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Valuing Ambiguity: The Case of Genetically Engineered Growth Enhancers

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A split-valuation method is developed and implemented to elicit the willingness to pay to consume—or avoid consuming—a product of ambiguous quality. The split-valuation method uses experimental auction markets to separate and value the positive and negative attributes of the ambiguous good. The results show that the method can be used to successfully value a good of ambiguous quality. Our application reveals that for a sample of students at a midwestern land-grant institution, the average respondent is willing to pay a premium for meat produced with the use of a genetically engineered growth enhancer that has 30% to 60% fewer calories and is 10% to 20% leaner.

Key words: ambiguity, experimental economics, growth hormones, valuation, Vickrey auction.

Introduction

Genetically engineered growth enhancers (i.e., PST and BST) now can be produced commercially. However, little is known about consumer acceptance of the product. The cost for companies to inform consumers about these products and processes, combined with their fear that highly vocal opponents will dominate media stories, likely will delay product introduction. This situation could lead to a stalemate (as was the case for food irradiation) whereby companies are unprepared to pay to inform consumers because the companies do not know how consumers will respond once they are fully informed.

For some consumers, the improved quality of biotechnologically produced products makes them more attractive than existing products; for others, the "unnatural" methods used in the biotechnology industry create suspicion and distaste. For the majority, however, the response is ambiguous. Surveys that have attempted to measure valuation responses under such ambiguous circumstances have found contradictory results. For example, a study by Pitman–Moore, a company that has developed a commercial porcine somatotropin (PST), found that average consumers would pay more for PST-treated pork because of its lower fat content than for untreated pork. In contrast, a study by Hoban and Burkhardt found that 45% of the respondents were very concerned, and 37% were somewhat concerned, about eating genetically engineered meat products. The contradictory responses may be due to insufficient incentives to assimilate the information and to compare the relevant trade-offs.

This study develops and implements an experimental method to value a good of ambiguous quality—leaner pork produced with genetically engineered growth enhancers. The experimental design uses an experimental auction market in which repeated market experience is employed to induce respondents to more honestly reveal the value they place

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on the product. Our experiment develops a split-valuation procedure to separate and value the positive and negative attributes of the good. Our objective is to develop a method that provides sufficient incentives and information such that respondents form their values based on realistic market experience with real money and real food. Because laboratory valuation experiments are still relatively new and because the results were opposite our ex ante expectations, we conducted further experiments to test the robustness of our method and conclusions. Our results suggest that the split-valuation method can reveal the value of a good of ambiguous quality. Students of a midwestern land-grant institution are willing to pay a premium for meat produced with growth enhancers that has 30% to 60% fewer calories. This result is robust over several experimental treatments.

The article proceeds as follows. The first section describes the split-valuation experimental design. The second section provides results from the baseline experimental auction designed to measure participants' willingness to pay to eat, or to avoid eating, a genetically engineered meat product that had a significantly lower fat level than that of a typical meat product. The third section describes additional experiments with new incentive features designed to measure the robustness of the baseline results. The fourth section provides statistical analysis of the experiment results. The fifth section describes an experiment designed to separate consumer response for lean and treated meat. The final section summarizes what we learned.

Experimental Design I, Baseline

Using experimental markets for nonmarket valuation is a relatively new technique. Following Bohm's 1972 pioneering work on valuing public goods, studies beginning in the early 1980s involving nonhypothetical settings and using economic experimentation include a foul-tasting liquid (Coursey, Hovis, and Schulze), tree density in a park (Brookshire and Coursey), a binary lottery (Shogren), candy bars and coffee mugs (Kahneman, Knetsch, and Thaler), beef steaks in vacuum skin packages (Menkhaus et al.), and food-borne pathogens (Shin et al. and Shogren et al.). These studies used auction processes and repeated market participation to accurately elicit consumer response to consumption choices. An important auction process is the Vickrey sealed-bid, second-price auction. The benefit of using a Vickrey auction is that each participant has incentive to submit a bid equal to his/her actual perception of value, independent of other bidders' behaviors. Truth telling is the dominant strategy, as the experience gained with repeated market trials allows for learning (Cox, Robertson, and Smith; Coursey). Note that valuation experiments differ from traditional experiments. Traditional experiments try to explicitly control preferences by induced preference theory (see Smith). In contrast, valuation experiments attempt to measure preferences, and therefore require an auction mechanism that has been shown to accurately reveal preferences. The Vickrey auction has been shown to more accurately reveal preference than several other auctions. This is the reason we, among others, chose to use the Vickrey auction in our experimental design. (Also see Menkhaus et al. for a discussion on alternative auction mechanisms.)

This study uses both the Vickrey auction and repeated market trials to elicit how much individuals would be willing to pay to eat, or avoid eating, a good of ambiguous quality—a leaner meat product produced by using growth enhancers. Care was taken in designing the experiment to ensure that participants knew that one type of meat was leaner than the other, and that the leaner meat had been produced by using growth enhancers. By using real products and real money, the participants were given incentive to concentrate on the trade-off between monetary compensation and a desire for either a leaner or a more typical meat product.

Each experiment used a split-valuation design. This design uses two treatments to separate and value the positive and negative attributes of the product—the lean treatment and the typical meat treatment. The two treatments reverse the initial endowment of food. The lean treatment estimated individual willingness to pay to upgrade a sandwich

of "typical" meat (T) to a sandwich made with leaner meat produced with a growth enhancer (L). The typical meat treatment estimated individual willingness to upgrade from a leaner, hormone-treated meat sandwich to one of typical meat. In each treatment, 15 individuals were paid to participate in a Vickrey auction. Students from nonintersecting undergraduate classes at Iowa State University were offered \$18 (\$3 + \$15) and a free meal to participate in the experiments at an on-campus taste-testing room. All experiments were conducted in late morning, at lunch time, or in early afternoon (11:00 a.m.–1:00 p.m.). Approximately 106 individuals participated in the auctions.

Each treatment had two stages. In stage one, participants were first familiarized with the auction mechanism via a candy bar auction consisting of five trials. Each participant began with an initial endowment of \$3. Over five trials, each participant submitted a bid to upgrade to a large candy bar from a small piece of candy. After each trial the highest bidder's identification number and the value of the second-highest bid were posted. At the end of the fifth trial, one out of the five trials was randomly selected as binding. The participant with the highest bid from the binding trial then paid the second-highest bid price to upgrade to the larger candy bar.

Stage two introduced the meat product. Each participant was given a \$15 endowment. For the lean treatment, participants were provided a generous meat sandwich that was presented as having fat, lean, and taste characteristics similar to those of sandwiches currently available in restaurants and supermarkets. The participants then were asked to bid for a sandwich presented as being 10% to 20% leaner than a typical meat sandwich, and were told that this lean improvement had been accomplished by using growth enhancers. No other information on the characteristics of the lean meat (such as taste, palatability, and tenderness) was given to the participants for the first 10 trials. After the first 10 trials, the participants were informed of the type of growth enhancer used and the safety of the product. Other than the lean/fat changes, they were told the product possessed characteristics identical to those of a typical meat sandwich (see the appendix for a sample instruction set used for the treatment). After this information was revealed, 10 more trials were conducted, for a total of 20 trials. At the end of all 20 trials, one of the 20 trials was randomly selected to be binding. Given the subjects would be eating an entire sandwich to receive the take-home pay, selecting one of the 20 trials controlled for wealth effects (McKee). The goal was to induce the subjects to take each trial seriously.

The typical meat treatment was identical to the lean treatment except that participants first were given the meat product characterized as leaner but produced with growth enhancers, and then were asked to bid for a typical meat sandwich. After 10 trials, the participants were provided the same information as was presented in the lean treatment. By comparing the elicited values in the two treatments, the split-valuation design allows us to determine the "net" value of the ambiguous good. The actual instructions for the typical meat treatment are presented in the appendix.

Experimental Results I

Figure 1 shows average willingness to pay for both the lean treatment and the typical meat treatment in Experiment I. Several observations can be made. First, the participants in the lean treatment were willing to pay relatively large amounts to obtain the leaner product. Second, the bids continually increased throughout the experiment, suggesting that the participants did not heavily discount the product based on the use of growth promotants. They were continually bidding more to be able to consume the leaner product. Third, a significant shift in the trend occurred after the 10th trial, when additional information on the growth enhancer was provided. This shift suggests that although there may have been some apprehension with respect to the production method, the information reassured participants that the product was safe and of high quality. Subsequently, participants increased their willingness to pay to obtain the leaner product. Menkhaus et al. also observed that information is extremely important in the marketing of new products.

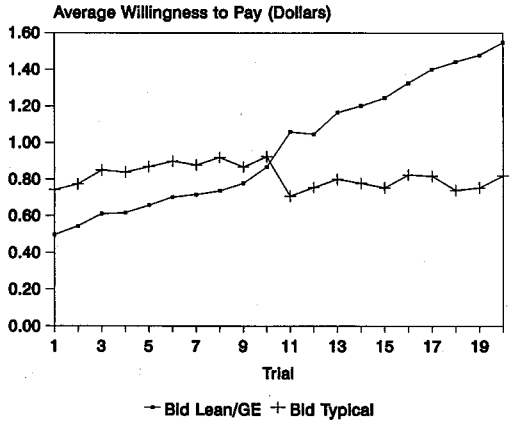

Figure 1. Experiment I: Average willingness to pay

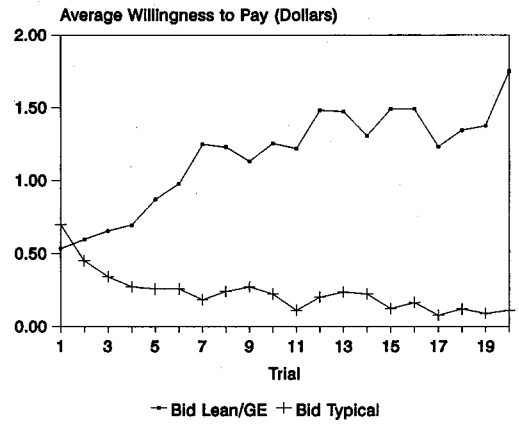

Figure 2. Experiment II: Average willingness to pay

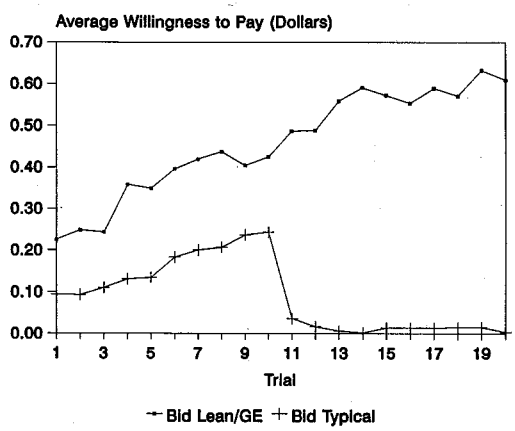

Figure 3. Experiment III: Average willingness to pay

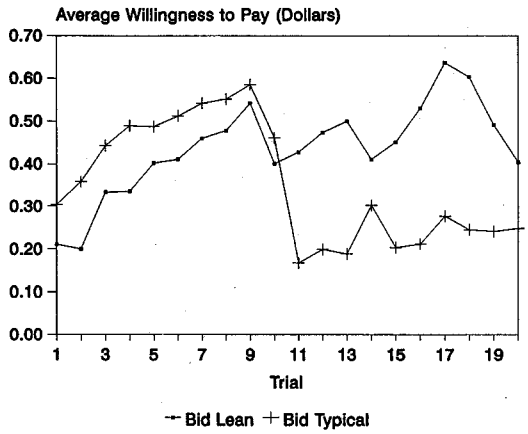

Figure 4. Experiment IV: Average willingness to pay

Values were significantly higher with information on the new product relative to the no information treatment.

Fourth, the bids of the participants in the typical meat treatment initially exceeded the bids from the lean treatment. This difference suggests there was indeed initial apprehension in both groups about the presence of growth enhancers. When information on the growth enhancer was provided, however, the willingness to pay dropped significantly in the typical meat treatment, implying an information response consistent with the lean treatment. By the 20th trial, the second group's willingness to pay had stabilized. Finally, the difference between the bids posted in both treatments by the end of the experiment roughly indicates a "net" willingness to pay for leaner meat treated with growth enhancers. This value is positive, and significantly different from zero.

The results of this baseline experiment were surprising. Based on our interpretation of media accounts of consumer reaction to genetically engineered products, the negative value associated with growth promotants promised to outweigh the positive value associated with lower fat and caloric content. We were also surprised at the obvious inconsistency between the two treatments. Participants in the lean treatment bid a positive amount to eat the typical product, yet those in the typical meat treatment also bid a positive amount to eat the lean product.

Experiments II and III, Incentive Features

The results in Experiment I pose a problem. Subjects randomly assigned to the typical meat treatment prefer typical meat sandwiches, but the subjects randomly assigned to the lean meat treatment prefer lean meat by an even larger (monetary equivalent) amount. This pattern suggests the presence of an experimental artifact *or* a more fundamental "auction" effect. The auction effect would exist if subjects placed a higher value on the product we auctioned, simply because it was being auctioned. The remaining experiments in this study were designed to determine which of these two possible explanations makes the most sense. Our hypothesis was that if experimental artifacts explain the presence of positive bidding in both experiments, then changes in the experimental procedures to remove likely artifacts should remove the problem. If positive bidding continues after these changes are made, the evidence supports the auction effect.

First, Experiment II was identical to Experiment I, except (*a*) we stressed that a bid of zero was acceptable if participants did not wish to exchange their product, and (*b*) the candy bar stage used candy bars of equal size but of different brands. Both features should induce lower bids to exchange one sandwich for another, thereby testing the robustness of the positive "net" benefit observed in Experiment I.

Figure 2 illustrates the willingness-to-pay results of Experiment II. Experiment II reveals a pattern similar to that of Experiment I. Note that the willingness to pay in the lean treatment is approximately the same magnitude as in Experiment I. This pattern suggests participants in both experiments exhibited similar preferences for lean meat. The bids for the typical meat treatment, however, were substantially lower than those in Experiment I. This result is consistent with the earlier observation that participants desire lean meat more than they are averse to the use of growth hormones. It also suggests that the change in the incentive features may have reduced the predisposition to over-bid for the typical meat product. But it is still disconcerting, if both groups preferred leaner meat, that the bids in the typical meat treatment were not closer to zero.

Second, Experiment III distributed the $15 endowment to the subjects prior to any bidding for the meat products. We expected that having money in hand would reduce willingness to pay because the payouts are now more tangible. Other aspects of Experiment III were identical to Experiment II.

As expected, all bids in Experiment III were substantially lower than those in Experiments I and II. This result suggests that participants were more reluctant to spend money in hand, thereby more accurately representing consumer response to the introduction of genetically engineered meat products. Figure 3 illustrates that although similar overall patterns emerge, willingness to pay to exchange meat products was considerably less in Experiment III than in either of the other two experiments.

Statistical Significance

Statistical tests were conducted to determine (*a*) if the willingness-to-pay differences within each experiment were significant, and (*b*) whether the changes made in experimental design were significant. Results were generated for tests of the willingness-to-pay (WTP) differences within each experiment (table 1), as well as for differences across experiments (table 2). Standard *t*-tests (Freund and Walpole, pp. 418–21) are used to test for differences between auctions within an experiment. Also, because it is unclear that the bids follow a normal distribution, nonparametric *U*-tests, or rank-sum tests, were conducted (see Freund and Walpole, pp. 530–32). The first trial is tested because it reflects the subjects' initial beliefs before market experience and the information set. The 10th trial is tested to determine if differences exist after repeated market experience but prior to providing the new information. The 11th trial is tested to see if WTP differences exist after the participants were provided new information. Finally, the 19th trial is tested to determine if the long-run differences in WTP between auctions are significant after repeated market

Table 1. Comparison of Mean WTP Between Lean and Typical Meat Treatments

Trial No.	Experiment I $n_L = 15$; $n_T = 13$ H_0: $\mu_L = \mu_T$	Experiment II $n_L = 13$; $n_T = 13$ H_0: $\mu_L = \mu_T$	Experiment III $n_L = 15$; $n_T = 13$ H_0: $\mu_L = \mu_T$
		t-tests	
1	−1.06	−.35	1.97
10	−.22	3.64**	1.59
11	1.52	4.47**	6.37**
19	2.27*	4.60**	8.71**
		U-tests	
1	89.00	78.00	67.00
10	89.00	28.00**	78.00
11	73.00	8.50**	19.50**
19	51.00*	12.50**	15.00**

Notes: Single asterisk (*) and double asterisk (**) denote rejection of H_0 at the .05 and .01 significance levels, respectively, for the *t*-test and the *U*-test. *T* = Typical meat treatment, in which participant was given lean (*L*) sandwich obtained with growth promotant and asked to bid for typical (*T*) sandwich; *L* = lean treatment.

exposure with new information. The 20th trial is not used because it is the last bid and participants seem to erratically alter their bids. This can be seen in figures 1, 2, and 3, where the 20th trial generally breaks an established pattern.

Table 1 provides results of tests for differences between the bids in the lean and typical meat treatments. The bids in trials 1 and 10 are not significant with one exception. This suggests that the naive bids with repeated experience do not capture the willingness-to-pay differences, which are disclosed only after information is revealed. In addition, Experiments I and II provide results similar to some of the survey results cited earlier (i.e., that people are willing to pay to avoid consuming products which have been treated with growth enhancers), but these results are not significant.

In all experiments, by trial 19 there is a significant positive net willingness to pay for leaner meat products derived through the use of growth promotants. In Experiments II and III, values are significant at both the 1% and 5% levels. Note that the *U*-tests provided the same selection criteria for each trial. Thus, the significance tests support the previous observations with respect to figures 1, 2, and 3.

Table 2 provides results of tests conducted for the same trials across all three experiments. In general, the bids for each treatment were significantly greater in Experiment I than in the other two experiments. The exception was the bids for the lean treatment in Experiment II, wherein participants bid higher than they did for the same auction of Experiment I. Similarly, all bids for both sets of auctions were higher for Experiment II compared to Experiment III. Thus, it appears that providing the money prior to the bidding in Experiment III significantly lowered the bids of participants. That participants seem to place a higher value on money in hand than money to be given later is consistent with economic principles—money in hand more accurately represents consumers' food purchases in the real world. Also, all bids for both treatments in Experiment I were higher than those in Experiment III. Because Experiment III takes into account all these factors, we believe that Experiment III represents the most realistic consumer response to our trade-off scenario.

Consumer Aversion to Growth Enhancers

From the tests described, one may conclude that participants in the experiments would, on average, be willing to pay more for the leaner, growth-enhanced product. But what

Table 2. Comparison of Mean WTP Values Among Experiments

	Trial 1	Trial 10	Trial 11	Trial 19
Experiment I vs. II				
H_0: $\mu_I = \mu_{II}$				
Lean	−.48	−2.36*	−3.02**	−1.69
Typical Meat	.11	3.17**	2.77*	2.68*
Experiment I vs. III				
H_0: $\mu_I = \mu_{III}$				
Lean	2.41*	2.79**	4.37**	3.87**
Typical Meat	3.12**	3.12**	3.40**	3.23**
Experiment II vs. III				
H_0: $\mu_{II} = \mu_{III}$				
Lean	1.14	3.10**	3.11**	2.77**
Typical Meat	1.78	.18	1.38	2.73**

Notes: Single asterisk (*) and double asterisk (**) denote rejection of H_0 at the .05 and .01 significance levels, respectively, for the *t*-test and the *U*-test. Typical meat treatment = participant given lean (*L*) sandwich obtained with growth promotant and asked to bid for typical (*T*) sandwich; Lean = opposite treatment.

about the atypical participants, those who were willing to pay to avoid the consumption of a hormone-treated product? Table 3 summarizes the bids of participants to avoid consumption of the leaner, hormone-treated product. Trials 1, 10, 11, and 19 are reported in correspondence to the trials for which significance tests were conducted in tables 1 and 2.

In all three experiments there were participants who were willing to bid positive values to avoid consuming the leaner, hormone-treated product. As suggested by earlier results, Experiment III resulted in the lowest number of consumers willing to pay for the typical product, and the values bid were lower than those in Experiments I and II. Nonetheless, the results provide evidence that there may be consumers who will pay for an untreated meat product even if it is fatter than the treated product. This raises the possibility of a significant "niche" market for untreated meat products when and if the commercial use of biotechnological growth enhancers becomes prevalent.

Table 3. Frequency Distribution of Bids for Typical Product

	Bid Range ($)					
Trial No.	.00	.00–.25	.26–.50	.51–.75	.76–1.00	>1.00
	Experiment I (N = 13)					
1	2	3	3	0	2	3
10	2	3	1	0	1	6
11	4	3	1	0	0	5
19	4	3	1	1	0	4
	Experiment II (N = 13)					
1	5	2	1	2	2	1
10	6	1	5	1	0	0
11	6	5	2	0	0	0
19	5	7	1	0	0	0
	Experiment III (N = 15)					
1	11	2	2	0	0	0
10	9	0	3	0	3	0
11	13	1	1	0	0	0
19	13	2	0	0	0	0

Experiment IV, Separating for Leanness and Growth Enhancement

The results from Experiments I–III show that average land-grant university students place a higher positive value on the reduced calories of hormonally treated meat than they put on the negative value associated with growth hormones. In all three experiments, however, participants were faced with a double-faceted product, one that had fewer calories *and* was produced with the aid of biotechnology. The question arises as to how the respondents would have behaved had these two attributes been presented separately.

Experiment IV separated these two effects. The lean treatment was changed to indicate that participants owned a typical meat sandwich and could bid to upgrade to a leaner meat sandwich. No mention was made as to why the meat was leaner. The typical meat treatment was changed such that participants owned a meat sandwich produced with the aid of a hormone and could bid to upgrade to a typical meat sandwich. No mention was made about the leanness of the hormone product. The information provided to the respondents after trial 10 indicated that the leaner sandwich was produced using an improved diet and better fat trimming, and that the hormone-treated sandwich was produced with the aid of a growth hormone. In all other respects, Experiment IV replicated Experiment III.

Figure 4 illustrates the results from Experiment IV. The average bid for the typical meat treatment started at \$.30 and rose to \$.50 by trial 10. When participants were informed that the hormone-treated product was safe, the bids decreased dramatically. Figure 4 also includes the dispersion of the bids. Two individuals in this experiment consistently bid between \$.50 and \$1 to avoid the hormone-treated sandwich. Most of the other bids (after trial 10) were zero. This pattern emerged in many of the other trials. A minority of the participants bid relatively large amounts to avoid the hormone-treated sandwich, and the majority were indifferent to the presence of the hormone.

The bids in the lean treatment started low and increased to approximately \$.50. Note that the dispersion pattern differed from the previous experiments. For example, in trial 17, the lowest bid was \$.25 and the highest bid was \$.81. All the participants found some value in having access to a leaner product.

Several other general observations emerge regarding Experiment IV. First, the participant bids for the lean product were very erratic, and did not seem to stabilize as in previous experiments. This may be due to at least two factors: (*a*) the number of participants ($n = 9$) was smaller than for all other experiments, and (*b*) the participants lost interest after nine or 10 trials. The effect of group size is to reduce the number of observations so that more weight is placed on extreme bids. Participant boredom may be a symptom of and the absence of a serious difference in product characteristics (i.e., immediate positive or negative consequences perceived from consuming alternative products).

Second, by the 11th trial, the average willingness to pay for a leaner product was greater than the average willingness to pay for a product treated with growth enhancers. Therefore, as with previous experiments, it appears that on average, the participants valued leaner meat products more than they discounted products treated with growth enhancers. This suggests the results of the first three experiments are robust.

Finally, as was expected, participants bidding for the typical product (recall they were not told of any lean benefits) bid higher values than participants in previous experiments. This is logical given that the participants in Experiment IV perceived no benefit from consuming a treated product and would be likely to discount the product more than a product which had some perceived benefit.

Summary

This article develops and implements a split-valuation experimental design to elicit participants' willingness to pay for a new product that has both positive and negative attri-

butes. The design uses repeated market experience to allow participants to more accurately reveal their preferences for the ambiguous product—a meat sandwich made leaner by the use of a growth hormone. Our results suggest that the split-valuation design can reveal the value of a good of ambiguous quality. The average participant was more concerned with reducing the fat content of the meat than with avoiding the biotechnological aspects of the product. This result was found to be robust with respect to experimental design. In two of the three experiments where the test product had both attributes (leanness and growth hormone), the negative connotation of the hormone initially exceeded the positive value of the reduced fat. After several trials or with new information, however, this preference ordering was reversed and, by trial 20, the positive value associated with leanness was dominant in all experiments. The split-valuation design revealed that for average students at a midwestern land-grant institution, improved products created with the aid of biotechnology could command a price premium. But we also observed that about 10% to 20% of the participants were prepared to bid large values to avoid eating a sandwich created with biotechnological products.

A final remark. Our objective was to develop a method to elicit the value of a good of ambiguous quality. We recognize that our subjects probably do not reflect the preferences of the general population (see Bennett, however, for contrary evidence). This is not an argument against our results, but rather an argument for a specific type of experiment—one where the method and respondent pool are continually developed and improved such that the lab environment approaches the naturally occurring world. Having evidence that our split-valuation method appears robust, we can now proceed into this more complex environment with confidence. A formal determination about the acceptability of PST pork in the general population will require several replications of the experiments with groups representative of demographic and regional variations. Our results suggest that the split-valuation method may be an effective tool to elicit this value from the general population.

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Appendix: Experimental Instructions I

General Instructions

You are about to participate in an experiment about decision making. Please follow the instructions carefully.

Specific Instructions

In this experiment you will be asked to decide how much you would be willing to pay for leaner meat. The experiment has two stages.

Your starting income will be \$3 in stage one. Your income will be \$15 for stage two. Your take-home income will consist of your initial income (\$3 + \$15) minus the value of goods purchased.

You will submit your bidding price on a recording card. Note only one of the five trials in stage one will be binding and only one of the 20 trials in stage two will be binding (i.e., determine actual take-home pay). A number will be randomly selected to identify these binding trials.

You cannot reveal your bids to any other participant. Any communication between bidders during a trial will result in an automatic penalty of \$3.

Step 1: There are two types of meat. The features of each are described below.

Product I	*Product II*
This meat is typical of meat currently available at restaurants and grocery stores.	This meat is 10–20% leaner and contains 30–60% fewer calories than *Product I* meat. It was produced by animals treated with a growth enhancer.

Step 2: You own the *Product I* meat in front of you. Everyone has the same *Product I* meat. You also have an initial income of \$15.

Step 3: Let's say you are willing to pay \$$y$ for the *Product I* meat and \$$z$ for the *Product II* meat. The *difference* (\$$z$ − \$$y$) is what you are willing to pay to consume the *Product II* meat. Please indicate your willingness to pay to consume the *Product II* meat. Only state the difference (\$$z$ − \$$y$) that you are willing to pay. The highest bidder will exchange his or her *Product I* meat for the *Product II* meat. He or she will pay *the second-highest bidder's price.*

Step 4: There will be 20 trials.

Step 5: After all 20 trials are complete, we will randomly select *one* binding trial to determine who buys the *Product II* meat.

Note: The meat will have to be consumed to leave with the take-home income.

Instructions for Trials 11–20

Product I	*Product II*
This meat is typical of meat currently available at restaurants and grocery stores.	This meat is 10–20% leaner and contains 30–60% fewer calories than *Product I* meat. It was produced by animals administered a growth enhancer.

Description of Growth Enhancer: The growth enhancer administered to the animals is known as a somatotropin. It has the effect of not only increasing daily gain and improving feed efficiency, but also increases the amount of lean meat produced and reduces the amount of fat produced. This is referred to as a partitioning effect of nutrients. Scientists assure us that other than the lean/fat changes, the composition of meat produced by treated animals is unchanged. Further studies have shown that there is no change in the taste, tenderness, or other palatability characteristics of the meat.