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Anchoring, Information, and Fragility of Choice Experiments: An Application to Consumer Willingness to Pay for Rice with Improved Storage Management

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This study uses an experimental auction and a discrete choice experiment to determine consumers' willingness to pay (WTP) for rice with improved insect control and for rice stored using Integrated Pest Management and investigates potential reasons—anchoring and information—why some studies have found inconsistencies between the two methods. Results indicate that WTP estimates from the choice experiment are lower than consumers' average auction bids. Anchoring in the choice experiment appears to be an explanation for the discrepancy. Providing consumers with additional information about the products improved choice experiment results, producing consistent preference ordering and increasing WTP estimates.

Key words: anchoring, choice experiment, information, second-price auction, willingness-to-pay

Introduction

Experimental auctions and discrete choice experiments are widely used to elicit consumers' willingness to pay (WTP) for various product attributes, but a major concern is whether those elicited values truly reflect consumer behavior. Chang, Lusk, and Norwood (2009) provided an extensive discussion of possible reasons for discrepancies between experimental methods and actual shopper behavior. Their tests of how well several elicitation methods predict shopper behavior show a reasonably high level of external validity when the variable of interest is market shares of the tested products.

A related concern is whether experimental predictions of consumer WTP values are accurate and whether alternative elicitation methods give similar estimates of WTP. As Lusk, Feldkamp, and Schroeder (2004) noted, product differentiation has increased, new technologies are being developed and applied, and producers and retailers are trying to increase "value added" in products. Accurately estimating WTP for specific product attributes and new features such as "organic" and "IPM" is critical in developing and marketing new products to target various customer segments (Feldkamp, Schroeder, and Lusk, 2005; Gao and Schroeder, 2009).

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(Gracia, Loureiro, and Nayga, 2011, p. 1358) noted that while "WTP values from hypothetical elicitation tasks have been found to almost always exceed WTP values from non-hypothetical elicitation tasks..." comparisons of empirical WTPs derived from auction and choice experiments have produced mixed results. This is critical because different predictions may lead to different business decisions. They suggested that price information within a choice experiment could influence valuations more than in an auction, since participants in a choice experiment are given a set of prices, more like a retail transaction, whereas auction participants are asked to provide prices.

This paper compares individuals' estimated WTPs between a non-hypothetical auction and a non-hypothetical choice experiment and investigates the effect of anchoring on differences in WTP estimates between the two methods. We also explore the effect of information on WTP estimates and preference ranking. Because of the increasing popularity of choice experiments (perhaps because they are easy for respondents to answer and more closely mimic real shopping experiences), our focus is on choice experiments and the extent to which they may be subject to anchoring and information effects.

Alfnes and Rickertsen (2007) found that auctions and choice experiments yielded the same rankings of alternatives but different estimated WTPs. Similarly, Lusk and Schroeder (2006) found that an auction and a choice experiment yielded the same preference ranking, but that auction bids were significantly lower than WTP values estimated from a choice experiment. Kimenju, Morawetz, and De Groote (2006) also found that auction bids were much lower than WTP values estimated from a choice experiment. But their results may have suffered from hypothetical bias, since they compared a non-hypothetical auction with a hypothetical choice experiment. In contrast, Frykblom and Shogren (2000) found no significant difference between WTP values derived from a Vickrey second-price auction and a choice experiment.

Corrigan et al. (2009) found that WTP estimates were relatively stable across rounds in an open-ended choice experiment, while the bids in ending rounds of auctions were almost twice as high as bids in beginning rounds of the auctions, so that the WTP estimates from choice experiments were almost equal to bids in the ending round of auctions. They also found that the effects of positive and negative information under open-ended choice experiments were more consistent with prior expectations than auctions were; in other words, positive information is more likely to lead to higher prices, and vice versa, in a choice experiment than in an auction. Aside from empirical results, Alfnes and Rickertsen (2007) also suggested that experimental auctions are limited by the availability of products and the use of locally recruited participants, while stated choice surveys lack economic incentive.

Numerous studies have examined how various procedural and design issues affect consumers' behavior in auctions or choice experiments (e.g., Carlsson, Frykblom, and Lagerkvist, 2007; Carlsson and Martinsson, 2008; Frykblom and Shogren, 2000; Louviere, Hensher, and Swait, 2000; Lusk and Norwood, 2005; Lusk and Shogren, 2007). However, less is known about the design issues that might explain behavior gaps between auctions and choice experiments.

Gracia, Loureiro, and Nayga (2011) noted that, as of the date of their article, only one previous study had evaluated the issue of differing WTP values between choice experiments and experimental auctions. That study, by Lusk and Schroeder (2006), found that auction bids were generally lower than valuations implied from choice experiments. Gracia, Loureiro, and Nayga (2011) found different results, with auction bids lower than WTP from choice experiments for some products and bidder demographics, and higher for others. Although they suggested several possibilities, neither article definitively identified the cause of this discrepancy.

Similarly, several studies since Gracia, Loureiro, and Nayga (2011) have examined differences between auction and choice experiments—with some, but not all, finding differences—but did not focus on reasons for any observed differences (Wu et al., 2016; Alphonce and Alfnes, 2017; Sáenz-Navajas et al., 2013; Ginon et al., 2014; Banerji et al., 2013; Xie, Gao, and House, 2013).

Potential Reasons for Differences in WTP Estimates

Factors that lead to a divergence in WTP estimates from choice experiments and other mechanisms, including auctions, may include the different value elicitation format (Alfnes and Rickertsen, 2007; Lusk and Schroeder, 2006) and the response format and experimental design used in choice studies (Frykblom and Shogren, 2000).

Gracia, Loureiro, and Nayga (2011) cited List (2003) to suggest that experience with a product may affect WTP estimates, since in their study the differences were greater for males, a group that in their study had less experience with the food products studied. They noted several other possible reasons for differences in elicitation methods between the WTP values, including an explanation offered by Lusk and Schroeder (2006) that preferences may be constructed differently in the two methods or that one of them may produce preferences inconsistent with expected utility.

Anchoring

Gracia, Loureiro, and Nayga (2011) suggested that auction bidders may not completely understand the incentive to completely reveal their true WTP values and that in the actual auction the participants may feel peer pressure to bid a particular way. In a choice experiment, however, they suggested that the price information that is part of the method could influence valuations more than in an auction, since participants in a choice experiment are given a set of prices, more like a retail transaction, whereas auction participants are asked to provide prices.

Further evidence that choice experiments are affected by anchoring is provided by Carlsson, Frykblom, and Lagerkvist (2007), who found that including price in a choice experiment significantly changed preferences and preference ranking of alternative attributes. Similarly, Carlsson and Martinsson (2008) found that increasing the price level in a choice experiment significantly increased estimated WTP to reduce power outages. Mørkbak, Christensen, and Gyrd-Hansen (2010) showed that both the range of price attributes and the maximum price affected estimated WTP. In contrast, Hanley, Adamowicz, and Wright (2005) showed that changes in the price vector used in the choice experiment design produced no significant effects on estimates of preferences.

Information

The amount of information given to participants may also affect WTP estimates. Lusk et al. (2001) found that giving choice experiment participants information about steak tenderness in addition to the information they gained from their own taste experience increased the value participants placed on tenderness.

Following Gracia, Loureiro, and Nayga (2011) and Lusk and Schroeder (2006), we hypothesize that providing participants with information related to product quality (and thus value) will serve as a proxy for experience, in addition to the experience gained through tasting the products. This additional information might affect WTP estimates from auction and choice experiment differently, especially for less-experienced participants, since auction participants, unlike choice experiment participants, get additional information from observing other participants' bids. In this paper, we investigate anchoring and information as possible causes of fragility in WTP estimates from choice experiments compared to auctions that result in differences in estimates of individuals' WTPs from the two methods.

Background

Rice is one of the main crops in the United States, with Arkansas, California, and Louisiana accounting for more than three-fourths of U.S. production. According to the USA Rice Federation's

2013–14 U.S. domestic rice usage report, 63% of domestic rice consumed in the United States is used directly, without further processing. Thus, physical attributes of rice—such as appearance, texture, and color—are very important to consumers. Insect infestation can affect these physical attributes during storage, reducing the quality of rice and thus its economic value.

Infestations of lesser grain borer (*Rhyzopertha dominica*), a common pest of stored grains and perhaps the most potentially destructive insect that infests stored rice (Luh, 1980), can reduce both the quantity and the quality of rice. Larvae feed inside the kernel until they mature into adults and burrow out, damaging the kernels. This may reduce milling yield and the proportion of whole rice kernels (Arthur, Ondier, and Siebenmorgen, 2012). In addition, infestations of this insect also cause an unpleasant odor, particularly if the population of insects is large (Ranalli et al., 2002).

Current insect control methods during rice storage can be categorized into i) conventional chemical-based pest management, and ii) integrated pest management (IPM), which is a balanced use of multiple control tactics—biological, chemical, and cultural—determined to be most appropriate for a particular situation in light of careful study of all factors involved (Way, 1977). IPM has potential benefits for environment and human health, but few, if any, studies have empirically evaluated its value to consumers of stored products.

Experimental Design and Procedures

We recruited 112 participants both on and off campus though email invitation and flyers, with compensation offered for participation. Study participants represented a wide range of demographics, with age ranging from 20 to above 60, education from high school to Ph.D. degree, income from below $20,000 to above $100,000, and rice consumption and purchase from zero times per year to once a week. The majority of participants were rice consumers, eating rice an average of once every two weeks.[1]

Summary statistics in table 1 show that 57% of participants were female and 40% were Asian. Most participants were relatively young and well educated: 56% were aged 20–30, and 77% had bachelor's degrees or higher. The average annual household income of all participants was between $20,000 and $40,000. Participants also answered questions related to the strength of their concerns about the environment, worker health, and development of pesticide resistance.

Nine sessions were conducted in August 2010, with each session lasting approximately one hour and consisting of 10–12 participants. Before the experiment, participants tasted and evaluated three rice samples using a sensory taste panel format. They evaluated each rice sample for appearance, flavor, texture, and overall acceptance using a nine-point scale (where 1 is extremely undesirable and 9 is extremely desirable). Prior to milling for human consumption, one set of samples had been infested with adult lesser grain borers (LGB) at a rate of 200 LGB/kg (poor insect control), one set had been infested with 20 adult LGB/kg (average insect control), and one set had not been infested (excellent insect control). After eight weeks, the rice samples were frozen to kill any internal infestation. Then the rice was milled so that the final product was suitable for human consumption. The rice samples were cooked and served following the procedures described in a sensory analysis for cooked long-grain rice conducted by Meullenet et al. (2000). The serving orders of the rice samples were completely randomized over participants by using a counterbalanced design to reduce the order effects.

[1] Because our solicitation of study participants indicated that the topic was rice, there may have been some self-selection bias, resulting in a relatively large proportion of people who ate rice frequently, including those of Asian origin. Recruiting flyers and advertisements are provided in the online supplement.

Table 1. Variable Definitions and Summary Statistics

Variable	Definition	Average
Race	1 if Asian; 0 if others	0.41 (0.49)
Gender	1 if Female; 0 if Male	0.57 (0.50)
Education	Education level of respondent 1=high school or below; 2=associate degree; 3=bachelor's; 4=master's; 5=doctor's degree or higher	3.17 (1.28)
Income	Household income level 1=less than \$20,000; 2=\$20,000 to \$39,000; 3=\$40,000 to \$59,999; 4=\$60,000 to \$79,999; 5=\$80,000 to \$99,999; 6=\$100,000 or more	2.26 (1.59)
Age	1=20–30; 2=31–40; 3=41–50; 4=51–60; 5= > 60	1.94 (1.26)
Rice Consumption	How often does respondent eat rice? 1=never; 2=once a year; 3=few times a year; 4=once a month; 5=every two weeks; 6=more than once a week	4.87 (1.43)
Environmental Concern	Respondent's level of concern level about environmental issues 1= not concerned; 2=somewhat concerned; 3=very concerned	2.41 (0.66)
Worker Safety Concern	Respondent's level of concern about worker safety issues 1= not concerned; 2=somewhat concerned; 3=very concerned	2.47 (0.59)
Resistance Concern	Respondent's level of concern about pesticide resistance issues 1= not concerned; 2=somewhat concerned; 3=very concerned	2.52 (0.58)

Notes: Numbers in parentheses are standard deviations.

Then, we gave the participants \$22 (\$2 of which was in coins) and informed them that they would have the opportunity to purchase one of the rice samples through auctions or choice experiments.[2] We also informed them that they could choose to buy rice that was the same in all respects as the rice they had tasted but that was stored using an integrated pest management (IPM) approach. Thus, with three possible levels of pre-milling insect control and two storage methods—IPM and non-IPM—participants could choose from among six rice products. Before bidding began, we provided participants with a brief written statement on the difference between IPM and conventional pest management methods and read the statement aloud to them. During bidding, participants retained the sheet on which they had recorded their evaluation of the rice samples.

We conducted four rounds of second-price auction and one round of choice experiment to determine participants' preferences for alternative rice products based on their prior taste evaluation.[3]Then we conducted another round of both auction and choice experiment after providing

[2] The purpose of the coins was to facilitate participants putting a precise value on the items for sale. To mitigate the possibility that the \$2 in coins could have implied an upper bound on auction bids, we emphasized in the instructions (see online supplement) that participants could bid more than \$2. We did in fact observe bids greater than \$2. More importantly, in comparing choice experiment results with auction results, any effect of an implied upper bound should have affected both in the same way.

[3] We posted the winning price after each round of the auction. Although the results of Corrigan et al. (2012) suggest that it might have been better to avoid posting these prices, we do not believe that this particular feature of the auction is responsible for the effect that anchoring has on the choice experiment WTP values, which is the main focus of our study, since both high- and low-price choice experiments should have been affected similarly.

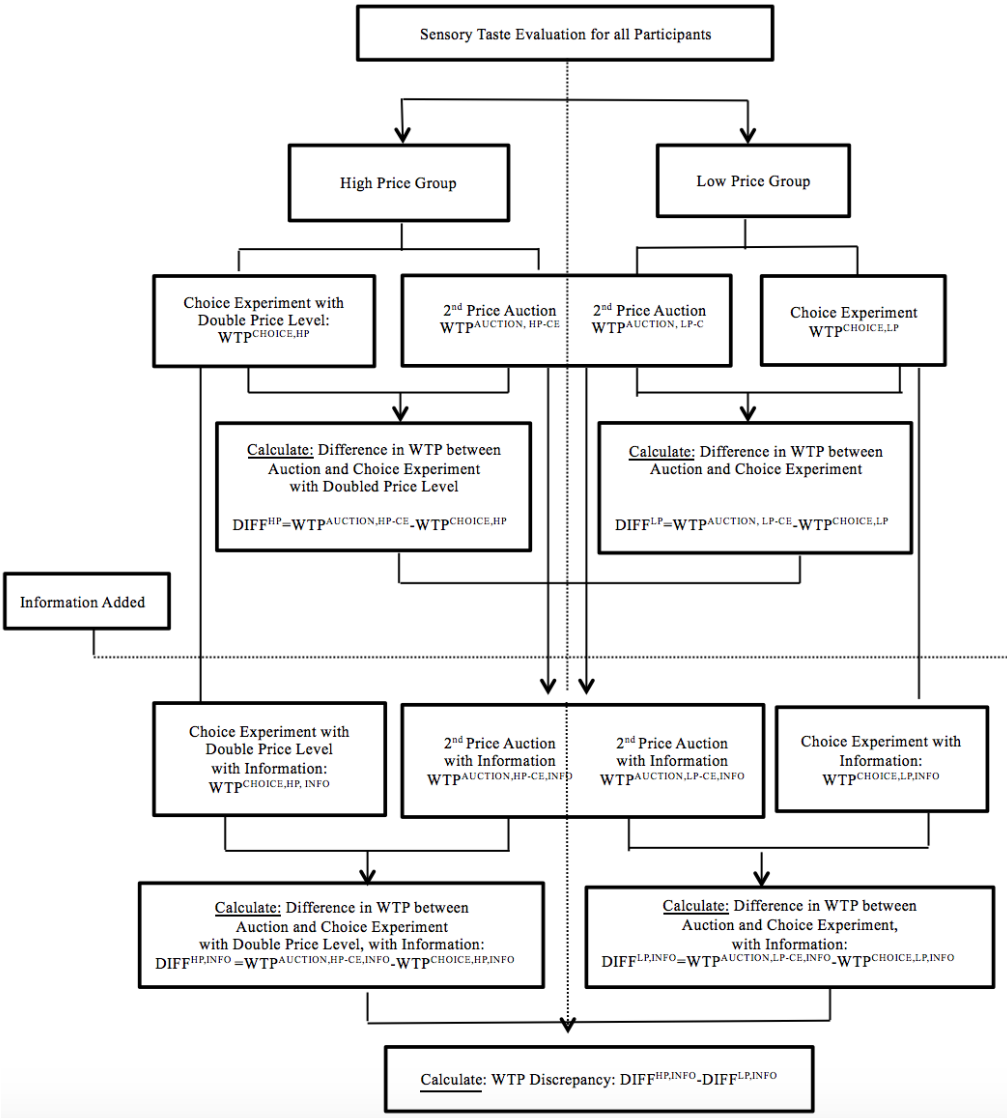

Figure 1. Outline of Experimental Procedure

participants with objective information about the quality of each rice sample. Specifically, we told them which rice samples were of superior quality (excellent pre-milling insect control), high quality (average pre-milling insect control), and good quality (poor pre-milling insect control.) We repeated the same procedures with another group of participants, changing only the price level used in the choice experiment. Thus, all participants completed a sensory taste evaluation and participated in a second-price auction.

Then, half of the participants completed a choice experiment with a low price level and half completed a choice experiment with a doubled price level. Each of these two groups completed another round of auction and choice experiment (either low price or doubled price) with extra quality information. Figure 1 illustrates the experimental design. We asked participants to complete a short survey on their demographic information and rice-purchasing habits at the end of each session. The choice forms and other explanatory materials used in the experiment are presented in the online supplement.

Generally, experimental auctions yield point estimates of WTP directly. In order to truly reveal consumer value, the auction must be incentive compatible, which requires an auction format (such as *n*th-price auction) that may not be familiar to participants. Discrete choice experiments are easy for respondents to answer and more closely mimic consumers' real shopping experiences, but they reveal WTP only indirectly and require assumptions about the form of the consumers' utility functions.

Although the demographic and preference factors are intended to account for differences in individual behavior in the experimental markets, to reduce the effect of prior beliefs and experiences on behavior in the choice experiment even further, we chose to give all the bidders the same experience of participating in the auction before participating in the choice experiment. In this sense, they all have the same "anchor" before participating in the choice experiment. This allowed us to focus on the effect of differing price levels in the choice experiment as a potential reason for differences in price behavior.[4]

Econometric Models

To test whether the auction and choice experiment yielded different WTP values, we compared the estimated WTP values from both the auction and the choice experiment for each rice sample. Although participants' auction bids for each rice sample can be directly interpreted as their WTP given certain conditions, in order to make the WTP values directly comparable with the WTP estimates from the choice experiment, we predicted WTP values for both auction and choice experiment. For the auction, we used three sets of variables to explain the variation in WTP: i) variables explaining variation in rice attributes, including insect control level during storage (poor insect control, average insect control, and excellent insect control) and storage management method (IPM vs. non-IPM); ii) variables for participants' sociodemographic characteristics and their attitudes towards environmental, pesticide resistance and worker safety issues; and iii) whether or not the participants had been provided with extra product quality information. We used the following left-censored tobit model to explain participants' WTP for the rice in the auction:

$$WTP_{ij}^{*} = b_0 + \alpha \boldsymbol{X}_j + \beta \boldsymbol{Y}_i + \gamma \boldsymbol{Z}_{ij} + \eta_i + \varepsilon_{ij}, \quad (1)$$

where WTP_{ij}^{*} is individual i's uncensored WTP for product j. If an individual's bid is positive, then WTP_{ij}^{*} is simply equal to the bid; however, if the bid is zero, then $WTP_{ij}^{*} \leq 0$. All model estimates are included in an online supplement. In an auction, participants cannot bid below zero, thus WTP^{*} is a latent variable censored from below zero. $\boldsymbol{X}_j$ is a vector of product quality attributes for product j, including indicator variables for poor insect control level PC_j and average insect control level AC_j, and the storage method IPM_j, where IPM_j is 1 if rice j is maintained with IPM methods and 0 otherwise. $\boldsymbol{Y}_i$ is a vector of participant i's sociodemographic information, including gender; race; age; income; education; how often the individual eats rice; his or her attitudes toward the environment, worker health and safety issues, and pesticide resistance issues; and his or her taste evaluation of the jth rice sample. $\boldsymbol{Z}_{ij}$ is a vector of design variable information and the interaction between information and quality attributes. $\boldsymbol{Z}_{ij}$ includes $Info_{ij}$, which is 1 if extra information is provided and 0 otherwise, and $InfoPC_{ij}$ and $InfoAC_{ij}$, which are interaction terms between $Info$ and insect control levels PC_j and AC_j. $\eta_i \sim N(0, \sigma_{\eta}^{2})$ is the random individual effect for the ith participant that captures the correlation between the bids made by the same participant, and $\varepsilon_{ij} \sim$

[4] A reviewer has correctly noted that in order to draw definitive conclusions about the fragility of the auction with respect to anchoring and information (in addition to conclusions about fragility of the choice experiment), the order in which participants participate in auction and choice experiment should be randomized in order to avoid a possible order effect. However, Ginon et al. (2014), who also used a within-subject design in order to allow WTP comparisons between auction and choice experiments for the same individuals, found no order effect when using pooled data for the auction/choice comparison.

$N(0, \sigma_\varepsilon^2)$ is the residual error term. All the parameters in equation (1) were estimated using maximum likelihood estimation.

In the choice experiment, instead of bidding directly how much they valued each rice product, participants had to choose from among alternative rice/price combinations or buy none at all. A Random Utility Model was used to analyze the choice data and to infer respondents' WTPs.

Suppose a participant's utility function can be expressed as

$$U_{ij} = V_{ij} + \varepsilon_{ij}, \tag{2}$$

where U_{ij} is participant i's utility from choosing the jth rice product, V_{ij} is the systematic portion of the utility function determined by the rice attributes, and ε_{ij} is a stochastic element.

The systematic portion of participant i's utility of choosing rice product j is

$$\begin{aligned} V_{ij} \quad = \quad & \beta_1 PoorControl_j + \beta_2 AverageControl_j + \beta_3 ExcellentControl_j \\ & + \beta_4 PoorControl\ IPM_j + \beta_5 AverageControl\ IPM_j + \beta_6 ExcellentControl\ IPM_j \\ & + \beta_{price} Price_j, \end{aligned} \tag{3}$$

where $Price_j$ is price used for rice product j in choice settings and the dummy variables $PoorControl_j$, $AverageControl_j$, $ExcellentControl_j$, $PoorControl\ IPM_j$, $AverageControl\ IPM_j$, and $ExcellentControl\ IPM_j$ denote, respectively, that the jth rice product is stored with poor insect control, average insect control, excellent insect control, poor insect control using IPM methods, average insect control using IPM methods, and excellent insect control using IPM methods (the base model is when the participant chooses to buy no product). The coefficients β_1 to β_6 represent the utility of having the corresponding characteristics compared to not having them.

If the ε_{ij} are distributed type i extreme value then the parameters in equation (3) can be estimated by maximizing the log-likelihood function:

$$LLF = \sum_{i=1}^{N} \sum_{j=1}^{7} (C_{ij} \times \ln(Prob_{ij})), \tag{4}$$

where $C_{ij} = 1$ if rice product j is chosen by consumer i and 0 otherwise and $Prob_{ij}$ is the probability of rice product j being chosen, $Prob_{ij} = \frac{\exp(V_{ij})}{\sum_{j=1}^{7} \exp(V_{ij})}$, where V_{ij} is calculated as in equation (3).

Participants' WTP can be expressed as the amount that a person will pay that makes the person indifferent between improving the quality of the good or keeping the same quality. We normalize the utility of "none" to zero and calculate the amount subjects are willing to pay for one rice product compared to choosing nothing. The value the consumer places on rice product j versus "none" is

$$\beta_j / \beta_{price}. \tag{5}$$

To predict each individual's WTP from the choice model, we extended model (3) to model (6) by including all interaction terms between rice products and participants' demographic information:

$$\begin{aligned} V_{ij} \quad = \quad & \beta_1'(PoorControl)_{ij} + \beta_2'(AverageControl)_{ij} + \beta_3'(ExcellentControl)_{ij} \\ & + \beta_4'(PoorControl\ IPM)_{ij} + \beta_5'(AverageControl\ IPM)_{ij} \\ & + \beta_6'(ExcellentControlIPM)_{ij} + \beta_{price}'(Price)_{ij} + \gamma_{ij} \boldsymbol{R}_j \boldsymbol{Y}_i, \end{aligned} \tag{6}$$

where $\boldsymbol{R}_j$ is the vector of all six rice products and $\boldsymbol{Y}_i$ is as defined in model (1). $\boldsymbol{R}_j \boldsymbol{Y}_i$ are interaction terms between participants' demographics and all six rice products. The parameters β' are estimated in the same way the parameters β are estimated. This extended model can predict each participant's marginal WTP for each rice product by solving the following equality:

$$V_{ij} = \beta_j' + \gamma_{ij} R_j Y_i + \beta_{price}' \times Price_j = V_{i0} = 0. \tag{7}$$

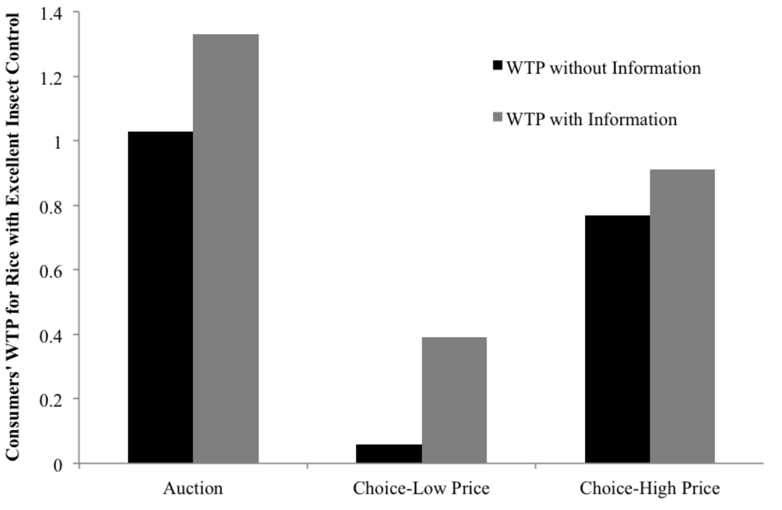

Figure 2. Mean WTP for Rice with Excellent Insect Control from Second-Price Auction, Low-Price Choice Experiment, and High-Price Choice Experiment, with and without Extra Product Information

Participant i's marginal WTP for the jth rice product is $-(\beta_j' + \gamma_{ij}R_jY_i)/\beta_{price}'$. We can predict each individual's WTP for each rice product from the auction using equation (1). To test whether the auction and choice experiment yielded different WTP values, we can directly compare these predicted WTPs from the auction and choice experiment.

We used paired t-tests to compare the predicted average WTPs from auction and choice experiment for each rice product. We hypothesize that anchoring, or different price levels used in the choice experiment, causes differences in the estimated WTP values. We also allow for the possibility that additional information given to participants about product quality might affect WTP. Sample t-tests were used to compare the difference between predicted WTP values from the auction and choice experiment with different price levels, both with and without extra product information.

We also used a random effects model to test the effects of both price levels and extra information on the differences between WTP values predicted from auction and choice experiment:

$$D_{ij} = \alpha_0 + \alpha_1 PL_i + \alpha_2 Info_i + \beta Y_i + \gamma_i + \delta_j + \omega_{ij}, \quad (8)$$

where D_{ij} is the difference between participant i's predicted WTP values from auction and choice experiment for rice product j, PL_i is the price level consumer i faced in choice experiment ($PL_i = 1$ when they faced a higher price level in the choice experiment, 0 otherwise), $Info_i = 1$ when consumer i was provided with extra rice quality information in the auction and choice experiment and 0 otherwise, Y_i are as defined before, $\gamma_i \sim N(0, \sigma_i^2)$ is the random effect with respect to different participants, $\delta_j \sim N(0, \sigma_j^2)$ is the random effect with respect to different rice products, $\omega_{ij} \sim N(0, \sigma_\omega^2)$ is a pure random error term, and γ_i, δ_j, and ω_{ij} are independent of one another.

Results and Discussion

A key result is that anchoring and the amount of product information provided in the choice experiment has a large effect on WTP measures from the choice experiment. As figure 2 illustrates, participants' WTP for rice with excellent insect control measured under the low-price choice experiment is very low compared to WTP from the auction. However, doubling the price level (changing the anchor) from Low Price to High Price makes WTP from the choice experiment much closer to WTP from the auction. Providing extra information to participants about product quality

Table 2. Participants' Taste Evaluation for Rice with Three Insect Control Levels in Appearance, Flavor, Texture and Overall Acceptance (9-point scale: 1 low, 9 high)

Taste Evaluation	Excellent Insect Control	Average Insect Control	Poor Insect Control	P-Value of ANOVA F test
Appearance	6.32	6.20	6.13	0.6793
	(1.61)	(1.57)	(1.76)	
Flavor	5.78	5.81	5.77	0.9827
	(1.83)	(1.77)	(1.82)	
Texture	6.13	6.17	6.13	0.3211
	(1.72)	(1.77)	(1.74)	
Overall Acceptance	6.06	6.13	5.96	0.7642
	(1.71)	(1.74)	(1.78)	

Notes: Numbers in parentheses are standard deviations.

makes consumers' WTP rankings from the choice experiment more consistent with objective quality and with preference rankings from the auction. Results are explained in greater detail below.

Rice Taste Panel Results

Participants' average scores for appearance, texture, flavor, and overall acceptance for three rice products with alternative stored insect control levels are presented in table 2. Participants ranked rice stored with excellent insect control highest in appearance but preferred rice stored with average insect control in terms of flavor, texture, and overall acceptance. For three of the four criteria, participants preferred rice stored with poor insect control least, but the magnitudes of differences across the insect control levels were very small. An ANOVA F test indicates that, on average, participants could not distinguish among the three insect control levels for rice for appearance, flavor, texture, and overall acceptance based on their own taste evaluation.

Comparison of WTP Values Derived from Auction and Choice Experiment

In the test of whether the auction and choice experiment yielded different WTP values, we compared the average of each participant's predicted WTP values derived from the second-price auction (using model 1)[5] and discrete choice experiment (using model 6). We used the same participants in both auction and choice experiment to make an in-sample comparison and real money to provide more incentive for participants to truly express the value they place on each rice product. Theoretically, both methods are incentive compatible and should yield similar WTP values within a given environment. However, based solely on their own taste evaluation of the rice products, when participants did not have any information on the objective quality level of the rice samples, the empirical results from auction and choice experiment were very different. As shown in table 3, in the auction, participants were willing to pay $1.03 for one pound of rice stored under regular (non-IPM) insect control methods regardless of the level of insect control, but in the choice experiment their WTP was $0.59 for one pound of rice with poor insect control, −$0.19 for rice with average insect control, and $0.06 for rice with excellent insect control using regular insect control methods.

Both methods showed that participants preferred rice stored with IPM methods to rice stored with conventional methods, but the magnitudes were different. In the auction, participants were willing to pay $0.06/pound extra for rice stored under IPM methods compared with rice stored

[5] Because we compared predicted bids from equation (1) to predicted willingness-to-pay values from the choice experiment, we double-checked whether the mean predictions from equation (1) were unbiased predictions of actual mean bids (as they should be given the construction of the likelihood function). A t-test was conducted comparing the means of the predicted WTP with those of the actual bids for each of the possible combinations of information, price level, insect control level, and type of insect control. There were no significant differences in actual and predicted mean values in each of these treatment combinations.

Table 3. Comparison of Predicted Willingness to Pay ($/pound) for All Rice Products Derived from Auction and Choice Experiment (without Additional Product Information)

Different Rice Products	$WTP^{AUCTION}$	WTP^{CHOICE}	Difference	Test
Excellent Insect Control	1.03	0.06	0.97	< 0.001
	(0.29)	(0.54)	(0.74)	
Average Insect Control	1.03	−0.19	1.21	< 0.001
	(0.28)	(0.64)	(0.77)	
Poor Insect Control	1.03	0.59	0.44	< 0.001
	(0.31)	(0.20)	(0.30)	
Excellent Insect Control - IPM	1.09	0.81	0.28	< 0.001
	(0.29)	(0.24)	(0.37)	
Average Insect Control - IPM	1.09	0.67	0.42	< 0.001
	(0.31)	(0.35)	(0.45)	
Poor Insect Control - IPM	1.09	0.65	0.44	< 0.001
	(0.31)	(0.38)	(0.34)	

Notes: $WTP^{AUCTION}$ and WTP^{CHOICE} are point predicted consumers' WTP from auction and choice models. Numbers in parentheses are standard errors. Standard errors for auction are calculated using conventional methods. Standard errors for choice experiment are calculated using delta methods. p-values for the two-tailed t-test of H_0: $WTP^{AUCTION} = WTP^{CHOICE}$.

under regular methods, but in the choice experiment they were willing to pay $0.86/pound more ($0.67 compared with −$0.19) for rice with average insect control and $0.75/pound more ($0.81 compared with $0.06) for rice with excellent insect control. Generally, auction WTP estimates were much higher than choice experiment WTP estimates.

Paired t-tests were conducted to test whether these differences were significant. Unlike the results of Lusk and Schroeder (2006), our results (table 3) show that predicted WTP values from the second-price auction were significantly higher than the corresponding WTP values derived from the choice experiment for all six rice samples. Thus, we conclude that WTP estimates derived from auction and choice experiment were not the same.

As noted above, participants on average could not distinguish differences in insect control levels among the rice products in the taste evaluation. The auction results were consistent with this finding: participants' WTP estimates for the three rice products were the same. In contrast, choice experiment WTP estimates for rice stored under IPM methods were higher for better levels of insect control but erratic for rice stored under regular methods: highest for poor insect control, lowest (and negative) for average insect control, and in between for excellent insect control.

Effects of Price Level in Choice Experiment on Difference in WTP Values between Auction and Choice Experiment

Since auction WTP estimates were much higher than choice experiment WTP estimates, we examined the effect of doubling the price level used in the choice experiment, from $0.40/lb. and $0.60/lb. to $0.80/lb. and $1.20/lb. in the choice experiment. The frequencies of consumers' selection of each option under two price levels are presented in table 4. When the price level doubled, participants were more likely to choose not to purchase any rice products; their frequency of choosing the "none" option increased from 7.18% under a lower price level to 10.47% under a higher price level. Also, participants behaved more rationally under the higher price scenario. Under the lower price scenario, the percentage of participants choosing rice with poor insect control (6.6%) was higher than the percentage choosing rice with average insect control (3.82%) and excellent insect control (6.02%). With a doubled price level, more participants chose rice stored with better insect control, with 5.52%, 7.92%, and 10.03% choosing poor, average, and excellent insect control, respectively. The percentage choosing rice stored using IPM methods was higher than the percentage choosing rice stored under conventional methods for all three insect control levels.

Table 4. Participants' Option Selection Frequency Under Two Price Levels in Choice Experiment

	Using Low Price Level		Using High Price Level	
Rice Products	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Excellent Insect Control	52	6.02%	138	10.03%
Medium Insect Control	33	3.82%	109	7.92%
Poor Insect Control	57	6.60%	76	5.52%
Excellent Insect Control - IPM	311	36.00%	442	32.12%
Medium Insect Control - IPM	199	23.03%	244	17.73%
Poor Insect Control - IPM	150	17.36%	233	16.21%
None	62	7.18%	144	10.47%
Total	864		1376	

Table 5. Multinomial Logit Estimates for Choice Experiment with Higher Price Level (HP) and Lower Price Level (LP)

Rice Attributes	Model 1 (HP – High Price)	Model 2 (LP – Low Price)	Model 3 (Pooled)
Intercept	−2.07*	−2.65*	−2.25*
	(0.12)	(0.21)	(0.10)
Price	−2.63*	−2.78*	−0.91*
	(0.24)	(0.53)	(0.12)
Excellent Insect Control	2.22*	1.03*	0.39*
	(0.29)	(0.40)	(0.18)
Average Insect Control	2.13*	0.14	0.12
	(0.29)	(0.39)	(0.19)
Poor Insect Control	2.11*	1.72*	0.55*
	(0.29)	(0.37)	(0.17)
Excellent Insect Control - IPM	3.58*	3.32*	2.06*
	(0.27)	(0.35)	(0.15)
Average Insect Control - IPM	3.19*	2.78*	1.61*
	(0.28)	(0.35)	(0.16)
Poor Insect Control - IPM	3.22*	2.72*	1.61*
	(0.27)	(0.35)	(0.16)
Log Likelihood	−1,265.86	−522.08	−-1,958.53
N	4,818	3,026	7,842

Notes: Numbers in parentheses are standard errors. Single asterisks (*) indicate statistical significance at the 0.05 level or lower.

A likelihood ratio test was used to test whether changing the price level led to different WTP estimations in the choice experiment. The restricted model is model (3) with pooled data from the choice experiment with both higher and lower price levels, while the unrestricted models are the separate models from the choice experiment, one with higher price level and one with lower price level. Table 5 shows the estimated coefficients of the unrestricted and restricted models. The null hypothesis is that estimated rice product parameters are equivalent across the three models: H_0 : $\beta_1^{HP} = \beta_1^{LP} = \cdots = \beta_6^{HP} = \beta_6^{LP}$. The test statistic is 341 ($2 \times (1{,}956.17 - 1{,}260.24 - 519.03)$) and the critical chi-square value with four degrees of freedom at 99% confidence level is 13.3. Thus, we reject the null hypothesis and conclude that the models with low price levels and high price levels are different.

To test whether doubling the price level in the choice experiment reduced the discrepancy between predicted WTP values from the auction and the choice experiment, we calculated the differences between predicted WTP from the auction and predicted WTP from the choice experiment

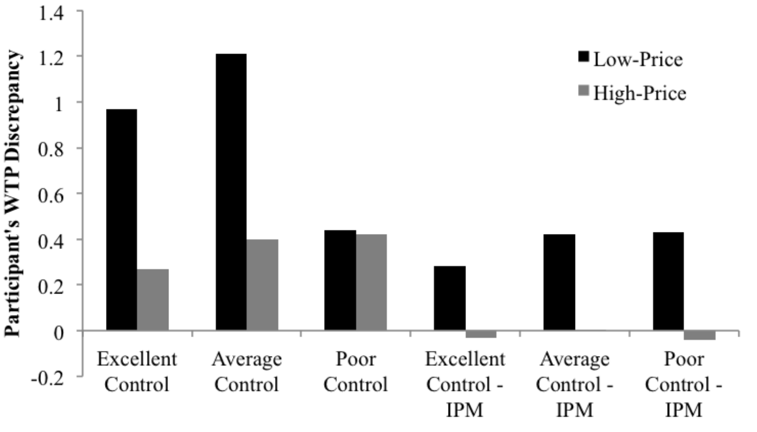

Figure 3. Effect of Doubling Price Level for Choice Experiment on WTP Discrepancy between Auction and Choice Experiment for Six Rice Products

for the low price level ($Diff^{LP} = WTP^{AUCTION,LP-CE}$- $WTP^{CHOICE,LP}$) and high price level ($Diff^{HP} = WTP^{AUCTION,HP-CE}$ - $WTP^{CHOICE,HP}$).[6] A two-sample t-test was used to test whether the discrepancy between auction and choice experiment was significantly reduced. Although Frykblom and Shogren (2000) found no effect of anchoring on participant behavior in a discrete choice experiment, our results indicate that doubling the price level in the choice experiment significantly changed predicted WTP values in the choice experiment and substantially reduced the discrepancy in WTP values between the auction and choice experiment.

As shown in table 6, doubling the price level substantially increased participants' WTP derived from the choice experiment for most of the rice products (compare the column headed Choice – Low Price Group ($WTP^{CHOICE,LP}$) with the column headed Choice – High Price Group ($WTP^{CHOICE,HP}$)). This significantly reduced the discrepancy between auction WTP and choice experiment WTP for those products. For rice stored under regular methods, participants' WTP in the choice experiment increased \$0.71/lb (from \$0.06/lb to \$0.77/lb) for rice with excellent insect control and \$0.80/lb (from −\$0.19/lb to \$0.61/lb) for rice with average insect control and decreased \$0.04/lb (from \$0.59/lb to \$0.55/lb) for rice with poor insect control. For rice stored under IPM methods, participants' WTP estimates in the choice experiment increased by \$0.32/lb (from \$0.81/lb to \$1.13/lb), \$0.41/lb. (from \$0.67/lb to \$1.08/lb), and \$0.43/lb. (from \$0.65/lb to \$1.08/lb) for rice with excellent, average, and poor insect control.

The reduction in differences between the two methods was significant for each rice product except for rice stored under conventional methods with poor insect control. Thus, we conclude that different price levels used in the choice experiment affected the WTP derived from the choice experiment, reducing the discrepancy between WTP values derived from the auction and choice experiment. Doubling the price level also made the WTP estimates more realistic, with no negative values and with similar values across products. Figure 3 summarizes participants' WTP discrepancy between the two methods when different price levels are used in choice experiments.

[6] $WTP^{AUCTION,LP-CE}$ indicates the auction WTP values from the participants who also completed the choice experiment with the lower price level. $WTP^{AUCTION,HP-CE}$ indicates the auction WTP values from the participants who also completed the choice experiment with the higher price level. $WTP^{CHOICE,LP}$ indicates the choice experiment WTP values from the participants who completed the choice experiment with the lower price level. $WTP^{CHOICE,HP}$ indicates the choice experiment WTP values from the participants who completed the choice experiment with the higher price level.

Table 6. Effects of Doubled Price Level in Choice Experiment on Difference in Predicted Participants' Willingness to Pay ($/pound) between Auction and Choice Experiment

Rice Product	Auction (Low-Price Group) ($WTP^{AUCTION,LP-CE}$)	Choice (Low-Price Group) ($WTP^{CHOICE,LP}$)	$DIFF^{LP}$	Auction (High-Price Group) ($WTP^{AUCTION,HP-CE}$)	Choice (High-Price Group) ($WTP^{CHOICE,HP}$)	$DIFF^{HP}$	Difference	Test
Excellent Insect Control	1.03	0.06	**0.97**	1.03	0.77	**0.27**	**−0.70**	< 0.001
	(0.31)	(0.54)	**(0.73)**	(0.29)	(0.20)	**(0.34)**	**(0.52)**	
Average Insect Control	1.03	−0.19	**1.21**	1.01	0.61	**0.40**	**−0.81**	< 0.001
	(0.28)	(0.64)	**(0.78)**	(0.28)	(0.42)	**(0.43)**	**(0.58)**	
Poor Insect Control	1.03	0.59	**0.44**	0.98	0.55	**0.42**	**−0.02**	0.946
	(0.29)	(0.20)	**(0.30)**	(0.26)	(0.43)	**(0.50)**	**(0.44)**	
Excellent Insect Control - IPM	1.09	0.81	**0.28**	1.10	1.13	**−0.03**	**−0.31**	< 0.001
	(0.31)	(0.24)	**(0.34)**	(0.29)	(0.38)	**(0.37)**	**(0.36)**	
Average Insect Control - IPM	1.09	0.67	**0.42**	1.08	1.08	**0.001**	**−0.42**	< 0.001
	(0.31)	(0.35)	**(0.45)**	(0.28)	(0.33)	**(0.53)**	**(0.50)**	
Poor Insect Control - IPM	1.09	0.65	**0.43**	1.04	1.08	**−0.04**	**−0.47**	< 0.001
	(0.29)	(0.38)	**(0.40)**	(0.26)	(0.13)	**(0.34)**	**(0.36)**	

Notes: $WTP^{AUCTION,LP-CE}$ and $WTP^{CHOICE,LP}$ are predicted WTP from participants who participated in auction and choice experiment with lower price level. $WTP^{AUCTION,HP-CE}$ and $WTP^{CHOICE,HP}$ are predicted WTP from participants who participated in auction and choice experiment with higher price level. $DIFF^{LP}$ and $DIFF^{HP}$ are differences between participants' predicted willingness to pay from auction and choice models with different price levels: $DIFF^{LP} = WTP^{AUCTION,LP-CE} - WTP^{CHOICE,LP}$; $DIFF^{HP} = WTP^{AUCTION,HP-CE} - WTP^{CHOICE,HP}$. Difference between differences of predicted participants' willingness to pay from auction and choice models with different price levels: Difference = $DIFF^{HP} - DIFF^{LP}$. Numbers in parentheses are standard errors. p-values for the two sample paired t-test of H_0: $DIFF^{HP} = DIFF^{LP}$.

Table 7. Effects of Extra Information on Difference in Predicted Participants' Willingness to Pay ($/pound) between Auction and Choice Experiment

Rice Product	Auction without Information	Pooled CE without Information	DIFFNOINFO	Auction with Information	Pooled CE with Information	DIFFINFO	Difference	Test
Excellent Insect Control	1.03	0.51	**0.52**	1.33	0.72	**0.61**	**0.09**	0.0013
	(0.29)	(0.50)	**(0.62)**	(0.29)	(0.39)	**(0.51)**	**(0.26)**	
Average Insect Control	1.02	0.32	**0.70**	1.15	0.55	**0.60**	**−0.10**	0.0604
	(0.29)	(0.64)	**(0.70)**	(0.29)	(0.31)	**(0.19)**	**(0.54)**	
Poor Insect Control	0.99	0.57	**0.43**	0.97	0.26	**0.71**	**0.28**	< 0.0001
	(0.28)	(0.37)	**(0.44)**	(0.29)	(0.49)	**(0.58)**	**(0.34)**	
Excellent Insect Control - IPM	1.09	1.01	**0.08**	1.39	1.30	**0.09**	**0.01**	0.6505
	(0.29)	(0.37)	**(0.39)**	(0.29)	(0.35)	**(0.39)**	**(0.22)**	
Average Insect Control - IPM	1.08	0.93	**0.15**	1.21	0.94	**0.27**	**0.12**	< 0.0001
	(0.29)	(0.40)	**(0.54)**	(0.28)	(0.34)	**(0.48)**	**(0.18)**	
Poor Insect Control - IPM	1.06	0.93	**0.13**	1.03	0.73	**0.30**	**0.17**	< 0.0001
	(0.28)	(0.32)	**(0.43)**	(0.28)	(0.57)	**(0.08)**	**(0.43)**	

Notes: Difference between differences of participants' willingness to pay predicted from auction and choice models with and without extra information: Difference = $DIFF^{INFO} - DIFF^{NOINFO}$. Numbers in parentheses are standard errors. p-values for the two sample t-test of H_0: $DIFF^{INFO} = DIFF^{NOINFO}$.

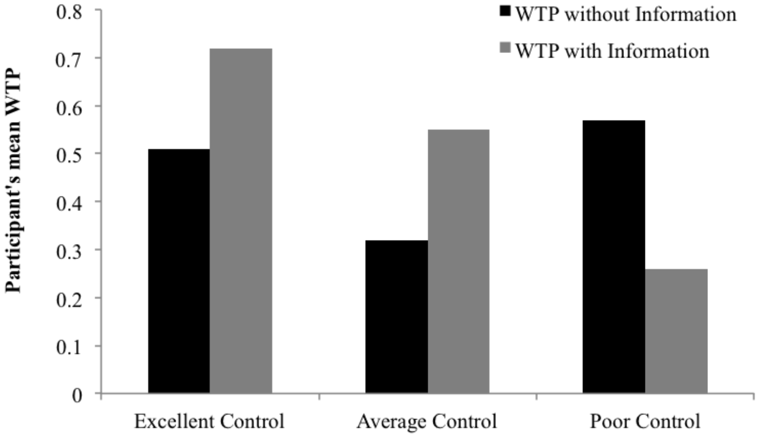

Figure 4. Effect of Extra Product Information on WTP for Rice in Choice Experiment

Effects of Amount of Information on Difference in WTP Values between Auction and Choice Experiment

To explore the effect of providing participants with additional product quality information on WTP value, we conducted another round of auction and choice experiment in which we provided participants extra objective information about the quality levels of each rice sample. Predicted WTP measures from auction and choice experiment with and without information are presented in table 7.

Data from the low-price and high-price experiments were pooled, averaging the effect of the two different price levels, in order to focus on the effect of additional information. Providing additional information had a similar effect on both auction and choice experiment: when participants were provided with objective information about rice quality, their WTP for rice with excellent and average insect control increased while their WTP for rice with poor insect control decreased. Also, providing extra information changed participants' preference ordering under the choice experiment to be consistent with preference ordering under the auction: rice with excellent insect control was preferred to rice with average insect control, which was preferred to rice with poor insect control.

Figure 4 illustrates the effect of extra product information on participants' WTP measures derived from the choice experiment using the pooled data from the low-price and high-price choice experiments (table 7). Without extra product information, participants' WTP measures for rice with three insect control levels were inconsistent with their stated preference ordering from the subjective taste evaluation. When they were given extra quality information, however, their WTP measures realigned to become consistent with the objective quality measures. Because extra information about the products improved consistency of preference rankings, especially for the choice experiment, we now focus on comparing WTP estimates between the auction and choice experiment when participants have that information.

To assess the effects of demographic factors as well as doubling the price level in the choice experiment and providing extra information on the discrepancy between auction and choice experiment WTP estimates, we used a random effects model with price level and demographic factors as independent variables and difference in predicted WTP values between auction and choice experiments as the dependent variable. In table 8, the estimated intercept is 0.45, which indicates that with a low price level in the choice experiments, participants' WTP for one pound of rice from the auction are \$0.45 higher than their predicted WTP from the choice experiment. With a higher price level, however, the WTP values derived from auction and choice experiment were nearly the same, with the difference in WTP values reduced by \$0.44, leaving a net difference of \$0.01.

Table 8. Effects of Doubled Price Level in Choice Experiment and Demographic Factors on Difference in Predicted WTP between Auction and Choice Experiment when Participants Have Additional Product Information

Independent Variable	Coefficient and Standard Error	p-value
Intercept	0.4469*	0.0079
	(0.1046)	
Price Level (Doubled = 1)	−0.4424*	< 0.0001
	(0.0245)	
Info (extra info = 1)	0.0942*	< 0.0001
	(0.0231)	
Race (Asian = 1)	−0.1816*	< 0.0001
	(0.0285)	
Gender (Female = 1)	−0.0756*	0.0020
	(0.0244)	
Education (category)	−0.0137	0.1953
	(0.0106)	
Income (category)	0.0366*	0.0002
	(0.0099)	
Age (category)	0.1282*	< 0.0001
	(0.0122)	
Variance of Rice Products Random Effect	0.056	
Variance of Participants Random Effect	0.028	

Notes: Numbers in parentheses are standard errors. Single asterisks (*) indicate statistical significance at the 0.05 level or lower.

Extra information actually increased the discrepancy between auction and choice bids after accounting for demographic factors. Table 8 also shows that all of the demographic factors considered (except education level) were statistically related to the difference in WTP values between auction and choice experiment. Extra information generally increased both auction and choice bids. Although it increased choice bids by a greater percentage than auction bids, it increased auction bids more in absolute terms, thus increasing the discrepancy between auction and choice bids in absolute terms. However, the sum of the coefficients of the statistically significant variables nearly offsets the coefficient on information, suggesting that the demographic variables may account for much of the difference between auction and choice bids attributable to information.

Compared to male participants, females behaved more consistently between the auction and choice experiment. To the extent that females are the main food purchasers, they may be more familiar with the price of rice. Similarly, Asian participants behaved more consistently between auction and choice experiment than non-Asian participants. Female and Asian participants may have had a better understanding of rice products compared with non-Asian participants. More Asian than non-Asian participants were regular rice eaters and may have had a better understanding of how much the rice products were worth to them, so that their WTP values were not influenced as much by the different value-eliciting mechanisms.

People with lower income levels exhibited smaller difference in WTP values between auction and choice experiment. Low-income participants may have been more price-conscious and more cautious when they bid on the rice products. Older participants exhibited a larger difference in WTP values than younger participants, possibly because they found the experimental procedures more difficult to understand.

Conclusions

In this study, we conducted a non-hypothetical second-price experimental auction and a non-hypothetical discrete choice experiment to determine participants' WTP for rice products with varying insect infestation levels and insect control methods. When participants relied only on their own taste experiences of the rice, on average they did not express a preference for rice that had better insect control and were not willing to pay extra for it. However, when told that the rice with better insect control was higher quality, they were willing to pay significantly more for it. This is similar to the results of Lusk et al. (2001), who found that a larger percentage of consumers preferred more tender steak when they were told it was tender than when relying only on their own taste tests.

We compared the elicited WTP values derived from both the auction and the discrete choice experiment. To make the WTP derived from both mechanisms comparable, we used a censored tobit model for the auction bids and an indirect utility model for the choice experiment results. We compared individual WTP values predicted from both models to test whether the two elicitation mechanisms yielded equivalent results. Our study shows that participants' WTP values predicted from a choice utility model were significantly lower than their corresponding WTP values predicted from a second-price auction.

We also found that WTP values from the second-price auction were more consistent with participants' stated preference ordering (from the taste evaluation) than predicted WTP values from the choice experiment. A possible reason for inconsistency in the choice experiment is that participants, especially those who were not regular rice consumers, could not easily distinguish the difference in rice quality levels. As a result, the values they placed on the rice products may have been more easily influenced by the value-eliciting method used. Providing additional product information to participants (telling them that the rice with better insect control was of higher quality) realigned predicted choice experiment WTP values with objective quality measures.

This study also investigated anchoring as a potential reason for fragility of WTP predictions from the choice experiment. Results show that participants' behavior changed when they faced different price levels in the choice experiment. Doubling the price level used in the choice experiment substantially reduced the discrepancy in WTP values between the two mechanisms.

Differences in behavior in these experiments were associated with differences in participant demographics. Specifically, the WTP discrepancies were smaller for female and Asian participants, suggesting that participants who were more familiar with the products behaved more consistently between the mechanisms.

Our findings suggest that WTP estimates derived from choice experiments can differ significantly with price level used. Participant behavior is susceptible to mechanism design in choice experiments. Further studies should recognize the fragility of choice experiments to anchoring and should provide consumers more product information to improve their product valuation. Additionally, since participants' demographic backgrounds affected how they behaved in the experiments, recruiting participants who are familiar with the products and are able to learn the mechanisms quickly may provide more reliable results with choice experiments.

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Table S1. Estimate of Equation (1) - Effects of Rice Attributes, Consumer Demographics, and Information on Consumers' WTP Using Censored Auction Data

Independent Variable	Coefficient and Standard Error	p-value
Intercept	−0.0905	0.6017
	(0.1733)	
X Vector		
HQ (*ExcellentControl*, High quality)	0.2211	0.2635
	(0.1977)	
MQ (*AverageControl*, Medium quality)	−0.0833	0.6768
	(0.1997)	
LQ (*PoorControl*, Low quality)	–Base–	–Base–
IPM (Storage methods)	0.0197	0.0874
	(0.1225)	
Taste	0.1034**	< 0.0001
	(0.0072)	
Y Vector		
Race	−0.1358**	0.0179
	(0.0574)	
Gender	−0.1730**	0.0002
	(0.0468)	
Education	−0.0096	0.3693
	(0.0107)	
Income	0.0247	0.2110
	(0.0197)	
Age	0.1083**	< 0.0001
	(0.0240)	
RiceConsumption	0.0964**	< 0.0001
	(0.0198)	
Environmental(*Concern*)	−0.2567**	< 0.0001
	(0.0494)	
Health(*Concern*)	−0.0116	0.8474
	(0.06)	
Resistance(*Concern*)	0.2604**	< 0.0001
	(0.0501)	
$HQ \times Race$	0.022	0.7433
	(0.0673)	
$MQ \times Race$	0.012	0.8572
	(0.0669)	
$IPM \times Race$	−0.0463	0.3974
	(0.0548)	
$HQ \times Gender$	0.1286**	0.0248
	(0.0573)	
$MQ \times Gender$	−0.0094	0.8704
	(0.0575)	
$IPM \times Gender$	0.0122	0.7939
	(0.0468)	
$HQ \times Education$	−0.0328	0.1548
	(0.0231)	
$MQ \times Education$	−0.0655**	0.0057
	(0.0237)	
$IPM \times Education$	−0.0053	0.4781
	(0.0075)	
$HQ \times Income$	−0.0409	0.0790
	(0.0233)	
$MQ \times Income$	0.0153	0.5190
	(0.0237)	

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Table S1. – continued from previous page

Independent Variable	Coefficient and Standard Error	p-value
Y Vector (continued)		
IPM × Income	0.0162	0.3913
	(0.0189)	
HQ × Age	0.0976**	0.0006
	(0.0284)	
MQ × Age	0.0102	0.7217
	(0.0287)	
IPM × Age	−0.0296	0.1983
	(0.0230)	
HQ × Environmental	0.1420**	0.0172
	(0.0596)	
MQ × Environmental	0.0544	0.3536
	(0.0586)	
IPM × Environmental	−0.0214	0.6514
	(0.0473)	
HQ × Health	0.1751**	0.0120
	(0.0697)	
MQ × Health	0.2373**	0.0007
	(0.0702)	
IPM × Health	0.0804	0.2306
	(0.0671)	
HQ × Resistance	−0.3880**	< 0.0001
	(0.0596)	
MQ × Resistance	−0.1403**	0.0196
	(0.0601)	
IPM × Resistance	−0.0026	0.9560
	(0.0479)	
Z Vector		
Information	−0.0422	0.6970
	(0.1083)	
Taste × Information	0.0031	0.8450
	(0.0159)	
HQ × Information	0.3202**	< 0.0001
	(0.0667)	
MQ × Information	0.1540**	0.0222
	(0.0674)	

Notes: Double asterisks (**) indicate statistical significance at the 0.05 level or lower. Numbers in parentheses are standard errors.

Table S2. Effects of Rice Attributes, Consumer Demographics on Consumers' WTP Using Choice Experiment Data without Information

Independent Variable	Coefficient and Standard Error	p-value
Intercept	-2.5582^{**}	< 0.0001
	(0.2164)	
R Vector		
HQ	8.4608^{**}	0.0338
	(3.9865)	
HQ × *IPM*	4.8863^{**}	< 0.0001
	(1.2051)	
MQ	−37.7644	0.8426
	(190.2012)	
MQ × *IPM*	0.1626	0.8410
	(1.6328)	
LQ	1.7397	0.4852
	(2.4924)	
LQ × *IPM*	-3.7551^{**}	0.0169
	(1.5722)	
R × Y Vector		
HQ × *Race*	2.4614	0.1901
	(1.8786)	
MQ × *Race*	18.6515	0.8380
	(91.2298)	
LQ × *Race*	−0.2267	0.3693
	(1.1299)	
HQ × *IPM* × *Race*	-1.2926^{**}	0.0176
	(0.5446)	
MQ × *IPM* × *Race*	2.4463^{**}	0.0009
	(0.7399)	
LQ × *IPM* × *Race*	-1.0726^{**}	0.0917
	(0.6361)	
HQ × *Income*	−0.8831	0.2655
	(0.7930)	
MQ × *Income*	3.6418	0.8457
	(18.7124)	
LQ × *Income*	0.0142	0.9552
	(0.2529)	
HQ × *IPM* × *Income*	-0.5225^{**}	0.0012
	(0.1614)	
MQ × *IPM* × *Income*	0.8720^{**}	< 0.0001
	(0.1681)	
LQ × *IPM* × *Income*	0.5432^{**}	0.0089
	(0.2077)	
HQ × *Gender*	2.6961^{**}	0.0426
	(1.3299)	
MQ × *Gender*	−15.8306	0.8233
	(70.8889)	
LQ × *Gender*	−1.0747	0.1903
	(0.8206)	
HQ × *IPM* × *Gender*	0.1058	0.7985
	(0.4146)	
MQ × *IPM* × *Gender*	−0.1705	0.6865
	(0.4224)	
LQ × *IPM* × *Gender*	-1.6504^{**}	0.0018
	(0.5290)	
HQ × *Age*	−1.3389	0.3223
	(1.3527)	

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Table S2. – continued from previous page

Independent Variable	Coefficient and Standard Error	p-value
R × Y Vector (continued)		
MQ × Age	−5.7974	0.6993
	(15.0086)	
LQ × Age	0.1050	0.7659
	(0.3526)	
HQIPM × Age	−0.00926	0.9614
	(0.1912)	
MQ × IPM × Age	−0.0757	0.7487
	(0.2364)	
LQ × IPM × Age	0.0981	0.6787
	(0.2367)	
HQ × Education	1.1661**	0.0485
	(0.5910)	
MQ × Education	−19.8247	0.6708
	(46.6346)	
LQ × Education	−0.4277	0.1594
	(0.3040)	
HQ × IPM × Education	0.2105	0.2176
	(0.1707)	
MQ × IPM × Education	−0.2590	0.2487
	(0.2245)	
LQ × IPM × Education	−0.5711**	0.0121
	(0.2276)	
HQ × Shop	−1.6326	0.0560
	(0.8545)	
MQ × Shop	−3.9941	0.9547
	(70.3825)	
LQ × Shop	−0.7378	0.1521
	(0.5151)	
HQ × IPM × Shop	1.1979**	< 0.0001
	(0.2981)	
MQ × IPM × Shop	−0.0670	0.8095
	(0.2777)	
LQ × IPM × Shop	−0.2184	0.5688
	(0.3833)	
HQ × Buy	−0.6177	0.4278
	(0.7790)	
MQ × Buy	−8.3309	0.8884
	(59.3609)	
LQ × Buy	0.5748	0.2046
	(0.4531)	
HQ × IPM × Buy	−0.5968**	0.0174
	(0.2509)	
MQ × IPM × Buy	−1.5229**	< 0.0001
	(0.3048)	
LQ × IPM × Buy	1.2224**	0.0002
	(0.3266)	
HQ × Eat	−0.7362	0.1652
	(0.5305)	
MQ × Eat	6.7949	0.8843
	(46.6988)	
LQ × Eat	−0.6787**	0.0610
	(0.3622)	
HQ × IPM × Eat	0.2746	0.1725
	(0.2013)	
MQ × IPM × Eat	0.9696**	0.0003
	(0.2705)	

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Table S2. – continued from previous page

Independent Variable	Coefficient and Standard Error	p-value
R × Y Vector (continued)		
LQ × IPM × Eat	0.5122**	0.0678
	(0.2805)	
HQ × Environmental	−1.0299	0.2811
	(0.9555)	
MQ × Environmental	20.5878	0.8213
	(91.1369)	
LQ × Environmental	0.4796	0.5374
	(0.7776)	
HQ × IPM × Environmental	0.6953	0.1055
	(0.4295)	
MQ × IPM × Environmental	1.7914**	< 0.0001
	(0.4510)	
LQ × IPM × Environmental	−0.1857	0.7099
	(0.4991)	
HQ × Health	−1.4377	0.2847
	(1.3457)	
MQ × Health	1.1402	0.9839
	(56.4447)	
LQ × Health	0.2806	0.7670
	(0.9471)	
HQ × IPM × Health	−0.1693	0.7259
	(0.4829)	
MQ × IPM × Health	−0.2883	0.6053
	(0.5578)	
LQ × IPM × Health	−1.9706**	0.0023
	(0.6461)	
HQ × Resistance	0.8943	0.5333
	(1.4355)	
MQ × Resistance	7.4997	0.8461
	(38.6321)	
LQ × Resistance	0.9365	0.2497
	(0.8136)	
HQ × IPM × Resistance	−0.9563**	0.0065
	(0.3515)	
MQ × IPM × Resistance	−0.8620**	0.0220
	(0.3763)	
LQ × IPM × Resistance	3.2285**	< 0.0001
	(0.5760)	
Price	−4.7262**	< 0.0001
	(0.8117)	

Notes: Double asterisks (**) indicate statistical significance at the 0.05 level or lower. Numbers in parentheses are standard errors.

Table S3. Effects of Rice Attributes, Consumer Demographics on Consumers' WTP Using Choice Experiment Data with Information

Independent Variable	Coefficient and Standard Error	p-value
Intercept	−2.6559**	< 0.0001
	(0.2258)	
R Vector		
HQ	6.6776**	0.0001
	(1.7449)	
HQ × *IPM*	2.2440**	0.0340
	(1.0583)	
MQ	2.5602	0.2127
	(2.0544)	
MQ × *IPM*	−1.5467	0.3776
	(1.7530)	
LQ	−8.6898	0.1498
	(6.0329)	
LQ × *IPM*	3.2271	0.1612
	(2.3034)	
R × Y Vector		
HQ × *Race*	1.5842	0.1275
	(1.0395)	
MQ × *Race*	2.0522**	0.0549
	(1.0690)	
LQ × *Race*	0.5896	0.7499
	(1.8494)	
HQ × *IPM* × *Race*	−0.1.1395**	0.0192
	(0.4865)	
MQ × *IPM* × *Race*	0.6725	0.3344
	(0.6954)	
LQ × *IPM* × *Race*	−0.6207	0.4649
	(0.8493)	
HQ × *Income*	−0.6263**	0.0372
	(0.3006)	
MQ × *Income*	0.1848	0.4478
	(0.2434)	
LQ × *Income*	−0.7397	0.3245
	(0.7508)	
HQ × *IPM* × *Income*	−0.1497	0.2038
	(0.1178)	
MQ × *IPM* × *Income*	0.9628**	< 0.0001
	(0.1663)	
LQ × *IPM* × *Income*	−1.5150	0.0575
	(0.7974)	
HQ × *Gender*	0.6423	0.3178
	(0.6429)	
MQ × *Gender*	0.5186	0.4770
	(0.7293)	
LQ × *Gender*	−2.8668**	0.0583
	(1.5138)	
HQ × *IPM* × *Gender*	0.5060	0.1357
	(0.3391)	
MQ × *IPM* × *Gender*	0.0184	0.9656
	(0.4271)	
LQ × *IPM* × *Gender*	−3.1303**	0.0002
	(0.8495)	
HQ × *Age*	0.4437	0.3732
	(0.4983)	

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Table S3. – continued from previous page

Independent Variable	Coefficient and Standard Error	p-value
R × Y Vector (continued)		
MQ × Age	−0.0626	0.8539
	(0.3402)	
LQ × Age	0.3147	0.5899
	(0.5840)	
HQ × IPM × Age	−0.0673	0.7013
	(0.1754)	
MQ × IPM × Age	−0.1523	0.4657
	(0.2087)	
LQ × IPM × Age	−0.2091	0.5260
	(0.3297)	
HQ × Education	0.3717	0.2225
	(0.3047)	
MQ × Education	−0.8112**	0.0212
	(0.3520)	
LQ × Education	−1.7743**	0.0456
	(0.8678)	
HQ × IPM × Education	0.4269**	0.0050
	(0.1519)	
MQ × IPM × Education	−0.2261	0.2980
	(0.2172)	
LQ × IPM × Education	1.5500**	0.0001
	(0.4004)	
HQ × Shop	−1.9464**	0.0003
	(0.5309)	
MQ × Shop	0.7748	0.1561
	(0.5463)	
LQ × Shop	2.2868**	0.0242
	(1.0147)	
HQ × IPM × Shop	0.5419**	0.0215
	(0.2356)	
MQ × IPM × Shop	−0.6759**	0.0224
	(0.2961)	
LQ × IPM × Shop	1.8966**	0.0113
	(0.7488)	
HQ × Buy	0.6774	0.1052
	(0.4182)	
MQ × Buy	−0.7273	0.0958
	(0.4367)	
LQ × Buy	−1.1742	0.1467
	(0.8092)	
HQ × IPM × Buy	−0.2753	0.2013
	(0.2154)	
MQ × IPM × Buy	−1.2575**	< 0.0001
	(0.3002)	
LQ × IPM × Buy	1.2300**	0.0078
	(0.4624)	
HQ × Eat	−1.0558**	0.0009
	(0.3183)	
MQ × Eat	0.6188	0.1019
	(0.3871)	
LQ × Eat	1.5969	0.0563
	(0.8367)	
HQ × IPM × Eat	0.3832**	0.0256
	(0.1717)	
MQ × IPM × Eat	0.8428**	0.0008
	(0.2504)	

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Table S3. – continued from previous page

Independent Variable	Coefficient and Standard Error	p-value
R × Y Vector (continued)		
LQ × IPM × Eat	0.1116	0.7836
	(0.4061)	
HQ × Environmental	−1.5631**	0.0105
	(0.6109)	
MQ × Environmental	0.5551	0.4213
	(0.6903)	
LQ × Environmental	−0.0744	0.9539
	(1.2855)	
HQ × IPM × Environmental	0.5710	0.0931
	(0.3400)	
MQ × IPM × Environmental	2.0558**	< 0.0001
	(0.4756)	
LQ × IPM × Environmental	−0.0971	0.8950
	(0.7361)	
HQ × Health	−0.2985	0.6652
	(0.6896)	
MQ × Health	−1.2705	0.1564
	(0.8965)	
LQ × Health	−1.1274	0.4303
	(1.4294)	
HQ × IPM × Health	−0.6892	0.1015
	(0.4208)	
MQ × IPM × Health	0.4577	0.4462
	(0.6009)	
LQ × IPM × Health	−1.2895	0.1984
	(1.0025)	
HQ × Resistance	1.1135	0.1149
	(0.7062)	
MQ × Resistance	0.0701	0.9031
	(0.5757)	
LQ × Resistance	4.6123	0.0658
	(2.5070)	
HQ × IPM × Resistance	−0.0739	0.8015
	(0.2940)	
MQ × IPM × Resistance	−0.7937**	0.0311
	(0.3781)	
LQ × IPM × Resistance	1.6870**	0.0331
	(0.7918)	
Price	−4.7294**	< 0.0001
	(0.7827)	

Notes: Double asterisks (**) indicate statistical significance at the 0.05 level or lower. Numbers in parentheses are standard errors.

Table S4. Effects of Rice Attributes, Consumer Demographics on Consumers' WTP Using Choice Experiment Data with Doubled Price Level without Information

Independent Variable	Coefficient and Standard Error	p-value
Intercept	-1.9603^{**} (0.1286)	< 0.0001
R Vector		
HQ	-2.3258 (1.8324)	0.2044
HQ × *IPM*	5.1753^{**} (1.0620)	< 0.0001
MQ	-2.1176 (1.9779)	0.2843
MQ × *IPM*	3.4519^{**} (1.0846)	0.0015
LQ	7.6560^{**} (1.9227)	< 0.0001
LQ × *IPM*	4.7801^{**} (1.0181)	< 0.0001
R × Y Vector		
HQ × *Race*	0.4403 (0.4339)	0.3102
MQ × *Race*	0.1936 (0.5509)	0.7252
LQ × *Race*	2.0940^{**} (0.5359)	< 0.0001
HQ × *IPM* × *Race*	-1.4510^{**} (0.3411)	< 0.0001
MQ × *IPM* × *Race*	0.7668^{**} (0.3225)	0.0174
LQ × *IPM* × *Race*	-0.4850 (0.3273)	0.1383
HQ × *Income*	0.0552 (0.1538)	0.7195
MQ × *Income*	-0.3301 (0.2262)	0.1445
LQ × *Income*	-0.6014^{**} (0.2171)	0.0056
HQ × *IPM* × *Income*	-0.2959^{**} (0.1038)	0.0044
MQ × *IPM* × *Income*	0.0697 (0.1189)	0.5577
LQ × *IPM* × *Income*	-0.0610 (0.1183)	0.6058
HQ × *Gender*	0.3306 (0.4002)	0.4087
MQ × *Gender*	-1.2160^{**} (0.4638)	0.0088
LQ × *Gender*	0.0543 (0.5016)	0.9137
HQ × *IPM* × *Gender*	0.7807^{**} (0.3010)	0.0095
MQ × *IPM* × *Gender*	-0.3098 (0.2755)	0.2608
LQ × *IPM* × *Gender*	0.1048 (0.2809)	0.7090
HQ × *Age*	0.4867^{**} (0.1752)	0.0055

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Table S4. – continued from previous page

Independent Variable	Coefficient and Standard Error	p-value
R × Y Vector (continued)		
MQ × Age	0.5572**	0.0209
	(0.2412)	
LQ × Age	0.2320	0.2907
	(0.2196)	
HQ × IPM × Age	−0.00936	0.9411
	(0.1267)	
MQ × IPM × Age	−0.4441**	0.0046
	(0.1566)	
LQ × IPM × Age	−0.3467**	0.0260
	(0.1557)	
HQ × Education	0.2115	0.1998
	(0.1649)	
MQ × Education	0.2836	0.1364
	(0.1904)	
LQ × Education	−0.7833**	< 0.0001
	(0.1917)	
HQ × IPM × Education	−0.1614	0.1466
	(0.1112)	
MQ × IPM × Education	0.3823**	0.0024
	(0.1262)	
LQ × IPM × Education	0.0872	0.4530
	(0.1163)	
HQ × Shop	−0.0995	0.6040
	(0.1918)	
MQ × Shop	0.3221	0.1475
	(0.2224)	
LQ × Shop	0.5983**	0.0059
	(0.2175)	
HQ × IPM × Shop	0.2253	0.1238
	(0.1464)	
MQ × IPM × Shop	−0.8647**	< 0.0001
	(0.1805)	
LQ × IPM × Shop	0.1401	0.3235
	(0.1419)	
HQ × Buy	−0.1141	0.5533
	(0.1925)	
MQ × Buy	−1.3200**	< 0.0001
	(0.2538)	
LQ × Buy	0.0713	0.7579
	(0.2312)	
HQ × IPM × Buy	0.1118	0.3808
	(0.1275)	
MQ × IPM × Buy	0.1904	0.1505
	(0.1325)	
LQ × IPM × Buy	−0.0350	0.7730
	(0.1213)	
HQ × Eat	0.3838	0.1202
	(0.2470)	
MQ × Eat	0.7551**	0.0068
	(0.2792)	
LQ × Eat	0.0475	0.8532
	(0.2568)	
HQ × IPM × Eat	−0.0491	0.7238
	(0.1390)	
MQ × IPM × Eat	−0.4752**	0.0022
	(0.1553)	

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Table S4. – continued from previous page

Independent Variable	Coefficient and Standard Error	p-value
R × Y Vector (continued)		
LQ × IPM × Eat	−0.0834	0.5493
	(0.1393)	
HQ × Environmental	−0.3054	0.4656
	(0.4186)	
MQ × Environmental	−2.3318**	< 0.0001
	(0.5881)	
LQ × Environmental	−1.4442**	0.0062
	(0.5281)	
HQ × IPM × Environmental	0.9277**	0.0019
	(0.2987)	
MQ × IPM × Environmental	−0.0684	0.8329
	(0.3242)	
LQ × IPM × Environmental	−0.2362	0.4617
	(0.3209)	
HQ × Health	0.9138**	0.0488
	(0.4637)	
MQ × Health	1.3495**	0.0183
	(0.5720)	
LQ × Health	−1.2351**	0.0185
	(0.5244)	
HQ × IPM × Health	−0.4603	0.1237
	(0.2990)	
MQ × IPM × Health	0.5290**	0.0881
	(0.3101)	
LQ × IPM × Health	0.4529	0.1273
	(0.2970)	
HQ × Resistance	−0.0909	0.8366
	(0.4404)	
MQ × Resistance	2.3330**	0.0001
	(0.6013)	
LQ × Resistance	0.8880	0.0969
	(0.5349)	
HQ × IPM × Resistance	−1.1012**	0.0004
	(0.3131)	
MQ × IPM × Resistance	−0.4354	0.1643
	(0.3131)	
LQ × IPM × Resistance	−0.2346	0.4667
	(0.3224)	
Price	−3.3862**	< 0.0001
	(0.6899)	

Notes: Double asterisks (**) indicate statistical significance at the 0.05 level or lower. Numbers in parentheses are standard errors.

Table S5. Effects of Rice Attributes, Consumer Demographics on Consumers' WTP Using Choice Experiment Data with Doubled Price Level and Extra Information

Independent Variable	Coefficient and Standard Error	p-value
Intercept	−2.1562**	< 0.0001
	(0.1387)	
R Vector		
HQ	0.8401	0.5646
	(1.4584)	
HQ × *IPM*	3.9596**	< 0.0001
	(0.9568)	
MQ	2.2843	0.2563
	(2.0123)	
MQ × *IPM*	4.6081**	< 0.0001
	(1.1392)	
LQ	6.3679**	0.0205
	(2.7473)	
LQ × *IPM*	4.2689**	0.0006
	(1.2378)	
R × Y Vector		
HQ × *Race*	1.6935**	< 0.0001
	(0.4057)	
MQ × *Race*	0.8913	0.1710
	(0.6510)	
LQ × *Race*	2.8283**	0.0040
	(0.9827)	
HQ × *IPM* × *Race*	−0.4939	0.0653
	(0.2680)	
MQ × *IPM* × *Race*	−0.6308	0.0703
	(0.3485)	
LQ × *IPM* × *Race*	−0.7533**	0.0427
	(0.3717)	
HQ × *Income*	−0.1366	0.3124
	(0.1352)	
MQ × *Income*	−0.6806**	0.0262
	(0.3061)	
LQ × *Income*	−1.0843**	0.0208
	(0.4692)	
HQ × *IPM* × *Income*	−0.5267**	< 0.0001
	(0.0963)	
MQ × *IPM* × *Income*	−0.1618	0.2380
	(0.1371)	
LQ × *IPM* × *Income*	−0.1164	0.4045
	(0.1396)	
HQ × *Gender*	0.5209	0.1355
	(0.3489)	
MQ × *Gender*	−1.3422**	0.0098
	(0.5195)	
LQ × *Gender*	−0.5099	0.4369
	(0.6558)	
HQ × *IPM* × *Gender*	0.2756	0.2563
	(0.2428)	
MQ × *IPM* × *Gender*	−0.2682	0.3653
	(0.2963)	
LQ × *IPM* × *Gender*	0.2389	0.4617
	(0.3246)	
HQ × *Age*	0.8173**	< 0.0001
	(0.1618)	

Continued on next page...

Table S5. – continued from previous page

Independent Variable	Coefficient and Standard Error	p-value
R × Y Vector		
MQ × Age	0.3627 (0.2786)	0.1929
LQ × Age	0.3295 (0.3805)	0.3865
HQ × IPM × Age	−0.0902 (0.1104)	0.4140
MQ × IPM × Age	−0.4649** (0.1738)	0.0075
LQ × IPM × Age	−0.5143** (0.1974)	0.0092
HQ × Education	−0.3120** (0.1461)	0.0327
MQ × Education	0.4543** (0.2258)	0.0443
LQ × Education	−0.5290** (0.2391)	0.0269
HQ × IPM × Education	−0.1843 (0.0990)	0.0627
MQ × IPM × Education	0.6322** (0.1427)	<0.0001
LQ × IPM × Education	0.1739 (0.1325)	0.1893
HQ × Shop	−0.4463** (0.1823)	0.0143
MQ × Shop	0.2264 (0.2371)	0.3398
LQ × Shop	−0.3125 (0.3381)	0.3552
HQ × IPM × Shop	0.1844 (0.1206)	0.1263
MQ × IPM × Shop	−0.3835** (0.1649)	0.0200
LQ × IPM × Shop	0.1968 (0.1661)	0.2361
HQ × Buy	0.1468 (0.1756)	0.4227
MQ × Buy	−1.2518** (0.2559)	<0.0001
LQ × Buy	−0.0744 (0.3118)	0.8115
HQ × IPM × Buy	−0.3052** (0.1120)	0.0064
MQ × IPM × Buy	0.0349 (0.1305)	0.7890
LQ × IPM × Buy	−0.1539 (0.2587)	0.2587
HQ × Eat	−0.1664 (0.1981)	0.4009
MQ × Eat	0.5445 (0.2850)	0.0561
LQ × Eat	−0.1148 (0.4041)	0.7764
HQ × IPM × Eat	−0.1469 (0.1227)	0.2313
MQ × IPM × Eat	−0.3991** (0.1509)	0.0082

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Table S5. – continued from previous page

Independent Variable	Coefficient and Standard Error	p-value
R × Y Vector (continued)		
LQ × IPM × Eat	0.1701	0.3083
	(0.1670)	
HQ × Environmental	−0.6204	0.1203
	(0.3993)	
MQ × Environmental	−2.4746**	0.0004
	(0.7026)	
LQ × Environmental	−2.1456**	0.0118
	(0.8522)	
HQ × IPM × Environmental	1.1263**	< 0.0001
	(0.2776)	
MQ × IPM × Environmental	−0.1268	0.7118
	(0.3433)	
LQ × IPM × Environmental	−0.4110	0.2757
	(0.3770)	
HQ × Health	0.7937	0.0895
	(0.4675)	
MQ × Health	0.4376	0.4599
	(0.5921)	
LQ × Health	0.3570	0.6364
	(0.7551)	
HQ × IPM × Health	−0.0970	0.7185
	(0.2591)	
MQ × IPM × Health	0.4316	0.1521
	(0.3014)	
LQ × IPM × Health	0.1848	0.5774
	(0.3318)	
HQ × Resistance	0.5371	0.1853
	(0.4055)	
MQ × Resistance	2.1291**	0.0010
	(0.6456)	
LQ × Resistance	1.0753	0.1521
	(0.7509)	
HQ × IPM × Resistance	−0.9479**	0.0005
	(0.2739)	
MQ × IPM × Resistance	−0.0501	0.8822
	(0.3381)	
LQ × IPM × Resistance	−0.0087	< 0.9832
	(0.3728)	
Price	−3.4403**	< 0.0001
	(0.3054)	

Notes: Double asterisks (**) indicate statistical significance at the 0.05 level or lower. Numbers in parentheses are standard errors.

Introductory Instructions

Thank you for agreeing to participate in today's session. As you entered the room, you should have been given $22 and a packet. You should also have been assigned an ID number, which is located on the upper right hand corner of the packet. You will use this ID number to identify yourself during this research session. We use random numbers in order to endure confidentiality.

Before we begin, I want to emphasize that your participation in this session is completely voluntary. If you do not wish to participate in the experiment, please say so at any time. Non-participants will not be penalized in any way. I want to assure you that the information you provide will be kept strictly confidential and used only for the purposed of this research.

In today's session, we are interested in your preference for several different kinds of rice. First, you will have a chance to taste three different kinds of rice samples which may be of different quality levels. The three rice samples are labeled by different random three digit numbers. After you taste them, please evaluate them and complete the taste evaluation form.

In the packet we give to you, you will find a survey which will ask you some questions about your rice consumption and your understanding of rice storage methods. This survey is anonymous and your name is in no way linked to the responses. After finishing all experiments, please complete the survey.

I will now begin going through a set of instruction with you and will read from this script so that I am able to clearly convey the procedures. Importantly, from this point forward, I ask that there be no talking among participants. Failure to comply with these instructions will result in disqualification from the experiment.

Oklahoma State University Study on Consumers' Preferences for Rice with Different Quality Levels and Storage Methods

This is the first part of our survey. We would like some background information about you. The survey is anonymous and your name is in no way linked to the responses.

1. What is your gender?
   - Male
   - Female
2. What is your race?
   - White
   - Hispanic
   - African American
   - Asian
   - Other
3. Which is the highest level of education you have obtained?
   - High school or below
   - Associate degree
   - Bachelors degree
   - Master degree
   - Doctoral degree or higher
4. What is your approximate annual household income before taxes in 2008?
   - Less than $20,000
   - $20,000 to $39,999
   - $40,000 to $59,999
   - $60,000 to $79,999
   - $80,000 to $99,999
   - $100,000 or more
5. What is your present age?
   - 20–30
   - 31–40
   - 41–50
   - 51-60
   - Above 61

Now we would like some information on your rice consumption and your understanding of rice storage management.

6. How often do you purchase rice?
   - About once a week
   - About every two weeks
   - About once a month
   - A few times a year
   - About once a year
   - Never
7. How often do you eat rice?
   - About once a week
   - About every two weeks
   - About once a month
   - A few times a year
   - About once a year
   - Never
8. How well do you understand the description of the two approaches of insect control in rice?
   - I understand it very well
   - I understand a little
   - I don’t understand it at all

Thank you for your help!

Instructions for Rice Tasting Evaluation

Now you will have a chance to taste three samples of rice that have been stored under different conditions, which may or may not affect the rice quality. You will be given three rice samples which are labeled with three random digit numbers. The label is randomly assigned to each rice samples, and is not related to the rice storage methods or quality levels. All the rice used is suitable for human consumption.

Each rice sample will be presented on a separate plate. You will be served the first sample of rice, which is identified with a number. You will taste and rate the rice sample for appearance, flavor, texture, and overall acceptability. Then the second and third samples of the rice will be served, and you again will evaluate the sample for each of the four sensory characteristics. You will take a 2-minute break after each sample evaluation and a cup of water to drink to refresh your month.

When you are evaluating rice samples for appearance, flavor, texture, and overall acceptability, a 9-points hedonic scale will be used for ranking. The scale range from 1 (the rice is **very undesirable** for appearance, flavor, texture, and overall acceptance) to 9 (the rice is **very desirable** for appearance, flavor, texture, and overall acceptance).

Taste Panel Evaluation Form

Rice ID: **ID:**

Please rate the rice sample, which are labeled with different number, for appearance, flavor, texture, and overall quality. Use the following scales: 1 = extremely undesirable and 9 = extremely desirable for appearance, flavor, texture, and overall quality.

Appearance:

Extremely undesirable ⟶ Extremely desirable

1 2 3 4 5 6 7 8 9

Flavor:

Extremely undesirable ⟶ Extremely desirable

1 2 3 4 5 6 7 8 9

Texture:

Extremely undesirable ⟶ Extremely desirable

1 2 3 4 5 6 7 8 9

Overall Acceptance:

Extremely undesirable ⟶ Extremely desirable

1 2 3 4 5 6 7 8 9

Explanation of IPM and Regular Rice Storage Methods

Maintaining wholesomeness of rice in storage depends on controlling temperature and moisture content of the grain, maintaining cleanliness, and preventing insect damage. One management approach to prevent insect damage is to control insects with routine application of pesticides. Research indicates that fumigants, a commonly used form of pesticide, likely don't directly affect humans because they leave no residual, but they may negatively affect humans, particularly workers, if application is not conducted correctly. Also, over time, insects may develop resistance to the pesticides.

Another approach is integrated pest management (IPM). IPM is a balanced use of multiple control tactics—biological, chemical, and cultural—as is most appropriate for a particular situation in light of careful study of all factors involved. Thus, while conventional pest management typically uses regular applications of pesticides, IPM programs evaluate the need for treatment and apply treatments considering both effectiveness and risk as needed. Sampling or monitoring is used to determine how many and what kinds of insects are present and to guide the application of control methods. Less risky and non-chemical actions are taken first, and additional pest control methods, including chemical pesticides, are employed only when needed.

Assume that both IPM and non-IPM approaches are equally effective in controlling insect and maintaining wholesomeness of grains, and that rice choices that you will bid on are each in a one-pound package. Before you start to bid, two dollars in coins will be given to you. Are there any questions before we begin?

Instructions for 2nd Price Auction

Now that you have had the chance to learn how the auction will work, we are interested in your preferences for six different kinds of rice. Each of you should have tasted and received an information sheet describing the pest management method different rice use.

We will give you the opportunity to participate in an auction to purchase the rice you desire. We will conduct an auction for each kind of rice. In a moment, you will be asked to indicate the most you are willing to pay for each of the rice samples by writing bids on the enclosed bid sheets.

1. First, each of you has been given a bid sheet in your packet. On this sheet you will write the most you are willing to pay for each kind of rice.
2. After you've finished writing your bids, one for each kind of rice, the monitor will collect the bid sheets.
3. In the front of the room, each of your bids will be ranked from highest to lowest for each kind of rice.
4. The highest bidders will win the auction but will pay the 2nd highest bid amount for that rice.
5. For each kind of rice we will write the winning participant's bidder number and the winning price on the chalkboard for everyone to see.
6. After posting the prices and winning bidder numbers, we will re-conduct the auction for 4 additional rounds.
7. At the completion of the 5th round, we will randomly draw a number from 1 to 5 to determine the binding round. For example, if we randomly draw the number 2, then we will ignore outcomes in all other rounds and only focus on the winning bidders and price in round 2. Importantly, all rounds have an equal chance of being binding.
8. After the binding round has been determined, we will randomly draw a number from 1 to 6 to determine which rice to actually sell. Importantly, all rice has an equal chance of being selected.
9. Once the binding round and the kind of rice have been determined, the winning bidders will come forward and pay the 2nd highest bid amount for the winning rice. All other participants will pay nothing and will not receive any rice. Important Notes
10. You will only have the opportunity to win an auction for one kind of rice. Because we randomly draw one binding round and one kind of selected rice, you cannot win more than one pound of rice. That is, under no bidding scenario will you take home more than one pound of rice from this experiment.
11. The winning bidder will actually pay money to obtain the winning rice. This procedure is not hypothetical.
12. In this auction, the best strategy is to bid exactly what it is worth to you to obtain each of the six kinds of rice. Consider the following: if you bid more than the rice is worth to you, you may end up having to buy rice for more than you really want to pay. Conversely, if you bid less than the rice is really worth to you, you may end up not winning the auction even though you could have bought rice at a price you were actually willing to pay. If you win the bid, you will get the rice you desire at a price lower than you were willing to pay. Thus, your best strategy is to bid exactly what each kind of rice is worth to you.
13. It is acceptable to bid $0.00 for any kind of rice in any of the rounds.

Instructions for the Choice Experiment

Now that you have had the chance to learn how the choice experiment will work. We are interested in your preferences for six different kinds of rice. Each of you should have tasted and received an information sheet describing several different kinds of rice.

We will give you the opportunity to participate in a choice experiment to purchase the rice you desire. We will give you a choice sheet that lists all six rice samples at different price levels. Each kind of rice is available in a one-pound package.

1. First, each of you has been given a choice sheet in your packet. There are eight different shopping scenarios listed on your choice sheet. For each shopping scenarios, you will choose the rice you are willing to purchase.
2. After you've finished choosing the rice, the monitor will collect the choose sheets.
3. We will randomly draw a number from 1 to 8 to determine the binding scenarios. For example, if we randomly draw the number 2, then we will ignore all other scenarios and only focus on the scenario 2. Importantly, all scenarios have an equal chance of being binding.
4. After binding scenario has been determined, we will randomly draw a number among your ID number. If your ID number is selected, you must purchase the rice that you chose in that binding scenario at the price listed. For example, if we selected participant 11, his choose in scenario 2 is the rice labeled 57IPM, and the price for 57IPM was $0.80, then participant 11 would pay $0.80 and he would receive the rice 571IPM. Everybody has an equal chance of being selected.

Important notes:

1. You will only have the opportunity to purchase one pound of rice, since we randomly draw one binding round. That is, under no scenario will you take home more than one pound of rice from this experiment.
2. If your ID number is randomly selected, you will actually pay money to obtain one pound of rice that you chose. This procedure is not hypothetical.
3. In this choice experiment, the best strategy is to choose the rice at the price level at which you are really willing to purchase.
4. It is acceptable to choose the option NONE in any choice round.

Auction Bid Sheet

ID: **Practice Round**

I would like to bid $ ____________ for the rice 537.

I would like to bid $ ____________ for the rice 537 IPM.

I would like to bid $ ____________ for the rice 258.

I would like to bid $ ____________ for the rice 258IPM.

I would like to bid $ ____________ for the rice 741.

I would like to bid $ ____________ for the rice 741IPM.

Choice Sheet

ID: **Round:**

Scenario 1:

	Rice						
I would like to choose…	Rice 537 $0.80 ⇩ ☐	Rice 537IPM $0.80 ⇩ ☐	Rice 258 $0.80 ⇩ ☐	Rice 258IPM $0.80 ⇩ ☐	Rice 741 $1.20 ⇩ ☐	Rice 741IPM $1.20 ⇩ ☐	None ⇩ ☐

Scenario 2:

	Rice						
I would like to choose…	Rice 537 $0.80 ⇩ ☐	Rice 537IPM $0.80 ⇩ ☐	Rice 258 $1.20 ⇩ ☐	Rice 258IPM $1.20 ⇩ ☐	Rice 741 $0.80 ⇩ ☐	Rice 741IPM $0.80 ⇩ ☐	None ⇩ ☐

Scenario 3:

	Rice						
I would like to choose…	Rice 537 $0.80 ⇩ ☐	Rice 537IPM $1.20 ⇩ ☐	Rice 258 $0.80 ⇩ ☐	Rice 258IPM $1.20 ⇩ ☐	Rice 741 $0.80 ⇩ ☐	Rice 741IPM $1.20 ⇩ ☐	None ⇩ ☐

Scenario 4:

	Rice						
I would like to choose…	Rice 537 $0.80 ⇩ ☐	Rice 537IPM $1.20 ⇩ ☐	Rice 258 $1.20 ⇩ ☐	Rice 258IPM $0.80 ⇩ ☐	Rice 741 $1.20 ⇩ ☐	Rice 741IPM $0.80 ⇩ ☐	None ⇩ ☐

Scenario 5:

	Rice						
I would like to choose…	Rice 537 $1.20 ⇩ ☐	Rice 537IPM $0.80 ⇩ ☐	Rice 258 $0.80 ⇩ ☐	Rice 258IPM $1.20 ⇩ ☐	Rice 741 $1.20 ⇩ ☐	Rice 741IPM $0.80 ⇩ ☐	None ⇩ ☐

Scenario 6:

	Rice						
I would like to choose…	Rice 537 $1.20 ⇩ ☐	Rice 537IPM $0.80 ⇩ ☐	Rice 258 $1.20 ⇩ ☐	Rice 258IPM $0.80 ⇩ ☐	Rice 741 $0.80 ⇩ ☐	Rice 741IPM $1.20 ⇩ ☐	None ⇩ ☐

Scenario 7:

	Rice						
I would like to choose…	Rice 537 $1.20 ⇩ ☐	Rice 537IPM $1.20 ⇩ ☐	Rice 258 $0.80 ⇩ ☐	Rice 258IPM $0.80 ⇩ ☐	Rice 741 $0.80 ⇩ ☐	Rice 741IPM $0.80 ⇩ ☐	None ⇩ ☐

Scenario 8:

	Rice						
I would like to choose…	Rice 537 $1.20 ⇩ ☐	Rice 537IPM $1.20 ⇩ ☐	Rice 258 $1.20 ⇩ ☐	Rice 258IPM $1.20 ⇩ ☐	Rice 741 $1.20 ⇩ ☐	Rice 741IPM $1.20 ⇩ ☐	None ⇩ ☐

Recruiting Flyers

OSU study on consumers' preference for rice with different quality levels and storage methods

Do you want some extra easy money? Do you want to know how economic experiments work? Are you interested in how the rice is stored after harvest? If any of your answers is YES, come and join our study on consumers' preference for rice quality and stored methods! You will be asked to taste and evaluate several rice samples, and you will receive a $20 cash for about one hour of your time. If you have any question, please contact…

Advertisement in the O'Colly (OSU Student Newspaper)

Participants are invited to serve as rice consumers in a research project conduct by OSU's Agricultural Economic Department. Participants are expected to join a rice taste panel and two rice purchasing experiments, which will last around one hour. Each participant will receive $20 cash. To sign up, or for more information, contact …

Thanks for your help!