rate each stimulus on a

rating scale of 1 to 7, where 1 meant that the respondent definitely would not buy the

product and 7 meant that the respondent definitely would buy the product, as presented in

the photograph.   Participants could mark anywhere between 1 and 7, and their mark was

later measured to the nearest tenth of a decimal place. Following Institutional Review

Board guidelines respondents were allowed to opt out of the survey without penalty at

any time during the survey, although fewer than about 1% did so.

The survey also consisted of seven questions about catfish nuggets usage and six

questions concerning demographics. The usage questions included: awareness of catfish

nuggets (yes or no), previous consumption of catfish nuggets (yes or no), previous

purchaser of catfish nuggets (yes or no), if yes would purchase them again, purchasing

frequency, location of purchase (grocery, fish market, or other), and how many pounds

per purchase on average. The last question that was included in the usage questions

asked participants to rate ten alternative names for catfish nuggets on a scale of 1(least

appealing name) to 7 (most appealing name). The questions about demographics were

year of birth, gender, ethnic group, years of education completed, and number of people

in the household and their age group, and income bracket. A total of 663 surveys were

administered, however only 614 of those surveys were usable.

Ordinary Least Squares was used to estimate each respondent's preference

coefficients (part-worths) each feature's level and one level for each feature is dropped to

avoid singularity. The following model specification was used:

$$R_j = \beta_1 + \beta_2 \, (P1) + \beta_3 \, (P3) + \beta_4 \, (C1) + \beta_5 \, (C3) + \beta_6 \, (O1) + \beta_7 \, (CM2) + E_j \quad [1]$$

where, R_j denotes rating value assigned by respondent j on the 7-point scale; P1 =

$1.49/lb. price level; P3 = $7.49/lb. price level; C1 = light color breading; C3 = dark

color breading; O1 = China as country of origin, and CM2 = oven baked as cooking

method.

The independent variables were effects coded. Effects coding is an alternative to

dummy coding in which the effects are uncorrelated with the intercept (Bech and Gryd-

Hansen, 2005). The reference level in effects coding is assigned a -1, as opposed to

dummy coding where the reference level is assigned 0. In effects coding: if the level is

present a 1 is assigned. The reference level is not present and is assigned a -1 and 0 (if a

third level is present) if otherwise (Bech and Gryd-Hansen, 2005). The reference profile

for this study was medium colored breaded catfish nuggets that are oven baked, the

country of origin is United States, and the price is $4.59/lb.

The estimated preference coefficients obtained through ordinary least squares regression are used to determine each respondent's relative importance of each attribute. The relative importance is calculated in the following way:

$$R.I._i = (range_i * 100)/ \sum_i (ranges) \qquad\qquad [2]$$

where, $R.I._i$ is the relative importance for feature i. The range is calculated by taking the difference between the highest and lowest coefficient for each feature and then summing the ranges across all of the features. The results are interpreted as the percentage of importance the consumer placed on each attribute when expressing his/her intention to buy.

Cluster analysis was used to group respondents with similar preference coefficients into clusters. PROC FASTCLUS was used to perform a disjoint cluster analysis on the basis of Euclidean distances computed from these preference coefficients (SAS User's Guide: Statistics, 1985). FASTCLUS initially develops cluster seeds that are the means of the clusters, and from there temporary clusters are developed and observations are assigned to the clusters with the nearest seeds. Whenever an observation is assigned, the cluster seeds are updated with the new cluster mean. Once all the cluster seeds are assigned, they are replaced with cluster means. Then the final clusters are formed by assigning the observations to the nearest seed. In this study 30 initial clusters were created to determine the presence of outliers. Clusters with less than three observations were classified as outliers. PROC CANDISC was used to produce plots of all clusters by using the first and second canonical variables as the axes. Then FASTCLUS was run again to assign the outliers to the nearest seed. Three clusters were

subjectively chosen based on the ability to clearly discern the outer edges of the clusters and each respondent was assigned a cluster number (1, 2, or 3).

Multinomial logit modeling allows us to provide a physical description of the clusters' members based on the demographic and usage information. Initially, clusters were created by grouping similar preference coefficients, but logit analysis allows us to identify membership probability. The cluster numbers are the dependent variable run against all the demographic and usage variables. The results from the model give us the likelihood of cluster membership based on demographic and usage information.

Results

The relative importance placed on each attribute for the 614 respondents are country of origin which accounted for 30% of the decision buying process, followed by the color of the breading with almost 28%, then 27% for price, and cooking method accounted for the final 14% of the decision buying process.

Table 1 shows the distribution of preferred levels for each attribute. By preferred, it is meant that the respondent had a greater utility for one level over the other levels. Of the 614 respondents, nearly 54% preferred the price level $1.49 per pound, 49% preferred the medium colored breading, and 79% preferred U.S. catfish nuggets and almost 58% preferred oven baked catfish nuggets.

Table 1. Distribution of Preferred Levels

Price per lb.	Level	Percentage
	$1.49	54.40
	$4.59	25.16
	$7.49	20.44
Breading Color	Level	Percentage
	Light	24.76
	Medium	49.02
	Dark	26.22
Country of Origin	Level	Percentage
	China	20.93
	U.S.	79.07
Cooking Method	Level	Percentage
	Deep Fried	42.26
	Oven Baked	57.74

In segmenting the market, we need to understand who the respondents are (based on demographic information) that chose the particular products described. Three consumer segments were identified by cluster analysis. Table 2 presents the three segments identified and the average preference coefficients and average values for demographics by segment and for the overall sample. The first segment was identified as the price-sensitive segment because they placed the highest relative importance (42%) on price. Segment I's large, positive preference coefficient for the lowest price that a product with this price indicates that would increase the base rating by 1.13 on the 7-point scale, or 29% (Campbell et al., 2004). Conversely, a price of $7.49, received a large, negative average preference coefficient of -1.11 which would decrease the base rating by 28%. Table 3 represents the percentage of respondents' who chose each level as their first choice for each of the three segments. In Segment I, 85% of the respondents' first choice was the $1.49 per pound price.

In Segment I, color of breading followed price with a relative importance of 25%, and with the largest preference coefficient being placed on the medium color choice for breading. However, consumers' preferences for this attribute were not as strong as for price. Respondents in Segment I assigned the medium color breading an average preference coefficient of 0.26. Respondents in this segment exhibited a negative preference for the dark breading. Dark breading received an average preference coefficient of -0.29, indicating that the base rating would decrease by 7% if the nugget breading was dark. The relative importance of cooking method for Segment I was 18%. Sixty-seven percent of respondents chose oven baked nuggets as their first choice, however 33% chose deep fried as their first choice for cooking method. Therefore, there are still a considerable number of Segment I's respondents that would choose deep fried nuggets.

Segment II was represented as the segment that strongly preferred the country of origin for catfish nuggets to be the U.S. This segment had the highest percentage of whites (only 34% were non-white), they were significantly older (47 vs. 44 overall), and had a significantly higher income range of $35,000 to $49,999 vs. $25,000 to $34,999 per year for the overall. They assigned a relative importance of 53% to country of origin; therefore over half of their buying decision was based on country of origin. The consumers in this segment clearly felt very strongly about the country of origin: the U.S. received an average preference coefficient of 1.57, indicating that if the nuggets' origin was the U.S. then the base rating would increase by 44% and if the origin was China then the base rating would decrease by 44%. Ninety-nine percent of the respondents in Segment II preferred U.S. as the country of origin. Both price and color of breading only

had relative importance of 18% each. Consumers in Segment II preferred the price of $1.49 which received an average preference coefficient of 0.12, and 50% of these respondents chose this price as their first choice. The medium colored breading average preference coefficient was 0.18 and 47% of respondents chose this as their first choice. The average preference coefficient for oven baked was 0.06, increasing the average rating by only 2%.

Segment III's highest relative importance (46%) was placed on color of breading. Consumers in this segment preferred the dark color breading, as indicated by an average preference coefficient of 0.67. More importantly, consumers had a very strong negative preference for light color breading; the average preference coefficient was -1.15. Fully 93% of the respondents preferred dark or medium breading while, only 7% preferred light breading. Segment III was the only segment to show a preference for the high price ($7.49/lb.). One reason for this could be that this segment associated a higher price with a better quality product. Respondents did not exhibit strong preferences for either country of origin or cooking method although, they preferred U.S. products and the oven baked cooking method. There were some interesting demographic characteristics for this segment. They had the highest percentage of non-white respondents (67%), they were significantly younger in age (41 vs. 44 overall), they had significantly lower income ranges, 4.46 versus 4.93 per year for the overall. Therefore, if the respondents could have chosen between the ranges of $25,000 to $35,000, then they would have marked towards the low end of $25,000. The respondents in Segment III also had significantly less education (13 years vs. 14 years overall).

Table 2. Preference Coefficients, relative importance, adjusted R^2, and demographics for segments and overall sample.

Attributes and Levels	Segment I	Segment II	Segment III	Overall
N	204	249	161	614
Market Share (%)	33.2	40.6	26.2	100.0
Intercept (base rating)	3.91[b]	3.58[c]*	4.18[a]*	3.85
Price/lb.				
$1.49	1.13[a]*	0.12[b]*	-0.12[c]	0.39
$ 4.59	-0.02[a]	0.02[a]	-0.01[a]	0.00
$7.49	-1.11[c]*	-0.14[b]*	0.13[a]*	-0.39
Relative Importance (%)	42.2[a]*	18.0[c]*	23.4[b]*	27.4
Color of Breading				
Light	0.02[a]*	0.10[a]*	-1.15[b]*	-0.25
Medium	0.26[b]	0.18[b]*	0.48[a]*	0.28
Dark	-0.29[b]*	-0.28[b]*	0.67[a]*	-0.03
Relative Importance (%)	25.0[b]	18.6[c]*	46.0[a]*	27.9
Country of Origin				
U.S.	0.22[b]*	1.57[a]*	0.07[c]*	0.73
China	-0.22[b]*	-1.57[c]*	-0.07[a]*	-0.73
Relative Importance (%)	14.7[b]*	53.1[a]*	14.5[b]*	30.3
Cooking Method				
Oven Baked	0.30[a]*	0.06[b]	0.03[b]*	0.13
Deep Fried	-0.30[b]*	-0.06[b]	-0.03[b]*	-0.13
Relative Importance (%)	18.0[a]*	10.4[b]*	16.1[a]	14.4
Adjusted R^2	0.54	0.69*	0.39*	0.56
Survey Store, City				
Piggly Wiggly, Opelika	7	8	9	8
Kroger, Auburn	14	10	8	11
Bruno's, Auburn	3	1	1	2
Piggly Wiggly, Columbus	12	12	23*	15
Piggly Wiggly, Apalachicola	7	8	7	7
Southern Family Foods, Luverne	2	4	6	3
Piggly Wiggly, Troy	9	8	11	9
Southern Family Foods, Troy	4	5	3	4
Piggly Wiggly, Montgomery	5	1*	3	3
Piggly Wiggly, Opelika	3	2	6	4
Kroger, Opelika	18	20	7*	16
Food World, Prattville	4	7	6	6
Kroger, Auburn	10	13	9	11
Ever heard of nuggets (% yes)	85[a]	88[a]	88[a]	87
Ever eaten nuggets (% yes)	74[a]	77[a]	77[a]	76
Ever bought nuggets (% yes)	54[a]	58[a]	60[a]	57
Age (years)	42.90[b]	47.10[a]*	41.48[b]*	44.23
Gender (% female)	66[a]	70[a]	73[a]	69
Ethinicity (% non-white)	51[b]	34[c]*	67[a]*	48
Education (years)	14.36[a]	14.25[a]	13.11[b]*	13.99
Income range (5 = $35-$50,000/year)	4.86[ab]	5.28[a]*	4.46[b]*	4.93
Family age structure (no. of persons)				
Babies (<4 years)	0.21	0.16	0.20	0.19
Small Kids (4 to 8 years)	0.19	0.20	0.21	0.20
Preteens (9 to 12 years)	0.19	0.17	0.16	0.17
Teens (13 to 18 years)	0.37	0.30	0.39	0.35
Young Adults (19 to 25 years)	0.42	0.33	0.42	0.38
Adults (26 to 35 years)	0.35	0.27	0.34	0.31
Middle Age (36 to 50 years)	0.64	0.57	0.72	0.63
Preretirement Age (51 to 65 years)	0.52	0.61	0.37*	0.52
Retirement Age (>65 years)	0.17	0.22	0.13	0.18

* Significantly different (p < .10) from overall sample in a two-tail *t* test.

[a,b,c]Means with different letters indicates significance.

Table 3. Percent of respondents who specified the level as their first choice.

Attributes and Levels	Segment I	Segment II	Segment III
Price/lb.			
$1.49	85	50	32
$ 4.59	12	31	32
$7.49	2	20	35
Color of Breading			
Light	29	39	7
Medium	50	47	40
Dark	21	14	53
Country of Origin			
U.S.	71	99	57
China	29	1	43
Cooking Method			
Oven Baked	67	55	52
Deep Fried	33	45	48

Demographics play an important role in understanding the segments identified. The marginal effects from the multinomial logit model indicate the probability of membership in a particular segment based on demographic information. Table 4 shows the marginal probabilities of membership by segment. In segment I, which represented 33% of the market, ethnicity and education were significant. The interpretations of these marginal effects are that if the consumer is non-white, then their probability of being in Segment I increase by about 9%; if they have one more year of education than average then their probability of being included in Segment I increase by about 2%.

Table 4. Marginal probabilities by consumer segment with respect to the vector of demographic variables (computed at the means)[z].

| | Marginal Probabilities of membership in each segment | | | | | |
| | Prob [Segment I] | | Prob [Segment II] | | Prob [Segment III] | |
Variable	Coefficient	p value	Coefficient	p value	Coefficient	p value
Intercept	-0.2745	0.14	0.2519	0.18	0.0226	0.89
Survey Store (% of segment)						
Store 1	0.1622	0.10	-0.1466	0.16	-0.0156	0.86
Store 2	0.2126	0.19	-0.1152	0.55	-0.0974	0.56
Store 3	-0.0515	0.58	0.0138	0.89	0.0378	0.61
Store 4	0.0565	0.60	-0.0618	0.57	0.0052	0.95
Store 5	-0.0219	0.88	-0.0904	0.51	0.1123	0.28
Store 6	0.0617	0.54	-0.0271	0.79	-0.0346	0.68
Store 7	0.0589	0.64	-0.0040	0.97	-0.0549	0.63
Store 8	0.3300	0.03	-0.3436	0.10	0.0136	0.92
Store 9	0.0001	1.00	-0.1184	0.42	0.1183	0.26
Store 10	0.1233	0.20	0.0656	0.50	-0.1888	0.04
Store 11	0.0262	0.82	-0.0171	0.88	-0.0091	0.93
Store 12	0.0171	0.87	0.0087	0.93	-0.0258	0.77
Previous knowledge of catfish nuggets (1=yes)	0.0567	0.49	-0.1057	0.23	0.0490	0.52
Ever eaten catfish nuggets (1=yes)	-0.0389	0.59	0.0566	0.46	-0.0178	0.78
Ever purchase catfish nuggets (1=yes)	0.0295	0.59	-0.0727	0.21	0.0431	0.38
Age (years)	-0.0020	0.30	0.0037	0.07	-0.0017	0.32
Gender (1=female)	-0.0684	0.14	0.0153	0.75	0.0531	0.22
Ethnicity (1=non-white)	0.0902	0.09	-0.2506	0.00	0.1604	0.00
Education (years)	0.0175	0.02	-0.0029	0.69	-0.0145	0.05
Income range	-0.0182	0.11	0.0090	0.44	0.0092	0.36
Age structure of family (no. of persons in household)						
Babies (<4 years)	0.0356	0.42	0.0073	0.88	-0.0429	0.27
Small Kids (4 to 8 years)	-0.0408	0.37	0.0433	0.36	-0.0026	0.95
Preteens (9 to 12 years)	-0.0030	0.95	0.0516	0.30	-0.0487	0.26
Teens (13 to 18 years)	0.0330	0.31	-0.0170	0.63	-0.0160	0.57
Young Adults (19 to 25 years)	0.0125	0.67	-0.0199	0.54	0.0074	0.78
Adults (26 to 35 years)	0.0602	0.14	-0.0524	0.24	-0.0078	0.83
Middle Age (36 to 50 years)	0.0382	0.27	-0.0478	0.20	0.0096	0.75
Preretirement Age (51 to 65 years)	0.0663	0.06	-0.0076	0.84	-0.0587	0.09
Retirement Age (>65 years)	0.0596	0.28	-0.0197	0.73	-0.0399	0.44

[z]Multinomial logit model likelihood ratio statistic significant at $p < 0.01$.

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The information from Table 2 and Table 4 give a good indication of the consumers' make-up in segment I. Therefore, the customer profile for segment I that was price sensitive are black females that receive at least 2 years of education beyond completion of high school and have an income range of $35,000 to $49,999 per year as indicated in Table 2. In the multinomial logit model, out of the 204 members assigned to Segment I, only 73 were correctly predicted or 36%. The other 93 members (46%) were incorrectly assigned to Segment II and 38 (19%) were incorrectly assigned to Segment III.

Segment II (41% market share) was represented by U.S. being the preferred country of origin. It is interesting that there is a segment based on country of origin due to the fact that during the dates (end of June to beginning of August) the survey was conducted, news outlets were reporting information about contaminated food products imported from China. So the results could possibly reflect the media attention. The demographic variables of age and ethnicity were significant variables in Table 4. The marginal probability of a consumer being assigned to Segment II increased by 0.37% when the consumer's age increased by one year. A non-white respondent had a decreased probability of membership in Segment II by 25%. This information is supported by the average demographics in Table 2. A consumer that was on average around 47 years of age and a white female with an income range $35,000 to $49,999 per year preferred oven-baked, medium color breaded catfish nuggets from the U.S. at $1.49/lb. The preference coefficient for cooking method was not strong nor significantly different from the overall, however it is important to note that to market to this specific customer profile, they would prefer an oven baked nugget (0.06) compared to a deep

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fried nugget (-0.06). The multinomial logit model correctly predicted 170 of the 249 members or 68%. There were 36 members (14%) incorrectly assigned to Segment I and 43 (17%) were incorrectly assigned to Segment III.

Segment III was identified as preferring the dark color breading and represented 26% of the market. As mentioned they had a strong negative preference for light color breading so in order to market to this segment it is important to note that a medium or dark breading would be the best product profile. A medium color breading would increase the base rating by 11% and a dark color breading would increase the base rating by 16%. The multinomial logit model revealed that both ethnicity and education were significant. The interpretation is that if you are non-white, it increases your probability of being assigned to Segment III by 16%. If the consumer receives one more year of education than average then their membership in Segment III would decrease by 1%. This is supported by Table 2 where the customer profile is a black female, average age of 41 years, and about 13 years of education in the income range of $25,000 to $34,999 per year.

A consumer in this segment prefers the higher price of $7.49, which represents 23% of the relative importance. The price of $7.49 would increase the average base rating by 3%. So it is possible that consumers in Segment III would be willing to pay a higher price for darker breaded nuggets. The preference coefficients for origin and cooking method are not very strong but it is important to note that the consumers prefer U.S. nuggets that are oven baked. It would increase the average base rating by about 1% for both attributes. In the multinomial logit model, out of the 161 members assigned to segment III, 65 were correctly predicted or 40%. The other 41 members (25%) were

incorrectly assigned to Segment I and 55 (34%) were incorrectly assigned to Segment II.

Conclusions

This conjoint study suggested that there is market potential for catfish nuggets and that consumers do have strong preferences for certain attributes in catfish nuggets. The cluster analysis revealed valuable information that could not have been detected from the conjoint study alone. Through cluster analysis, three segments were identified: Segment I represented the price sensitive, Segment II represented the U.S. as country of origin, and Segment III represented the dark color breading. It was interesting to find out that there was some preference for the highest price, $7.49, (in Segment III) which indicates that if a dark breaded nugget was introduced into this particular market then consumers might be willing to pay the higher price. This is unusual since the lower prices are usually preferred. We also discovered that cooking method did not influence buying intentions as strongly as originally thought.

The marginal probabilities allowed for more descriptive profiles of the segments based on demographics, independent of preference coefficients. This information allows marketers to determine the customer profiles and target these segments with a specific product. It is easier to identify a customer that she is likely to be an older white female that prefers catfish nuggets from U.S. when you have the additional demographic information. This information offers something that is observable and measurable. This information can then be given to catfish processors so that they have a better understanding of what kind of catfish nuggets to develop and who to sell the nuggets to.

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APPENDIX A

INFORMATION LETTER

COLLEGE OF AGRICULTURE

DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY

INFORMATION LETTER
for a Research Study Entitled
"Development and Marketing of a Value-Added Catfish Nugget"

You are invited to participate in a research study to determine consumer preferences for catfish nuggets. This study is being conducted by Jessica Hill, under the supervision of Dr. Bob Nelson, a professor of agricultural economics at Auburn University. We hope to learn more about the potential market for certain features of catfish nuggets. You were selected as a possible participant because you may be a consumer of catfish products and may have an interest in expressing your preferences for features of catfish nuggets.

If you decide to participate, I will ask you to complete a survey by rating a number of pictures on a scale from 1 to 7 and then answering some questions about your socioeconomic characteristics and catfish consumption habits. Completion of the survey should take about 15 to 20 minutes.

You may or may not find any immediate benefit from participating. However, the results of our study may ultimately benefit all catfish consumers by providing them with more choices and better products.

All information obtained in connection with this study will be anonymous, i.e. there will be no way to connect you with your responses after you hand in the survey. Numbers in the upper corner of the survey are for identifying the location of the store only.

Information collected through your participation may be used to fulfill an educational requirement, published in a professional journal and presented at professional meetings.

You may withdraw from participation at any time without penalty. Your decision whether or not to participate will not jeopardize your future relations with Auburn University or the Department of Agricultural Economics & Rural Sociology.

If you have any questions I invite you to ask them now. If you have questions later, I will be happy to answer them. Our contact information is:

Jessica Hill	Dr. Bob Nelson
(334) 844-5622	(334) 844-5621
hilljei@auburn.edu	nelsorg@auburn.edu

For more information regarding your rights as a research participant you may contact the Auburn University Office of Human Subjects Research or the Institutional Review Board by phone (334)-844-5966 or e-mail at hsubjec@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WISH TO PARTICIPATE IN THIS RESEARCH STUDY. THE INFORMATION YOU PROVIDE INDICATES YOUR WILLINGNESS TO PARTICIPATE.

Robert G. Nelson   7/2/07
Investigator obtaining consent / Date

Robert G. Nelson
Print Name

HUMAN SUBJECTS
OFFICE OF RESEARCH
PROJECT # 06-259 EX 0701
APPROVED 1/18/07 TO 1/17/08

Page 1 of 1

Owing much to the past, Auburn's greater debt is ever to the future.

APPENDIX B

SURVEY INSTRUMENT

Auburn University is conducting a survey to better understand consumer preferences for catfish nuggets. We would greatly appreciate it if you would take a few minutes to answer some questions about your preferences for the catfish nuggets on display. Your participation here today will help improve the kinds of catfish products available to you in the future.

<u>Product Profile Ratings – Catfish Nuggets</u>   Please look at each of the 12 panels of breaded catfish nuggets. For each panel, place a mark anywhere on the line between 1 and 7 to indicate how willing you would be to purchase the product from the frozen-food section at that price, and then prepare it as described in the panel. A response of 1 would indicate that you are definitely <u>not</u> willing to buy that product, while a response of 7 would indicate that you are very willing to buy that product. In your evaluation, please consider all of the following: color of the cooked product, price per pound in the frozen form, cooking method and origin of product.

Panel A	Definitely would NOT buy product	May or may not buy product	Defintely **would** buy product
	1 . . . . 2 . . . . 3 . . . . 4 . . . . 5 . . . . .6 7		

Panel B	Definitely would NOT buy product	May or may not buy product	Defintely **would** buy product
	1 . . . . 2 . . . . 3 . . . . 4 . . . . 5 . . . . .6 7		

Panel C	Definitely would NOT buy product	May or may not buy product	Defintely **would** buy product
	1 . . . . 2 . . . . 3 . . . . 4 . . . . 5 . . . . .6 7		

Panel D	Definitely would NOT buy product	May or may not buy product	Defintely **would** buy product
	1 . . . . 2 . . . . 3 . . . . 4 . . . . 5 . . . . .6 7		

Panel E	Definitely would NOT buy product	May or may not buy product	Defintely **would** buy product
	1 . . . . 2 . . . . 3 . . . . 4 . . . . 5 . . . . .6 7		

Panel F	Definitely would NOT buy product	May or may not buy product	Defintely **would** buy product
	1 . . . . 2 . . . . 3 . . . . 4 . . . . 5 . . . . .6 7		

APPENDIX B

SURVEY INSTRUMENT

Panel G

Definitely would	May or may not	Defintely **would**
NOT buy product	buy product	buy product

1 . . . . 2 . . . . 3 . . . . 4 . . . . 5 . . . . .6 7

Panel H

Definitely would	May or may not	Defintely **would**
NOT buy product	buy product	buy product

1 . . . . 2 . . . . 3 . . . . 4 . . . . 5 . . . . .6 7

Panel I

Definitely would	May or may not	Defintely **would**
NOT buy product	buy product	buy product

1 . . . . 2 . . . . 3 . . . . 4 . . . . 5 . . . . .6 7

Panel J

Definitely would	May or may not	Defintely **would**
NOT buy product	buy product	buy product

1 . . . . 2 . . . . 3 . . . . 4 . . . . 5 . . . . .6 7

Panel K

Definitely would	May or may not	Definitely **would**
NOT buy product	buy product	buy product

1 . . . . 2 . . . . 3 . . . . 4 . . . . 5 . . . . .6 7

Panel L

Definitely would	May or may not	Definitely **would**
NOT buy product	buy product	buy product

1 . . . . 2 . . . . 3 . . . . 4 . . . . 5 . . . . .6 7

On the next two pages, we would like to ask you for some additional information on usage and demographics to help us determine if there are different segments of consumers who prefer different features in catfish nuggets. You may, of course, decline to answer any question, but we encourage you to answer *all* of the questions since we cannot use incomplete survey forms in our analysis. Your responses will be very helpful to us in our study and, since there is no identifying information on the survey, we promise you that **your answers will remain anonymous to us and anyone else.**

APPENDIX B

SURVEY INSTRUMENT

<u>Demographic Information</u>

8. In what year were you born? _____

9. What is your gender?   female [ ]   male [ ]

10. What is your ethnic group? Asian [ ]   Black [ ]   Hispanic [ ]

    Multiracial [ ]   Native American [ ]   White [ ]   Other [ ]

11. How many years of education have you completed?
    (e.g. 12 years = high school degree)   _____ years

12. Counting yourself, how many people in your household are in the following age groups?
    (please write in the <u>number</u> of persons in each age group)

    ____ less than 4 years old   _____ 13 to 18 years old   ____ 36 to 50 years old

    ____ 4 to 8 years old   _____ 19 to 25 years old   ____ 51 to 65 years old

    ____ 9 to 12 years old   _____ 26 to 35 years old   ____ 66 years or more

13. What was the approximate income of your household in 2006 before taxes?

    [ ] Less than $10,000 per year   [ ] $50,000 to 74,999 per year

    [ ] $10,000 to 14,999 per year   [ ] $75,000 to 99,000 per year

    [ ] $15,000 to 24,999 per year   [ ] $100,000 to 149,999 per year

    [ ] $25,000 to 34,999 per year   [ ] $150,000 to 199,999 per year

    [ ] $35,000 to 49, 999 per year   [ ] more than $200,000 per year

Thank you so much for your participation!

APPENDIX B

SURVEY INSTRUMENT

<u>Usage Information</u>

1. Have you ever heard of catfish nuggets? Yes ☐   No ☐

2. Have you ever eaten catfish nuggets?   Yes ☐   No ☐

3. Have you ever purchased catfish nuggets? Yes ☐   Would you purchase them again?____

    No ☐   If never purchased, skip to question 7

4. How often do you buy catfish nuggets? Number of times per year _____

5. Where do you buy most of your catfish nuggets?

    grocery store ☐   fish market ☐   other _____

6. How many pounds of catfish nuggets do you buy each time, on average? _____

7. We are considering several other names for catfish nuggets. Of the names on the following list, we would like to know how appealing you find each name. Please rate your preference for each name by placing a mark on the scale from 1 to 7, where 1 indicates "Least appealing" and 7 indicates "Most appealing."

	Least appealing						**Most appealing**
Catfish **nuggets**	1	2	3	4	5	6	7
Catfish **tenders**	1	2	3	4	5	6	7
Catfish **selects**	1	2	3	4	5	6	7
Catfish **wedges**	1	2	3	4	5	6	7
Catfish **strips**	1	2	3	4	5	6	7
Catfish **fins**	1	2	3	4	5	6	7
Catfish **poppers**	1	2	3	4	5	6	7
Catfish **nibblers**	1	2	3	4	5	6	7
Catfish **planks**	1	2	3	4	5	6	7
Catfish **wings**	1	2	3	4	5	6	7

APPENDIX C

PANEL

Cooking Method: Deep Fry
Product of: USA
Price/lb (frozen): $4.59

APPENDIX D

RATING RESULTS FOR ALTERNATIVE NAMES

Please rate each of the following names from 1 (least appealing) to 7 (most appealing).

Name		Nibblers	Poppers	Tenders	Selects	Wings	Strips	Wedges	Planks	Fins	Nuggets
Count		538	538	538	538	538	538	538	538	538	538
	Rating										
Frequnecy	1	135	126	56	112	303	74	214	276	367	32
	2	84	73	32	60	92	45	97	78	77	18
	3	69	61	37	50	38	36	78	55	23	35
	4	77	71	65	80	43	81	50	38	22	55
	5	66	82	85	68	21	80	36	31	14	69
	6	44	65	119	74	21	99	23	24	12	102
	7	63	60	144	94	20	123	40	36	23	227
Average Rating		3.42	3.61	4.87	3.96	2.10	4.53	2.65	2.39	1.80	5.43

APPENDIX E

CHART OF RESPONDENTS' FIRST FOR NAMES

Percentage of Respondents' First Choice For Alternative Names for Catfish Nuggets

Y-axis: Percentage of Respondents (0 to 70)

X-axis: Alternative Names — Nuggets, Tenders, Strips, Selects, Poppers, Nibblers, Planks, Wedges, Wings, Fins