CREDENCE ATTRIBUTES, CONSUMER VALUATION, AND ENDOWMNET EFFECTS IN AUCTIONS: THE CASE OF SWEET POTATOES

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Abstract
There have been few studies that examine valuations of location of origin before and after consumers have consumed the product (or health advertising). Results of non-hypothetical experiments show that knowledge of origin does have an impact on valuation as well as the taste attribute (experience) and the health attribute (credence).

Keywords: Experimental auctions, location of origin, health effects, sweet potatoes

Introduction

Marketing products on the basis of product attributes is a popular means of generating product differentiation. Consistent with Lancaster's theory, this approach presumes that utility-maximizing consumers derive utility from product attributes, not from the product itself. Attributes may be observational such as color, size, or other appearance characteristics. Other attributes may be proxies for underlying quality such as location of origin. There are also experience attributes, such as taste, whereby consumers have no information until post-consumption. Finally, there may be credence attributes, such as nutritional characteristics, where consumption provides no information and the consumer is reliant on third-party or external information to identify the existence of the attribute in the product.

Proxy, credence, and experience attributes complicate consumer valuation of products because pre- and post-consumption values may not coincide. From a marketing perspective, lack of consistency between pre- and post-consumption valuations can significantly affect repeat purchase decisions. From an economic perspective, this lack of consistency complicates predictions of market demand and also may affect welfare measures arising from valuation exercises.

There is a considerable body of literature related to eliciting consumer values for products and services (see Lusk for a broad review). Most studies tend to: (1) elicit values for product attributes in isolation (that is, examine the value of one attribute at a time), (2) examine valuations in hypothetical experiments, or (3) both of these. The objective of this study is to examine the impact of a proxy, a credence, and an experience

attribute in a non-hypothetical setting allowing for pre- and post-consumption valuations. The product used in this study is the sweet potato. The sweet potato is a simple product that is grown in a number of distinct regions. The product is purchased based mainly on visual appearance, but has the experience attribute of taste. Finally, it has an important credence attribute—nutritional characteristics relative to the common white potato—that may significantly alter valuation.

We use a controlled, uniform 5th price auction to elicit values for the sweet potatoes—both when location is known and unknown and before and after tasting and added health information. We generally find significant differences between pre- and post-consumption valuations and also generally find significant effects for location of origin and health information. Interestingly, we also find that location of origin not only affects the level of bids, but also the *marginal* differences in bids between different potatoes.

Background

Several studies have identified that subjects alter their WTP after additional attributes—experience, credence, or proxy—are revealed to the consumer. Taste attributes in previous studies have had both positive, negative, and neglible effects on WTP measures. Melton et al. found significant differences between pre- and post-consumption WTP for pork chops when pictures were used for visual appraisals, but no significant differences when the actual product was used in visual inspection. Chern et al. found that consumers decreased their WTP for pulsed electric field (PEF) orange juice by 17% after tasting the orange juice. Thus, there is evidence that pre- and post-

consumption WTP may differ, suggesting that WTP based solely on visual appraisals could be misleading.

Credence attributes, such as health information, have also received much attention in the literature. Studies have looked at the influence of both positive and negative health and nutritional information on consumer behavior (Ippolito and Mathios; Viscusi et al.; Fox et al.; and Swartz and Strand). Ippolito and Mathios find nutritional advertising influenced consumers behavior in the cereal market. Fox et al.'s study indicates people increase WTP measures when presented with positive information and decrease WTP measures when presented with negative information. Further, when presented with both positive and negative information, people respond to the negative information. Proxy attributes such as location of origin may signal quality as in the case of Hawaiian produce (Suryanata) or US beef (Loureiro and Umberger). However, there is also evidence that location of origin has a negative impact on WTP measures (Loureiro and Hine).

Experimental Design

Following standard procedures, subjects were recruited from undergraduate economics courses to participate in an economic experiment in decision-making. Further, subjects were told the focus of the economic experiment was a sweet potato auction and that they would be required to consume sweet potatoes in the experiment.[1] Auction type or format was not disclosed. Subjects were asked to report to an experimental lab at a specified time and place.

[1] The office for regulatory compliance and protection of human subjects required subjects to be forewarned concerning items that they are required to consume.

Two treatments were conducted. In both treatments subjects were asked their WTP for a five-pound bag of each of three types of sweet potatoes after a visual inspection.[2] Subjects were then provided a cooked sample of each type of sweet potato that they were required to consume. Based on this new piece of information, subjects were again asked their WTP for a five-pound bag of each type of sweet potato. Next, subjects were presented with several pieces of health information and a comparison of the sweet potato health benefits with the health benefits of the common Irish potato. Again, after subjects had time to assimilate the health information, subjects were asked to submit a WTP bid for a five-pound bag of each type of potato. In the first treatment, the sweet potatoes were defined as potato A, B, and C. In the second treatment, subjects knew the location in which the sweet potatoes were grown: A = Louisiana, B = Mississippi, and C = North Carolina.

A Vickrey style sealed bid auction was used to elicit WTP values. The advantage of using a Vickrey style auction is, theoretically, Vickrey auctions are demand-revealing. The 2nd price Vickrey auction is commonly used; however, the 2nd price auction often fails to engage off-margin bidders. An alternative approach is the random nth price auction, which has the benefit of engaging off-margin bidders (Shogren et al., 2001). Unfortunately, product supply becomes an issue in this experiment. With forty total respondents bidding on a five pound bag of potatoes, a total of two-hundred pounds of potatoes would need to be procured with no prior knowledge of the actual quantity to be sold. Instead we use a uniform 5th price auction, which engages more bidders than the 2nd

[2] The sweet potatoes differed by the location in which they were grown—Mississippi, Louisiana, and North Carolina, and by the color of the potato. The color ranged from light yellowish-brown (North Carolina) to a purplish hue (Mississippi).

price auction while providing certainty concerning the necessary quantity of sweet potatoes to be kept on supply.

Our general experiment design follows a 10 step process.[3]

Step 1. Subjects were assigned an identification number, signed a consent form and asked to complete a survey concerning demographics and past consumption of sweet potatoes.[4] Each subject was paid between $10 and $20 participation fee.[5]

Step 2. Instructions were read to the group followed by clarifying questions and answers. To ensure subjects understood the structure of the uniform 5th price auction, a non-binding trial auction[6] was conducted in which subjects simultaneously submitted a bid for each of three different candy bars—Butterfinger, Baby Ruth, and Snickers. Bids were collected and rank ordered, the market price determined and announced, and the identification numbers of winners publicly disclosed for each candy bar. If a participant won more than one candy bar they were given the option of which candy bar they would hypothetically buy. Following the candy bar auction, participants were again asked if they had any questions, a short quiz on auction procedures was conducted and discussed.

[3] Experiment instructions are available from the authors.

[4] The purpose of the survey was two-fold. First, completion of the survey was intended to make the participant feel as if he had "earned" the initial endowment (Cherry et al., 2002). Second, the survey was used to collect socio-demographic data for use in the analysis.

[5] To allow for random variability in the initial endowments and attempt to eliminate the windfall effect, the participants were given an opportunity to increase their initial endowment by answering a set of ten randomly chosen Graduate Management Admissions Test (GMAT) questions. Participants received an additional dollar for every correct answer. By allowing participants to earn money, Cherry et al. (2002) has shown that participants will act more rationally. Earnings were given to the participants in an envelope to preserve anonymity. This procedure has been shown to eliminate windfall effects in that heterogeneous endowments then have no impact on bidding behavior (Nalley, Hudson, and Parkhurst).

[6] Subjects were informed that this auction would be hypothetical but would be useful in learning the specifics of the auction procedure. The hypothetical practice auction was used to control for wealth effects.

Step 3. Participants were told they would be taking part in an identical auction dealing with sweet potatoes. However, this auction would be binding—meaning winners would receive a five-pound bag of sweet potatoes for which the winner would pay the endogenously determined market price.[7] Before the auction began, it was explained to the participants that there would be three rounds in this auction in which only one round would be binding. The binding round would be randomly chosen at the conclusion of the auction.

Step 4. The three sweet potatoes were displayed.[8] In treatment 1 the sweet potatoes were denoted as A, B, and C. In treatment 2 they were labeled Louisiana, Mississippi, and North Carolina. Participants were asked to come to the display table and examine the three sweet potatoes. To maintain control, participants lined up in single file and were asked to remain silent throughout the experiment.

Step 5. Based on their visual inspection, participants simultaneously submitted three bids, representing their maximum WTP, one bid for each sweet potato. The bid sheets were then collected.

Step 6. Cooked samples of each of the three sweet potatoes were presented on separate trays behind each of the respective whole sweet potatoes. Participants were asked to approach the display table and eat a sample of each sweet potato. Before each sample subjects were instructed to eat a saltine cracker followed with water so as not to

[7] Subjects were aware that money would be changing hands.
[8] The displayed sweet potatoes (A, B, and C) were chosen randomly from forty pound boxes. Each box was purchased directly from a packer from their supply bound for grocery stores. The sweet potatoes from each box were numbered and a number was then randomly chosen out of a hat to see which potato would represent potato A, B, and C in the auction.

confuse the taste of the previous sweet potato with the current. After sampling all three sweet potatoes, participants returned to their seats.

Step 7. Participants were instructed to simultaneously bid their maximum WTP for a five pound bag of each sweet potato based on its visual and taste attributes. Proctors then collected the bid sheets.

Step 8. An information sheet concerning the nutritional content of a sweet potato and a comparison between the nutritional values of a sweet potato and an Irish potato (white potato) was provided to each participant.[9] The nutritional information was also projected on the board and read to the participants by the proctor. Subjects were given two minutes to compare the nutritional values of the sweet potato to the Irish potato.

Step 9. Participants were then asked to submit their maximum WTP bid for a five-pound bag of each sweet potato based on their visual, taste, and health attributes. Bid sheets were then collected.

Step 10. The binding bidding round was randomly chosen and the identification numbers of winners and the endogenously determined market prices announced. The auction winners received a five-pound bag of sweet potatoes and paid the associated price. Participants who won the one auction for more than one potato were only required to purchase one five-pound bag—their choice.

Results

We present our results in four stages: 1) survey results; 2) relative values; 3) information effects; and 4) location effects.

[9] Nutritional handouts are available from the authors upon request

Survey Results

The descriptive statistics for the demographic information is presented in Table 1. Male representation was 70% of the sample and the majority of the participants in both treatments were Caucasian. Average age was 23 for treatment 1 and 25 for treatment two, which is indicative of a college sample. Roughly 65% of participants had purchased sweet potatoes prior to this experiment, suggesting that most consumers in the experiment had some prior experience with sweet potatoes. Not surprisingly, sweet potatoes were associated with holidays. Only 15% of participants had knowledge of where the sweet potatoes they had purchased in the past were grown. When asked if location of origin was an important attribute in their buying decision with 1 being very important and 5 being very unimportant, the average response for participants was very high, roughly 4, suggesting that location of origin was not an important factor in prior purchase decisions.

Relative Value

Table 2 presents the descriptive statistics for aggregate bidding behavior across rounds and sweet potatoes. Note differences in average bids exist across sweet potatoes at each information node. However, the variety of sweet potato is identical with only the growing conditions differing between states.[10] So, the maintained hypothesis is average WTP is equal across sweet potatoes. Alternatively, if growing conditions have a distinct influence on the sweet potato, individual valuations should differ across sweet potatoes. Formerly, we state our null hypothesis:

[10] Agronomists argue that differences in soil type have an effect on the sugar content and skin color and texture of the potatoes (Graves).

H_o: $WTP_{LA} = WTP_{MS} = WTP_{NC}$

A nonparametric Quade test[11] is used to examine differences in bids across sweet potatoes at each of the different bidding opportunities (results presented in Table 3). For both treatments, location of origin known and unknown, average bids were not statistically different following the visual inspection, indicating participants were indifferent across sweet potatoes on average.[12] However, following participants' tasting experience, significant differences in WTP emerged. In both treatments, bids were statistically different at the 5% level. In the origin unknown treatment, the NC sweet potato was valued highest, while in the origin known treatment, the MS sweet potato had the highest average value. When the participants were exposed to the health information (round 3), statistical differences (P= 0.05) persisted only in the origin unknown treatment, and, as expected, the health information did not change aggregate preference ordering. However, in the origin known treatment, there was no statistical difference in the mean bids using the nonparametric Quade test for the "health" round, which is interesting because it indicates relative valuation changed in the face of information that should be value-neutral or consistent across sweet potatoes.

To summarize, no significant difference in mean bids were observed based on visual inspection only. However, upon experiencing the attribute of taste, a distinct preference ordering for sweet potatoes was revealed. Interestingly, the attribute of health,

[11] The distribution of bids was tested for normality using Shapiro-Wilk test and the Kolmogrov-Smirnov test and, in general, normality was rejected.[11] Thus, the non-parametric test results will be highlighted from this point forward. For completeness, a parametric two-way ANOVA was also used to examine differences in bids across potatoes—the results are reported in Table3.

[12] In the origin known treatment, if a "hometown bias" was prevalent and persistent, we would expect the Mississippi potato to be valued significantly higher, which was not the case.

which should not alter preference ordering, did change the strength of preference ordering in the origin known treatment.[13]

Information Effects

Individuals' preferences for sweet potatoes were updated with two pieces of additional information: a taste experience and a health information shock. We examine the taste experience first and the health information shock second.

Taste Experience. There is no *a priori* expectation that taste should either increase or decrease the mean bid from the visual valuation. The expectation is that a negative tasting experience would decrease the individual's WTP and a positive experience would increase WTP. However, sweet potatoes are an established product (65% of our sample had purchased sweet potatoes), for which, presumably, participants have complete information sets—they already know how a sweet potato tastes, and have factored the taste attribute into their WTP. Given 65% of our sample have purchased sweet potatoes (we assume the percentage that has consumed them is at least as large) we follow the latter logic and construct our null hypothesis accordingly:

$$H_o: \ WTP_{i,V} = WTP_{i,T}, \qquad i = LA, MS, NC; \ V = visual; \ T = taste.$$

After the participants were exposed to the experience attribute of taste, bids dropped by an average of \$0.44 (see table 2). We formerly test the null hypothesis for each treatment using a nonparametric Wilcoxon signed rank test[14] (results are presented in Table 4). For the unknown location of origin treatment, the results indicate that for

[13] From Table 2 we see that the ordering of mean bids remained the same with each potato increasing by between \$0.13 and \$0.19. However the bids are more tightly clustered, which is evidenced by smaller standard deviations.

[14] For completeness, a parametric paired t-test is also conducted. The results are in Table 4.

the LA and MS sweet potato mean WTP bids were statistically different ($p < 0.05$) between the visual and the taste rounds. Here taste had a significant negative effect on individuals' valuations. However, no significant impact was noted for the NC sweet potato. In the treatment in which location of origin is known, we observe the opposite. NC sweet potatoes have a statistically significant negative impact ($p < 0.10$), whereas LA and MS sweet potatoes exhibit no significant difference in mean bids. One possible explanation for the change in mean WTP following taste is that our microwaved sweet potatoes were not prepared in the manner most of the participants were accustomed—68% of the participants associated sweet potatoes with Thanksgiving and Christmas. The samples participants tasted were likely bland in comparison. Nevertheless, these results indicate a general lack of correspondence between WTP values under alternative information sets, which is consistent with prior research.

Health Information Shock. Unlike the taste experience, health information may or may not be known *a priori*. It is possible individuals are unaware of sweet potato health benefits, regardless of past consumption. However, we do assume that most people place a positive value on healthy attributes. As such, the introduction of health information is expected to either increase or have no effect on mean bids. The null hypothesis is:

$$H_o: \ WTP_{i,T} \geq WTP_{i,H}, \qquad i = LA, MS, NC; \ T = taste; \ H = health.$$

Note from Table 2, mean bids increased by roughly \$0.13 following the provision of health information. A Wilcoxon signed rank test is used to test the null hypothesis for each treatment (results are presented in Table 4). The presence of additional health information had a positive influence on mean WTP bids. For four of the six samples,

health information had a significant positive influence—MS unknown origin ($p < 0.05$), MS known origin ($p < 0.08$), LA unknown origin ($p < 0.07$), and LA known origin ($p < 0.07$). These results indicate that providing individuals with health information will have a positive effect on consumer demand.

By examining the initial (sight only) versus the final (sight + taste + health) bids, we see that bids were significantly different 50% of the time. This result further reinforces previous results by Melton et al. and Chern et al. that simple visual inspection is insufficient to generate consistent WTP values with post-consumption WTP values.

Location Effects

A common practice in retail sales is to highlight to the local consumers the origin of homemade products, thus increasing the mean WTP of local consumers (creating a 'hometown' bias). However, does this 'hometown' bias spill over into produce, and in particular, sweet potatoes. Following Lusk and Hudson, we use a Mann Whitney test to test the differences in mean bids between the location of origin unknown (LU) treatment and the location of origin known (LK) treatment. If the bids are constant between treatments, bidders did not distinguish sweet potatoes based on location of origin. The null hypothesis is:

$$H_o: \ WTP_{LU} = WTP_{LK}$$

Comparisons are conducted between treatments for each potato and each round, resulting in nine total tests. Test results are reported in Table 5.[15] Of the nine tests, six show WTP bids were significantly different between treatments ($p < 0.10$). In every case, there was

[15] For completeness the parametric equivalent, two sample t-test is reported in Table 5.

a notable increase—$0.84 per bid on average. Intuitively, this result suggests that the participants were placing a premium on the information attribute, location of origin.[16] However, the existence of a 'hometown' bias is neither accepted nor rejected by these results. Interestingly though, preference orderings do change between treatments. In the origin unknown treatment, NC has the largest mean WTP. But in the origin known treatment, it is MS with the largest mean WTP. Thus, weak evidence that a 'hometown' bias exists in our sample.

Conclusions

The results of this study point to several conclusions. First, from a marketing perspective, the lack of correspondence between consumer valuations across information sets potentially complicates repeat purchase decisions. If consumers initially value a potato high based on sight, but later discount that value based on taste (assuming sweet potato preparation is consistent with this experiment), some consumers may not try the product again. More generally, this result, taken with previous results from Melton et al. and Chern et al. suggest that simple visual inspection of food products may be insufficient to generate reliable WTP values.

Second, results show that health advertising can be effective. While health advertising generally increased bids, the resulting increase in demand may be insufficient to offset advertising costs. Finally, knowledge of location of origin generally increases bids, and in this experiment changed preference ordering, suggesting location of origin matters in purchase decisions.

[16] By placing a "premium" on the location of origin attribute, the consumer may be indicating that location of origin is a signal of quality.

This study does point to the need for additional research—ordering effects. That is, would health advertising have the same effect on WTP if it were introduced before consumption as after? We observe statistical differences in WTP across potatoes when location of origin is unknown in both the taste and health rounds. However, when location of origin is known, we only observe statistical differences in the taste round. Thus, the addition of the location of origin information changed the strength of preference ordering. While no a direct test of this phenomenon, these results suggest that the ordering of information introduction may have some influence on the marginal impact of that information, which is a topic also introduced by Lusk.

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Table 1. Survey Results: Descriptive Statistics

Variable	Description	Treatment: Origin Unknown (LU)	Treatment: Origin Known (LK)
Gender	1= male, 0= female	.800 (.410)	.600 (.502)
Ethnicity	1= Caucasian; 2=African American; 3= Hispanic; 4= Asian; 5= Other	1.100 (.447)	1.650 (1.268)
Age	Age of participants in years	23.100 (4.063) [18,37]	25.050 (6.210) [18,40]
Purchased Sweet Potatoes	1= yes, 0 =no	.700 (.470)	.600 (.502)
Associate Sweet Potatoes with Holidays.	1= yes, 0 =no	.650 (.4893)	.700 (.470)
Location of Origin Known	1= yes, 0 =no	.250 (.444)	.050 (.223)
Price	1= very important 5 = very unimportant	3.050 (1.394)	2.800 (1.361)
Visual Appeal	1= very important 5 = very unimportant	2.200 (1.436)	2.200 (1.507)
Location of Origin	1= very important 5 = very unimportant	4.100 (1.071)	3.950 (1.190)
Taste	1= very important 5 = very unimportant	1.600 (1.231)	1.850 (1.460)
Health	1= very important 5 = very unimportant	3.100 (1.140)	2.850 (1.268)

Table 2. Descriptive Statistics: Aggregate Bids

	Mean	Median	Mode	Standard Deviation	Max	Min
Origin Unknown						
Visual						
A—LA	1.74	1.25	1.00	1.39	4.25	0
B—MS	1.68	1.40	2.00	1.47	5.00	0
C—NC	1.71	1.00	1.00	1.42	4.75	0
Taste						
A—LA	1.30	1.13	0.25	1.03	3.00	0
B—MS	1.23	1.00	1.00	0.97	3.00	0
C—NC	1.57	150	1.00	1.19	3.50	0
Information						
A—LA	1.43	1.13	1.00	1.16	4.00	0
B—MS	1.32	1.00	0.50	1.09	3.75	0
C—NC	1.65	1.53	1.00	1.31	4.10	0
Origin Known						
Visual						
A—LA	2.40	2.00	2.00	1.18	5.00	0
B—MS	2.40	2.00	2.00	1.74	7.00	0
C—NC	2.03	1.73	1.00	1.38	6.00	0
Taste						
A—LA	2.34	2.00	2.00	1.40	6.00	0
B—MS	2.58	2.50	3.00	1.62	7.00	0
C—NC	2.02	1.63	1.00	1.71	7.00	0
Information						
A—LA	2.47	2.00	2.00	1.48	6.00	0.50
B—MS	2.77	2.38	2.00	1.51	7.00	0.75
C—NC	2.18	1.50	1.00	1.24	5.00	1.00

Table 3. Comparison of Mean Bids Across Sweet Potatoes

Round	Quade[a]	Two-Way ANOVA[b]
Location of Origin Unknown		
1- Sight Only	0.1369	0.017
2- Taste	5.2102*	3.341**
3- Health	3.9031*	3.735**
Location of Origin Known		
1- Sight Only	0.8492	2.066
2- Taste	2.9842*	3.577**
3- Health	0.8324	3.904**

* Statistically significant at the 5% level
** Statistically significant at the 10% level
[a] Is the T value as calculated from the Quade Test (Conover, p. 374).
[b] Is the F value across potatoes sum of squares from Two-Way Anova

Table 4. Information Effects

Round	Wilcoxon test[a]	Paired t-test[b]
	Location of Origin Unknown	
Louisiana		
Sight vs. Taste	-1.9904*	-2.1156*
Taste vs. Health	1.5109	1.3648**
Initial vs. Final[c]	-1.7464*	-1.6577**
Mississippi		
Sight vs. Taste	-2.1052*	-2.3528*
Taste vs. Health	1.6977	1.3589**
Initial vs. Final	-1.6970**	-1.9086**
North Carolina		
Sight vs. Taste	-0.6650	-0.5556
Taste vs. Health	0.2996	0.8404
Initial vs. Final	-0.3800	-0.2268
	Location of Origin Known	
Louisiana		
Sight vs. Taste	-0.2213	-0.3225
Taste vs. Health	1.4966	1.4653**
Initial vs. Final	0.3158	0.3158
Mississippi		
Sight vs. Taste	0.9979	0.8788
Taste vs. Health	1.4106	1.5975**
Initial vs. Final	1.7376**	1.7645**
North Carolina		
Sight vs. Taste	-1.4067**	-0.0438
Taste vs. Health	1.1779	0.6429
Initial vs. Final	0.5976	.8164

* Denotes statistical significance at the 5% level
** Denotes statistical significance at the 10% level
[a] Is the T value calculated from the Wilcoxon signed ranks test
[b] Is the t value calculated from the paired t-test
[c] Comparison of round 3 to round 1

Table 5. Location Effects: Mann-Whitney Test.

Round	Mann-Whitney [a]	Two sample t-test [b]
	Louisiana	
1-Sight	-1.6157**	-1.5471
2-Taste	-2.3114*	-2.5879*
3-Health	-2.2649*	-2.4916*
	Mississippi	
1-Sight	-1.2721	-3.5469*
2-Taste	-2.9026*	-3.1624*
3-Health	-2.9778*	-3.3899*
	North Carolina	
1-Sight	-0.9852	-0.7069
2-Taste	-0.5152	-0.9332
3-Health	-1.3357**	-1.2635

* Denotes statistical significance at the 5% level

** Denotes statistical significance at the 10%level

[a] Is the T value calculated from the Mann-Whitney test.

[b] Is the t value calculated from the two-sample t-test