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A COMPARISON OF TWO APPROACHES TO UNDERSTANDING CONSUMER OPINIONS OF BIOTECHNOLOGY

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Two approaches to risk communication about complex and controversial technology are compared through analysis of responses to a nationwide survey of 2,070 consumers conducted in the United States. Results indicate that key components of the cognitive science approach, which emphasizes the importance of information exchange, and the sociocultural approach, which emphasizes the importance of trust and perceived ethical legitimacy, complement one another as determinants of consumer opinion formation regarding complex and controversial technology. Implications for risk communication approaches regarding biotechnology are described.

A major issue challenging the biotechnology industry as well as the general public is the controversial nature of biotechnology among consumers. Negative reactions to biotechnology have ranged from suspicion of genetically engineered products in the United States to the threatening of the structure of the European Union over the introduction of recombinant soybeans and corn (Nestle, 1998). Consumer skepticism in the U.S. might be short-lived as bioengineered foods become more common on grocery shelves. On the other hand, the potential negative consequences of not addressing consumer concerns might significantly affect the rate of adoption of biotechnology products (Dutton, 1999; Dwyer, 2000; Kling, 1997; PRNewswire, 2000). Consumer concerns about the safety of bioengineered foods, for example, influenced Gerber's (the maker of baby foods)

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decision to stop using ingredients from genetically engineered crops (Bailey, 2001; CBS News, 2000; Milo Ohr, 2000).

What are the key determinants of consumer opinions of biotechnology? The *cognitive science approach* emphasizes that knowledge itself, once transmitted, will lead to the acceptance of a technology (Bradbury, 1989; Lupton, 1999). Research using the cognitive science approach examines the ways in which people respond to objectively defined risk (Sandman, 1987; Slovic, 1987) and explores communication strategies to reduce unwarranted public outrage regarding presumed beneficial technologies.

This view has not gone unchallenged. The *sociocultural approach* considers risk as a social process rather than as an independent entity that exists apart from the individuals, groups, and institutions that perceive it (Bradbury, 1989). This approach argues that, although an understanding of scientific facts is an essential element of public opinion, public opinion is influenced strongly as well by trust in institutions, perceptions of value-orientations, and perceived social acceptability. Freudenburg and Rursch (1994), for example, note that "there is a growing body of evidence that levels of information simply are not the significant factors in explaining citizen opposition to controversial technologies" (p. 953). Issues of trust and value-orientation become important in public assessments of technology. Thus, communication strategies that incorporate exercises in trust-building and well-reasoned public discourse are equally as essential to public adoption of complex and controversial technology as are attempts at public education about scientific findings.

The sociocultural perspective has been used to address the ways in which consumer risk assessments reflect public discourse on technology adoption. Beck (1999), for example, argues that neither objective hazards nor cultural, political or normative influences can be ignored. Beck claims that once potential risks become salient in the public forum, the public is left with the responsibility of deciding if the risk is worth the potential hazards. Thus, ultimately, the people will decide if they wish to eat genetically modified organisms (i.e., GMOs). While this decision is somewhat complicated by the lack of disclosure in labeling by the biotech industry as well as the U.S. Food and Drug Administration's decision to require labeling only in foods whose nutritional value has been altered, the lessons learned in Europe's rejection of GMOs speaks loudly as to where the final decision of adoption or rejection lies.

This study examined the relative efficacy of the cognitive science and sociocultural approaches to understanding public opinions of biotechnology. It compared the explanatory power of measures of knowledge and sense of control – indicators of the cognitive science approach – with that of measures of trust and perceived social acceptability – indicators of the sociocultural approach. The importance of finding support for either of these approaches lies in possible

implications for communication strategies. If the cognitive science perspective more clearly explains the nature of the development of consumer opinion of complex and controversial technologies, then an emphasis needs to involve media-based presentations of scientific facts, public relation statements, and policy positions intended to reduce consumer outrage. If the social constructionist view adds significantly to the understanding of consumer opinions, then an emphasis on risk as a socially developed and maintained entity is vital.

METHOD

Sample and Survey Procedures

The sample was 10,000 households selected at random from a nationwide listing of residential dwellings in the 48 contiguous states of the United States. One adult in each household was asked to complete and return a mailed instrument containing questions on food-buying habits, opinions of food safety issues, opinions of biotechnology, food selection when shopping for food, and household characteristics. The mailing procedure consisted of just two contacts – an initial mailing with a covering letter and questionnaire and a follow-up postcard mailed one week later. The response rate for this procedure, accounting for an estimated undeliverable rate of 15 percent, was 30 percent (2,510 completed instruments). This response rate falls below what would be preferred for a survey sample. Nevertheless, the resulting sample characteristics closely match the social-demographic characteristics of the U.S. population.

We wanted respondents who were not yet aware of biotechnology to know some basic information about it from the viewpoints of its proponents and opponents. Thus, respondents were supplied with this explanation of biotechnology:

> Biotechnology (also called genetic engineering) involves changing the genetic molecular structure of plants and animals to produce different varieties or species. Supporters of applying biotechnology methods in food production think that doing this will make it possible to increase the rate of food production, make the food supply more resistant to diseases, and create new foods for consumption. Others, however, think that biotechnology has the potential to create serious ethical and food safety issues, may contribute additional environmental problems, and may result in narrowing of the gene pool and risks to the natural environment.

Measurement

The procedure was to regress indicators of public acceptance of biotechnology on variables reflecting the essential elements of the cognitive science and sociocultural approaches (Table 1). Opinions of biotechnology were measured using two related variables: intent to eat genetically engineered foods and willingness to eat meat produced by genetic engineering. Variables used to represent the main elements of the cognitive science approach were perceptions of safety,

nutritiousness, environmental protection, food productivity, sense of control over the technology, and opinions of scientific experts. Elements of the sociocultural approach were represented by measures of trust, perceived ethical legitimacy of biotechnology, perceived social acceptability of the technology, and perceived opinions of biotechnology opponents.

A latent variable measuring concern about food safety was used to place the respondents' opinions of biotechnology within the content of their overall assessment of food safety. Food safety concern (alpha reliability = .94) was measured as the averaged expression of concern about: antibiotic residues in meat and poultry, aerial spraying of pesticides, use of chemical fertilizers, use of insecticides, groundwater contamination from livestock manure, pesticide residues in fresh fruit and vegetables, food additives such as dyes or preservatives, and hormone residues in foods. Similarly, we measured concern about foodborne illness to assess the respondents' wariness about food safety. We asked respondents to tell us how concerned they were about E. coli contamination, salmonella in the food chain, and hepatitis. The summated latent variable had an alpha reliability of .91.

We measured opinions about genetically modified foods using five related variables: safety, ethics, nutritional value, environmental effects, and effects on food production. The safety of genetically modified (biotech) food was measured as the response to the statement, "Eating genetically modified food is a safe thing to do." Ethical legitimacy was measured by response to the statement, "Biotechnology poses no significant ethical issues." The perceived nutritiousness of genetically modified food was assessed based upon the (reverse coded) response to the statement, "Eating genetically modified food will decrease the nutritional value of my diet." The perceived environmental safety of genetic engineering was measured from the response to the statement, "Genetically modified foods are safe for the environment." Perceived production benefits was measured using the response to the statement, "Biotechnology will help increase food production."

Sense of control over eating foods produced using genetic modification was measured as a latent variable (alpha reliability = .82) based upon the averaged responses to the statements, "I will have the final say-so over whether I eat genetically modified food," and "The final decision about whether to eat genetically modified food will be up to me." Trust in persons/agencies responsible for developing/monitoring genetically modified food was measured with two statements, "I trust the food scientists who say that genetically modified food is a good idea," and "I trust public health officials who support biotechnology."

Perceived social acceptability of eating genetically modified foods was the averaged responses (alpha reliability = .64) to the statements, "Most people will be in favor of eating genetically modified food," and "Eating genetically modi-

fied food likely will be accepted by the American public." Inputs from "experts" was measured as responses to two statements, "Food scientists think I should eat genetically modified food," and "Consumer advocacy groups think I should eat genetically modified food." Each of these statements was weighted by responses to statements about compliance with expert opinion (i.e., "I do what food scientists think I should do," and "I do what consumer advocacy groups think I should do"). Social demographic control variables included age (measured in years), education (measured in years), and total household income before taxes in the year preceding the survey (1999) recorded in seven ordinal categories.

RESULTS

Listwise deletion of missing cases yielded a final sample of 2,070 persons.

TABLE 1
DESCRIPTIVE STATISTICS FOR VARIABLES USED IN THE MODELS (*N*=2,070).

Variable	Frequency	Percent
Income Categories:		
Less than $10,000	63	3.0
$10,000 to $19,999	172	8.3
$20,000 to $34,999	412	19.9
$35,000 to $49,999	440	21.3
$50,000 to $74,999	523	25.3
$75,000 to $100,000	255	12.3
More than $100,000	205	9.9

	Description	*M*	*SD*
Intent to eat genetically modified food	range: 1 - 5	2.99	0.90
Willingness to eat genetically modified meat	range: 1 - 5	3.07	1.14
Perceived safety of biotech foods	range: 1 - 5	3.06	0.80
Perceived nutritiousness of biotech foods	range: 1 - 5	3.28	0.74
Perceived environmental safety of biotechnology	range: 1 - 5	3.12	0.70
Perceived production benefits of biotechnology	range: 1 - 5	3.50	0.73
Sense of control over biotechnology	range: 1 - 5	4.00	0.92
Perceived opinions of food scientists	range: 1 - 25	6.78	3.55
Perceived opinions of consumer advocates	range: 1 - 25	5.79	3.04
Trust in scientists who endorse biotech	range: 1 - 5	2.96	0.92
Trust in public health officials who endorse biotech	range: 1 - 5	3.01	0.89
Perceived ethical legitimacy of biotechnology	range: 1 - 5	2.69	0.88
Perceived social acceptability of biotechnology	range: 1 - 5	2.99	0.65
Concerns about food safety	range: 1 - 5	3.77	1.02
Concerns about foodborne illness	range: 1 - 5	4.31	0.94
Age of the respondent	range: 1 - 93	53.21	15.14
Education of the respondent	range: 1 - 30	14.19	3.13

The sample consisted of older, well-educated persons of moderate income (Table 1). The average scores on food safety concern (3.77) and concerns about foodborne illness (4.31) indicated wariness about food safety. The averaged scores for perceived safety (3.06), intent to eat (2.99), and willingness to eat (3.07) bioengineered foods showed neither strong acceptance nor strong rejection of biotechnology. We included in the description of biotechnology sent to the respondents viewpoints of both proponents and opponents. Previous studies (e.g., Sapp & Harrod, 1990) indicate that any "negative" information has a strong influence on initial opinions of complex and controversial technology, and that type of influence might have affected initial reactions to biotechnology among the respondents. The respondents did not express strong trust in scientists and public health officials who endorse biotechnology. They were concerned about food safety and the potential for experiencing foodborne illness. And respondents were somewhat concerned about the ethical legitimacy of biotechnology.

The results of ordinary least squares regression analysis were used to determine the relative effects of indicators of cognitive and social influences on opin-

TABLE 2
STANDARDIZED PARAMETER ESTIMATES FOR THE INDEPENDENT VARIABLES ON INTENT AND WILLINGNESS TO EAT GENETICALLY MODIFIED FOODS (*N*=2,070).

Variables	Intent to Eat	Willingness to Eat
Perceived safety of biotech foods	.254**	.240**
Perceived nutritiousness of biotech foods	.114**	.129**
Perceived environmental safety of biotechnology	.132**	.033
Perceived production benefits of biotechnology	.150**	.047*
Sense of control over biotechnology	-.009	-.045**
Perceived opinions of food scientists	.033*	-.012
Perceived opinions of consumer advocates	-.001	-.001
Trust in scientists who endorse biotechnology	.120**	.128**
Trust in public health officials endorsing biotechnology	.124**	.073**
Perceived ethical compatibility of biotechnology	.093**	.055**
Perceived social acceptability of biotechnology	.088**	.073**
Concerns about food safety	-.014	-.216**
Concerns about foodborne illness	.013	.075**
Age of the respondent	.032*	-.023
Education of the respondent	-.008	.036
Household income	.003	.028
R-Square	.60	.43
F ratio	194.008**	97.962**

* Parameter estimate or *F* ratio is statistically significant at $p < .05$.
** Parameter estimate or *F* ratio is statistically significant at $p. < .01$.

ions of biotechnology. The results (Table 2) show that perceived safety of biotechnology is the most important indicator of intent and willingness to eat. Likewise, other indicators of cognitive influences on acceptance, such as perceived nutritiousness, environmental safety, and production benefits, significantly affect intent and willingness to eat. But sociocultural factors seem to be very important indicators of acceptance as well. Trust in scientists and public health officials, for example, were important indicators of acceptance, as were perceived social acceptability and perceived ethical legitimacy of genetically engineered foods.

CONCLUSION AND DISCUSSION

The study examined the relative effects of variables reflecting the cognitive science and sociocultural approaches to understanding consumer responses to complex and controversial new technologies. The results support Beck's (1999) eclectic approach to understanding consumer risk assessments, wherein consumer risk assessments cannot be understood solely in terms of individualist interpretations of technical information, but must also be understood to reflect perceived social acceptability and trust in experts.

The development of social acceptability and trust in experts and the formation of attitudes, beliefs, norms, and values occur through social interaction with others within a context of normative expectations. If attitudes and beliefs are not well established, as is often the case with new and controversial technology, it logically follows that normative influences may carry more weight in the development of those beliefs and attitudes. Furthermore, if the norms that help guide decisions to adopt or reject the new technology are not yet formed, new group norms must be developed. In novel situations especially, group norms function to provide context and guide behavior (e.g., Sherif, 1936). Thus, newly established group norms motivate individual compliance with group pressures and provide context for individual perception of the situation. In novel or ambiguous social situations, group norms not only serve as guideposts for behavior, but also provide social context that is matched against individual perceptions in the development of attitudes and beliefs.

Several well-established and empirically supported theoretical approaches have been developed to help social scientists understand social interaction processes involved in consumer opinion formation regarding complex and controversial new technologies. The innovation-decision process (Rogers, 1995), the theory of rational expectations (Fishbein & Ajzen, 1975), and the health-belief model (Rosenstock, 1974) are examples of conceptual approaches to understanding how initially ill-formed opinions become more crystallized over time through consideration of persuasive arguments, inputs from social compar-

ison with others, and formation of new normative expectations. The results of the current study indicate that such approaches might prove useful in understanding consumer opinion formation regarding genetically engineered foods.

Individuals, rather than experts, ultimately will decide whether to adopt or reject new technology. Additionally, a large proportion of the individual's decision is influenced by norms, attitudes, beliefs and values. Social influences must then be incorporated within theoretical approaches to best understand the potential adoption or rejection of complex and controversial new technologies. It follows that biotech corporations, whose current policies regarding consumer skepticism and outrage seem to involve only direct and peripheral route persuasive techniques, could benefit from examining the issue from the vantage point of sociocultural risk theory. Strategies might involve building trust by working with opinion leaders and recognizing the influence of socially constructed ethical positions, perceived social acceptability, and social networking on consumer opinion formation. Similarly, organizations that challenge the efficacy and/or ethics of genetically engineered foods will need to address both the cognitive and social constructionist elements of consumer opinion formation.

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