Selected College Students' Knowledge and Perceptions of Biotechnology Issues Reported in the Mass Media

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Abstract

The purpose of this study was to determine college students' awareness of and attitudes toward biotechnology issues reported in the mass media. Future agricultural communicators (N = 330) representing 11 land-grant universities in 10 states recorded their knowledge and perceptions of biotechnology issues as reported in the mass media. Respondents were mostly seniors (46%), female (55%), and considered themselves "B" average students (60%). Students achieved only 30% correct responses (M = 3.05) in a knowledge assessment of biotechnology practices, illustrating a lack of knowledge. However, nearly 84% of the respondents perceived their level of knowledge as average to high (24% perceived they possessed above-average scientific knowledge). Future agricultural communicators were somewhat accepting of biotechnology practices for genetically modified organisms involving plant life (M = 3.28), but viewed these same practices as

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somewhat unacceptable for use on humans (M = 1.84). Significant, low positive relationships existed between respondents' perceived and assessed levels of biotechnology knowledge (r = .17) and between their assessed knowledge and acceptance of biotechnology practices (r = .16). Selected college students in the agricultural sciences have much less knowledge about biotechnology practices than what they believed to possess. Although correctable through increased study of biotechnology, this finding may pose serious problems for students choosing to "communicate" the science of biotechnology issues in the mass media. Agricultural communications faculty nationwide should analyze their curricula to determine if students are being given the opportunity to study biotechnology issues while learning how to communicate it to a larger audience.

Introduction

Biotechnology is a hot topic in the media. However, agricultural communicators often struggle to translate information from scientists about biotechnological breakthroughs into terms the public can understand. This struggle, which may be seen as an information and education gap, may be caused by communicators' lack of understanding the "technical" science behind biotechnology issues, or the public's lack of scientific knowledge in general. The results of this struggle are frequently disappointing for communicators and scientists. Communications researchers, media critics, communicators, and scientists encourage improved education in this area. But whom do we educate and when? College of agriculture students who will be future agricultural communicators and scientists are an obvious audience.

Theoretical Framework

The study of biotechnology and public perceptions is not new, nor is the controversy about biotechnology. As early as 1989, Hoban noted the potential importance of biotechnology, and the importance of communication channels in educating

agricultural producers about these new technologies. Hoban stated "biotechnology has already generated controversy over ethical issues and environmental release of genetically altered organisms" (Conclusion section, para. 2). Reiners and Roth (1989) conducted a study of public perceptions, suggesting general public support for biotechnology practices, but with early signs of concern.

Public concern about the implications of food biotechnology may not necessarily be caused by a lack of information. A variety of research-based sources on biotechnology is readily available. Examples include the *Comparative Environmental Impacts of Biotechnology-derived and Traditional Soybean, Corn, and Cotton Crops* (Carpenter et. al., 2002) or *Evaluation of the U.S. Regulatory Process for Crops Developed through Biotechnology* (Chassy et. al., 2001), both available online through the Council for Agricultural Science and Technology. However, while easy to access, these documents, and most others on biotechnology, are not easily understood by the public. Also, these Internet sources would not serve members of the public who lack Internet access. Hagedorn and Allender-Hagedorn (1995) noted unsympathic scientific responses to public concerns about biotechnology. The authors found that the scientists' responses offered were "often incomprehensible to the majority of citizens" (Hagedorn & Allender-Hagedorn, 1995).

An incomprehensible response from scientists working in biotechnology leaves the mass media as most consumers' major source of information on the subject (Hoban, 1999 & 2002).Hagedorn and Allender-Hagedorn (1995) point to the media as a key partner in developing public awareness and perceptions of biotechnology. The media tends to focus on sensational news stories, or to squeeze stories into a sound-bite format (Hoban, 2002). Thus, the public hears only part of the story and that part tends to arouse concern. However, even with the stories that are reported, studies indicate that many people feel they do not have sufficient information about biotechnology (Hoban, 2002; Einsiedel & Thorne, 1999).

The public's perceived lack of information complicates the National Academy of Science's 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 two groups felt about each other. Neither group believed the media was doing a good job of explaining science to the public. The authors suggested 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.

Vestal and Briers' (1999) study of 88 journalists representing 65 of the nation's largest metropolitan newspapers found that journalists' knowledge of food biotechnology was relatively low. Of the study's respondents, 92% indicated that they were "aware" or "somewhat aware" of how biotechnology affects their food, health, and environment. Respondents' attitudes toward food biotechnology indicated that the group believed genetic modification of humans was the least acceptable use of biotechnology, followed by genetic modification of animals as "highly" or "somewhat unacceptable." Statistically significant relationships existed between journalists' beliefs about the effects of biotechnology, their family's relationship to agriculture, and their perceived level of biotechnology knowledge. Journalists whose families owned agricultural land or who had a high perceived knowledge about biotechnology tended to believe that biotechnology would have more positive than negative effects. The study also identified a gap between the journalists' actual knowledge (30% correct responses) about food biotechnology and their perceived knowledge (average to high knowledge). How do these relationships and lack of biotechnology knowledge among media professionals compare to the knowledge and perceptions of college of agriculture students?

Purpose and Objectives

The purpose was to determine college of agriculture students' knowledge and perceptions of biotechnology issues reported in the mass media. The objectives guiding this inquiry were to:

1. Assess students' knowledge of biotechnology issues reported in the mass media.

2. Determine students' attitudes toward biotechnology issues.
3. Determine if relationships exist between students' assessed and perceived levels of biotechnology knowl edge and their perceptions toward biotechnology issues.
4. Determine if relationships exist between students' assessed and perceived levels of biotechnology knowl edge and selected demographics.

Methods

Descriptive methodology and a correlational design were used to complete the study. Web-based survey data collection methods (Ladner, Wingenbach, & Raven, 2002) were used after obtaining approval to conduct the study through the Texas A&M University Institutional Review Board (#2002-381).

The self-selected population for this census study consisted of undergraduate students majoring in agricultural communications, enrolled in agricultural communications courses, and/or participating in the Agricultural Communicators of Tomorrow organization (N = 343). Total responses numbered 343; 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). Content validity was established by a panel of experts from the University of Arkansas, University of Florida, Kansas State University, Michigan State University, and the University of Kentucky. Face validity was established through a pilot study of students

(Kansas State, Texas Tech, and Texas A&M) who were not a part of this study.

The instrument contained 70 questions measuring students' knowledge, attitudes and perceptions toward biotechnology issues as reported in the mass media. These constructs were quantified through response sets in seven scales that included 1) knowledge of biotechnology; 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 of biotechnology issues; 6) attitudes toward effects of biotechnology on selected issues; and 7) perceptions about the acceptance rates (consumers and agriculturists) of using government-approved biotechnology practices in foodproduction.

Students' knowledge about biotechnology issues was measured using nine multiple-choice questions. Attitudes and perceptions were measured using four-point, modified Likert-type scales. Responses to the scale measuring acceptance of biotechnology practices could range from Highly Unacceptable (1) to Highly Acceptable (4). Vestal and Briers (1999) reported a Cronbach's alpha coefficient of .87 for the acceptance scale; Cronbach's alpha was .91 for the same scale in this study. 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, 4 = Extremely Important) measuring importance of investigative reporting and .85 for importance of biotechnology research. Scales measuring faith in biotechnology information sources (.73) and attitudes toward effects of biotechnology (.70) were deemed reliable. The researchers concluded that the scales used in this study provided reliable data for analyses and interpretation.

Pre-notice e-mail 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 biweekly e-mail 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. Significant relationships between selected variables were established using bivariate analyses.

Results

Usable responses ($N = 330$) were gathered from college of agriculture students at 11 universities in 10 states and representing six programs of study. Specific areas of self-reported majors included those in agricultural education, other college of agriculture (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).

Students' knowledge of biotechnology issues reported in the mass media was assessed using nine multiple-choice questions. The research design did not preclude students from using the Internet to search for answers they did not know, and one could expect unknowledgeable respondents to score 25% correct for questions with four possible choices. However, respondents in this study achieved only 30% correct responses ($M = 3.05$, $SD = 1.51$). This lack of knowledge about biotechnology practices mirrors the findings of Vestal and Briers (1999) and Bruhn (as cited in Vestal & Briers, 1999). Nearly 84% of the respondents perceived their level of scientific knowledge as average to high ($M = 3.07$, $SD = .74$). Of those respondents, 24% believed they had "above-average" scientific knowledge. Again, these findings match those found by Vestal and Briers, where metro news journalists perceived a higher level of scientific knowledge than they actually possessed.

College of agriculture students responded to 28 questions designed to assess their attitudes toward biotechnology issues. These questions were contained in scales measuring acceptance of biotechnology practices, importance of biotechnology, faith in biotechnology information sources, potential barriers to

Table 1. *Demographic Frequencies of Respondents (N = 330)*

Variables	*f*	Percent
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	0.6
Major:		
Agricultural Education	79	23.9
Other College of Agriculture	78	23.6
Agricultural Communications	6	20.0
Liberal Arts	52	15.8
Animal Science	29	8.8
Health-related Fields	18	5.5
Undecided	3	0.9
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	0.9
< 1.00	1	0.3

Table 2. *Descriptive Statistics for Attitudes toward Biotechnology Issues*

Variables	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 by activist groups	2.94	.98
What effect will biotechnology practices have on[c]		
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 were used throughout each section measuring students' attitudes. [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 Negative, 2 = Negative, 3 = Positive, 4 = Very Positive.

using biotechnology in food production, and effects of biotechnology (Table 2).

Future agricultural communicators 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 ($M = 1.84$). Respondents believed it was important to continue biotechnology research ($M = 3.02$-3.53) and important for journalists to use investigative reporting styles ($M = 2.91$-3.33). In general, students believed that biotechnology practices will have positive effects on fish/wildlife, family farms, healthful foods, and world hunger (Table 2). Respondents estimated the time required for consumers and agriculturists to accept using government approved biotechnology in food production. Students estimated agriculturists will take 3 to 5 years to accept government-approved biotechnology practices, but consumers will take twice as long (6 to 10 years) (Table 3).

Table 3. *Frequencies for Acceptance of Government-approved Biotechnology Practices (n = 324)*

Item	*f*	Percent
Estimated time it will take the average farmer to accept U.S. Government (EPA, FDA, and USDA) approved biotechnology as an acceptable farm practice.		
3-5 years	96	29.1
6-10 years	95	28.8
> 10 years	65	19.7
0-2 years	56	17.0
Never	12	3.6
Estimated time it will take the average consumer to accept U.S. Government (EPA, FDA, and USDA) approved biotechnology as an acceptable farm practice.		
6-10 years	111	33.6
3-5 years	102	30.9
> 10 years	56	17.0
0-2 years	39	11.8
Never	16	4.8

Table 4. *Pearson Correlations between Respondents' Assessed and Perceived Biotechnology Knowledge and Selected Demographics (n = 320)*

Variables	Assessed Knowledge	Sig.	Perceived Knowledge	Sig.
Assessed Knowledge of Biotechnology Issues	1.00			
Perceived Knowledge of Biotechnology Issues	.17**	.00	1.00	
Summated Scale Scores				
Acceptance of Biotechnology Practices[a]	.16**	.00	.23**	.00
Importance of Biotechnology[b]	.07	.21	.05	.41
Effects of Biotechnology[c]	.05	.35	.13*	.02
Selected Demographics				
Family owns agricultural production property[d]	.06	.29	.18**	.00
Have lived on a farm or ranch[d]	.09	.12	.16**	.00
Have worked on a farm or ranch[d]	.11*	.05	.23**	.00

Note. Four-point, Likert-type scales for each section were summated to determine students' overall attitudes toward biotechnology practices. [a]Acceptance of Biotechnology Practices ranged from 0-36. [b]Importance of Biotechnology ranged from 0-60. [c]Effects of Biotechnology ranged from 0-16. [d]0 = No, 1 = Yes. *p<0.05. **p<0.01.

To fulfill the third objective, respondents' attitude scores were summated using their acceptance ($M = 27.38$, $SD = 5.75$), importance ($M = 47.95$, $SD = 7.86$), and biotechnology effects ($M = 11.84$, $SD = 2.14$) scores, and analyzed with their knowledge scores. Also, selected demographics (family-owned agricultural production property, have lived on a farm/ranch, and have worked on a farm/ranch) were analyzed with their knowledge scores to determine if a significant relationship existed (Table 4). Significant, but low positive relationships existed between respondents' assessed and perceived levels of biotechnology knowledge ($r = .17$), and between assessed knowledge and their acceptance of biotechnology practices ($r = .16$). Interestingly, a stronger positive relationship, albeit low, occurred between perceived level of knowledge and acceptance of biotechnology practices.

A significant (low) positive relationship existed between respondents' assessed knowledge of biotechnology and farm or ranch work experience ($r = .11$) (Table 4). An interesting outcome of the analyses revealed significant, but low positive relationships between respondents' perceived level of biotechnology knowledge and all selected demographic variables. Those relationships were for family-owned agricultural production property ($r = .18$), have lived on a farm or ranch ($r = .16$), and have worked on a farm or ranch ($r = .23$).

Recommendations and Implications

Undergraduate students majoring in agricultural communications, enrolled in agricultural communications courses, and/or participating in the Agricultural Communicators of Tomorrow student organization will inevitably become communicators for the agriculture industry. To some extent, their expected future success and effectiveness as communicators may be affected by their understanding and knowledge of issues within agriculture. Biotechnology practices affecting production 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 ("Opinion: Better," 2002).

Future agricultural communicators (84%) in this study believed their level of scientific knowledge was average to high, and 24% of those respondents believed they had "above-average" scientific knowledge. Conversely, respondents averaged only 30% correct responses in the knowledge assessment questions. A logical deduction from this study indicates that average knowledge would yield 4.5 correct responses in the biotechnology assessment. However, a substantial discrepancy exists between the respondents perceived and assessed knowledge. These results are consistent with the attitudes and beliefs of professional journalists surveyed by Vestal and Briers (1999). If current college students are no more knowledgeable about biotechnology than are professional journalists who have been out of school for more than 15 years (Vestal & Briers, 1999), then the future of knowledgeable, accurate communications about biotechnology may be at risk. Agricultural communications educators are encouraged to examine their curricula to determine if students are being given an opportunity to increase their understanding of science, especially biotechnology. Educators must ensure future agricultural communicators are adequately prepared to investigate, understand, and communicate the science of biotechnology, basing their communications on knowledge and/or experience, rather than on already-present global attitudes perpetuated by an uninformed populace.

Experience in agriculture and respondents' knowledge of biotechnology was related. A low but significant correlation existed between students who have worked on a farm or ranch and their assessed biotechnology knowledge. Low but significant relationships also existed between respondents' "perceived knowledge" and agricultural backgrounds such as those who have family-owned agricultural production property, or have lived or worked on a farm or ranch. Therefore, as was revealed by Vestal and Briers (1999), experience influences the agricultural communicator's perceptions of biotechnology. The difference between perception and reality may be debatable, but what is not debatable is perceived and actual biotechnology knowledge possessed by each agricultural communicator. If students, and the professional journalists studied by Vestal and Briers, lack sufficient knowledge about biotechnology, how will they know what is truth when investigating a future story? Future agricultural communicators should be

given opportunities to interact with people involved in science and biotechnology enterprises. The possibilities include student internships, field experience, and visits to biothechnology firms and agencies like the USDA, NRCS or Farm Services Agency, who are in the business of communicating the science of biotechnology to others.

Low positive relationships existed between respondents' assessed and perceived levels of biotechnology knowledge. The more confidence respondents indicated in their perceived knowledge, the more correct responses were given in the knowledge assessment. Educators can use this relationship to expand upon the limited knowledge of agricultural communicators. Understanding the science of biotechnology will increase students' confidence in communicating these issues in future careers. If the perceptions reported in this study were developed from knowledge gained in science classes, labs, and interactions with biotechnology scientists, then students may not have a clear understanding of the "knowledge" learned through these events since they perceive themselves as more knowledgeable about scientific information than what is reality. Educators need to evaluate the clarity of their science teaching to ensure that true understanding and knowledge transfer have been acquired by students.

Mirroring the results from Vestal and Briers (1999), there was a positive relationship between the acceptance of biotechnology practices and both perceived knowledge and assessed knowledge. This contributes to the current literature surrounding knowledge and perceptions. As an individual's knowledge of biotechnology increases (perceived or assessed), the individual is more likely to view biotechnology positively. Continuing to develop the knowledge base among agricultural communicators will allow them to share information factually and clearly with agricultural and nonagricultural audiences. Future agricultural communicators indicated that biotechnology practices were acceptable when involving plant life, but unacceptable for human use. Respondents believed that farmers would accept government-approved biotechnology practices in 3 to 5 years, while consumers would take longer, 6 to 10 years.

Agricultural communicators at the collegiate level maintainsimilar beliefs and knowledge bases to professional

journalists (Vestal & Briers, 1999) and to the public (Hossain, Benjamin, Adelaja, Schillin, & Hallman, 2002; NSF, 2000). The challenge for educators is to develop methods, both in and out of the classroom, to help students and professionals expand their knowledge and experience with biotechnology. To do less is to ignore the warning from Ryan-Harshman (1999).

Only a small percentage of what is read or heard is truly well balanced. Sometimes, in biotechnology reporting, this is true because the intent is to present the topic negatively; but more often, this is true because a low level of scientific knowledge combined with a wariness of technology and business lends a negative bias to reports. (p. 2)

Keywords

College students, biotechnology perceptions, mass media.

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