Experts and Advocates: How Consumers Respond to Information about Food Safety

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In at least two recent controversies (irradiation and genetic modification) the public has had to decide between assertions made about food safety by advocacy groups and by statements from scientific experts. In both cases the weight of the scientific evidence suggested that these foods were safe, and in both cases the typical response from advocates was that "no-one knows what effect genetic organisms (or food irradiation) will have on our health"
http://www.greenpeace.org.uk/Multimedia/Live/FullReport/1222.PDF.
These statements need not be mutually contradictory because the scientific evidence, properly evaluated, cannot guarantee that a particular food is completely safe. However to the general public these statements must seem at odds.

Our research has examined how consumers respond to this type of controversy. Specifically, we explore how favorable and unfavorable information on irradiation affects willingness-to-pay to control the food-borne pathogen *Trichinella* in irradiated pork. Based on literature currently available to the public, the favorable description emphasizes the safety and benefits of the process; the unfavorable description stresses the potential risks. Following the experimental design described by Shogren *et al*., we elicit willingness-to-pay values in a repeated-trial, 2^{nd} price auction in which the binding trial is chosen at random at the end of the experiment.[1] Repeated valuation allows participants to re-evaluate their preferences given new information about the product or other feedback from the market. We use this feature to examine the adjustment in willingness-to-pay values that follows the introduction of new information when all participants start from a common informational baseline.

One surprising result is that when we presented both positive and negative information at the same time, the negative information dominated. This was true even though the source of the negative information was identified as being a consumer advocacy group and the information itself was written in a manner that was non-scientific. We re-ran this particular experiment four times to ensure that this result was robust.

Experimental Design

Using a random sample of 200 households obtained from a commercial survey company, eighty-seven primary food shoppers were recruited to participate in what was described only as a "consumer economics experiment" in return for a payment of $40.00. No other information was given at the time of recruitment to avoid systematic non-participation

[1] Similar experiments have been used to value pork attributes (Melton *et al*.), food safety (Hayes *et al*., Fox *et al*.), and reductions in pesticide use (Roosen *et al*.). Roosen et al. compared values elicited in repeated trials with those elicited in a final one-shot binding trial. The absence of significant differences suggested that participants viewed the process rationally by bidding a consistent willingness-to-pay in each trial.

bias related to irradiation, food-safety, or any other feature of the experiment. Participants were assigned to ten groups ranging in size from six to twelve. There were three treatments: the first examined the effect of positive information about irradiation (POS), the second examined the effect of negative information (NEG), and the third examined the effect of both types (BOTH). Of the first six groups scheduled, two participated in each of the three treatments. The final four groups were assigned to the BOTH treatment. All experiments were conducted in a food taste-tasting lab at Iowa State University. The experiments contained several controls to ensure that participants knew what was going on and to elicit *ex-ante* and *ex-post* attitudes[2].

Subjects received the following descriptions of two pork sandwiches:

- *Type I.* This is a typical pork sandwich. The pork in this sandwich has a typical chance of being contaminated with *Trichinella*,
- *Type II.* The pork in this sandwich has been treated by irradiation to control *Trichinella*. Because of this treatment we can guarantee that this pork will not cause Trichinosis.

The monitor informed subjects that they had each been endowed with a typical pork sandwich (*Type I*), and that an irradiated (*Type II*) pork sandwich would be sold using the second-price, sealed-bid auction. A second-price, sealed bid auction was used in which the highest bidder wins and pays the second highest bid (Vickrey). The auction had ten rounds (or trials) of bidding, each with equal probability of being binding. In each trial, the monitor publicly displayed the identification number of the highest bidder and three bids: the second highest, average, and lowest bid. The monitor explained that we would select a number at random to determine the binding round. The highest bidder in the binding round would then exchage his or her *Type I* sandwich for the *Type II* sandwich and paid the market price, i.e. the second highest bid in that round. They were informed that they would have to consume either a typical or an irradiated pork sandwich to complete the experiment and leave with their take home income.[3] The monitor then provided each subject with a "neutral" description of the food irradiation process.[4]

Food Irradiation

> The U.S. Food and Drug Administration (FDA) has recently approved the use of ionizing radiation to control Trichinella in pork products and Salmonella in poultry. Based on it's evaluation of several toxicity studies, the FDA concluded that irradiation of food products at approved levels did not present a toxicological hazard to consumers nor did it adversely effect the nutritional value of the product.

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[2] We use the second-price auction because it is incentive compatible for independent private values—it is in the best interest of subjects to reveal their true preferences for the good. Market experience might be feared to unduly influence bids as posted prices turn independent private values into affiliated private values, especially if people are unfamiliar with the good up for sale. List and Shogren (1998) find that that affiliated private values can exist in repeated second price auctions for neoteric agricultural goods such as irradiated meat, but the repeated trial design with non-price information removed the correlation of values, while providing the experience bidders needed to understand the market. A complete set of instructions for the experiment is available from the authors.

[3] All subjects knew that they could leave without prejudice at any time during the experiment.

[4] The "neutral", positive, and negative descriptions are included in the appendix.

Irradiation of pork products at approved levels results in a 10,000 fold reduction in the viability of *Trichinella* organisms present in the meat.

The forms of ionizing energy used in food processing include gamma rays, x-rays, and accelerated electrons. Ionizing energy works by breaking chemical bonds in organic molecules. When a sufficient number of critical bonds are split in the bacteria and other pests in food, the organisms are killed.
The energy levels of the gamma rays, accelerated electrons, and x-rays legally permitted for processing food do not induce measurable radioactivity in food.

This description is based on a review of the scientific literature on food irradiation

Subjects also received a description of the symptoms of trichinosis and were informed the objective odds of contracting trichinosis from the *Type I* sandwich were approximately *1 in 2,628,000*.
The first five rounds of bidding (trials) were then conducted, with the second highest, mean, and lowest bid publicly posted following each trial.
After trial 5, the monitor provided additional information about irradiation. Participants in the POS treatment (groups 1 and 2, n=18), received a favorable description of the process based on information provided by the American Council on Science and Health.

Food Irradiation

Food irradiation (also called ion pasteurization) is a process that destroys harmful bacteria and pathogens by treating foods with ionizing radiation.

Food irradiation has been shown to be highly effective in destroying Trichinella in pork, Salmonella in poultry, E.coli in beef, and other bacteria and parasites responsible for food poisoning. Extensive research has proven that this process is a safe and reliable way to improve the quality of food. Because food irradiation does not involve washing foods with chemicals and leaves no residue in food, it is safer than many current food processing techniques.

The Food and Drug administration has approved irradiation for use on wheat, potatoes, pork, poultry, fruits, vegetables and spices. The process has also been approved the American Medical Association and the World Health Organization. It has been successfully used in over 20 countries since 1950. Food irradiation is especially useful for those most at risk from food-bone illness such as victims of AIDS, organ transplant patients, and the elderly, and was approved for hospital diets in the U.K. as far back as 1969.

Each year as many as 9,000 people die in the U.S. from food-borne illness. Millions more suffer short term illness due to pathogens such as Salmonella, Listeria and E.coli. By eliminating these pathogens from food, irradiation can help to greatly reduce the number of food borne illnesses.

This description is based on information supplied by the American Council on Science and Health, a consumer education association.

Participants in the NEG treatment (groups 3 and 4, n=19) received an unfavorable description of irradiation based on information from Food and Water, Inc.

Food Irradiation

Food irradiation is a process whereby food is exposed to radioactive materials, and receives as much as 300,000 rads of radiation -the equivalent of 30 million chest x-rays- in order to extend the shelf life of the food and kill insects and bacteria.

While it is unlikely that food products themselves will become radioactive, irradiation results in the creation of chemicals called radiolytic products in food. Some radiolytic products are known carcinogens. Studies have also suggested that irradiation may be linked to cancer and birth defects. Furthermore, foods exposed to radiation contain lower levels of essential vitamins.

Food irradiation can kill most of the pathogenic bacteria present in food, but so can proper cooking. Moreover, doses of radiation that are adequate to kill Salmonella or Trichinella are not enough to kill the bacteria that cause botulism. However, such doses would kill the bacteria which signal spoilage through a foul odor. Thus, with irradiation, we would not be able to rely on the usual warning signs that tell us when food is dangerous to eat.

Food irradiation was developed in the 1950's by the Atomic Energy Commission. The objective was to seek potential uses for the byproducts of nuclear weapons production. Today's food irradiation industry is a private, for-profit business enterprise with ties to the U.S. nuclear weapons and nuclear power industries.

Food irradiation also poses potential environmental dangers because of the use of radioactive materials in the process. Workers can be exposed on the job, and entire communities can be exposed in the event of a leak from the plant. Plus, radioactive materials would have to be transported around the country, putting thousands of people at risk in the case of a traffic accident.

This description is based on information supplied by Food and Water, Inc., a consumer advocacy group.

Participants in the BOTH treatment (groups 5 – 10, n=50) were provided, simultaneously, with both the favorable and unfavorable descriptions of irradiation.

Results

Figure 1 show the effect of new information about irradiation on the average bids for irradiated pork.

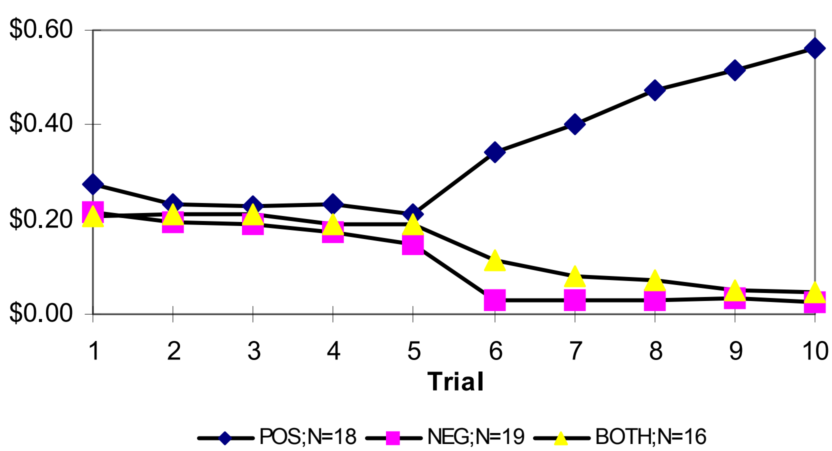


Figure 1: Effect of Information on the Average Bid for Irradiated Pork (Groups 1 – 6)

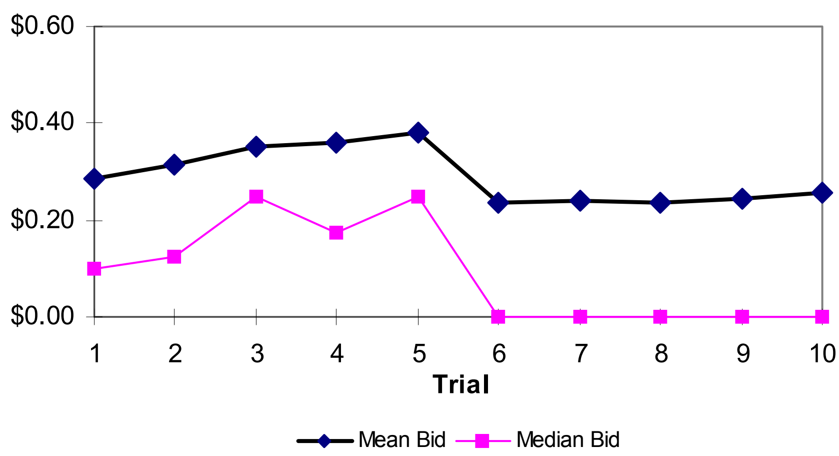
These results are based on the first six groups of participants, two for each of the three informational treatments – POS, NEG, and BOTH. Some observations are immediately apparent. The favorable description of food irradiation, provided following trial 5, caused the average bid for irradiated pork to increase in the POS treatment. Between trials 5 and 6, eight of the eighteen subjects submitted higher bids, eight submitted unchanged bids, and two submitted lower bids. Overall, the result in the POS treatment is as expected - providing good news about the product increases its value.

Figure 1 also shows that the unfavorable description caused the average bid to decrease between trials 5 and 6. In trial 10, about ninety percent (17 of 19) of the subjects submitted a $0.00 bid to upgrade to irradiated pork—indicating either indifference or a preference for the non-irradiated product, which seems more likely. This is as expected too—bad news about a product should decrease its value..

In the BOTH treatment, we provided the favorable and unfavorable descriptions simultaneously. Figure 1 shows that the average bid decreased between trials 5 and 6, and continued to fall. Of the sixteen subjects, nine decreased their bid between trials 5 and 6, one increased, and six remained unchanged at $0.00. By trial 10, ten of the sixteen bidders (63%) submitted $0.00 bids.

We tested the robustness of this result by repeating the BOTH treatment with the final four groups. Figure 2 shows the effect of the information on the mean and median bid and suggests that the bad news effect is robust.

Figure 2: Effect of Positive and Negative Information on Mean and Median Bids for Irradiated Pork (Groups 7 – 10, n=34)



Of the thirty-four subjects, sixteen reduced their bid and eighteen remained unchanged after reading both the positive and negative descriptions. Of the eighteen that were unchanged, twelve were already bidding $0.00. In trial 10, twenty-one of the thirty-four subjects (62%) bid $0.00.

Figures 1 and 2 suggest that the effect of simultaneous provision of positive and negative information is qualitatively very similar to that of providing only negative information. We tested this hypothesis by modeling the effect of information as a function of participant characteristics and experimental treatment. The dependent variable is categorical and based on the categorization in table 1 – taking the value of 1 if the effect of new information is positive, 0 if the effect is ambiguous, and –1 if the effect is negative. Table 1 reports the results from both ordinary least squares and ordered probit estimations.

Table 1: Effect of Information

	Model	
Variables	OLS	Ordered Probit
Constant	-0.79 ***	-1.04
	(0.254)	(0.766)
Prior Attitude	0.13	0.487
	(0.099)	(0.344)
Male	0.06	0.126
	(0.119)	(0.370)
Age	-0.04	-0.126*
	(0.024)	(0.074)
Education	0.05	0.166
	(0.033)	(0.101)
POS Treatment	1.30 ***	2.599 ***
	(0.134)	(0.472)
NEG Treatment	-0.07	-0.184
	(0.131)	(0.469)
Correct Predictions		0.74
R^2	0.61	

Note: * denotes significance at the 10% level, ** at the 5% level, and *** at the 1% level.

The only significant coefficient in either model is that associated with the POS treatment, but the interesting result is the non-significance of the coefficient for the NEG treatment. Because the base treatment is BOTH, the result indicates that the effect of providing negative information alone was not significantly different from that of providing both types simultaneously.

Discussion

In this paper, we are concerned with the relative and combined effects of different descriptions of the new food technology. The descriptions we used were based on literature from the pro- and anti-technology campaigns and are true and accurate at least in the sense that they are representative of the type of information consumers are exposed to when controversial new food technologies are introduced. Our primary result is that negative information dominates positive. Positive information alone resulted in more favorable assessments of the irradiated product and higher bids to obtain it. But, when combined with negative information, the effect was similar to that of providing only negative information. This result is true even though we identified the source of the negative information as a consumer advocacy group, and simultaneously presented information about safety from a wide variety if scientific bodies.

Given that the media provides both sides of every story, the descriptions created by advocacy groups are widely available. Our results suggest that when these advocacy groups indicate that new food technologies are unsafe, then consumers will avoid these foods even if scientific bodies say the technologies are unsafe. These results help explain why food irradiation has had little commercial success and may help explain why consumers in some markets are so concerned with genetically modified organisms. The results also indicate the enormous responsibilities of those who write negative descriptions of new food technologies and those who report on these controversies.