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AGRICULTURAL COMMUNICATIONS STUDENTS' AWARENESS AND PERCEPTIONS OF BIOTECHNOLOGY ISSUES

Gary J. Wingenbach, Assistant Professor
Tracy A. Rutherford, Assistant Professor
Deborah W. Dunsford, Senior Lecturer
Texas A&M University

Abstract

The purpose of this study was to determine college students' awareness of and perceptions toward biotechnology issues reported in the mass media. Agricultural communications students (N = 330) responded from 11 land-grant universities in 10 states; respondents were mostly seniors (46%), female (55%), and considered themselves "B" average students (60%). Respondents were most aware of biotechnology practices affecting their food, but only somewhat aware of their effects on health or the environment. They were somewhat accepting of biotechnology practices for genetically modified organisms involving plant life, but viewed these same practices as somewhat unacceptable for using on humans. Respondents ranked knowledge from science classes, experience in science labs, and university professors' biotechnology beliefs as the top three sources used most often to form their perceptions about biotechnology. Agricultural communications educators are encouraged to seek opportunities that engage students in the learning processes of biotechnology, especially for students who lack an agricultural background. Such opportunities may include establishing student internships; site visits to biotechnology firms, regulatory and communication agencies; and professional interactions with biotechnology scientists.

Introduction

All credible mass media science reporters strive for objectivity. While true objectivity is impossible for humans to achieve, communicators attempt to combine a clear understanding of their topic with the audience's reading comprehension levels. Every writer chooses what to include or exclude from a news story. However, when the topic is biotechnology, agricultural communicators face hidden challenges that may be based on their own awareness of and perceptions toward biotechnology practices. An important step in educating agricultural communications students is to determine what sources they use to form perceptions about biotechnology and what influences their perceptions toward biotechnology practices.

Conceptual Framework

For most consumers, the mass media is the major source of information about biotechnology (Hoban, 1998, 1999, 2002). Hagedorn and Allender-Hagedorn (1995) pointed to the media as a key partner in developing public awareness and perceptions toward biotechnology. According to Hoban (2002), the media tends to focus on sensational news stories, or to squeeze stories into a sound-bite format. Thus, the public hears only part of the story and that part tends to arouse concern. Even with the stories that are reported, studies indicate that many people do not feel they have sufficient information about biotechnology (Hoban, 2002; Einsiedel & Thorne, 1999).

Public concern about the implications of using biotechnology practices in food

production is not the result of a lack of information. A variety of research-based sources on biotechnology are readily available. Examples include the *Comparative Environmental Impacts of Biotechnology-derived and Traditional Soybean, Corn, and Cotton Crops* (Carpenter, Felsot, Goode, Hammig, Onstad, & Sankula, 2002) or *Evaluation of the U.S. Regulatory Process for Crops Developed through Biotechnology* (Chassy, Abramson, Bridges, Dyer, Faust, Harlander, Hefle, Munro, & Rice, 2001), both available online through the Council for Agricultural Science and Technology. However, while easy to access, these documents, and most others regarding biotechnology, are not easily understood by the public. Hagedorn and Allender-Hagedorn (1995) noted scientists' unsympathic responses to public concerns about biotechnology. They found scientists' responses were often incomprehensible to the majority of citizens (Hagedorn & Allender-Hagedorn, 1995).

The public's perceived lack of information complicates the National Academy of Sciences' desire for a public that understands the basics of biotechnology and its implications to personal and public health (Armstrong, 2000). Chappell and Hartz (1998) surveyed 2,000 journalists and 2,000 scientists to determine how the each group felt about each other's purpose in communicating science to the public. Neither group believed the media was doing a good job of explaining science to the public. The authors recommended that both groups would benefit from more skills training—scientists need more communications skills and journalists need more science skills (Chappell & Hartz, 1998). Helping college students acquire skills in communications and science is critical to educating the public on biotechnology issues.

Vestal and Briers' (1999) study of media professionals from the nation's largest metropolitan newspapers revealed that journalists had the most faith in statements about food biotechnology from university scientists and health professionals. Journalists had less faith in statements made by biotechnology and food companies. Regarding reporting styles, journalists preferred investigative and interpretative reporting on biotechnology processes. Statistically significant relationships existed between journalists' beliefs about the effects of biotechnology and their family's relationship to agriculture. Journalists whose families owned agricultural land tended to believe that biotechnology practices had more positive than negative effects on fish and wildlife, world hunger, family farms, and healthful foods.

Researchers from two studies (Hossain, Benjamin, Adelaja, Schilling, & Hallman, 2002; National Science Foundation, 2000) found that gender was an influencing factor when forming perceptions toward biotechnology. Houssain et al. found that male consumers were less skeptical and less concerned about the government's ability to regulate genetically modified products. NSF (2000) found that females were more likely to believe the harms outweighed the benefits of biotechnology. Does gender affect perceptions toward biotechnology practices in a college setting?

An important outcome from the study by Vestal and Briers (1999) was the finding that journalists who lacked knowledge or experience with biotechnology practices did not have accurate perceptions about biotechnology issues. Sanbonmatsu and Fazio (1990) found it was possible for people to base their perceptions on already-present global attitudes toward topics or technologies when knowledge or experience with the topic or technology was low. This finding was supported in marketing research by Schoell and Guiltinan (1995) who asserted that consumers' perceptions and attitudes are influenced by family, friends, class, and the culture in which they live. Thus, it is possible that if a person lacks knowledge and experience about a topic [biotechnology issues], then he or she cannot accurately perceive it. But, can the same be said for agricultural communications students who have opportunities to become engaged in science classes, labs, and dialogue with university scientists working in biotechnology science? Do practical biotechnology science experiences play a greater role in determining students' perceptions about

biotechnology than already-present global attitudes?

Purpose and Objectives

The purpose of this study was to determine agricultural communications students' awareness of and perceptions toward biotechnology issues reported in the mass media. The objectives guiding this inquiry were to:

1. Describe students' awareness of biotechnology practices affecting food, health, or environmental issues as reported in the mass media.
2. Determine students' perceptions toward biotechnology issues.
3. Determine the sources students use most often to form their perceptions about biotechnology issues.

Methods

Descriptive research methodology employing Web-based survey data collection methods (Ladner, Wingenbach, & Raven, 2002) was used to complete the study, after obtaining approval from the Texas A&M University Institutional Review Board (#2002-381).

The population for this census study consisted of undergraduate students who were majoring in agricultural communications, or who were enrolled in agricultural communications courses, and/or participating in the Agricultural Communicators of Tomorrow student organization. A total of 343 responses were collected, however incomplete data reduced the usable number of respondents to 330 (96.21%). Valid responses were gathered from students at Clemson University, Oklahoma State University, Texas A&M University, Michigan State University, Western Illinois University, University of Arkansas, University of Florida, North Carolina State University, Kansas State University, Washington State University, and Texas Tech University. Results of this study should not be generalized beyond the confines of the respondent group.

A modified version of the instrument, *Metro News Journalists' Perceptions of Food Biotechnology* (Vestal & Briers, 1999) was derived from research based on the work of Duhé (1993), Barton (1992), and the *North Carolina Nationwide Survey on Biotechnology* (as cited in Vestal & Briers, 1999). A panel of experts from the University of Arkansas, University of Florida, Kansas State University, Michigan State University, and the University of Kentucky established content validity. Face validity was established through a pilot study of students (Kansas State, Texas Tech and Texas A&M Universities) who were not in this study.

The instrument measured students' awareness of and perceptions toward biotechnology issues as reported in the mass media. These constructs were quantified through response sets in nine scales that included 1) awareness of biotechnology practices affecting food, health, or the environment (Scale = No, Somewhat, Yes); 2) acceptance of genetically modified organisms; 3) acceptance of biotechnology practices; 4) levels of importance placed on biotechnology research; 5) levels of importance placed on investigative reporting styles; 6) faith in biotechnology information sources; 7) potential barriers to using biotechnology practices; 8) perceptions toward effects of biotechnology on selected issues; and 9) perceptions on the acceptance rates (consumers versus agriculturists) of using government approved biotechnology practices in food production.

Perceptions were measured using four-point, Likert-type scales. The acceptance of biotechnology practices scale could range from Highly Unacceptable (1) to Highly Acceptable (4); Cronbach's alpha coefficient was .91 for the acceptance scale. The scale measuring potential barriers (1=Very Low to 4=Very High) to using biotechnology in food production achieved a Cronbach's alpha of .77. Additional reliability analyses for scales not reported in the study by Vestal and Briers, but conducted in this study revealed Cronbach's alpha coefficients of .90 for the scales (1=Not At All Important to 4=Extremely Important) measuring importance of investigative reporting; .85 for importance of biotechnology research; .73 for faith in biotechnology information

sources; and .70 for perceptions toward the effects of biotechnology.

One important modification to Vestal and Briers' (1999) instrument was the addition of six items to determine what sources agricultural communications students use most often to form their perceptions about biotechnology. Researchers were interested in knowing if college students relied on already-present global attitudes toward biotechnology (as reported in the mass media or from family and friends' beliefs), or if they relied on their knowledge and experiences gained through science classes, labs, and dialogue with university professors about biotechnology. Respondents were asked to rank these six factors according to what they used most often to form their perceptions about biotechnology.

Pre-notice email and listserv announcements describing the study were sent to land grant university faculty members in early August 2002. Colleagues were asked to review the online instrument, provide clarification where necessary, and encourage undergraduates to participate in the study. Data collection began in mid-August with bi-weekly email reminders to faculty members and was completed in seven weeks. Respondents accessed the instrument through a closed Web address. Respondents were instructed to read and agree to an Informed Consent Form before entering the survey site. Descriptive statistics were derived for each section and the instrument as a whole. Demographic data were analyzed using percentages and frequencies.

Results

Usable responses (N = 330) were gathered from agricultural communications students at 11 universities in 10 states. The respondents represented six majors (Table 1). Specific areas of self-reported majors included those in agricultural education, other college of agriculture majors (poultry, forestry, and food sciences, and agribusiness/agricultural economics), agricultural communications, liberal arts (journalism, math, economics, education, and business), animal science, and health-related fields (nursing, pharmacy, and rehabilitation science).

Respondents were mostly seniors (46%), female (55%), and considered themselves "B" average students (60%) from their self-reported overall grade point averages (Table 1); not all percentages equal 100% due to missing information. More than one-half (52.4%) of the respondents' families owned agricultural production property, or have lived on a farm or ranch (56.1%). Nearly two-thirds (64.5%) of the respondents have worked on a farm or ranch.

Table 1
Demographic Frequencies of Respondents (N = 330)

Variables	*f*	%
University		
Clemson University	81	24.5
Oklahoma State University	73	22.1
Texas A&M University	61	18.5
Michigan State University	41	12.4
Western Illinois University	23	7.0
University of Arkansas	16	4.8
University of Florida	12	3.6
North Carolina State University	11	3.3
Kansas State University	5	1.5
Washington State University	5	1.5
Texas Tech University	2	.6
Major		
Agricultural Education	79	23.9
Other College of Agriculture	78	23.6
Agricultural Communications	66	20.0
Liberal Arts	52	15.8
Animal Science	29	8.8
Health-Related Fields	18	5.5
Undecided	3	.9
Class Status		
Senior	152	46.1
Freshman	79	23.9
Junior	56	17.0
Sophomore	25	7.6
Other	10	3.0
Gender		
Female	181	54.8
Male	140	42.4
Overall Grade Point Average		
3.00 - 3.99	198	60.0
2.00 - 2.99	105	31.8
4.00	16	4.8
1.00 - 1.99	3	.9
< 1.00	1	.3
Agricultural Factors[a]		
Family owns agricultural production property.	173	52.4
Have lived on a farm or ranch.	185	56.1
Have worked on a farm or ranch.	213	64.5

Note. [a]Frequencies indicate a positive response.

In answering the first objective, students' awareness of biotechnology practices affecting food, health, or environmental issues was determined using

a three-point scale (1=No, 2=Somewhat, 3=Yes). Table 2 illustrates that respondents' were most aware of how biotechnology will affect their food (47%), but only somewhat aware of its effects on health (53%) or the environment (50%).

Table 2

Frequencies of Respondents' Awareness of Biotechnology Effects (N = 330)

	No		Somewhat		Yes	
Variables	*f*	%	*f*	%	*f*	%
Food	30	9.1	145	43.9	155	47.0
Health	29	8.8	175	53.0	126	38.2
Environment	38	11.5	166	50.3	126	38.2

To answer the second objective, agricultural communications students recorded their perceptions toward biotechnology issues. Respondents answered questions in scales measuring their acceptance of biotechnology practices, importance of biotechnology, faith in biotechnology information sources, potential barriers to using biotechnology in food production, and effects of biotechnology (Table 3).

Respondents were somewhat accepting of biotechnology practices for genetically modified organisms involving plant life (*M* = 3.28), but viewed these same practices as somewhat unacceptable for human use (*M* = 1.84). Students believed it was important to continue biotechnology research (*M* = 3.02-3.53) and important for journalists to continue investigative reporting styles (*M* = 2.91-3.33). Respondents had highest faith in statements about biotechnology made by university scientists (*M* = 3.17) and least faith in statements made by celebrities (*M* = 1.40).

Agricultural communications students objected most to the use of biotechnology in food production for fear of environmental harm (*M* = 2.80) and were least concerned about its use for religious/ethical reasons related to "tampering with nature" (*M* = 2.19). Apparently this incongruent finding indicates that respondents were sophisticated enough to separate their moral and societal values about the environment, or they may have misunderstood the question. In general, respondents believed that biotechnology practices will have positive effects on fish/wildlife, family farms, healthful foods, and world hunger (Table 3).

Table 3
Descriptive Statistics for Perceptions Toward Biotechnology Issues (n = 281)

Items	*M*	*SD*
Acceptance levels for genetically modified organisms involving[a]		
Forests/landscape plants	3.28	.79
Food crops	3.28	.78
Microorganisms	3.07	.79
Animals	2.60	.99
Humans	1.84	.98
Acceptance levels of biotechnology practices involving[a]		
Insect resistant cotton	3.41	.74
Insect resistant corn	3.36	.77
Slow vine ripening tomatoes	3.34	.76
Herbicide resistant soybeans	3.33	.77
Importance levels placed on biotechnology research to[b]		
Benefits to the environment	3.53	.64
Harming the environment	3.47	.73
Safer food	3.44	.69
Risk compared to pesticides	3.23	.74
Reduction of pesticides	3.13	.78
Added nutritional value	3.10	.73
Control of released genes	3.02	.82
Importance levels for journalists to[b]		
Investigate claims and statements made by government agencies	3.33	.76
Investigate claims and statements made by food companies	3.28	.74
Investigate claims and statements made by biotech companies	3.24	.75
Provide analysis and interpretation about the undesirable consequences of biotechnology	3.23	.84
Provide analysis and interpretation about the desirable consequences of biotechnology	3.18	.83
Investigate claims and statements made by university scientists	3.17	.77
Investigate claims and statements made activist groups	2.94	.98
Mirror events and avoid interpretation	2.91	.94
Faith in biotechnology information sources[c]		
University scientists	3.17	.68
Health professionals	3.11	.65
Farm groups	3.00	.65
Biotech companies	2.81	.73
Government agencies	2.69	.76
Food companies	2.63	.67
Celebrities	1.40	.64

Table Continues

Table 3 Continued

Items	*M*	*SD*
Potential barriers to using biotechnology in food production[c]		
Fear of environmental harm.	2.80	.91
Fear of food safety consequences	2.74	.91
Fear of genes moving unchecked to other plants, insects, or microorganisms.	2.46	.89
Religious/ethical concerns about "tampering with nature."	2.19	.98
What effect will biotechnology practices have on[d]		
World hunger	3.34	.58
Healthful foods	3.07	.64
Family farms	2.78	.85
Fish and wildlife	2.74	.67

Note. Four-point, Likert-type scales measured students' perceptions. [a]1=Highly Unacceptable, 2=Somewhat Unacceptable, 3=Somewhat Acceptable, 4=Highly Acceptable. [b]1=Not at all Important, 2=Somewhat Important, 3= Important, 4=Extremely Important. [c]1=Very Low, 2=Low, 3=High, 4=Very High. [d]1=Very Negative, 2=Negative, 3=Positive, 4=Very Positive.

Additional analysis revealed differing levels of students' perceptions toward biotechnology when viewed by their awareness of biotechnology practices affecting food, health, or the environment (Table 4). Agricultural communications students who were aware of biotechnology practices affecting food perceived biotechnology practices in a more positive light than did all other respondents. It should be noted that a lower mean score in "potential barriers to using biotechnology in food production" indicates a more positive attitude held toward biotechnology practices. The same findings were revealed among subgroups when comparing mean scores by biotechnology practices affecting health. Data analyses revealed that respondents who were aware of biotechnology practices affecting the environment had more positive perceptions toward biotechnology than did all other respondents (Table 4).

Table 4
Respondents' Perceptions Toward Biotechnology by Awareness of Biotechnology Practices Affecting Food, Health, and Environment (N = 330)

	M			
Variables	No	Somewhat	Yes	Grand
Food	(*n* = 30)	(*n* = 145)	(*n* = 155)	(*N* = 330)
Acceptance of biotechnology practices[a]	26.53	25.79	29.04	27.38
Importance of research and reporting[b]	45.67	46.53	49.72	47.95
Faith in biotechnology sources[c]	18.83	18.07	19.40	18.77
Potential barriers[d]	10.47	10.53	9.64	10.11
Effects of biotechnology[e]	12.00	11.22	12.39	11.84
Health	(*n* = 29)	(*n* = 175)	(*n* = 126)	(*N* = 330)
Acceptance of biotechnology practices[a]	25.03	26.97	28.50	27.38
Importance of research and reporting[b]	43.48	47.76	49.26	47.95
Faith in biotechnology sources[c]	18.24	18.51	19.26	18.77
Potential barriers[d]	10.07	10.46	9.63	10.11
Effects of biotechnology[e]	11.24	11.59	12.32	11.84
Environment	(*n* = 38)	(*n* = 166)	(*n* = 126)	(*N* = 330)
Acceptance of biotechnology practices[a]	26.47	26.66	28.61	27.38
Importance of research and reporting[b]	45.97	47.35	49.34	47.95
Faith in biotechnology sources[c]	18.13	18.30	19.59	18.77
Potential barriers[d]	10.21	10.31	9.81	10.11
Effects of biotechnology[e]	11.16	11.50	12.49	11.84

Note. Four-point scales were summated to determine students' overall perceptions toward biotechnology practices. [a]Acceptance of Biotechnology Practices ranged from 9-36. [b]Importance of Biotechnology ranged from 16-60. [c]Faith in Biotechnology Sources ranged from 8-28. [d]Potential Barriers ranged from 2-16. [e]Biotechnology Effects ranged from 5-16.

Respondents had different perceptions toward biotechnology when viewed by selected demographics, which included family owned agricultural production property, have lived on a farm or ranch, have worked on a farm or ranch, and gender (Table 5). Agricultural communications students whose families owned agricultural production property had more positive perceptions in accepting biotechnology practices, faith in biotechnology information sources, and feared less the potential barriers to using biotechnology in food production than did respondents whose families did not own agricultural production property. The same findings were revealed for respondents who have lived on a farm or ranch (Table 5).

Analysis of summated mean scores revealed differing levels of perceptions toward biotechnology between respondents who have and have not worked on a farm or ranch. Those who have worked on a farm or ranch had more positive perceptions in accepting biotechnology practices, feared less the potential barriers to using biotechnology in food production, and perceived the effects of biotechnology were more positive than did respondents who have not worked on a farm or ranch.

Males tend to have more positive perceptions toward biotechnology practices and are less skeptical of it than are females (Hossain et al., 2002). The results of this study found males had more positive perceptions in acceptance of biotechnology practices and perceived the effects of biotechnology more positively than did females (Table 5).

Table 5
Respondents' Perceptions Toward Biotechnology by Selected Demographics (N = 330)

	M		
Variables	No	Yes	Total
Family owned agricultural production property	(*n* = 151)	(*n* = 173)	(*n* = 324)
Acceptance of biotechnology practices[a]	25.77	28.84	27.41
Importance of research and reporting[b]	47.47	48.42	47.98
Faith in biotechnology sources[c]	18.19	19.29	18.78
Potential barriers[d]	10.50	9.80	10.12
Effects of biotechnology[e]	11.77	11.92	11.85
Have lived on a farm or ranch	(*n* = 137)	(*n* = 185)	(*n* = 322)
Acceptance of biotechnology practices[a]	25.47	28.79	27.38
Importance of research and reporting[b]	47.68	48.24	48.01
Faith in biotechnology sources[c]	18.23	19.15	18.76
Potential barriers[d]	10.75	9.70	10.15
Effects of biotechnology[e]	11.70	11.95	11.84
Have worked on a farm or ranch	(*n* = 110)	(*n* = 213)	(*n* = 323)
Acceptance of biotechnology practices[a]	25.22	28.52	27.39
Importance of research and reporting[b]	47.54	48.20	47.98
Faith in biotechnology sources[c]	18.34	19.00	18.77
Potential barriers[d]	10.78	9.79	10.13
Effects of biotechnology[e]	11.48	12.04	11.85
	Female	Male	Total
Gender	(*n* = 181)	(*n* = 140)	(*n* = 321)
Acceptance of biotechnology practices[a]	26.54	28.45	27.37
Importance of research and reporting[b]	48.02	47.86	47.95
Faith in biotechnology sources[c]	18.81	18.70	18.76
Potential barriers[d]	10.35	9.84	10.13
Effects of biotechnology[e]	11.58	12.18	11.84

Note. Four-point scales were summated to determine students' overall perceptions toward biotechnology practices. [a]Acceptance of Biotechnology Practices ranged from 9-36. [b]Importance of Biotechnology ranged from 16-60. [c]Faith in Biotechnology Sources ranged from 8-28. [d]Potential Barriers ranged from 2-16. [e]Effects of Biotechnology ranged from 5-16.

Two additional questions allowed respondents to estimate the time required for consumers and agriculturists to accept using government approved biotechnology in food production. Students estimated it will take agriculturists an average of 3-5 years to accept government approved biotechnology practices in food production, but consumers will take twice as long (6-10 years). An average of 4-5% (*n* = 12-16) of the respondents believed that consumers and farmers will never accept government approved biotechnology practices in food production.

To answer the third objective, respondents' were asked to rank order the sources they used to form perceptions about biotechnology. Six factors were included from the literature to determine if agricultural communications students relied on already-present global attitudes as reported in the mass media, or knowledge and experiences to form their perceptions about biotechnology (Table 6). Respondents

ranked knowledge from science classes, experience in science labs, and university professors' biotechnology beliefs as the top three sources used most often to form their perceptions about biotechnology (Table 6).

Table 6
Respondents' Ranking of Sources Used to Form Biotechnology Perceptions (n = 326)

Sources	Ranking Frequencies 1st	2nd	3rd	4th	5th	6th	Overall Rank[a]
Knowledge from science classes	163	63	45	23	21	12	1
Experience in science labs	26	98	77	35	45	45	2
University professors' beliefs about biotechnology	39	58	79	70	40	40	3
Family's beliefs about biotechnology	52	39	54	73	73	35	4
Perceptions toward biotechnology (reported in mass media)	39	47	59	72	40	70	5
Friends' beliefs about biotechnology	5	23	31	56	102	109	6

Note. [a]Overall rank was determined by weighting rank scores in reverse order; 1st place rank scores received six points each, while 6th place rank scores received one point each. Individual weighted scores for each source were summated to derive the overall rank.

Conclusions, Recommendations, and Implications

Students who enrolled in agricultural communications courses, were agricultural communications majors, or who participated in the Agricultural Communicators of Tomorrow student organization will someday become communicators for the agriculture industry. Communicators' stories are influenced by their perceptions, which are formed through knowledge and experience, or through already-present global attitudes reported in the mass media. Accurate, reality-based perceptions toward any topic have the propensity for fair, objective, unbiased communications of that topic, an important factor to consider, especially in the case of communications about biotechnology science. Biotechnology practices affecting agriculture, food, health, and the environment are major issues now, and will continue to be major issues in the future (Casey, 2002). The impact biotechnology has on food and fiber production, consumption, and the sale and trade of agricultural products worldwide will no doubt have a political consequence, as has occurred already in Zambia (Chicago Tribune, 2002).

Students in this study gained their biotechnology awareness through knowledge from science classes, experience in science labs, and from university professors' beliefs about biotechnology. While all these factors, and others not tested herein, influenced the formation of students' perceptions toward biotechnology, students in this study did not form their perceptions (primarily) on already-present global attitudes. The same cannot be said of consumers in the decision making process where many form their perceptions based on the beliefs of family, friends, and what is reported through the mass media (Schoell & Guiltinan, 1995). This finding emphasizes the need for science coursework, experience, and interactions students have during their education. Agricultural communications programs and the faculty in those programs should emphasize the technical science components of a student's curriculum. Academic advisors and educators are encouraged to motivate students to study science—biotechnology science in particular—beyond the minimum hours needed to graduate. Formal and informal science education experiences are needed.

Educators also should be aware of the influence their beliefs have on students'

perceptions about biotechnology. Agricultural communications faculty members must keep abreast of the scientific advances that continue to change production practices in the agricultural industry. Knowledge and experience increase the likelihood of an informed, unbiased opinion and perception, even for university professors. Our perceptions, positive and negative, can influence students' perceptions of biotechnology science. Students should be engaged in meaningful discussions about the science of biotechnology and current issues surrounding the topic. If educators continue our learning about biotechnology issues, then we can be assured this interaction will help agricultural communications students develop perceptions based on sound knowledge and critical consumption of information.

Awareness of biotechnology practices impacted respondents' perceptions. Agricultural communications students who were aware of biotechnology practices tended to have more positive perceptions toward biotechnology than did other respondents. This finding is consistent with the research linking science knowledge to positive perceptions (Vestal & Briers, 1999). Awareness nurtures inquiry, but inquiry must be satisfied through knowledge and experience from reliable scientific sources, otherwise students' perceptions will be based on the uninformed opinions of others.

Demographic characteristics (family ownership of agricultural production property and having lived or worked on a farm or ranch) influenced respondents' perceptions in acceptance of biotechnology practices. Ownership of production property and having lived on a farm or ranch positively influenced students' perceptions in acceptance of biotechnology practices, faith in biotechnology information sources, and less fear of the potential barriers to using biotechnology in food production. Those respondents who had worked on a farm or ranch had more positive perceptions about acceptance of biotechnology practices, less fear of potential barriers to using biotechnology in food production, and perceived the effects of biotechnology more positively than did respondents lacking these characteristics. This influence could be attributed to respondents' agricultural experiences and their ability in using those experiences to form perceptions about biotechnology. This finding implies a need to expand the experiential learning opportunities for agricultural communicators, especially those with non-agricultural backgrounds. Such opportunities may include establishing student internships; site visits to biotechnology firms, regulatory and communication agencies; and professional interactions with biotechnology scientists.

This study supports previous findings that gender is an influencing factor in forming perceptions toward biotechnology (Hossain et al., 2002; NSF 2000). In this study, males had more positive perceptions toward accepting biotechnology practices and toward the perceived beneficial effects of biotechnology than did females. Educators and scientists should be aware that their collective perceptions toward biotechnology influence students' perceptions of biotechnology. This finding, coupled with related research showing females make math and science career decisions as early as sixth grade (Jensen & McMullen, 1994) provides evidence of the importance between biotechnology scientists' discussions with students well before the collegiate years. Females' perceptions toward biotechnology and science may be changed if scientists "communicate" its importance beyond their normal audience. Finally, educators need to evaluate the clarity of their science teaching to ensure true understanding of biotechnology knowledge has been acquired by students.

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GARY J. WINGENBACH is an Assistant Professor in the Department of Agricultural Education at Texas A&M University, 146 Scoates Hall, College Station, TX 77843. E-mail: g-wingenbach@tamu.edu.

TRACY A. RUTHERFORD is an Assistant Professor in the Department of Agricultural Education at Texas A&M University, 143 Scoates Hall, College Station, TX 77843. E-mail: TRutherford@tamu.edu.

DEBORAH W. DUNSFORD is a Senior Lecturer in the Department of Agricultural Education at Texas A&M University, 145 Scoates Hall, College Station, TX 77843. E-mail: d-dunsford@tamu.edu