

**Understanding the U.S. Public's Lack of Knowledge About Agricultural Biotechnology and
Its Implications for Print Media**

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Abstract

Agricultural biotechnology is a modern development that has recently had a major impact on the food system in the United States. Yet, according to recent surveys, the U.S. public is largely uninformed about this technology. When brought to their attention, though, the public is more interested in agricultural biotechnology's relation to their health and the environment rather than to economic issues. Newspapers are a major source for informing the public about agricultural biotechnology. Therefore, to better understand the public's lack of knowledge, we examined the 2004 coverage of agricultural biotechnology in four national newspapers, the *Los Angeles Times*, the *New York Times*, the *Wall Street Journal*, and the *Washington Post*. We found coverage does not reflect those aspects of agricultural biotechnology that most interest the public. Articles were primarily framed in terms of public accountability, which is relevant to the public. However, the angles covered in these articles primarily addressed social and economic issues, not health and environmental concerns. Furthermore, social, economic, and legal/regulatory controversies were the most commonly reported controversies rather than health or the environment. Thus articles on agricultural biotechnology do not address the concerns of the general public and may not be viewed as relevant by them. News is events driven. The emphasis of reporting, therefore, is not likely to change unless a major environmental or public health event related to agricultural biotechnology occurs. To facilitate public interest in and dialogue about agricultural biotechnology, change agents will thus need to depend on informational strategies other than newspapers.

Introduction

Agricultural biotechnology is a modern development that in recent years has had a major impact on agriculture in the United States as well as many other regions of the world.

Agricultural biotechnology is often touted as the next great revolution since the green revolution in agriculture. Yet it has also raised many questions about its impact on human health, the environment, and other underlying social issues (Priest, 2001). Regardless of one's views on agricultural biotechnology, one cannot deny the significant role it plays in the United States' pantries. An estimated 60-70% of all processed foods in the United States are thought to contain at least one genetically modified (GM) ingredient (GEO-PIE project: GE foods in the market, 2004). The most common GM crops – corn, canola, and soy – are often the bases of these foods (GEO-PIE project: GE foods in the market, 2004).

Agricultural biotechnology has a history of controversy, starting with the first agricultural biotechnology food product approved for human consumption in 1993, milk from cows treated with recombinant bovine somatotropin (Priest, 2001). Today, GM foods are contested across the globe and have lead to major trade disagreements between the United States and the European Union (Agricultural biotechnology topics international/trade, 2005).

With such controversy surrounding agricultural biotechnology, one might expect the American public to be involved in the debate over the technology that is having such an impact on our food supply. However, a national telephone surveys by Hallman, Hebden, Cuite, Aquino, and Lang (2004) has shown just how uninformed the American public is. While 48% of those surveyed by Hallman et al. (2004) in 2004 thought GM foods were in their supermarkets, less than one-third believed they had ever eaten GM foods. Considering the prevalence of GM crops in American processed foods, this belief is a gross underestimation.

However, this group also found that the public is interested in the topic. When asked, 94% of respondents wished to see labeling of GM ingredients (Hallman, Hebden, Aquino, Cuite, & Lang, 2003). Furthermore, issues relating to health and the environment could influence their acceptance of GM crops. Of those who initially disapproved of GM crops, 31% were more likely to buy GM food if it was “grown in a more environmentally friendly way,” and 26% were more likely to buy if “it contained less fat than ordinary food” (Hallman et al., 2003, pg. 11). When asked, the public was also uneasy about the health consequences of growing GM crops. Over one-third (37%) of respondents did not believe GM food was safe to consume while another 18% were unsure (Hallman et al., 2003). Furthermore, when asked what topics they would like to see covered in a hypothetical television show featuring genetically modified foods, respondents were more interested in learning about possible health and environmental effects than in issues related to cost (Hallman et al., 2004). Therefore, while the public is uninformed about agricultural biotechnology, when asked, they are concerned about the technology’s health and environmental implications, both its potential risks and benefits (Hallman et al., 2003; Hallman et al., 2004).

Research has shown that when a person is interested in a topic, not only are they more likely to read about that topic, they are also more likely to remember what they read (Hidi, 2001). The public is interested in agricultural biotechnology when they are introduced to the topic, especially its implications for environmental and health issues (Hallman et al., 2004). Thus, the question is why are so few people knowledgeable on the topic of agricultural biotechnology? Previous research suggests peaks in public awareness of agricultural biotechnology may correlate with peaks in reporting (Marks & Kalaitzandonakes, 2001). In September of 2000, Marks and Kalaitzandonakes (2001) noted an increase in newspaper

coverage devoted to the Starlink event, where GM corn not approved for human consumption entered the food supply. This reporting directly preceded the findings of two studies in which U.S. public awareness of agricultural biotechnology increased from previous measurements - in one case from 40% in 1999 to 49% in October, 2000 (Marks & Kalaitzandonakes, 2001). These peaks suggest that the amount of coverage may influence public awareness of this topic (Marks & Kalaitzandonakes, 2001). This leads to further questions about agricultural biotechnology newspaper coverage. How frequently is the topic covered? When agricultural biotechnology is covered, is the public being introduced to agricultural biotechnology in a way that addresses the aspects of the topic in which they are most interested, health and the environment?

Furthermore, from where does the public get its information about agricultural biotechnology? One study found 90% of Americans learned about agricultural biotechnology from television and newsprint sources (Hoban & Kendall, 1993). Research has also shown that the content of science and technology articles influences the public's knowledge of these issues (Einsiedel & Thorne, 1999).

To understand why the public is not informed on the historically controversial topic of agricultural biotechnology, we investigated one of the major sources the public has for becoming informed, the national newsprint media. The way these media report on agricultural biotechnology may offer some explanation for the public's lack of understanding. Furthermore, the quality of reporting on agricultural biotechnology may influence future public opinion should it ever solidify.

Theoretical Framework

To investigate the quality of reporting to which the general public is exposed by the national newsprint media, we first wanted to look at article framing, an important aspect of the

overall presentation of an article. Framing has been described as a “perceived reality” made “more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation” (Entman, 1993, pg. 52). Framing is especially important with complex topics. With framing, writers organize the various aspects of the topic, decide what type of story they wish to tell, and what information would be most useful in telling that story (Entman, 1993; Scheufele, 1999; Tuchman, 1978). The frame also influences the relevant values readers use to analyze the information presented since “the quality of civic debate necessarily depends on the information available” (Tuchman, 1978, pg. ix).

Agricultural biotechnology is a complex topic with many societal implications. As such, certain frames have been identified for agricultural biotechnology reporting:

Progress: celebration of new development, breakthrough; direction of history; conflict between progressive/conservative-reactionary

Economic prospect: economic potential; prospects for investment and profits; R&D arguments

Ethical: call for ethical principles; thresholds; boundaries; distinctions between acceptable/ unacceptable risks in discussions on known risks; dilemmas. Professional ethics.

Pandora’s box: call for restraint in the face of the unknown risk; the opening of flood gates warning; unknown risks as anticipated threats; catastrophe warning

Runaway: fatalism after the innovation; having adopted the new technology/products, a price may well have to be paid in the future; no control any more after the event

Nature/nurture: environmental versus genetic determination; inheritance issues

Public accountability: call for public control, participation, public involvement; regulatory mechanisms; private versus public interests

Globalization: call for global perspective; national competitiveness within a global economy; opposite: splendid isolation (Nisbet & Lewenstein, 2002, p. 372)

Early reporting of agricultural biotechnology and general biotechnology framed articles primarily in terms of its scientific progress or economic prospect (Nisbet & Lewenstein, 2002; Thomson & Dininni, 2004). Over time, however, a shift away from scientific progress and economic prospect framing occurred (Nisbet & Lewenstein, 2002; Thomson & Dininni, 2004; Thomson, Dininni, & Kramer, 2005). Between 1995 and 1999, general biotechnology framing was moving towards ethical framing (Nisbet & Lewenstein, 2002). In 2001 and 2002, agricultural biotechnology was also increasingly being framed in terms of public accountability (Thomson & Dininni, 2004; Thomson et al., 2005). One interpretation of this shift might be that of a social maturation where writers and readers move from considering the technology in terms of its novelty and creativity towards considering its broader social impacts. Furthermore, these social impacts may have more relevance to the readers' concerns, and thus more long-term interest, than the technology's novelty.

Because of an article's frame, certain angles may have more salience within the article (Entman, 1993). For example, an economic prospect article would be primarily concerned with economic angles and might only discuss other angles, such as health, social or environmental angles, to the extent that they affect the primary angle of economics. Furthermore, an economic prospect framed article may not deal at all with health or environmental issues. However, a runaway or a Pandora's box framed article might not report on economic issues because, in such an article, damage to the environment or to public health would be the primary concern and

economics would not be relevant. An initial investigation by Thomson and Dininni (2004) found that the angles of newspaper reporting did change in focus depending on frame. In 2002, the most common angle reported in articles framed in terms of public accountability were social aspects whereas economic prospect/scientific progress framed articles mentioned economic angles most often (Thomson & Dininni, 2004). Interestingly, the most commonly used angles (Thomson & Dininni, 2004) were not the angles about which the public expressed the most interest - health and environmental issues (Hallman et al., 2004).

Framing has also been shown to have an effect on controversy reporting of general biotechnology such that progress framing was associated with reduced controversy reporting (Ten Eyck & Williment, 2003). Nisbet and Lewenstein (2002) also found controversy reporting in general biotechnology in national newspapers has increased over the years from about 30% of articles mentioning some controversy in 1970-1974 to 67% in 1995-1999. Ten Eyck and Williment (2003) noted that while general biotechnology reporting of controversy was dependent on frame, food-related biotechnology was controversial even initially and prior to general biotechnology being reported as controversial. Priest (2001) also discussed some of the health-related and economic controversies which surrounded the introduction of rBST milk. However, no studies were identified that have systematically examined which aspects of the technology are being reported as controversial.

Purpose and Objectives

The purpose of this study was to investigate the coverage of agricultural biotechnology reporting in four national newspapers for the most recent full year of coverage. The specific objectives were to:

1. Identify frames used to report agricultural biotechnology;

2. Identify the angles of agricultural biotechnology's impact reported and their relationship to article framing;
3. Identify the types of controversies reported and their relationship to article framing.

Methods

For this study, the *Los Angeles Times*, the *New York Times*, the *Wall Street Journal*, and the *Washington Post* were selected as the sample national newspapers. They were chosen based on their national recognition, daily circulation, and searchability. Each is a respected newspaper. The *Los Angeles Times* has been described as "the largest and most influential daily on the West Coast" (Bagdikian, 1997/1999, pg. 152). The *New York Times*, as well as the *Wall Street Journal* and the *Washington Post* are often used as peer sources for story ideas for other media across the country (Gans, 1980/1999). Gitlin (1980/1999) also noted many newspapers, which have shut down their out-of-town bureaus, have also shown an increased dependence on news from wire services, especially the *Los Angeles Times*, the *New York Times*, and the *Washington Post* wire services. Based on their year 2000 circulations, each is within the top five most circulated papers in the United States (Facts about newspapers 2001, 2001).

Articles were selected using Lexis-Nexis (the *New York Times* and the *Washington Post*), Newsbank (the *Los Angeles Times*), and Factiva (the *Washington Post*) for the calendar year January 1, 2004 to December 31, 2004 using the following search terms:

"ag biotech" OR "GMO" OR "gm crop" OR "gm food" OR "agricultural biotechnology" OR "genetically engineered crop" OR "ge crop" OR "ge food" OR "genetically engineered food" OR "genetically altered crop" OR "genetically altered food" OR "genetically modified food" OR "GMF" OR "genetically modified crop" OR "genetically modified organism"

All articles found in this search (N= 154) were coded using a code developed by Thomson and Dininni (2004) and refined by Dininni, Thomson, and Kramer (2005). The final code contained 32 variables, including the variables of frame, angle, and controversy type.

To determine inter-coder reliability, two volunteers were recruited to code eight articles following a brief training session. Both volunteers were only trained for reliability purposes and did no further coding. All coding for data analysis was performed by a single coder once code reliability was determined. The eight articles were selected such that each paper was represented by two articles. For the *New York Times*, the *Wall Street Journal*, and the *Washington Post*, two articles each were randomly selected from all articles found that were published in those papers for the calendar year of 2001; the same was done for the *Los Angeles Times* for the calendar year of 2004. The volunteers were trained and given a practice article to code which was not one of the randomly selected articles. A tentative inter-coder reliability was determined, and the volunteers were further trained to clear up any confusion. Once the volunteers understood the codebook, they were given the eight articles to code on their own. For each variable, the percent agreement between the two volunteers and the main coder for each article was determined (0% for no agreement, 66% for two coders in agreement, and 100% for all in agreement). The percent agreements in each of the eight articles were then averaged to determine the inter-coder reliability for each variable.

The variable of frame was based on the agricultural biotechnology frames defined in the theoretical framework. However, for this code, scientific progress and economic prospect were combined because previous work by Thomson and Dininni (2004) found they can be difficult to distinguish. Pandora's box and runaway were also combined since the two are also closely related and difficult to distinguish when coding. The other frames were distinct enough to retain.

Articles were coded using the following frames: ethical, nature/nurture, public accountability, globalization, scientific progress/economic prospect, and Pandora's box/runaway. Inter-coder reliability was 0.75.

The variable of angle was defined by Dininni and Thomson as "emphasis on social, environmental, health and/or economic impact of agricultural biotechnology" (2003, p. 2). The inter-coder reliability for each angle was 0.88 for social, 0.83 for environmental, 0.75 for health, and 0.75 for economic. Articles could have more than one angle. If the angle was mentioned even once, the article was coded as containing that angle.

The refined Dininni et al. (2005) code included a variable for the type of controversy reported. This variable expanded on Nisbet and Lewenstein's (2002) variable of reporting of controversy where absence or presence of controversy was coded. Although Nisbet and Lewenstein (2002) did not specifically define controversy, the American Heritage College Dictionary defined it as "a dispute, esp. a public one, between sides holding opposing views" (Berube et al., 2000, pg. 303). Articles in our study were examined for the type of controversies reported. Types of controversy identified were: economic controversy, environmental controversy, health controversy, legal/regulatory controversy, social controversy, technology usefulness controversy, or other controversy. Legal/regulatory controversy referred to controversies surrounding legal issues, voluntary regulatory mechanisms or mandatory regulatory mechanisms (Dininni et al., 2005) and had an inter-coder reliability of 0.75. Technology usefulness controversy pertained to genetic augmentation working as claimed, augmented strains still producing or becoming obsolete, the technology growing or becoming obsolete, or arguments for agricultural biotechnology based on potential benefits yet to be developed (Dininni et al., 2005). Inter-coder reliability for it was 0.92. Social controversy,

environmental controversy, health controversy, and economic controversy pertain to social, environmental, health, and economic disagreements. Their respective inter-coder reliabilities were 0.88, 0.92, 0.71, and 0.79. Other controversy, with an inter-coder reliability of 0.92, pertained to any other type of controversy that did not fit into the defined categories.

Data collected from the newspapers using the code were analyzed using the SPSS 13.0 for Windows data analysis software.

Results

Objective 1: Article Framing

We first examined article framing to determine what the most prominent frames across the four newspapers were (See Table 1). For the *Los Angeles Times*, the *New York Times*, and the

Table 1

Frame Across Newspapers

| Frame | Newspapers | | | |
|------------------------|--------------------------|-----------------------|------------------------|----------------------------|
| | <i>Los Angeles Times</i> | <i>New York Times</i> | <i>Washington Post</i> | <i>Wall Street Journal</i> |
| Sci. Prog./ Eco. Pros. | 5 | 13 | 10 | 6 |
| Public Accountability | 17 | 20 | 17 | 4 |
| Ethical | 2 | 6 | 4 | 1 |
| Globalization | 0 | 5 | 4 | 8 |
| Runaway/Pandora's Box | 0 | 6 | 3 | 0 |
| Nature/Nurture | 0 | 0 | 1 | 1 |
| Other | 4 | 10 | 6 | 1 |
| N | 28 | 60 | 45 | 21 |

Washington Post, the most prevalent frame was public accountability. However, the relative level of use for this frame was different across these three newspapers. About 60% of the articles in the *Los Angeles Times* were framed using public accountability while one-third and just over one-third of the articles in the *New York Times* and *Washington Post* respectively were framed this way. The next most prominent frame for these three newspapers was scientific progress/economic prospect. The rate of use was similar among the three newspapers at about 20% of the articles. The *Wall Street Journal*, however, was distinct from the other three papers in how most articles were framed. The *Wall Street Journal's* most prominent frame was globalization, with over one third of the articles using this frame. The next most common frame was scientific progress/ economic prospect, with 6 out of 21 articles framed that way. Overall, the most frequent frame for articles was public accountability, and the next most common frame was scientific progress/ economic prospect.

Objectives 2 & 3: Angle of Agricultural Biotechnology's Impact

We examined the angles of agricultural biotechnology's impacts reported in each article (See Table 2). Articles could have more than one angle. Across each newspaper, the most common angle reported was social. This angle is consistent with news media being a conduit for socially relevant information. All four newspapers also had economic issues as the second most reported angle for agricultural biotechnology. While over half of the articles in each paper mentioned economic issues, the percentage of articles ranged from a low of 53% in the *Los Angeles Times* to 100% of the *Wall Street Journal* articles.

Environmental and health issues were not covered as extensively as economic issues in any of the four newspapers. Both issues were each reported in less than half of the articles for two out of the four newspapers. The *New York Times* reported on environmental issues in just

over half of its articles (31 out of 60) while the *Wall Street Journal* reported on health issues in 11 out of 21 articles. Across these four newspapers, environmental and health angles were always reported less often than social and economic angles.

Table 2

Angle of Reporting Across Newspapers

| Angle ^a | Newspapers | | | |
|--------------------|--------------------------|-----------------------|------------------------|----------------------------|
| | <i>Los Angeles Times</i> | <i>New York Times</i> | <i>Washington Post</i> | <i>Wall Street Journal</i> |
| Economic | 15 | 43 | 32 | 21 |
| Environmental | 11 | 31 | 22 | 10 |
| Health | 12 | 28 | 19 | 11 |
| Social | 27 | 54 | 44 | 21 |
| Other | 0 | 1 | 1 | 0 |
| N | 28 | 60 | 45 | 21 |

Note. ^aEach article could contain more than one angle.

Next, we compared the frames to the angles reported (See Table 3). For the most frequent frame overall, public accountability, the most dominant angle was social; 41 out of 58 articles reported on social issues. The next most prominent angle for this frame was economic, with half of the articles reporting these issues. For scientific progress/economic prospect framing, economic issues were most frequently reported in 24 out of 34 articles with social issues closely following in 23 articles.

Again, neither of the most commonly used frames, public accountability and scientific progress/ economic prospect, reported environmental and health issue as often as social or

economic issues. For public accountability framing, environmental and health issues were only reported in 41% and 36% of articles respectively. Environmental and health issues were reported in less than one-third of all scientific progress/economic prospect framed articles.

Table 3

Reporting Angle By Frame Across the Los Angeles Times, the New York Times, the Washington Post, and the Wall Street Journal

| Frame | Angle ^a | | | | N ^b |
|------------------------|--------------------|----------|--------|--------|----------------|
| | Economic | Environ. | Health | Social | |
| Sci. Prog./ Eco. Pros. | 24 | 11 | 6 | 23 | 34 |
| Public Accountability | 29 | 24 | 21 | 41 | 58 |
| Ethical | 8 | 8 | 10 | 11 | 13 |
| Globalization | 16 | 9 | 8 | 17 | 17 |
| Runaway/Pandora's Box | 8 | 8 | 5 | 9 | 9 |
| Nature/Nurture | 1 | 1 | 2 | 2 | 2 |
| None | 7 | 2 | 6 | 16 | 21 |

Note. ^aEach article could contain more than one angle. ^bData are compiled for all four newspapers.

Objectives 4 & 5: Types of Controversy Reported for Agricultural Biotechnology

We next examined the types of controversies reported for agricultural biotechnology (See Table 4). More than one type of controversy could be mentioned in an article. Across all four newspapers, social controversies were reported most often, from 75% of the *Washington Post's* articles to 95% of the *Wall Street Journal's* articles. The two next most commonly reported types of controversies were economic and legal/regulatory. However, differences among the

newspapers existed. In the *Los Angeles Times* and the *Washington Post*, legal/regulatory controversy was the second most reported type of controversy while economic controversy was the third. In the *New York Times* and the *Wall Street Journal*, this order was reversed. Overall 84% of articles mentioned some social controversy, 57% mentioned a legal/regulatory controversy, and 53% mentioned an economic controversy.

Table 4

Types of Controversy Reported Across Newspapers

| Controversy ^a | Newspapers | | | |
|--------------------------|--------------------------|-----------------------|------------------------|----------------------------|
| | <i>Los Angeles Times</i> | <i>New York Times</i> | <i>Washington Post</i> | <i>Wall Street Journal</i> |
| Economic | 12 | 32 | 18 | 19 |
| Environmental | 9 | 19 | 13 | 9 |
| Health | 11 | 18 | 15 | 10 |
| Legal/Regulatory | 19 | 31 | 21 | 17 |
| Social | 26 | 49 | 34 | 20 |
| Technology Promise | 3 | 10 | 5 | 3 |
| Other | 0 | 1 | 0 | 0 |
| N | 28 | 60 | 45 | 21 |

Note. ^aEach article could contain more than one type of controversy.

As with angle of reporting, health and environmental controversies were not mentioned as often as social and economic controversies, as well as legal/regulatory controversies. Health controversies were only mentioned in 35% of articles overall. Less than one-third of the total articles mentioned environmental controversies.

Finally, we compared article frames to the types of controversy reported in overall national reporting of agricultural biotechnology (See Table 5). For all frames, social controversy was the most commonly reported type of controversy. For public accountability, the most often used frame, the next most reported controversies were legal/regulatory controversies, reported in almost three-quarters of articles. Economic controversy followed in half of the articles. In scientific progress/economic prospect framing, economic controversies were the second most reported controversies in 16 out of 34 articles while legal/regulatory controversies closely followed with 15 articles reporting them.

Table 5

Overall Type of Controversy Reported By Frame for All Four Newspapers

| Frame | Controversy ^a | | | | | | | N ^b |
|------------------------|--------------------------|------|--------|---------------|------|----------------|-------|----------------|
| | Econ. | Env. | Health | Leg./ Reg. | Soc. | Tech. Prom. | Other | |
| Sci. Prog./ Eco. Pros. | 16 | 6 | 5 | 15 | 23 | 4 | 0 | 34 |
| Public Accountability | 29 | 24 | 24 | 43 | 51 | 5 | 1 | 58 |
| Ethical | 7 | 6 | 8 | 7 | 10 | 5 | 0 | 13 |
| Globalization | 16 | 5 | 6 | 13 | 17 | 2 | 0 | 17 |
| Runaway/Pandora's Box | 6 | 6 | 4 | 4 | 7 | 3 | 0 | 9 |
| Nature/Nurture | 1 | 1 | 2 | 1 | 3 | 0 | 0 | 2 |
| None | 6 | 2 | 5 | 5 | 19 | 2 | 0 | 21 |

Note. ^aEach article could contain more than one type of controversy. ^bData are compiled from all four newspapers.

Coverage of environmental and health controversies in public accountability framing was higher than we found in overall coverage. Environmental and health controversies were each reported in 41% of articles using public accountability framing but in less than 18% of scientific progress/economic prospect framed articles.

Conclusions and Discussions

First, agricultural biotechnology is not extensively reported in the national newsprint media. Across four national newspapers, only 154 articles were published for the calendar year of 2004. Even the most prolific newspaper, the *New York Times*, published only 60 pieces, just over one piece a week. Experts suggest extensive coverage is needed to increase public knowledge about a subject for which they are not predisposed to seek information (Calvert, 2000). It is unclear exactly how much coverage constitutes “extensive.” However, in 2000 and 2001, the *New York Times* published 124 and 189 articles respectively (Thomson & Dininni, 2004). This coincided with both Starlink reporting and an increased awareness of agricultural biotechnology in the general public (Marks & Kalaitzandonakes, 2001). Total coverage among four papers in 2004 did not reach the level of coverage for a single paper in 2001. Furthermore, while the studies Marks and Kalaitzandonakes (2001) referenced considered awareness, no mention was made of public knowledge. Yet, the public can have heard or read something about the technology, and thus be aware it exists, without understanding much about it (Hallman et al., 2003; Hallman et al., 2004). While awareness might be the logical first step towards knowledge-gain and understanding, continuing on that path would likely require increased exposure, not less. Therefore, if newspapers are a major source of information about agricultural biotechnology for the public (Hoban & Kendall, 1993), and so few pieces are printed, it is no wonder the public is not informed (Hallman et al., 2004).

Second, national newspapers are continuing the move away from scientific progress/economic prospect framing. In 2002 national newspaper reporting, public accountability was the most commonly used frame, found in 26% of all articles (Thomson et al., 2005). Scientific progress/economic prospect framing followed closely in 23% of all articles (Thomson et al., 2005). By 2004, public accountability framing had increased to one-third of all articles, and scientific progress/economic prospect framing had dropped to 20%. This shift suggests that newspaper coverage is maturing beyond reporting on the potential of the technology to the impacts it is having on regulation, something more relevant to the public's concerns.

Even the *Wall Street Journal*, which differed from the other three papers in that its most prominent frame was globalization, showed a broadening in its reporting. Articles were also primarily framed using scientific progress/economic prospect in 2001 (Thomson et al., 2005). In 2002, framing in the *Wall Street Journal* moved to globalization, with 34% of its articles using this frame (Thomson et al., 2005). Globalization framing increased to 38% in 2004. While the globalization frame still focused on economic issues, instead of using scientific progress/economic prospect framing to report on the potentials of agricultural biotechnology, the use of globalization framing meant articles covered how agricultural biotechnology affects the broader issue of global competition.

Across the newspapers, framing continued to move away from the technology's potential to the impacts it is having. Yet despite this move, the impacts being reported do not appear to correspond with the primary concerns of the public – health and the environment (Hallman et al., 2004). This analysis showed social and economic issues were the most commonly reported angles. This reporting held true across newspapers as well as across the two most commonly

used frames, public accountability and scientific progress/economic prospect. The public has expressed less concern with the economic issues raised by agricultural biotechnology than with health and environmental issues (Hallman et al., 2004), and people are more likely to read and learn about topics they perceive are more relevant to them (Hidi, 2001). Furthermore, newspaper readers are often distracted while reading (Calvert, 2000). Therefore, reporting on aspects in which the public is less interested may not catch readers' attention, further contributing to the public's lack of knowledge on the topic.

The controversies reported also are not related to the issues in which the public is most interested. While public accountability framing reflected a consideration of broader social issues, the controversies reported were social, economic, and legal/regulatory. Considering public accountability addresses regulating the technology, one would expect legal/ regulatory controversies. However, articles also focused on economic issues involved in this regulation rather than on public health and environmental safety reasons for having these regulations. In terms of relevance, economic controversies might have salience for those interested in investment and trade, but public health and environmental controversies would have relevance for the public at large. Again, the controversies in which the public is interested regarding agricultural biotechnology are not as widely reported as other controversies, therefore these articles are not likely to catch the general public's eye and to capture their interest in the topic of agricultural biotechnology.

This study focused on national newspaper coverage of agricultural biotechnology. While this approach can provide a good national overview of coverage, it is limited in that regional reporting can differ from national coverage (Thomson & Dininni, 2004). Reporting can also vary

across regions (Thomson & Dininni, 2004). If there are regional differences in public knowledge of agricultural biotechnology, regional differences in coverage could be a contributing factor.

Implications and Recommendations

Our results demonstrate that national newspaper reporting of agricultural biotechnology is not covering the issues of greatest concern and most relevance to the public on this topic. The public is largely uninformed about agricultural biotechnology (Hallman et al., 2003; Hallman et al., 2004). With news reporting focusing on issues not relevant to them, it seems unlikely the public will ever become more informed through newspaper reporting.

However, expecting newspapers to increase coverage on a topic in which the public has limited interest may not be realistic. News reporting is current events driven, meaning news tends to report what has happened most recently rather than what might happen or what has happened in the past (Park, 1940/1999). The topics that the average reader would likely find most relevant, however, are not necessarily those that would be part of current events. Health and environmental issues are potential effects or past events, such as the Starlink scandal, not current happenings. In contrast, economic issues are easily visible in the events of the day, such as trade disputes. Unless a major environmental or public health event related to agricultural biotechnology occurs again, these topics are not likely to take center stage in newspaper coverage of agricultural biotechnology.

Instead, facilitating public interest in and dialogue about agricultural biotechnology will depend on strategies other than waiting for newspapers to change the manner in which they cover agricultural biotechnology. The professionals looking at agricultural biotechnology, especially in the broader context of how it affects the local food system, are already aware of its importance to the public and local communities. They have the creative insights crucial for

making the topic “real” to the public. It is then their responsibility to use these insights to inform the public of agricultural biotechnology’s relevance. When being interviewed by journalists covering agricultural biotechnology, professionals can answer the journalist’s questions in such a way as to make the information relevant and meaningful to the general public.

Those change agents interested in improving public dialogue about agricultural biotechnology will also have to use more active strategies than relying on media coverage. A part of the broader topic of local food systems, agricultural biotechnology affects the food available in a community, which is an issue relevant to everyone in that community. To have meaningful dialogue, the local food systems, and the subtopic of how they are affected by agricultural biotechnology, should be discussed in a context so that the public finds it personally relevant: how it affects their health, the local environment, and the local economy. For example, an educator might use a structure similar to the UK Café Scientifique to foster a dialogue (Café Scientifique, 2005). In such a group, members of the scientific community meet with members of the local community over a cup of coffee to discuss current issues brought up due to scientific progress (Café Scientifique, 2005). Regardless of the method used to improve dialogue about agricultural biotechnology, though, change agents have the responsibility of making the topic meaningful to the public and of discussing public concerns.

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