The Influence of Environmental-Impact Information on Consumer Willingness to Pay for Products Labeled as Free of Genetically Modified Ingredients

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Limited information is available about consumer willingness to pay for genetically modified food products. This information is of immediate interest to the food industry. An experimental auction was conducted to assess willingness to pay for food items labeled as free of genetically modified ingredients and to evaluate the influence of positive and negative information about the impact of biotechnology on the environment. Two hypotheses were tested and rejected: 1) Participant bids for products labeled with a non-genetically modified ingredient guarantee equal those for traditionally labeled products, and 2) Information bias will not influence the willingness-to-pay differential between non-GM and traditionally labeled products.

As application of genetic modification in crop varieties grows and expands in scope, participants throughout the marketing channel face new opportunities and challenges associated with the development, use, and handling of the resultant products. They must evaluate the potential benefits, costs, and associated risks as part of their strategic decision-making process. For example, growers are faced with decisions about whether to grow genetically modified (GM) crops. Biotechnology companies must make investment decisions including research, commercialization, and marketing of GM technologies, organisms, and products. Food manufacturers must consider the use of commodities produced with biotechnology and determine labeling and promotion strategies for resultant food products. Consumers have new choices associated with food and other products produced with biotechnology. These and other stakeholders will benefit from information about consumer acceptance of biotechnology and factors influencing it. This information will facilitate decision-making and reduce associated risks.

Acceptance by consumers and participants at each step in the marketing channel is of paramount importance to the commercial success of products including GM ingredients or developed using biotechnology. However, there is little information available about the willingness of consumers to purchase GM food products (Lusk, Daniels, Mark, and Lusk 2001). This is in part because consumers are not well-informed about biotechnology (Rousu et al. 2002b; Roper Starch Worldwide, Inc. 2000), and in part because available market research is limited. Hallman et al. (2002) surveyed 1203 U.S. residents in the spring of 2001. They found that Americans are not well-informed about technologies used in agriculture and the food industry, including biotechnology. Nearly sixty percent either did not believe that or were not sure whether GM products were available in grocery stores. Perhaps partly as a result, they did not tend to hold strong beliefs regarding the role of biotechnology in food production. Approximately 60 percent approved of the use of GM to create new plants and believed biotechnology will improve the quality of their lives and the lives of others, and that unjustified fears about biotechnology have hindered development of beneficial foods. Support of the use of biotechnology among respondents rose considerably when specific products and benefits were mentioned.

One of the most discussed topics in the biotechnology debate is how its adoption will impact the environment. Hallman et al. (2002) found that a strong majority of Americans were concerned about the environmental effects of biotechnology. This concern is likely in part because of the number, strength, and activities of environmental interest groups (e.g., Greenpeace, Friends of the Earth)

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(Rousu et al. 2002a)[1]. There is some evidence that these and other groups opposing the adoption of biotechnology have been more effective in presenting their message than have those providing information about the positive or neutral effects of biotechnology. Huffman et al. (2002a) found that consumers who identified themselves as more informed about biotechnology were more likely to be unwilling to pay for GM products. However, Lusk et al. (2002) present evidence that consumer opinions can be changed. Participants' willingness to accept a GM product increased when they were presented with information about the environmental benefits of GM crop production.

Similarly, the purpose of this paper is to assess whether willingness to pay for food products can be motivated by information available about the environmental effects of the technology used in producing their ingredients. Specifically considered is the effect information provided about the influence of biotechnology on the environment has on willingness to pay a premium for food products guaranteed free of GM ingredients.

Literature Review

Literature addressing issues related to biotechnology including production and use of GM crops in the United States and elsewhere; associated ethical, environmental, and safety concerns; and regulatory options including labeling overshadows that devoted to the assessment of consumer willingness to pay for food products made with or including GM components. The latter is discussed here in some detail. Refer to Uzogara (2000) and Persley and Siedow (1999) for detailed considerations of other issues.

In the current study, revealed preference is used to assess willingness to pay through an experimental auction. Experimental auctions have the potential to provide more reliable measures of willingness to pay than do hypothetical surveys (Lusk, Fox, and McIlvain 1999). Specific benefits of experimental auctions are described in some detail in Fox et al. (1998) and Lusk et al. (2002). One important advantage is that requiring participants to purchase products from winning bids decreases hypothetical bias. Consumer acceptance elicited from other methods (e.g., surveys) may not translate into willingness to pay (Lusk, Fox, Schroeder, Mintert, and Koohmaraie 2001). (Further reducing hypothetical bias is addressed by Lusk [2003] who considers providing information about hypothetical bias to participants prior to bidding.) Another advantage of experimental auctions, specifically over discrete-choice models, is that an exact bid can be elicited (Lusk et al. 2002). One noted disadvantage to many experimental auctions is the expense, particularly that associated with paying participants, and the resulting relatively small sample sizes.

Experimental auctions have been used in a number of studies to estimate consumer demand for new food items such as those introduced in the current study (e.g., see Alfnes and Rickertsen 2003; Buzby et al. 1998; Fox 1995; Fox et al. 1998; Hayes et al. 1995; Huffman et al. 2002b; Lusk, Daniels, Mark, and Lusk 2001; Lusk, Fox, Schroeder, Mintert, and Koohmaraie 2001; Lusk et al. 2002; Lusk 2003; Rousu et al. 2002b;). Selected studies are reviewed here.

An initial effort to assess revealed consumer willingness to pay for a product guaranteed to be produced without biotechnology is reported in Fox et al. (1994). A Vickrey sealed-bid, second-price auction was used to estimate consumer willingness to pay to replace milk from cows receiving bovine somatotropin (bST) with that from cows not receiving bST. The Vickrey second-price auction has frequently been used in valuation experiments (Lusk, Daniels, Mark, and Lusk 2001). Average bids to exchange a glass of milk were positive, but most, particularly in two of three metropolitan areas, were either zero or exceeded $1, supporting the existence of market segments for bST-free milk.

Lusk, Daniels, Mark, and Lusk (2001) assessed willingness to pay among students endowed with a bag of corn chips including GM ingredients to switch for non-GM corn chips using first- and second-price auctions. All students were from Midwestern towns and enrolled in an agriculture major, and most came from the farm. Not surprising given the nature of the population, students had little objection to GM foods and expressed a strong willingness to consume them. Seventy percent were unwilling to pay for non-GM corn chips and the average bid was only $0.07 per ounce. As demonstrated elsewhere, there was evidence of a

[1] Many anti-biotechnology interest groups are entirely against the production of GM organisms. There are also proponents who believe that environmental benefits associated with the use of biotechnology do exist (e.g., The Council for Biotechnology).

market segment that valued the non-GM guarantee: 20 percent of students were willing to pay at least $0.25 per ounce. The only variable significant in explaining the probability of a non-zero bid was frequency of chip consumption; the relationship was negative. The amount students were willing to pay for the non-GM corn chips was influenced negatively by chip consumption and positively by regular exercise. Scale-differential questions where participants indicated their degree of concern for GM foods were useful in predicting both the probability that individual students would pay to exchange for non-GM corn chips and the amount they would pay.

Huffman et al. (2002b) used a random nth-price experimental auction to assess willingness to pay for products under both voluntary (standard label versus non-GM label) and mandatory (standard label versus GM label) labeling scenarios. A criticism of the Vickrey second-price auction is that it fails to disclose the complete demand curve for the auctioned item among participants. This is because participants who believe their bid is likely to be much higher or lower than the market-clearing price may adjust their bid, resulting in insincere bids (Shogren et al. 2001). The random nth-price auction corrects for this problem because it attracts sincere bids from bidders who might be off the margin. The nth-price auction is both random (all bidders have the same positive probability of purchasing the item) and endogenous (the market-clearing price has some relation to the participants' individual values of the product). Sincerity of bids results from a participant's inability to use a market-clearing price as a marker, and the equal opportunity among participants to purchase the good[2]. Shogren et al. (2001) concur that the nth-price auction can help regain off-margin bidders, but found it did not perform as well for on-margin bidders. They hypothesize that this may be because it may be more confusing for participants.

Huffman et al. (2002b) included participants in two Midwestern cities bidding on three products. Products were selected to represent highly processed (tortilla chips), refined and distilled (vegetable oil), and fresh (potatoes) products. Six groups bid on products with a label indicating only the name of the product, and on those also noting "This product is made without genetic engineering." Four groups bid on products with the plain label and on those with labels indicating "This product is made with genetic engineering." Participants bid on either the GM (or implied GM) or non-GM products in each round (i.e., bids by individuals for GM and non-GM products did not occur simultaneously). Round sequence was randomized, and only one round was binding so as to prevent reduction of bid prices as participants moved along their individual demand curve. Prior to bidding, participants were provided one-page information summaries. Information provided was positive, negative, or verifiable (unbiased). (Rousu et al. [2002b] used data from six of the ten treatments to evaluate the effect of asymmetric [biased] information on willingness to pay for products with GM ingredients.)

Participants bid more for products presumed non-GM, regardless of labeling strategy. No demographic characteristics appeared to impact the discount for the GM-perceived products. For the GM-labeled treatments (mandatory-labeling scenario), bid order influenced bid price (Rousu et al. 2002b). Participants bidding on products with the GM label in the first round paid a smaller premium for food with a standard label than did those who bid on products with a standard label first. Those who perceived themselves to be at least somewhat informed about GM bid far less for GM foods, suggesting their prior information was weighted by a negative bias.

Huffman et al. (2002a) used data from the four groups tested under the mandatory-labeling policy-scenario to evaluate the influence of information and demographic characteristics on the probability that a consumer will be "out of the market" for GM food products. When defined as a zero bid, ten percent of consumers were "out of the market" over all products. The percentage was lower for oil than for less-refined products (tortilla chips and potatoes). Providing negative (positive) information about biotechnology increased (decreased) the probability a consumer would be "out of the market." Consumers who reported always reading labels for an initial purchase of a food item and those reporting they were at least somewhat informed about GM foods were more likely to be "out of the market."

Lusk et al. (2002) elicited willingness to accept compensation to exchange a non-GM product for a GM product. Use of this method allowed them

[2] The bidder-affiliation effect described by List and Shogren (1999) was not of concern for this or the current study because bids were not posted between rounds.

to impose a consumption requirement and was expected to reduce the percentage of zero bids from that often found when willingness to pay is directly elicited. They selected a fifth-price auction to reduce the inefficiencies reported by Shogren et al. (2001) with second- and random nth-price auctions for off- and on-margin bidders, respectively. The impact of providing information on benefits of GM was considered. They found that providing information about positive effects of GM on the environment, health, and the Third World decreased compensation required by participants to consume a GM food product. Those reporting themselves as more knowledgeable about GM foods and those less concerned about the specific issue addressed by the information provided were less influenced by new information.

Methods and Procedures

A random nth-price experimental auction was used to elicit and estimate the influence of information bias on consumer willingness to pay for foods with a standard NutriFacts label relative to foods also labeled with a non-GM guarantee. Methods closely parallel those described in Huffman et al. (2002b) and Rousu et al. (2002b). Key differences include the composition of the participant population, type and form of products, product labeling, scope of information provided to participants and the timing of its introduction, and simultaneous (versus sequential) bidding on non-GM and presumed GM products.

One hundred twelve students from North Dakota State University (NDSU) were recruited to participate in the auction using a sample of convenience. Students were recruited through large-section anthropology, sociology, and communication classes. Monetary compensation of $15 was provided to encourage participation, but its distribution prior to required purchase(s) also served to eliminate any budgetary constraint. To increase participation, additional students were recruited from the student union just prior to the auctions. Approximately thirty-three participants participated at each of three different times over two days. A fourth auction was conducted a week later in a College of Agriculture service course with seventeen students to increase sample size.

At each time, students were randomly assigned one of three treatments defined by the information they would receive about the environmental impact of biotechnology. Independent auctions were held by treatment group (i.e., auctions were held in each of three separate rooms at each time). Each participant received a packet including a pre-auction survey, detailed instructions, information about biotechnology or North Dakota agriculture, and a post-auction survey. Instructions can be found in the appendix[3]. Moderators reviewed step-by-step instructions orally with participants throughout the auction. Participants were instructed that it was in their best interest to bid their true value for the product and told why. The intent was to reduce hypothetical bias.

Non-hypothetical practice rounds were conducted to ensure participants understood the auction process. In the initial practice round, participants bid on two candy bars (one with and one without almonds). In the second practice round, participants bid on two versions of each of two unique products. The two versions of each product were offered side by side (e.g., two pens, one black and one blue).

The experimental auction consisted of two rounds. In the first round, participants bid on two varieties of each of three food products: individually wrapped muffins and chocolate chip cookies, and bags of potato chips. These products were selected to meet two key criteria. First, they include ingredients which are commonly produced in North Dakota and for which GM varieties exist (e.g., wheat) or already have been commercialized (e.g., corn, oil seeds, potatoes). Second, consumers, regardless of demographic characteristics, universally purchase them. Individual-serving, convenience-sized products were used to appeal to college students in the school environment.

Participants bid discretely by sealed bid on two variations of each of the three products, one with a standard NutriFacts label and one with an additional label indicating "This product does not contain genetically modified ingredients" (Figure 1) (i.e., participants were asked to bid on the products with the standard label as well as on those identified as non-GM). The two versions of each product were offered simultaneously to each participant and participants had the opportunity to win both the non-GM and GM version of each.

Labeling products containing GM ingredients was rejected as a strategy for the current study.

[3] Survey instruments are available upon request from the author.

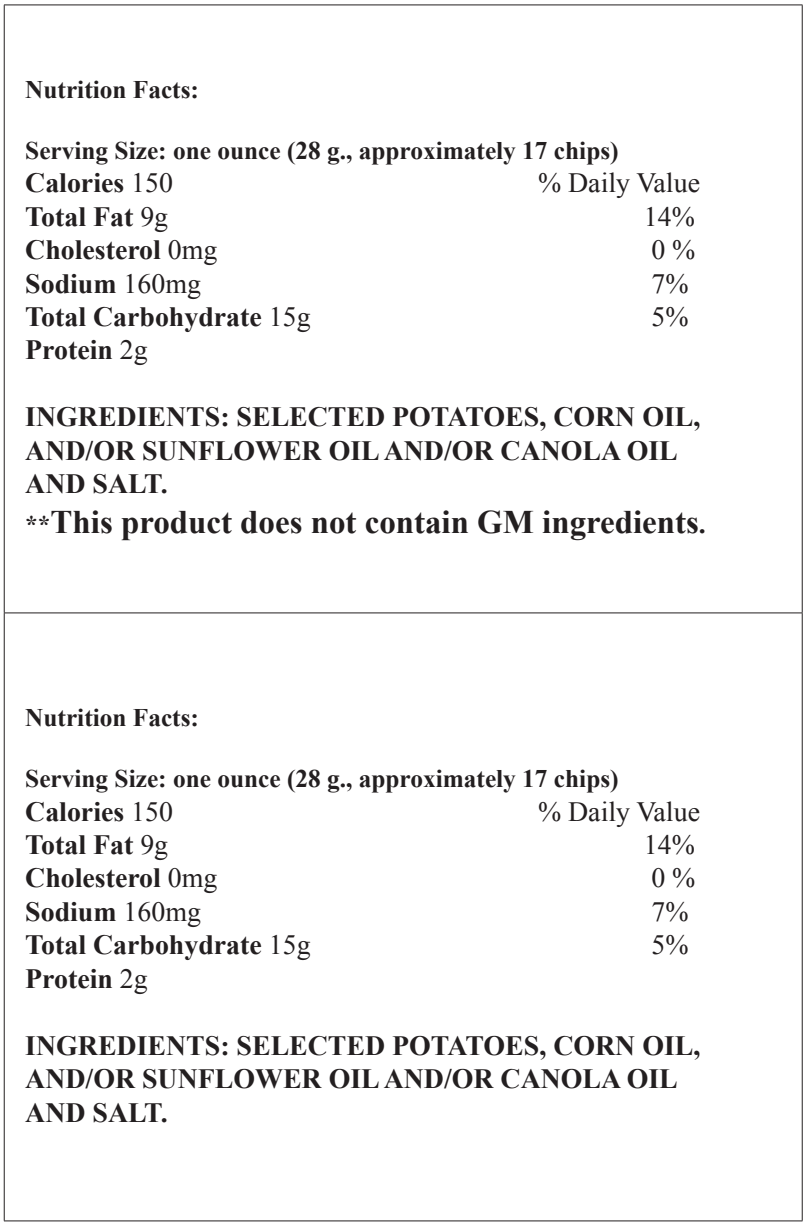

Figure 1. Product Labels.

The current U.S. labeling policy for food products regarding biotechnology is voluntary. Huffman et al. (2002b) demonstrate that when consumers can accurately read market signals (i.e., can interpret information identically whether from voluntary or mandatory labeling strategies), a voluntary labeling policy provides higher welfare. Furthermore, in light of public ignorance of biotechnology and the extent of adverse controversy, it is unlikely that firms would voluntarily adopt a strategy of labeling foods as containing GM ingredients[4].

After the first round of bidding, participants were provided and instructed to read one-page sheets with either supportive (hereafter referred

[4] An innovative strategy for firms--and the industry in general, should they one day be required to label products that contain GM ingredients and perhaps even otherwise--is to increase general consumer acceptance by making claims regarding their inclusion an expected and customary practice. That is, to increase consumer comfort level by making the GM-product label one they expect to see on products they consume.

to as positive) or critical (hereafter referred to as negative) information about the effects of biotechnology on the environment, or general information about North Dakota agriculture (control)[5]. The bias in selection of the information presented was not revealed to participants. Under each impact statement there were from one to five supporting statements. Sources reporting individual benefits or disadvantages for the environment were cited. Positive impact statements included:

- Fewer, less toxic pesticides used by farmers who grow genetically modified crops
- Yield gains
- Soil and water conservation
- Potential for less energy use and fewer air emissions due to more efficiency in product transport.

Negative impact statements included:

- Increased use of certain herbicides
- Lower yields
- Increased tolerance in certain insects
- Genes could move to wild species, creating weeds
- Harm to non-target species.

A second round of bidding followed. Participants had been informed as part of their initial instructions that only one of the two rounds would be binding so as to dampen any reduction in the marginal value product assigned to the products by participants as they moved along their demand curve. They were also informed that the auction design guaranteed that no participant would pay more than their bid for the product. Prices were not posted between rounds.

Results

Respondent Profiles

As a sample of convenience, the participant population was not representative of the University population. The majors of the 112 participants were concentrated in the social sciences, with 30 percent in sociology and 26 percent in the humanities; only 9.8 percent of NDSU undergraduate students are in the College of Arts, Humanities and Social Sciences, which includes these majors. Fourteen percent of participants reported a major within the College of Agriculture, compared with the eight percent of NDSU students. Majors of other participants included psychology, computer science, natural resources management, business, and those within the hard sciences. The participant population was nearly evenly split by gender, with males composing 50.9 percent and females 49.1 percent. Most were Caucasian (93.1 percent), single (82.1 percent), did not have children (88.4 percent), and lived with at least one other person (75 percent). Information is only available on the gender (57.2 percent male) and race (94.9 percent Caucasian) of NDSU students for comparative purposes. Thirty percent of participants grew up on a farm. Just over one-third (37.5 percent) were originally from a moderately sized city (between 10,000 and 100,000 inhabitants). Half were evenly split between rural towns (less than 1000) and towns (between 1000 and 9999). Approximately ten percent were from Minneapolis or St. Paul or their surrounding suburbs.

Both pre- and post-auction surveys included questions regarding the knowledge, behavior, and attitudes of participants. Although they did not reveal evidence suggesting they are active environmentalists, overall they expressed a general concern about the environment. Nearly 60 percent said they used recycled products always or frequently, although only 45 percent reported recycling always or frequently. More than two-thirds of participants agreed that more action needs to be taken to preserve the environment. A much lower percentage agreed that man has upset nature's balance (28.6 percent) or that pesticides are poisonous and should be prohibited (17 percent). The former seems to contradict Hallman et al. (2002, p. 28) who reported that ninety percent of Americans surveyed felt that "the balance of nature can be easily disrupted by humans."

Participants reported their knowledge and perceptions of GM foods. They were asked how well informed they were regarding GM foods. The average response was 5.73, where 1 = extremely well informed and 8 = not informed at all. This concurs with the results of Hallman et al. (2002) and others who found that Americans in general freely admit to being relatively uninformed about biotechnology. In the current study, nearly two-thirds of participants

[5] Originally, positive- and negative-biased were used to describe the information read by participants between rounds. A reviewer noted that the information provided in each is objective. It was in fact our selection of the information provided to participants that was biased.

said they were only somewhat informed or not informed at all. Only eleven percent considered themselves well informed or extremely well informed although participants were, in general, aware that GM products are common. When asked how much of the food they consume is GM, the overall average was approximately half. Most participants perceived there to be only a moderate (38.4%) or low (46.4%) level of risk or no risk (5.4%) associated with consuming GM foods.

Finally, participants were asked about their use of food product labels. Participants reporting that they read nutritional labels "always," "frequently," "occasionally," and "never" were nearly evenly split over the range of responses (uniform distribution). This is consistent with results reported by Hallman et al. (2002). Although ninety percent of Americans they surveyed thought GM food should be labeled as such, only 53 percent reported that they would look at food labels for this information and only 45 percent expressed a willingness to pay more for non-GM foods. This and other evidence suggests that there is an option value associated with labeling (Rousu and Huffman 2001).

Willingness to Pay

Prior to the treatment (information shock) there was a difference between mean bids for the non-GM and presumed-GM versions of each product, with non-GM bids being higher (Table 1). The average bids for the non-GM versions of potato chips, cookies and muffins were 11.0, 10.2, and 13.5 percent higher than for their presumed-GM counterparts, respectively. Mean bids were different for the non-GM and presumed-GM versions of the cookie and the muffin using a paired-samples t-test; mean bids were different for each product using the more general non-parametric Wilcoxon signed ranks t-test[6].

Premium bids for non-GM products are consistent with the results of Huffman et al. (2002a) that previously held information regarding biotechnology or GM foods may be negative-biased and with the results of other past studies which generally suggest that most consumers will pay more for non-GM products when they perceive no direct benefit from the GM version. Lusk et al. (2002) attribute this to fear or concern about the products of biotechnology, but presumably this may also be due to other concerns about the use of biotechnology (e.g., effect on the environment, ethical issues).

Effect of the treatment was considered next. Overall, the percentage premium for the non-GM product bid by participants in the control group did not change (Table 2)[7]. There was also no change in the premium offered for the non-GM version of any of the three products. There was apparently no differential effect for GM versus non-GM products due to repeated bidding.

The average premium for non-GM products decreased after participants were provided positive information about the effect of GM on the environment. This concurs with the results of Lusk et al. (2002) who reported a reduction in compensation required for participants to accept a GM good after exposure to information about the environmental benefits of GM-crop production. In the current study, when all product bids were pooled the average premium decreased from 15.53 percent to -0.53 percent. The premium bid offered for the non-GM version of each product also decreased, although the difference was significant only for muffins.

Negative information about the impact of biotechnology on the environment increased the premium for non-GM products from 2.64 to 9.05 percent. However, there was no change in absolute premium offered for the non-GM version of any of the three products. This may suggest that participants in general had already been exposed to negative information about biotechnology.

Bids for the non-GM and presumed-GM version of each product before and after the information shock were compared by treatment. There was no change in bids for either version for the control group for any of the three products (Table 3). There were also no statistically significant changes in price for either version of any of the three products after participants were exposed to negative information about biotechnology on the environment. However, participant bids did change after exposure to positive information. As expected, for each product the bid for the presumed-GM version increased although the change was statistically significant only in the case of the cookie. Average bids for the non-GM

[6] Both the parametric t-test and the non-parametric Wilcoxon signed-ranks test statistics were used to compare means.

[7] Percentage difference rather than actual numeric difference was used when bids for all products were combined because average price differs by product type.

Table 1. Comparison of Average Non-GM and Presumed GM Bids by Product Prior to Information Shock.

	Average bid (in dollars)						Asymptotic
Product	non-GM	GM	Difference	t –value[a]	Significance	z-value[b]	significance
Potato chips	0.5610	0.5056	0.0554	- 1.614	.110	-2.537	.011**
Cookie	0.2486	0.2255	0.0231	- 2.607	.010***	-2.718	.007***
Muffin	0.3205	0.2823	0.0382	- 3.003	.003***	-3.748	.000***

[a] t-value is from a paired-samples t-test (2-tailed).
[b] z-value is from the non-parametric Wilcoxon signed ranks test (2-tailed).
* indicates $p < 0.10$. ** indicates $p < 0.05$. *** indicates $p < 0.001$.

version decreased for potato chips and the muffin. Average bids for the non-GM cookie increased but, because average GM bids increased more, the non-GM premium decreased after the participants were asked to read information about the benefits of GM to the environment.

Conclusions

The results of the experimental auction concur with the literature that, in general, consumers are willing to pay a premium for non-GM products. The effect of information regarding environmental impacts of GM crops on willingness to pay for GM food products was consistent with expectations. Information about the positive effects of GM crops on the environment resulted in increased bids for standard-label (presumed GM) products over those identified as non-GM. And, over all products, negative information increased the premium participants were willing to pay for products with a non-GM guarantee. However, the results did not always hold for individual products, particularly when participants received negative information.

The results indicate that consumers do read labels, at least in an experimental setting and when included information is constrained to a standard NutriFacts label and a statement regarding the GM components of the product. Participants were instructed to evaluate the products, but were not specifically told to read the labels. Because the products offered were identical except for the label, only participants who actually carefully viewed the labels would have differentiated between the products.

Overall, the results indicate that students are concerned about the environment and how it is affected by the use of biotechnology, and that they value non-GM labeled products. And, willingness to pay can be influenced by information provided. While caution is advised about applying the results of this study to a more general population or to one in a different or broader locale, or to GM food products in general, the results are useful. College students in the Northern Plains represent a market segment similar to that which might be found at colleges and universities throughout much of the United States (in the case of the participant population, especially at a Liberal Arts College). The results support providing environmental-impact information, particularly to this market segment, as a potentially viable strategy for agribusiness firms, and in doing so concur with the results of Lusk et al. (2002). They also suggest that negative information about the environmental impact of biotechnology may be less effective. Because a majority of retail food items in the United States do contain GM ingredients, should those against biotechnology continue informational campaigns, ensuring consumers understand the impact of GM crop production and feel safe consuming the resulting food products should be a priority for the industry.

Directions for Future Research

Two important characteristics of this research that may limit its applicability include the homogeneity of the participant population as compared to the more general market and the nature and scope of

Table 2. Comparison of Bid Differential Before and After Information Shock[a, b].

	Control			Positive information			Negative information		
Product	Before	After	Sign.	Before	After	Sign.	Before	After	Sign.
Potato chips	.003	.038	.194 (.429)	.149	.052	.369 (.255)	.022	.017	.862 (.827)
Cookie	.021	.002	.303 (.854)	.049	.015	.219 (.141)	.003	.016	.615 (.512)
Muffin	.019	.012	.645 (.792)	.058	.008	.052 (.016)**	.038	.062	.241 (.169)
Overall[c]	7.248	9.790	0.609 (.301)	15.534	-0.530	.005*** (.001)***	2.643	9.051	.132 (.061)*

[a] Differential is price for the non-GM product less price for the presumed GM product except as noted for overall difference.
[b] t-value is from a paired-samples t-test (2-tailed). Significance of z-value from non-parametric Wilcoxon signed-ranks test (2-tailed) is shown in parentheses.
[c] Overall difference is in percents. All others are dollar units.
* indicates $p < 0.10$. ** indicates $p < 0.05$. *** indicates $p < 0.001$.

Table 3. Comparison of Bids Before and After Information Shock[a, b].

Product	Control				Positive information				Negative information			
	GM		non-GM		GM		non-GM		GM		non-GM	
	change	sign.	change	sign.	change	sign.	change	sign.	change	sign.	change	sign.
Potato chips	- .008	.794 (.646)	.027	.417 (.865)	.026	.688 (.859)	- .071	.455 (.097)*	- .048	.187 (.258)	- .053	.135 (.325)
Cookie	.028	.108 (.269)	.010	.382 (.477)	.049	.078* (.034)**	.015	.696 (.975)	.053	.284 (.807)	.066	.105 (.327)
Muffin	.021	.377 (.653)	.014	.572 (.805)	.037	.154 (.366)	- .013	.068* (.090)*	- .018	.475 (.298)	.005	.817 (.720)

[a] Differential is pr□
[b] t-value is from a paired-samples t-test (2-tailed); Significance of z-value from non-parametric Wilcoxon signed-ranks test (2-tailed) is provided in parentheses.
* indicates $p < 0.10$. ** indicates $p < 0.05$. *** indicates $p < 0.001$.

the information provided to participants (treatment). Regarding the former, the nature of the participating population not only inherently limits direct application of the results to a wider population but also resulted in consideration of only immediately consumable food products (i.e., individual sized amounts). There is no evidentiary support that willingness to pay for non-GM refreshments is representative of the willingness to pay for other non-GM food products (e.g., those more likely to be consumed at home).

Regarding the nature and scope of information limitation, the environmental-impact information provided to participants was designed to be both visually attractive and credible. Nonetheless, it was limited to a one-page scientific summary. This format would unlikely be the choice of a firm or organization with the objective of influencing consumer acceptance of biotechnology. They rather likely would consider other, more-engaging means such as radio, television, or print media, and well-designed pamphlets and presentations aimed at specific target markets. It is also expected that firms offering a retail food product that does not contain GM ingredients would use more creative means to promote this on the product packaging, including the label, in contrast to the simple label statement used in the current study.

As the use of methods in experimental economics grows, it is anticipated that future research will be designed to at least in part overcome these limitations. Applying the methods employed to test willingness to pay for different products would widen the scope of findings for the region (e.g., foods used in menu preparation, foods designed to appeal to health-conscious consumers). Creative labeling may change the price premium consumers are willing to pay for non-GM products, and changing the method of information presentation may change consumer attitudes about and preferences for products based on their GM composition. For example, using a television or magazine advertisement as a means to convey information about biotechnology could be more influential and alluring to a greater percentage of the population. If financially and geographically feasible, engaging a more-diverse population to participate in a future study would be helpful. Results then could be generalized more easily over the comprehensive population.

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Appendix: Instructions to Participants

Welcome! Thank you for choosing to participate in an experiment about decision making. In this folder is a packet of information that you will need during the experiment. Once you have looked at a form during the experiment, feel free to go back and examine that form again if need be, however, please do not look ahead until we reach the right point in the experiment.

Please follow the instructions carefully. Please do not talk to any other participants.

I would like to emphasize that all information obtained today will be used only for group comparisons. No information on any individual will be divulged for any reason.

Please turn to the next page, and fill out the questionnaire.

[Pre-auction questionaire]

STOP -- Please do not turn the page until instructed by your monitor. [This instruction was regularly included and emphasized with a large figure with the simple text 'STOP'. Participants were also regularly reminded to include their identification number on their surveys and bid sheets. These instructions are hereafter not included for length considerations.]

Once again, I would like to thank you for participating in this experiment today.

Today we will be holding auctions of some common products. There will be some detailed instructions of how the auction works shortly. Because we are trying to determine values of different products, we ask that you please refrain from communicating with other participants. If you have any questions, the monitors will assist you; simply raise your hand.

How the Auction Works

Step One: Explanation of auction format.

We are going to hold what is called an nth price auction today. This type of auction has you write

down your bids on a sheet of paper. The bids are private, so no one else will know what you are bidding. The way this auction works can be shown in 4 steps.

1. Examine the products. Before we ask you to bid on a product, we will let you come up to the front of the room and examine the products that you will be bidding on.

2. Write down your bid for the product. After the products are examined, you can write down what you would like to bid for the product on your "bid sheet". The amount you write down is the value of the item to you, not what you think the price would be in a store.

3. Choosing of the n^{th} price. Once everyone has bid, we will determine what will be called the n^{th} price. The nth price is randomly chosen. First a number between 2 and the number of people participating will be randomly drawn. The bids are then put in order from highest to lowest. The number drawn will determine which bid is used as the nth price and thus the purchase price for the product. Everybody who bids **higher** than this price will purchase the product at the n^{th} price. So, you will never pay a price for a product higher than what you bid. Your monitor will go through an example of this.

4. Determining who purchases products. Your monitor will go through an example of this. Please note that in this auction it is in your best interest to bid your true value of the product. Unlike many auctions, in which you might bid less to try to get a deal, this auction does not reward that. This is because you do not necessarily pay your price, but, if you have a winning bid, you pay the bid of the n^{th} participant. Likewise, it is not in your interest to bid more than you are truly willing to pay, because you may have to pay more than you wanted to for the product.

Step Two: Short quiz on auction format (this sheet will not be collected)

True or False

1. The people who purchase products will always pay the amount they bid for a product.

2. If you have the fourth highest bid, and the randomly drawn n^{th} price is the second, you purchase the product should the round be binding.

3. You might get to pay less than your bid for a product, but you will never have to pay more than your bid for a product.

Multiple Choice

4. If the bidding price that is randomly drawn is the seventh price, how many people purchase the good? a) 4 b) 5 c) 6 d) 7 e) 8

Practice Rounds

Step One: Explanation. There will be two rounds of bidding in the practice rounds. We are about to begin the first practice round. Only one of the two practice rounds will be binding. That is, only one of the two practice rounds will be chosen as the round where people will purchase goods (i.e., only one round "counts"). Since you do not know which round will be chosen, it is in your best interest to bid your true value for the products in both practice rounds. The round that binds has been computer generated, and will be revealed after the second practice round.

In the binding round, the participants who get to purchase the product will pay the price they bid, or a lower price, and take the product home.

Step Two: Examine the product in practice round one (cards).

Step Three: Bid on the deck of cards. Please fill out your bid on the bid sheet for cards provided.

REMEMBER: You should write down the value of the product to you, not the value it would be in a store.

Step Four: Examine the four products available in the second stage of the practice round.

Step Five: Bid on each of the four products on the bid sheets provided. Now instead of one product to bid on, there are four. Please bid on these four products, and remember that only one of these two rounds will be binding.

Step Six: Selection of the binding round.

Step Seven: Determination of the n^{th} price for each product.

Step Eight: Announcement of the auction winners for each product (goods and money will be exchanged at the end of the auction).

First Round of the Experimental Auction

Step One: Examine the six products.

Step Two: Please bid on these six products using the corresponding bid sheets provided.

Again, there will be two rounds of bidding, but only one of the two rounds will be chosen as bind-

ing. This means people with "winning" bids will be required to purchase the products in only one of the rounds.

** After you are done bidding, please read the information provided.

[Treatment]

Second Round

Steps One and Two repeated.

Step Three: Selection of the binding round.

Step Four: Determination of the n^{th} price for all three goods

Step Five: Posting of the winning prices

[Post-auction questionnaire administrated.]

[Exchange of money and goods.]