Attention Cycles and Frames in the Plant Biotechnology Debate

Managing Power and Participation through the Press/Policy Connection

Matthew C. Nisbet and Mike Huge

Power in policy making revolves in part around the ability to control media attention to an issue while framing an issue in favorable terms. These two characteristics of media coverage both reflect and shape where an issue is decided, by whom, and with what outcomes. In understanding this process, a number of studies have observed cyclical waves in media attention and historical shifts in how an issue is framed, linking these features to policy decisions. Yet there has been little theoretical specification and testing of the social mechanisms that drive these cycles. With this in mind, this study outlines a model for understanding "mediated issue development." The theoretical components of the model include the type of policy arena where debate takes place, the media lobbying activities of strategic actors, the journalistic need for narrative structure, and the competition from other issues for attention across policy and media environments. Related factors include the type of journalist assigned coverage and the level of attention from opinion pages. Using data from a content analysis of twenty-five years of coverage at the *New York Times* and *Washington Post*, the model is applied and tested against the issue of plant biotechnology. Generalizability of the model is the primary goal, and the authors conclude with comparisons to other issues such as the Human Genome Project and intelligent design. Understanding, however, why plant biotechnology remains at low levels of controversy in the United States compared to the rest of the world remains the object of considerable curiosity, and the focus of this study posits several explanations.

Keywords: *framing; attention cycles; public arenas; problem definition; scope of participation; biotechnology*

Like many issue entrepreneurs competing to shape policy in the nation's capital, environmentalist Larry Bohlen figured that a major media controversy might

Press/Politics 11(2):3-40
DOI: 10.1177/1081180X06286701

steal power and influence away from industry, turning the tables on what he perceived to be a long history of flawed regulatory decisions concerning plant biotechnology. In 2000, he suspected that StarLink, a genetically modified (GM) corn variety approved only for animal feed, was mixing with traditional corn strains during harvest and processing and was likely to have made its way into common food products such as taco shells, corn dogs, and tortilla chips. Bohlen feared that if consumers ingested StarLink corn, genetically engineered to express a special protein, they risked severe allergic reactions.[1]

What made the possible mixing of StarLink corn with traditional varieties especially useful as a focusing event was StarLink's lack of approval for human consumption. Since the early 1980s, a few interest groups had been calling attention to perceived systemic-level problems in the monitoring and successful segregation of plant biotechnology products, but despite extensive efforts, these groups had little success in changing policy. As we will review, a series of key federal policy decisions in the late 1980s and early 1990s had successfully limited official debate about the technology to a narrow range of short-term health and environmental factors. Out of bounds for serious consideration in regulation were uncertainties about long-term environmental or health risks, or calculations of social, ethical, or economic impacts. Yet Bohlen and others hoped that if contamination of the human food supply could be shown in the case of StarLink corn, it might focus public and policy maker attention on reconsidering the central assumptions of GM agriculture policy.

Sponsored by a coalition of interest groups calling themselves Genetically Engineered Food Alert, Bohlen sent samples of Taco Bell shells to a lab to be tested for traces of StarLink. When results confirmed Bohlen's suspicions, he searched a newspaper database to find a reporter who might be receptive to the story and identified Marc Kaufman of the the *Washington Post*. Kaufman had joined the *Post* in 1999, after seventeen years with the *Philadelphia Inquirer* working as a general assignment and political reporter. Though Kaufman did not have formal training in science, he had spent three years at the *Inquirer* covering science and health (for more on Bohlen's strategy, see Rodemeyer and Jones 2002). Kaufman double-checked the claims with Environmental Protection Agency (EPA) and Food and Drug Administration (FDA) scientists, and in a September 18, 2000, second-page *Washington Post* story detailing the discovery, Kaufman quoted Bohlen as voicing the following warning: "This corn is absolutely not supposed to be in our food, but an independent lab found it there anyway. This shows a major regulatory failure and raises some real human health concerns."[2] On September 22, after confirming the presence of StarLink in their taco shells, Kraft Foods issued a nationwide recall. The company's decision drew the attention of the *New York Times* to the event for the first time. In a September 23 article fronting the business section of the paper, the lead quote featured another Genetically Engineered Food Alert spokesperson: "I view it as a very poignant

cautionary tale that our regulatory system is not up to the task of preventing potential problems with genetically engineered food."[3] News of the StarLink discovery triggered quakes across the food industry that would play out for the next two years. Other food companies including Safeway and Kellogg's would be forced to recall millions of boxes of taco shells and similar products. Aventis, developer of StarLink, would fire the president, vice president, and chief financial officer of their Crop Science division, putting the division up for sale, with estimates of $100 million in losses (Taylor and Tick 2001).

As Marion Nestle (2004) suggests, when news reports in late December 2000 revealed that the EPA knew as early as 1997 that StarLink corn had contaminated the human food supply, one possible interpretation by journalists was that of a major political cover-up, complete with the drama of possible congressional hearings. What did Aventis and the EPA know, and when did they know it? And why did it take a coalition of environmental groups to draw attention to the public health risk rather than industry or regulators? As we will review, however, major news organizations did not react to the issue as a revelation worthy of the scandal label, assigning coverage to the politics desk and the front page. Instead, the press characterized the controversy predominantly from an industry and regulatory angle, with coverage delegated predominantly to business and science reporters, an editorial decision consistent with several decades of news coverage of the technology.

The StarLink affair generated a historic spike in press attention to plant biotechnology, but even compared to other science and food-related issues at the time, plant biotechnology received only modest attention. In part, Bohlen's creative press strategy was hindered by its timing, coming during the heat of a historically tight presidential race, with any subsequent political fallout from StarLink lost in the competing noise of the controversy over the disputed Florida vote count. Not surprisingly, polls indicate that the American public's concern over plant biotechnology remained minimal and that the event had little or no impact on collective public attention (Shanahan et al. 2001). Moreover, as we will review, history shows that regulatory change in response was incremental at most. The StarLink affair became just another event where the press played an important role in both reflecting and shaping the scope of controversy surrounding plant biotechnology.

Toward a Model of Mediated Issue Development

Bohlen's efforts to alter the direction of biotechnology policy making by boosting the level of media attention and by morphing the image of the issue in the press are time-honored tactics employed by operatives across the policy spectrum. As part of the power game of politics, advocates routinely attempt to control media attention to an issue while defining an issue in favorable terms.

Rarely, however, do insiders offer a systematic account of how press lobbying activities and strategies can be applied across issues and time, shaping the trajectory of policy making. Communication researchers, political scientists, and sociologists have generated a vast literature on the link between press coverage and the policy process. If advocates and policy makers can be faulted for a narrow short-term focus, scholars can be criticized for a lack of clarity and consistency in their theorizing. Part of the problem is that scholars from different (and even the same) disciplines often end up using varying terms and concepts in studying the same phenomena.

With an eye toward integration in theorizing, in this study we bring together multiple common threads from the interdisciplinary literature in understanding the exercise of power in the press-policy connection. One shared point of departure we identify is a decades-old idea of Anthony Downs (1972) dubbed the "issue attention cycle." Other common themes we highlight include E.E. Schnattschneider's (1960) classic "mobilization of bias" and "scope of participation" thesis, studies of the links between policy agendas and problem definition, research on social problems construction, a sizable literature specific to media framing, work related to news narratives and journalistic norms, and literature on the social dynamics of science-related disputes.

Downs (1972) was able to articulate in a provocative way what appears to be an essential element about the mysterious nature of collective attention. According to Downs, an issue rests in a preproblem stage until a triggering event catapults it into public attention. This triggering process is often followed by a period of public concern and collective enthusiasm to solve the problem. Yet policy makers and the media inevitably exhaust dramatic elements of the issue that are needed to sustain interest, and new issues in the attention pipeline take its place. Once the issue has passed through the attention cycle, it remains on average more likely to receive future attention than other issues that might have been left behind in the primeval soup of prediscovery. The rise in attention leads to the creation of institutional arrangements to solve the problem, and these institutional arrangements persist long after initial attention subsides. Also according to Downs, important aspects of the issue may become attached to a separate issue that later comes to dominate attention.

Various studies have poked holes in Downs's (1972) explanation, demanding more evidence and elaboration while recognizing the value of his original ideas. Notably, many researchers fault Downs's issue attention hypothesis for failing to articulate the underlying mechanisms that might drive attention cycles, for neglecting the important connection between attention and definition of an issue, and for overlooking the influence of competing issues on the media and public agenda.

For example, sociologists Stephen Hilgartner and Charles Bosk (1988) argue that levels of attention to a problem are a function not of objective conditions

alone but are determined by a social contest over the nature and importance of issues. Political operatives select a particular interpretation of an issue from a plurality of realities, and the interpretation that comes to dominate public discourse has profound implications for the future life cycle of the issue, for the interest groups involved, and for policy decisions. This interpretative struggle occurs across various "public arenas," social environments such as the news media or various political institutions where issues compete for attention. These arenas have limited carrying capacities, meaning that they can only pay attention to a limited number of problems at any given time. Consequently, unless carrying capacity increases, the rise of one issue to agenda status means that another issue is likely to be bumped from consideration. As Hilgartner and Bosk argue, competition means that there are a few very successful problems that achieve widespread "celebrity" status and attention, a few other moderately successful issues, and an overwhelming number of less successful issues. As we will see in the case of plant biotechnology, when an issue shifts through Downs's (1972) upward swing in attention, a historic peak in the issue's level of attention does not necessarily mean that the topic achieves celebrity status and dominates the media agenda. Rather, its importance is contingent on a number of principles of selection that we outline, as well as the status of other competing issues at the time.

Given these lingering questions, we conceptualize in this study several important underlying social mechanisms that drive cycles of media attention and definition to policy issues, what we call a "a model of mediated issue development."[4] In Figure 1, we sketch the cycle of attention outlined by Downs (1972) and then highlight as underlying mechanisms (1) the type of policy venue where debate takes place or is centered, (2) the media lobbying activities of competing strategic actors as they attempt to interpret or "frame" the issue advantageously, (3) the tendency for different types of journalists to depend heavily on shared news values and norms to narrate the policy world, and (4) the context relative to other competing issues. Some issues achieve celebrity status as they go through these cycles, but other issues—even in their peak years of attention—still rest relatively modestly on the overall media agenda. An important part of this process is the shift in coverage across news beats, from specialist journalists such as science writers and business reporters to political writers and general assignment reporters, and the spread in attention across the opinion pages. It may be useful for the reader to refer back to this figure as an aid and heuristic as these mechanisms are further explained throughout the article.

To demonstrate these mechanisms, we identify and review the major stages in political development specific to plant biotech. We then measure and trace patterns in media attention to, and definition of, plant biotechnology and present data from a content analysis of coverage appearing in the *New York Times* and *Washington Post* from the earliest mention of the technology in 1978 through the

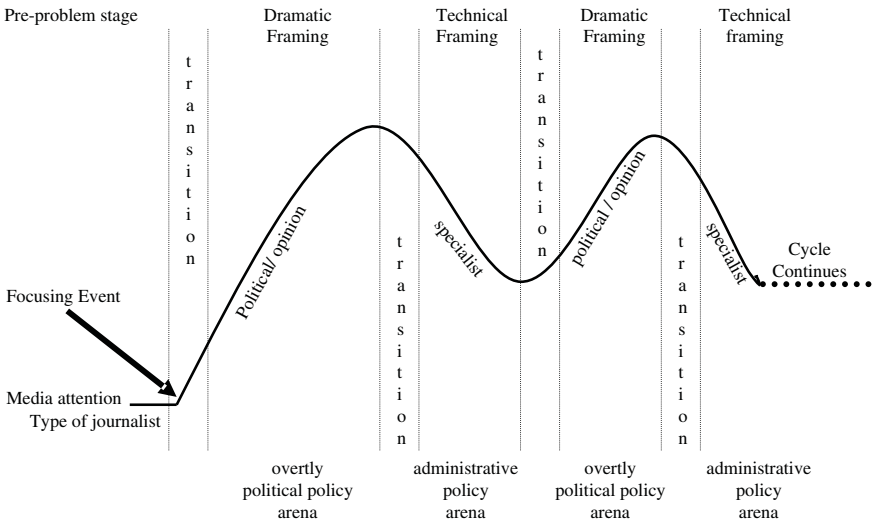

Figure 1
Model of Mediated Issue Development

end of 2004. This study is part of a larger project to assemble multiple data points across a range of issues, probing and identifying contingencies, boundary conditions, and necessary alterations in the model. In thinking about generalizability, however, we do not want to downplay the intrinsic importance of understanding the dynamics of the plant biotechnology debate. Understanding why the issue remains at low levels of collective attention and controversy in the United States compared to the rest of the world remains the object of considerable curiosity, and the focus of this study offers several possible explanations.[5]

Competition and mobilization of bias across policy venues and arenas. As previously mentioned, a few key principles and mechanisms underlie the model. First, advocates and officials competing to shape American policy operate within a political system with multiple venues as access points. For example, on the issue of plant biotechnology, influence can be gained within administrative, regulatory or funding agencies such as the EPA, the U.S. Department of Agriculture (USDA), the FDA, or an independent scientific advisory body such as the National Academy of Sciences (NAS). At other times, influence over decision making might occur within more overtly political arenas such as Congress or the White House. According to Schnattschneider (1960), power and influence across these policy venues turns on the number of actors, interest groups, and people that become involved in a policy matter, a phenomenon he first identified as "the scope of participation."

As Schnattschneider (1960) argues and others elaborate, the political system is an uneven playing field. Each policy venue holds certain biases and tends to favor certain actors and arguments over others. For those actors advantaged by status quo decision making on an issue within any single policy venue, it is in their best interest to limit the scope of participation since adding new seats to the bargaining table might disrupt the balance of power. For the disadvantaged, it is almost always wise to try to expand the scope of participation since recruiting new players to the conflict increases the potential for a change in power (Cobb and Elder 1983). New participants do not join the conflict randomly or distribute themselves equally across sides. Instead, they are lured by the way parties in the conflict manipulate the image of the issue (Rochefort and Cobb 1994). Therefore, the ability to advantageously define an issue, according to Schnattschneider, "is the supreme instrument of power." We will return to issue definition and framing in a subsequent section.

Administrative and overtly political policy arenas. Typically in administrative venues, the scope of participation is limited, with just a few actors given access and input to decision makers. These venues are characterized by consensus: Things happen incrementally, and scant attention follows. In overtly political arenas, the scope of participation is much wider, with a diversity of actors granted access and input. In these venues, consensus usually erodes, conflict can be high, there is the potential for nonincremental change, and when things happen, heavier media and public attention follows (Maynard-Moody 1992, 1995). The contests within each of these policy venues also vary in nature. When the site of decision making moves to an overtly political context such as Congress, the possible intensity of conflict and scope of participation expands.

In the case of emerging technologies such as plant biotechnology, administrative policy arenas typically afford special access and input from industry and the scientific community, enabling mostly insular decision making by administrators, scientists, and independently constituted scientific advisory boards. Decisions are often to the exclusion of the general public or other interests, and arguments based in scientific and technical terms are typically the most persuasive (Maynard-Moody 1992, 1995). Within this institutional arrangement, science and industry many times enjoy what Baumgartner and Jones (1993) term a "policy monopoly," and these administrative policy venues are often perceived as having issue ownership (Rochefort and Cobb 1994) over scientific topics. Absent any major redefinition, these technical arenas remain the recognized authorities on the causes, consequences, and solutions pertaining to science-related issues. As we will discuss in subsequent sections, scientific authority is created and defended in these arenas in part through the dominance of impersonal and neutral technical discourse (Nelkin 1975, 1992).[6]

In contrast to administrative contexts, overtly political arenas such as Congress and the White House are open to a greater diversity of interest group involvement and are a more pluralistic policy domain. In these venues, consumer groups, citizen activists, and environmentalists might all hold either equal or greater sway over decision making. The scientific community holds less authority, and dramatic arguments centered on ethics or social concerns often win out over an emphasis on scientific evidence or cost-benefit calculations (Maynard-Moody 1992, 1995; Nelkin 1975, 1992). After some deliberation, however, and a temporary solution is adopted, overtly political arenas ultimately prove inadequate for handling certain technical decisions, and policy is delegated back to the administrative context for further formulation and implementation (Maynard-Moody 1992, 1995).[7]

Framing. Examining the issues of nuclear energy, tobacco, and pesticides, past research finds striking similarities in the links between issue definition, media attention, and policy venues. In the case of each issue, its early history was characterized by positive image making and enthusiasm for creating institutional arrangements that would further market development. Yet ultimately these pro-industry policy monopolies were broken up by opponents who successfully redefined the issue in provocative and negative ways and who shifted decision making away from administrative arenas to more overtly political contexts (Baumgartner and Jones 1993; Bosso 1987; Weart 1988). As we will detail, our findings, as well as previous studies of agricultural biotechnology, partially confirm this pattern. Early U.S. media attention to biotechnology was relatively minimal and positive, contributing to favorable policy frameworks in the 1980s. Only since the late 1990s has negative attention to the technology appeared, but to date, a relative policy monopoly still holds (Nisbet and Lewenstein 2002; Ten Eyck et al. 2001).

With each of these issues, did changes in the nature of media discourse parallel changes in the nature of "real-world" conditions? Did nuclear energy and tobacco, for example, become inherently more risky across decades, leading eventually to the demise of their favored policy status? Both the policy definition and social problems literatures emphasize the constructivist nature of issues. Understanding shifts of power on an issue depends on analyzing the relationship between the approximately "objective" conditions surrounding an issue and their perceived and subjective definitions (Hilgartner and Bosk 1988). The emphasis on social construction introduces framing as a second key mechanism underlying the issue attention cycle.

A "frame" is a central organizing idea or story line to a controversy that provides meaning to an unfolding of a series of events, suggesting what the controversy is about and the essence of an issue (Gamson and Modigliani 1989). Frames are "thought organizers," devices for packaging complex issues in persuasive

ways by focusing on certain interpretations over others, suggesting what is relevant about an issue and what should be ignored (Ferree et al. 2002). Framing occurs at the policy level, the media level, and/or the public level (Scheufele 1999). At the media level, "frames may best be viewed as an abstract principle, tool, or schemata of interpretation that work through media texts to structure social meaning" (Reese 2001: 14). By giving more weight to some dimensions of a controversy over others, the frames in news coverage help guide policy maker and citizen evaluations about the causes and consequences of an issue, and what should be done (Ferree et al. 2002; Pan and Kosicki 1993).

Frames as general organizing devices should not be confused with specific policy positions. Individuals can disagree on an issue but share the same interpretative frame. Each frame as an organizing device for arguments and interpretations is "valence neutral," meaning that it can take pro, anti, and neutral positions, though one position might be in more common use than others (Ferree et al. 2002; Gamson and Modigliani 1989). Consider the ethics/morality frame we elaborate on later. This interpretation could be applied to package plant biotechnology as "playing God in the Garden," and violating the natural order of things, therefore leading to negative attributions about the issue. But the ethics frame could also be used to package plant biotechnology in a promotional light, emphasizing the moral duty to pursue a "gene revolution" that could "end world hunger."

By linking strategic interpretations to the type of policy arena where debate takes place, and how much attention an issue receives, in this study, we integrate the framing literature with parallel work on problem definition in political science. Across issues, a number of problem definition scholars have argued that when issues are debated within administrative contexts, as a way to limit wider involvement, advantaged actors typically define or frame an issue in narrowly technical terms using referential symbols that are devoid of emotional content (Bennett 2001; Edelman 1964; Nelkin 1992). Problem definition has important implications for how much attention an issue receives since interpretations that emphasize the technical dimension of an issue have less "symbolic weight," "potency," and/or "urgency," and are therefore an effective way to limit conflict expansion and subsequent attention to an issue (Cobb and Elder 1983). As part of the strategic effort to shift an issue away from an administrative policy arena to an overtly political arena, disadvantaged actors try to expand the scope of participation and intensity of conflict by employing definitions that evoke emotionally charged condensational symbols (Bennett 2001; Edelman 1964; Nelkin 1992). Again, in an important factor connecting issue attention and framing, definitions emphasizing dramatic dimensions of an issue—including ethics, morality, conflict, and uncertainty—are the type of "symbolically urgent" tactics that help drive conflict expansion and wider public concern (Cobb and Elder 1983).

Strategic actors understand that any single issue competes with many others for attention, and these actors actively work to frame an issue in ways that either deflect or attract attention, and persuade others to support their side. For political operatives, "framing an issue is therefore a strategic means to attract more supporters, to mobilize collective actions, to expand actors' realm of influences, and to increase their chances of winning" (Pan and Kosicki 2001: 40). Of particular relevance to this study, previous research has pinpointed the shift in framing of an issue from technical terms to dramatic terms as a key element in promoting the scope of participation around science-related controversies (Nelkin 1992). In sum, as Sheingate (forthcoming) notes in his policy study of biotechnology, and as we detail, how plant genetic engineering has been defined both reflects and shapes where the issue has been decided, by whom, and with what outcomes.

Transfer across newsbeats and specialist journalists. Of importance to understanding framing at the media level, often an issue will transcend various "news beats." For example, as an issue shifts from the science or industry sectors into overtly political arenas, coverage by science writers or business journalists may give way to coverage by political and general assignment reporters. This transfer of an issue across coverage domains from specialist journalists to political reporters helps explain in part a rise in media attention and the concomitant rise in emphasis of the strategy frame. Conversely, a shift in beats away from political reporters and back to specialist journalists helps explain a drop in media attention and a return to more technical frames.

Coverage of science has traditionally been associated with the science writer, a specialist journalist that various researchers have characterized as defining themselves apart from other members of the journalistic profession (Dunwoody 1980). In this capacity, science writers often view themselves as conduits between scientists and the public, with the goal of effectively communicating a scientist's results so that the public can have a better appreciation and understanding of the science topic or subject. Given this orientation, science journalists have been described as most likely to define an issue using scientific and technical frames (Nelkin 1995). Even science journalists, however, require elements of drama to write a news story. Scientific uncertainty, in this case, serves as a dramatic device (McComas and Shanahan 1999).[8] Very little research exists on the coverage tendencies of business writers when it comes to technology, but given their beat, we might expect an emphasis on economic and market development and the surrounding policy context. If science journalists hold expertise in the technical background of science, and business writers focus on market development, political journalists specialize in the technical matters of the political game (Hallin 1994; Kepplinger 1992, 1995; Lawrence 2000), meaning that

political journalists are much more likely to rely on the strategy frame as a way to interpret the complexities of many public issues (Mooney and Nisbet 2005; Nisbet 2004).

In light of these differences in reporting style and preferred frames across categories of correspondent, the shift in news beats and media definition has important implications for the amount of attention an issue receives. Any topic can become "politically relevant" and rise into the coverage domain of the political reporter with dramatic politically oriented frames replacing technically oriented frames. Therefore, due to the greater number of political reporters in comparison to science writers, and due to the greater amount of space given political coverage, when an issue becomes defined as politically relevant, the potential for volume of coverage about the topic increases (Kepplinger 1992, 1995). Moreover, when an issue is successfully defined as politically relevant, it is easier for political reporters to fit the issue into a narrative structure with a clear beginning to the controversy, and resolution of the conflict typically marked by legislative passage or other government action, conditions that conform to Cook's (1996) "conflict with movement." In contrast, when the issue remains defined by technical frames, it is much more difficult for a science writer or business reporter to fit the issue into a narrative structure. Scientific research has a perpetually moving goal line, with one discovery leading to the next discovery, and applications or significant breakthroughs often decades in the future. Similarly, market growth and developments are less easily defined in terms of conflict, with fewer identifiable climactic events to build coverage around in anticipation of a resolution to the narrative. As a result, science writers and business reporters are less likely than political journalists to be able to consistently produce news about an issue, instead relying more on routine channel opportunities such as a newly released scientific study, press conference, official report, stock price fluctuation, new product introduction, or company merger to file a story.

Ethical and moral frames are often difficult for all types of journalists to include in news narratives. Although reporters may occasionally take time to contextualize the ethics debate within news coverage, it remains challenging to think of news pegs or hooks for covering the ethical dimension of a policy debate, unless it is connected to some type of routine channel source such as the release of an ethics commission report. Coverage of ethics may also interfere with journalists' preference for the appearance of impartiality. Instead, editors are likely to delegate coverage of ethics to the opinion pages. Actors and sources connected to the debate generate fresh material in the form of letters, op-eds, and arranged editorial meetings that strategically emphasize the ethical side of an issue, and editors are happy to take advantage of the material, covering this dramatic dimension while insulating themselves partly from direct criticism. Therefore, as an issue moves to overtly political arenas, and sources start

lobbying the opinion pages of media outlets with submissions framed in ethical/moral terms, the prominence of the ethical/moral frame rises in coverage, and the total volume of coverage (as defined as the sum of both news and opinion articles) devoted to the topic increases.

Policy Background on Plant Biotechnology

In this section and in Table 1, drawing upon a number of selected policy studies on the topic, we identify key stages of policy development specific to plant biotechnology. Though we do not want to imply that the complex nature of the issue should be understood in a linear fashion, in analyzing and understanding twenty-five years of news coverage of plant biotechnology, it is useful to break down and compare our news media findings across roughly identifiable historical stages and their key events, since, as we have explained, media coverage is likely to both reflect and shape the policy debate. Moreover, as McComas and Shanahan (1999) have argued, since journalists rely heavily on narrative to structure the complexity of public affairs, the media tend to construct issues linearly, with beginnings, middles, and ends.

As we detail in Table 1, a number of early U.S. policy decisions addressed regulatory uncertainty by narrowly defining questions about genetic engineering in technical ways. Dominant definitions either turned on short-term threats to the environment and human health or were in line with market logic that prioritized commercialization over social or ethical considerations. By only considering short-term technological impacts, these early policy decisions rarely, if ever, considered ethical or social questions. In each case, the cognitive authority of science (and sometimes the market) was evoked to legitimate the decision and to undermine the claims of biotechnology opponents (Jasanoff 2005; Priest 2001). As part of this technical framing of the debate, these early policy decisions had strong feedback and reinforcing effects in limiting the scope of participation in future policy making to scientists, federal agencies, and industry (Sheingate forthcoming); insulating key decisions within primarily administrative arenas; and walling off input from environmental, consumer, or other social groups. In Europe, where there was a much wider and pluralistic scope of participation in decision making, policy heavily weighed social and economic considerations and defined biotechnology as a unique process that required special regulatory attention (Jasanoff 2005). Starting in the late 1990s, the mobilization of biotech opponents in the United States around the publication of several scientific studies and the StarLink Affair did little to change U.S. regulatory policy. Decision making remained insulated within mostly administrative arenas, with minimal attention from Congress or the White House. These events, however, did slow the growth of industry, impacting the economic fortunes of several industry leaders.

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Table 1
Stages of U.S. policy development on U.S. plant biotechnology

Stage	Policy Arenas	Key Events
Managing regulatory uncertainty and walling off participation, 1975–87	National Institutes of Health (NIH), White House Office of Science and Technology Policy (WH OS&TP), Environmental Protection Agency (EPA), Federal Drug Administration (FDA), U.S. Department of Agriculture (USDA), Limited Congress	Fearing Congress might enact legislation regulating recombinant DNA research, in 1975, scientists meeting at Asilomar, California, ask for regulatory oversight of recombinant DNA research from the NIH, with proposals for experiments evaluated by peer review. Later, in 1980, the U.S. Supreme Court, in a 5-4 decision, concludes that companies could patent the products of biotechnology, a decision that helps catalyze biotech's commercialization. Across the early 1980s, uncertainty over the adequacy of the NIH peer-review scheme grows in reaction to a chain of events, including requests for field trials, jurisdictional challenges from the EPA, federal lawsuits, local protests in California, and House inquiry hearings (Jasanoff 2005; Sheingate forthcoming). In 1986, the Reagan administration, guided by a preference for deregulation and fearing that Congress might move to pass special biotech legislation, issues an Inter-Agency Coordinating Framework. By applying an emphasis on the "substantial equivalence" of biotech end products, rather than the process by which they were made, the Coordinating Framework creates no new regulation and assigns authority to the FDA, EPA, and USDA.
Early market development and regulatory precedents, 1988–94	FDA, USDA, EPA	In 1988, the FDA begins review of rBST, a bioengineered hormone that increases milk production in cows, and issues final approval of rBST-derived milk in 1993, requiring no special labeling. Setting an important precedent for later plant biotech decisions, the FDA rules that concerns over socioeconomic impacts cannot be used as grounds for deciding approval or labeling. Based on the 1986 Framework, the only considerations that matter are environmental and health risks (Nestle 2004; Jasanoff 2005). Applying the same logic, the FDA approves recombinant chymosin in 1990, an enzyme used in cheese making. Similarly, in 1994, the Flavr Savr tomato is approved by the FDA without the requirement of labeling (Nestle 2004). The FDA formalizes its rules on genetically modified (GM) food in 1992, rules that do not require premarket approval. The USDA relaxes its rules on field trials, stipulating only prior notification.

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Table 1 (continued)

Stage	Policy Arenas	Key Events
Consolidation and investor optimism, 1995–97	EPA, USDA, FDA	The mid-1990s feature heavy investor speculation in biotech companies, especially Monsanto, as the EPA approves BT pesticide producing crops, and Monsanto introduces its trademark Roundup Ready soy. Monsanto launches a global PR campaign to hype the benefits of plant biotechnology while aggressively buying up smaller biotech companies, a move that consolidates its ownership of important patents and boosts its stock price from $10 to nearly $60 (Leiss 2000). In 1997, British scientists announce the birth of the cloned sheep Dolly, galvanizing worldwide attention. Yet the overwhelming focus is on human genetic engineering, with little spillover in the United States to plant biotechnology (Nisbet and Lewenstein 2002; Priest 2001).
Trade conflict and social protest, 1998–99	EPA, FDA, USDA, U.S. State Department, Limited Congress	The EU establishes in 1998 an elaborate system for labeling and tracing GM products, resulting in a de facto moratorium on U.S. imports. In several major European countries, a wider scope of participation in policy decisions that includes consumer, labor, and environmental groups sets the precedent for EU regulation that rejects the American emphasis on substantial equivalence of GM products and defines genetic modification as a process with unique social implications (Jasanoff 2005). In 1999, a series of high-profile focusing events turns European public attention to potential safety risks of plant biotechnology. Events include protests led by antiglobalization leaders in France, statements of opposition from England's Prince Charles, and the claims of a British scientist who announces on television that rats fed GM potato suffered adverse health effects (Jasanoff 2005). In the United States, the publication of a letter to *Nature* in May 1999 reports that Monarch butterflies fed GM corn pollen in the lab subsequently died. Environmental groups press their case about the ecological risks of plant biotechnology.

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Table 1 (continued)

Stage	Policy Arenas	Key Events
		During the summer of 1999, protests outside the World Trade Organization (WTO) meetings in Seattle include GM food opponents, and protests also occur at FDA public comment hearings on labeling in several cities (Nisbet and Lewenstein 2002). The trade conflict with Europe and the emerging social protests take their toll on the plant biotech industry. By December 1999, with its share price at $38, Monsanto merges with Pharmacia & Upjohn, spinning off its plant biotechnology operations and the Monsanto name (Leiss 2000). In Congress, Rep. Dennis Kucinich introduces a series of failed bills proposed each year through 2005 that would require labeling and increase regulatory testing and review of GM products (Becker 2005).
Food contamination, 2000–2	EPA, FDA, USDA, U.S. State Department, Limited Congress	(The dominant event of this period, the contamination of food products by StarLink corn, is detailed in the opening to this article.) In early 2000, the Cartegena Biosafety Protocol is adopted by 176 countries. The Protocol, differing substantially from American policy definitions of biotechnology, advocates a "precautionary approach" to risk assessment, the labeling of genetically modified organisms (GMO) shipments, and the inclusion of economic impacts in trade decisions (Segarra 2000). Later in 2000, researchers publish the genome for Golden Rice, a GM variety designed to combat Vitamin A deficiency in less developed countries. In 2001, a report in *Nature* details gene flow from GM varieties to native Maize in remote areas of Mexico. An industry PR campaign attacks both the researchers and the science, leading to critical letters and an editorial note in *Nature* questioning the scientific basis for publishing the original paper (Jasanoff 2005; Nestle 2004).

(continued)

Table 1 (continued)

Stage	Policy Arenas	Key Events
Moral diplomacy and agency review, 2003–4	EPA, FDA, USDA, U.S. State Department, Limited Congress, Limited White House	In 2003, the United States initiates a case before the WTO contending that the EU moratorium on imports has not only blocked trade but also fueled unwarranted concerns about GM food globally. In a rare instance where plant biotech is directly addressed by a U.S. president, George W. Bush, against the backdrop of Anglo-Euro tensions over Iraq, emphasizes the perceived moral imperative of winning the trade war: "For the sake of a continent threatened by famine, I urge the European governments to end their opposition to biotechnology." In spring 2004, the EU breaks the moratorium by approving a few biotech products, though leaving thirty products still embargoed (Becker 2005). While trade disputes fester, in 2004, the National Academy of Sciences (NAS) reconfirms the legitimacy of product-based regulation of biotech food but signals a possible shift by advocating that modified foods be evaluated on a case-by-case basis and that the ability of scientists to predict adverse long-term consequences remains limited. A separate NAS 2004 report cites studies that some GM organisms can cross-breed with traditional crops and urges developers to take measures to prevent cross-breeding (Becker 2005).

Media Analysis

In applying the principles of our model to understanding the role of the media in the plant biotechnology debate, we were interested not only in media attention but also in its relationship to socially constructed meanings and interpretations. Therefore, we chose to compare our evaluation of policy development against trends and indicators compiled from a quantitative content analysis of coverage at the *New York Times* and the *Washington Post*, where we focused on frames and the type of journalist assigned coverage as key content features. In subsequent studies of this topic and other tests of our model, we hope that this type of analysis can be complemented by interviews and surveys of journalists and sources. This choice to focus on the elite national newspapers of record complements what other media analysts have observed: stories tend to spread

vertically within the news hierarchy, with editors at regional news outlets often deferring to elite newspapers and newswires to set the news agenda. The *Times* and *Post* devote considerable resources to coverage of national politics, and both newspapers are national leaders in science and technology coverage, with a large and prestigious staff of science writers and editors. In particular, the *Times*'s weekly science section is regarded as an international model for quality, depth, and breadth of science coverage. Given their influence, both papers are primary targets of media lobbying by various political actors.

We ran a Lexis-Nexis keyword search using a comprehensive search string to reach a best approximation of the total population of articles in the *Washington Post* and *New York Times*.[9] During analysis, we discarded articles that were not substantially related to plant biotechnology, were duplicates, or were nonarticles, such as content summaries for a newspaper edition, resulting in a final combined population of 767 news and opinion articles. We developed the coding instrument across a period of several months. As key features of content, we identified a typology of relevant frames by reviewing congressional testimony, official government reports, and Web sites, as well as articles in a diversity of newspapers and magazines. Guiding this process, we relied on previous studies of frames in coverage of politics and in coverage of technical controversies (Capella and Jamieson 1997; Durant et al. 1998; Gamson and Modigliani 1989; McComas and Shanahan 1999; Nisbet et al. 2003; Nisbet and Lewenstein 2002; Patterson 2001), with the assumption that although some frames may be issue- or domain-specific, other frames such as the strategy frame are generalizable across issues. We further developed the validity of the frame typology in a series of pilot studies that the authors, as the two coders in the project, used to familiarize and train themselves in applying the frames to print coverage. These nine frames are outlined in Table 2.

Some frames, including strategy/conflict, ethics/morality, scientific uncertainty, and public engagement, have stronger elements of drama and emotion than other frames, such as the release of a new scientific study, scientific background, policy/regulatory background, market or economic development, or patenting/property rights. These latter frames tend to be more technical and contextual.

Adopting a frame operationalization scheme used by Nisbet et al. (2003), each frame was coded as not present = 0, present = 1, or outstanding focus/appearing in the lead = 2. This scoring system allows us to calculate and display a mean score for each frame across years, rendering a relative indicator of frame prominence. We tested our intercoder agreement on a 20 percent probability sample of the population of articles. Using Krippendorf's alpha (1980), a conservative measure that corrects for chance agreement among coders, we reached a reliability for each variable in the content analysis that was .80 or

Table 2
Framing typology for coverage of plant biotechnology

More technical frames

New research (Rsch): Focus on new research released, discovery announced, new medical or scientific application announced, clinical trial results announced (e.g., government study, scientific journal article, scientific meeting paper, science-by-press-conference).

Scientific background (Sbkd): General scientific, technical, or medical background of the issue (e.g., description of previous research, recap of "known" results and findings, description of potential agricultural or medical applications/uses).

Policy and/or regulatory background (Policy): Focus on regulatory rules for plant biotech/framework for regulation/jurisdiction or oversight over research and market regulation. Includes regulatory approval and oversight for field testing, field application, and market introduction. Focus on rules, enforcement, and technical details of labeling and consumer disclosure. Includes international trade agreements, European or other national/trade zone policy, or regulation related to ag biotech.

Market/economic prospects, or international competitiveness (Market): Focus on international trade, imports/exports, agricultural commodity prices, company market share, stock prices, company mergers and takeovers, overall growth or health of industry, financial health of farmers, reaction of investors, development/introduction of products for market, implications for domestic economy, global competitiveness, and free/fair trade.

Patenting, property rights, ownership, and access (Patent): Focus on ownership and control of new research, control and ownership of seeds or field and market products, patenting/patent approval of new crop strains, or discussion of national, international, or cross-national property rights. Also, international agreements, such as the specifics of WTO rules.

More dramatic frames

Ethics and/or morality (Ethics): Focus on the ethics of genetically modified (GM) agricultural practice, focus on environmental values, emphasis on ethics of tampering with nature or "playing God," or "Frankenfood." Focus on traditional/indigenous perspectives or values, discussion of impeding scientific/medical or social progress, emphasis on "hope" and solution to world hunger, malnutrition, or production of breakthrough medications/treatments.

Scientific uncertainty (Uncertain): Includes focus on the "precautionary principle," definition of environmental and human health risks, or moving ahead in the face of unknown risks and benefits. Includes emphasis on contesting the results of field trials or human health trials, uncertainty about the ability to reliably sort in harvesting and processing non–genetically modified organisms (GMO) and GMO crops, or ensure that food products contain no GMO products. Or criticism of scientific claims of opponents, dismissing as not legitimate or "sound science."

Political strategy and/or conflict (Strat): Focus on the strategy, actions, or deliberations of political figures, presidential administrations, members of Congress, other elected federal or state officials, government agencies. Includes the lobbying of interest groups, and the tactics of strategic actors. Focus here is not on specifics or context of policy but rather on who is ahead or who is behind in the political conflict and their tactics for gaining an advantage. Can apply to contexts outside of the United States.

(continued)

Table 2 (continued)

Public engagement/education (Engage): Focus on poll results, reporting of public opinion statistics, reference to public/consumer "support," "awareness," "concern," "education," "demands," "backlash," and so on; or general reference to "public opinion," "public sentiment," or the "battle over" public opinion. Focus on informing the public as a way to either ease their concerns or to raise alarm. Besides poll results, also includes focus on reaction or opinion specifically from an "average man on the street," or a nonexpert or local community leader. Also include emphasis on personal narrative or testimonial of a farmer, citizen, consumer, or activist.

higher. After establishing reliability, we then moved forward to code the rest of the articles in the population.

We also wanted to record the type of journalist authoring an article. At major papers such as the *New York Times* and *Washington Post*, reporters can be segmented into science journalists, political/general assignment reporters, foreign correspondents, business reporters, wire services, style or arts reporters, and other journalists, as well as guest opinion authors, regular columnists, letter writers, and in-house editorials. For each article appearing in the *Washington Post* and *New York Times*, author names were recorded during coding. Later, each recorded author was categorized by specialty or type of opinion article. In some cases, the specialty or beat of the reporter could be identified by their byline (i.e., science desk, national desk, metro desk, foreign desk, style desk, etc.), and other times the reporter's specialty was identified by making reference to the news organization's Web site, or through Web searches that offered background information about the journalist, though not all authors could be categorized.[10]

Media Trends and Policy Development

In Figure 2, we see a classic Downsian pattern to media attention. A single first mention of plant biotechnology-related applications appears in a news article detailing the conclusions of a government report on agricultural industrialization appearing in the *Washington Post* in 1978. Mention of plant biotechnology did not occur again until a single article on the biotech industry appeared in the *New York Times* in 1983, followed by a series of articles in the *Times* and *Post* in 1984 detailing challenges to the NIH's decision to allow field tests of GM organisms. Media attention then slowly but only marginally increases across the 1980s, despite the growing uncertainty over regulation and significant events including requests for field tests, lawsuits, and localized protests in California. Starting in 1986, there is a first but very small upward swing in media attention to twenty-six articles, increasing to thirty-one articles in 1987. During this rise

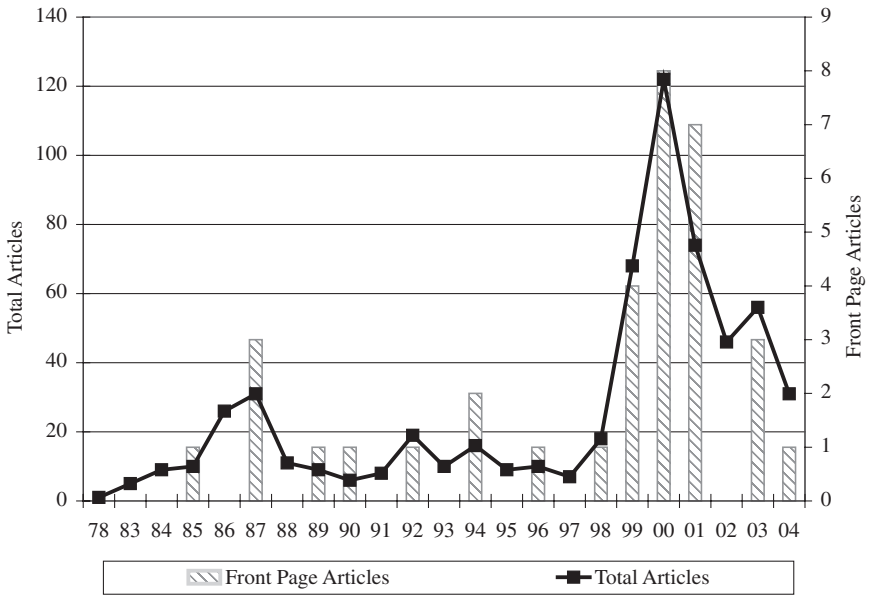

Figure 2
Media Attention to Plant Biotechnology

in attention, the Reagan administration announced its Inter-Agency Framework, the business pages ran features on proposed new plant biotech products, and news reports focused on separate cases of unapproved releases of GM organisms. After the 1986 Inter-Agency Framework successfully insulated decision making within administrative policy arenas, media attention subsides to less than twenty articles annually across most of the 1990s. The low level of media attention is in contrast to the key events that occurred during this period, including the precedent-setting FDA approvals of rBST, chymosin, and the FlavrSavr tomato in the early 1990s; the rise of Monsanto during the mid-1990s; and continued scientific research and technological development.

We interpret these findings as consistent with the conclusions of previous studies, which argued that low levels of media attention to the Inter-Agency Framework decision in the late 1980s (Nisbet and Lewenstein 2002), and the lack of attention from the national press to the rBST approval process (Priest 2001), served as important episodes of "non–decision making." In these cases, absent a media spotlight on plant biotechnology, industry and scientists were able to better manage the scope of participation, keeping decision making behind closed doors and away from wider social input. McInerney et al. (2004) cite the Monarch announcement in 1999 as providing an important impetus for

journalists to devote greater attention to the plant biotechnology debate and to actively question the safety of GM agriculture. Based on interviews with Greenpeace and Union of Concerned Scientist staff members, Nisbet and Lewenstein (2002) conclude that the Monarch study may have been potentially important because it was perceived as catalyzing increased commitment to the issue from large membership environmental groups such as the Sierra Club. Indeed, in one content analysis, the Monarch announcement was found to result in a sharp increase in the reporting of risks about plant biotechnology (Marks et al. 2003). However, Jasanoff observes that the media in covering the Monarch study missed an opportunity to contextualize the findings within a wider debate over the ecological issues linked to plant biotechnology and whether regulators were addressing these questions (quoted in Rodemeyer and Jones 2002).

In terms of the StarLink affair, biotech critics had hoped that the discovery would serve as an important catalyzing event, a potential "turn-the-tables-on-industry" focusing moment. Yet as we detail in Table 1 and in the opening of this article, though the Monarch study and the StarLink affair in combination with other events may have impacted the fortunes of the biotech industry, they have done little to change the nature of policy regulation. One likely reason is that despite Downsian upswings in attention in 1987 and 2000 and the potential of many other focusing events to generate widespread media attention, plant biotechnology has never achieved "celebrity" status as a topic and has always rested relatively modestly on the overall media agenda, even during its peak year of attention in 2000. We reach this conclusion after examining two key indicators. First, in Figure 2, as indicated by the limited number of front-page articles devoted to the issue, plant biotechnology has never been given major agenda priority by the two elite newspapers, with a historic high of only eight and seven front-page articles in 2000 and 2001, respectively. In another indicator, in Table 3, we ran article frequencies from the combined coverage appearing in the two elite papers for various topics covered in 2000, the peak year historically for media attention to plant biotechnology.

Although the issue received greater or equal attention in the elite press than several events that the media considered top stories, such as the Florida tobacco case and the terrorist attack on the U.S.S. *Cole*, other technological or scientific topics received far greater attention, including broadband Internet, nuclear energy, West Nile virus, climate change, the Human Genome Project, Y2K, and the Firestone tire safety controversy. Even other food-related issues such as *Salmonella* or *E-Coli* poisoning received relatively similar levels of attention as plant biotechnology. The issue was dwarfed in coverage by attention to celebrity issues in 2000 including Elian Gonzalez, rising oil prices, the Microsoft antitrust case, the dot-com crash, gun control, and most notably, the 2000 presidential election.

Table 3
Topical media attention, 2000: Issue or topic with number of related *New York Times* and *Washington Post* articles for 2000

Gun control, 1,000+	**Plant biotechnology, 155**
Presidential election, 1,000+	Campaign finance reform, 143
Elian Gonzalez, 774	Kursk submarine, 132
Rising oil prices, 735	Steven Spielberg, 120
Microsoft antitrust case, 702	Alternative medicine, 116
Slobodan Milosevic, 596	Florida tobacco case, 108
Firestone tire safety, 463	U.S.S. *Cole*, 108
Nuclear energy, 403	Monica Lewinsky, 100
Michael Jordan, 377	EPA air pollution regulations, 92
Broadband Internet, 373	Mad Cow Disease, 91
Human Genome Project, 324	Stem cell research, 76
AOL–Time Warner merger, 295	Assisted suicide, 72
Dot-com crash, 267	Welfare reform, 61
Super Bowl, 262	High-definition TV, 52
Climate change or global warming, 234	Welfare reform, 61
Napster, 221	High-definition TV, 52
Beatles or Rolling Stones, 213	Lyme disease, 36
West Nile Virus, 207	Nanotechnology, 33
Endangered species, 206	Animal or human cloning, 32
Y2K, 196	Alien abductions, UFOs, or Roswell, NM, 24
Space shuttle, 168	Shooting of six-year-old in Michigan, 17
Food-borne illnesses, *E. Coli*, or *Salmonella*, 158	Kansas evolution debate, 11

Source: Lexis-Nexis Universe index of *New York Times* and *Washington Post* for 2000.
Note: The issues chosen for comparison with agricultural biotechnology are derived in part from the top ten national news stories as indicated by the end-of-the-year Associated Press poll of newspaper editors, including (1) the presidential election, (2) Elian Gonzalez, (3) U.S.S. *Cole* attack, (4) oil prices, (5) Firestone tire safety, (6) Microsoft antitrust case, (7) Human Genome Project, (8) the year 2000 and Y2K, (9) removal of Slobodan Milosevic from power, and (10) Jury verdict in Florida tobacco case (Mark Evans, "2000's Top Stories: Election, Elian," Associated Press, Dec. 22, 2000). In a separate survey of business editors, the Associated Press found that the StarLink corn affair was ranked the fourteenth top business story of 2000 (Adam Geller, "Stock Market Tumble Leads List of Top AP Business Stories for 2000," Associated Press, Dec. 26, 2000). Other issues, either related to science and technology, politics, business, or popular culture reflect the authors' estimation of major 2000 events or trends.

Issue definitions and frames constraining media attention? If relatively low levels of press attention have helped limit the scope and intensity of debate over plant biotechnology, according to the model we have outlined, it is likely that plant biotechnology's more commonplace status as a media issue is paralleled by a consistent appearance of technical frames in coverage. In Figure 3, displaying the relative prominence of technical frames across the outlined stages of policy development, more thematic backgrounders emphasizing the specifics of policy

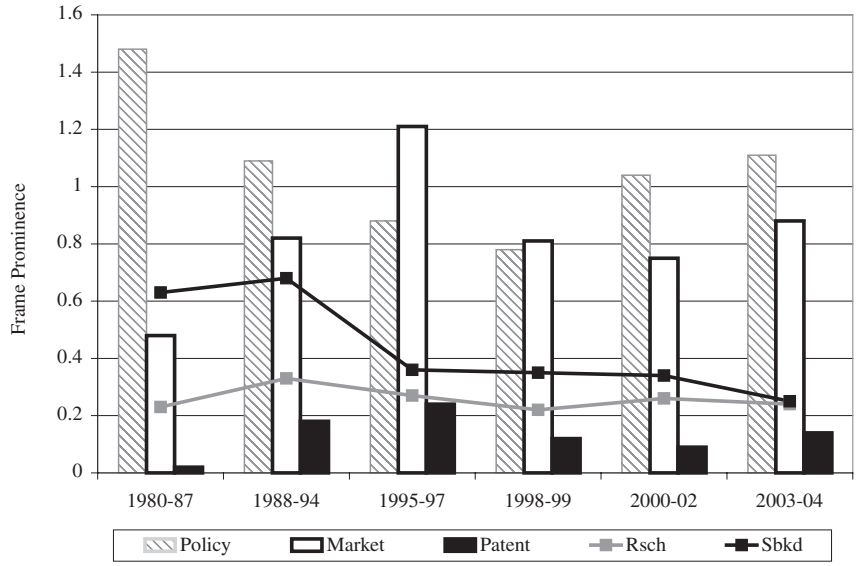

Figure 3
Technical Frames across Stages of Development
Note: Bars and lines indicate mean prominence of each frame across policy stages of development, with each article scored for each frame as 2 = dominant or lead frame of story, 1 = frame present but not dominant, and 0 = frame not present. Content analysis includes a population of articles, so all changes are significant.

and regulation have been dominant interpretations, appearing on average as a frame in every article (mean prominence greater or equal to 1.0) in four of the six policy stages, with the heaviest emphasis during the first stage ($M = 1.48$).

A second technical emphasis on market development and economic competitiveness has also been dominant in coverage, peaking in 1995 to 1997 during the meteoric rise of Monsanto ($M = 1.21$). Across the history of plant biotechnology, an emphasis in coverage on patenting and property rights has been extremely rare, despite the importance of this dimension as a key feature driving technological development and investment (the frame peaks at 0.24). The two technical frames dealing with the science of plant biotechnology are less prominent then either the policy or economic interpretations. In this case, in the two earliest stages, when media coverage was minimal, an emphasis on scientific background is stronger (Ms = 0.63 and 0.68, respectively), but as of 1998 and 1999, when media attention rises, the prominence of this technical frame is relatively low ($M = 0.35$). Somewhat surprisingly, across the history of plant biotechnology, there have been very few articles framed around release of a new

scientific study or paper, the traditional package for science in the press (peaking at 0.35).

So, in examining the pattern of frames across time, interpretations focused consistently and heavily on the technical details of policy background and economic developments. It is likely that these dominant technical interpretations have helped dampen wider social excitement and American concern over plant biotechnology and defused the dramatic and narrative appeal of the issue to political and general/assignment journalists. Indeed, as Figure 4 indicates, with the exception of scientific uncertainty, dramatic frames have not been nearly as prominent in coverage as technical interpretations.

When we examine the two key dramatic frames of strategy/conflict and ethics/morality, we see that these frames are almost completely absent from media coverage in the earliest stage of policy development (*M*s = 0.22 and 0.02, respectively). The strategy/conflict frame rose in prominence across years, with this emphasis still limited but peaking across the years 1998 to 2004, as social protest emerged in 1998 and 1999 ($M = 0.56$), the StarLink affair surfaced in 2000 to 2002 ($M = 0.47$), and the Bush White House paid brief attention to the issue in 2003 and 2004 ($M = 0.63$). The ethics/morality frame also rises in prominence but still is not a major emphasis in later years, peaking in 2003 and 2004 ($M = 0.38$). Though not as prominent as technical interpretations, an emphasis on the public's acceptance of plant biotechnology has been relatively consistent across coverage, peaking in 1998 and 1999 with protest in the United States and Europe ($M = 0.67$). Scientific uncertainty is the single dramatic frame that rivals technical frames in prominence, with its emphasis greatest during 1980 to 1987 ($M = 1.17$) and 2000 to 2002 ($M = 1.05$), the two stages featuring Downsian peaks in coverage, and instances where critics were able to question, but with extremely limited success, the legitimacy of the U.S. regulatory process. In between the rise and decline of these two peaks in the emphasis on uncertainty, notice that the frame is least prominent in 1995 and 1996, the key years where the biotech industry achieved rapid and unprecedented market growth and a period where media attention was minimal. In sum, across stages of development, the dramatic interpretations of strategy/conflict and ethics/morality remained relatively weak in emphasis and were eclipsed by a greater media focus on technical frames of policy background and economic development. Strategy/conflict and ethics/morality did rise in prominence as media attention to the issue picked up, yet the emphasis on these dramatic interpretations was still limited.

Does the relatively weak prominence of these dramatic frames in coverage provide another clue to why plant biotechnology has never climbed to the top of the U.S. media agenda? To answer this question, it helps to place the relative emphasis on technical versus dramatic frames in context. Consider findings from a study of the stem cell controversy using a similar framing typology

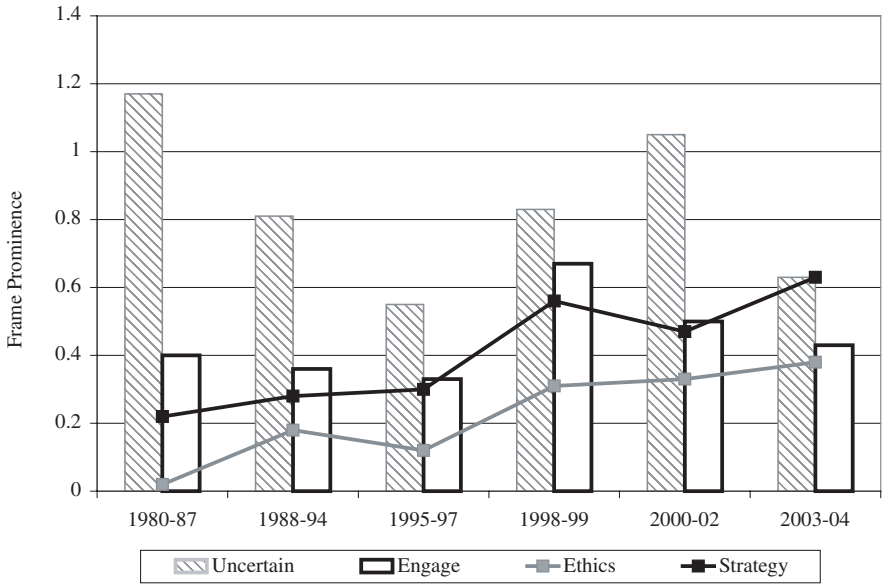

Figure 4
Dramatic Frames across Stages of Development
Note: Bars and lines indicate mean prominence of each frame across policy stages of development, with each article scored for each frame as 2 = dominant or lead frame of story, 1 = frame present but not dominant, and 0 = frame not present. Content analysis includes a population of articles, so all changes are significant.

(Nisbet et al. 2003). Unlike plant biotechnology, stem cell research achieved celebrity status as an issue of widespread debate and concern in 2001 (or at least the eight months before the September 11 attacks). Stem cell research rose from relative obscurity in 2000 to the top of the media agenda during the summer of 2001 with nearly five hundred articles appearing across the *New York Times* and *Washington Post*. Coverage by papers featured an almost exclusive and heavy emphasis on political strategy/conflict ($M = 1.02$), and morality/ethics ($M = 0.62$), with little or no emphasis on technical interpretations including market/economic development ($M = 0.12$), scientific background ($M = 0.37$), and the release of new scientific studies ($M = 0.30$), though there was a comparatively strong emphasis on policy background ($M = 0.70$).

The shift across news beats and attention from opinion pages. As a final part of our analysis, we examined the relationship between media attention, media frames, and the type of journalist assigned coverage, as well as the amount of attention to the topic from opinion pages. According to Table 4, news articles have dominated coverage, but across the 1990s, the proportion of letters to the editor increases, peaking in 1998 and 1999 at more than a quarter of coverage (26.6

percent), as various interest groups lobbied to get their messages directly across on opinion pages. This increased attention from the opinion pages in the late 1990s helps explain an increase in the total volume of coverage devoted to plant biotechnology and the increase in attention to the topic during that period. In terms of the type of journalist assigned coverage, the first two stages are dominated by science writers (37.6 and 23.4 percent, respectively), but by the mid-1990s with the rise of Monsanto, business reporters emerge as the major specialist correspondents, accounting for more than a quarter of articles in 1995 to 1997 (27.3 percent) and 1998 and 1999 (25.2 percent). Business writers increased in prominence in 2000 to 2002 (32.1 percent) and 2003 and 2004 (40.0 percent). Of importance, neither political/general assignment reporters nor foreign correspondents account for substantial amounts of coverage, even in the peak period of coverage from 2000 to 2002 (12.1 and 11.1 percent, respectively).

In Table 5, when we took a closer look at the nature of coverage authored by each author, the relative dominance in coverage by specialist journalists explains the prominence of technical frames focused on policy background and market development as these were the preferred interpretations of business reporters ($M = 1.00$, $M = 1.13$) and to a lesser extent science writers ($M = 1.09$, $M = 0.49$). The relative absence of political/general assignment reporters and foreign correspondents in coverage explains the weak emphasis in coverage of the strategy/conflict frame as these reporters were most likely to feature this interpretation (Ms = 0.51 and 0.85, respectively). The absence of the strategy frame is likely a threefold result: (1) Events related to StarLink did not lead editors and political journalists to interpret the issue as worthy of political coverage, and (2) because few political journalists were assigned to the story, (3) the total potential volume of coverage remained constrained within science and business pages, where the strategy frame was unlikely to be applied by specialist correspondents. In Table 6, we can see that much of the renewed emphasis on uncertainty in 1998 and 1999 derived from the increase in the number of letters to the editor printed at the two papers ($M = 0.99$) as various strategic actors used the opinion pages as a way to cast doubt on U.S. regulatory policy. More so than news articles, these letters also emphasized the ethics/morality interpretation ($M = 0.40$), though guest op-eds had the heaviest emphasis on this angle ($M = 0.88$).

In sum, from an analysis of the type of journalists assigned coverage, and the amount of attention from the opinion pages, we can see that the modest status of plant biotechnology on the overall media agenda—even in its peak years of coverage—is attributable in part to the fact that the issue never attracted heavy attention from political and general assignment reporters. Instead, the issue was covered for the most part by business reporters and science writers who tended to interpret the issue in consistently technical ways. It helps to place these

Table 4
Type of article and journalist across stages of development (in percentages)

	Managing Uncertainty, Participation, 1980–87 (n = 86)	Market Development, Precedent, 1988–94 (n = 99)	Rise of Monsanto, 1995–97 (n = 33)	Trade Conflict, Protest, 1998–99 (n = 139)	Food Contamination, 2000–2 (n = 305)	Diplomacy and Review, 2003–4 (n = 105)
Format						
News	95.3	84	78.8	61.9	79.3	81.0
Op-ed	—	—	3.0	7.2	2.0	4.8
Editorial	2.4	1.1	3.0	2.9	2.6	5.7
Columnist	—	1.1	—	—	1.0	1.0
Letter	2.4	9.6	15.2	26.6	13.1	6.7
Magazine	—	1.1	—	0.7	0.3	1.0
Review	—	—	—	0.7	0.7	—
Journalist						
Science	37.6	23.4	15.2	15.1	9.1	3.8
Business	14.1	10.6	27.3	25.2	32.1	40.0
Political	1.2	11.7	—	1.4	12.1	1.9
Foreign	—	3.2	6.1	5.8	11.1	11.4
Style	—	2.1	3.0	3.6	1.3	—
News wire	7.1	7.4	12.1	1.4	6.6	5.7

Note: Percentages for type of journalist reflect proportion of total relevant articles published, which includes opinion articles. Not all authors could be categorized by journalist type.

Table 5
Frame prominence by type of journalist

	Science Writer (n = 112)	Business Writer (n = 202)	Political Reporter (n = 52)	Foreign Correspondent (n = 59)	Style Writer (n = 12)	News Wire Service (n = 45)	All News Articles (n = 600)
Technical frames							
Rsch	0.70	0.21	0.34	0.02	0.00	0.40	0.32
Sbkd	0.79	0.32	0.57	0.14	0.42	0.22	0.42
Policy	1.09	1.00	1.21	0.66	1.75	1.00	1.08
Market	0.49	1.13	0.72	1.12	0.58	0.60	0.87
Patent	0.04	0.20	0.09	0.17	0.00	0.07	0.12
Dramatic frames							
Ethics	0.15	0.14	0.09	0.61	0.08	0.09	0.20
Uncertain	1.30	0.82	1.17	0.64	1.25	0.71	0.91
Strategy	0.40	0.46	0.51	0.85	0.75	0.16	0.48
Engage	0.45	0.47	0.57	1.17	1.42	0.11	0.47

Note: Statistics indicate mean prominence of each frame across type of journalist, with each article scored for each frame as 2 = dominant or lead frame of story, 1 = frame present but not dominant, and 0 = frame not present. Content analysis includes a population of articles, so all differences are significant. For explanation of frame abbreviations, see Table 2.

Table 6
Frame prominence by type of opinion article

	Guest Op-Ed ($n = 20$)	In-House Editorial ($n = 22$)	Columnist ($n = 5$)	Letter to the Editor ($n = 100$)
Technical frames				
Rsch	—	—	—	0.02
Sbkd	0.48	0.27	0.40	0.32
Policy	1.20	1.27	0.60	0.83
Market	0.84	0.82	0.40	0.25
Patent	0.08	0.09	—	0.03
Dramatic frames				
Ethics	0.88	0.32	1.20	0.49
Uncertain	0.96	0.65	1.00	0.99
Strategy	0.68	0.60	0.80	0.12
Engage	0.80	0.41	1.00	0.45

Note: Statistics indicate mean prominence of each frame across type of opinion article, with each article scored for each frame as 2 = dominant or lead frame of story, 1 = frame present but not dominant, and 0 = frame not present. Content analysis includes a population of articles, so all differences are significant. For explanation of frame abbreviations, see Table 2.

journalist trends in context by comparing our results to similar features in stem cell coverage in 2001. During this period of peak attention for stem cell research, 25 percent of coverage was contributed by political/general assignment reporters compared to just 12.1 percent of coverage for plant biotechnology during its peak in attention. And for stem cell research in 2001, political reporters interpreted the issue almost exclusively through the lens of political strategy ($M = 1.6$). Moreover, 34 percent of coverage appeared on the opinion pages in 2001, compared to just 20.7 percent of coverage for plant biotechnology during its peak, and the emphasis on opinion pages focused heavily on morality/ethics ($M = 0.85$) and strategy/conflict ($M = 1.1$) (Nisbet 2004).

Conclusion

When we return to Downs's (1972) original issue attention hypothesis, we find that our data conform to his general expectations. Plant biotechnology went relatively unnoticed for decades, until the triggering event of social protest and the Monarch study in 1999, followed by a historic peak in media attention to the issue in 2000 generated by the StarLink affair. Beyond confirming Downs's basic cycle hypothesis, our study more importantly contributes a detailed theoretical understanding of the dynamic social mechanisms that promote in part this cyclical pattern, clarifies the important linkage to how an issue is framed, accounts

for the competition for attention among issues and the limited carrying capacity of policy and media agendas, and demonstrates how the media plays an instrumental role in both reflecting and shaping the policy process. As we outline and demonstrate, these relationships include the policy arena where debate takes place, the media lobbying activities of competing strategic actors, and the journalistic need for narrative structure. An important part of this process is the possible shift in coverage across news beats and to the opinion pages.

Previous research has attempted to understand why plant biotechnology has experienced limited political conflict in the United States, especially in comparison to the United Kingdom and several European countries. Applying the principles outlined in the model and the findings in our study, one major reason is that plant biotechnology proponents have been very successful at limiting the scope of participation surrounding the issue, as early policy decisions framed the issue in advantageous technical terms, establishing a virtual "policy monopoly" within the administrative policy arenas of the FDA, the EPA, the USDA, and various scientific advisory boards, with little significant attention from Congress or the presidency. Though increased media attention to plant biotechnology and more dramatic definitions of the issue have surfaced in recent years, challenging the status quo in regulation, the ability of biotech proponents in early policy decisions to define the debate around short-term environmental and health risks have led to lasting and powerful feedback effects (Sheingate forthcoming). As we note, the early success of biotech proponents is in part attributable to minimal media coverage, which made the 1986 Inter-Agency Framework and the precedent-setting early 1990s market approvals essentially "nondecisions" for the wider public. This is in contrast to the United Kingdom and Europe, where from the beginning, Jasanoff (2005) and others have noted that there was a much wider scope of participation in policy decisions. The early inclusion of environmental, consumer, and labor groups, and the comparatively stronger emphasis on transparency and public accountability, led to a very different European regulatory regime that took into account social and economic factors as well as the possibility of unknown future technical risks.

Despite attempts to shift debate toward more dramatic frames by various opposition groups, media discourse in the United States around plant biotechnology has remained predominantly technical. Because the issue has remained within administrative arenas, and because the issue has remained defined in technical and scientific terms, it is likely that journalists have been unable to place plant biotechnology into a larger narrative structure, giving greater meaning to passing events, thereby facilitating an increase in coverage of the issue. Cycles of attention to plant biotechnology have appeared, but they remain small-scale perturbations rather than escalating into the large scale news dramas that have surrounded media celebrity issues like stem cell research. Indeed, given the limited carrying capacity of the news media, competition with celebrity issues such as

the stem cell debate, presidential elections, and, after 2001, terrorism and war may have all significantly constrained attention to plant biotech, just when the conditions in terms of focusing events and drama might have otherwise propelled the issue into the wider media spotlight.

There are two emerging trends, however, that might eventually weaken the ability of biotechnology proponents to control the scope of participation in policy making about plant biotechnology. First, critics have added narrative fidelity to their framing efforts by connecting plant biotechnology to other contemporary issues. For example, in her recent book, scientist and ecologist Jane Goodall (2005) links plant biotechnology to parallel controversies confronting the American food system including childhood obesity, organics, animal welfare, and the survival of traditional farmers. If and when plant biotechnology becomes a topic of widespread attention and concern in the United States, it will likely be because it resonates and is framed in combination with these other food system issues. Second, evolving trends in international trade increasingly leave the United States as an outlier in its regulation and definition of the risks associated with plant biotechnology. And as we reviewed in this study, while opponents have not had much success at changing the U.S. policy regime, they have had success in shaping the actions and fortunes of industry members. It may be that change in U.S. regulation of plant biotechnology comes about not through the domestic internal pressures channeled through the press/policy connection but rather through the external pressures of international trade.

The model of mediated issue development is applicable to understanding other issues. Consider the Human Genome Project, a scientific issue with a substantially more successful media career in 2000 than plant biotechnology (324 articles compared to 155 articles, see Table 3).[11] The key focusing event was a press conference at the White House hosted by President Bill Clinton and Prime Minister Tony Blair announcing that rival teams of scientists had ended a two-year competition to be the first to map the human gene sequence, with the two teams agreeing to jointly release their nearly complete versions of the genome. The scientific "race" to be the first to "crack the human genetic code" and achieve what Nicholas Wade (2000) in a *New York Times* lead described as "the pinnacle of human self-discovery" matched perfectly the journalistic preference for the strategy frame, making it easy for journalists to fit into a larger narrative structure and therefore cover. In fact, the emphasis on strategy framing reached such an extreme that headlines related to genome research in 2000 resembled both war and sports coverage, with an emphasis on scientific factions going to battle. (Besides this "winners" versus "losers" emphasis, coverage also included heavy profiling of the personalities leading the two competing groups.) This strategy coverage was paired with the moral imperative of scientific progress, amplified by the comments of President Clinton, who referred to the research as "learning the language in which God created life." After both scientific teams reached the

"goal line" in 2000 with publication of the genome sequence in the journals *Nature* and *Science*, coverage of the issue steadily declined across subsequent years (only eighty articles appearing by 2004). With the competition over, journalists could no longer fit the issue into a particular narrative structure and turned their attention to other issues, even though genomics research has continued forward on multiple fronts, with many policy and scientific questions left unresolved. The rise in attention to the Genome Project helped mobilize wide public enthusiasm for federal support of the project, creating in this first Downsian upswing of attention the government infrastructure and funding to continue large-scale research on genomics into the future. Currently in a low-attention stage of the cycle, future major upswings in attention to genomics are likely to be driven by strategic actors who may oppose developments based on social and ethical grounds surrounding the "eugenics" of engineering "superhumans," or the use of genetic information to "discriminate" in job hiring, or in calculating health insurance risks.

As Mooney and Nisbet (2005) describe, the model also appears to apply to the debate over intelligent design (ID), an issue that climbed to relative media celebrity status in 2005. As school boards, state legislatures, and the courts paid increasing attention to the claims of the ID movement, there was a transfer in attention to the issue across news beats, with coverage no longer dominated by science writers, becoming instead the subject of articles by political reporters and opinion writers. As this shift in news beats took place, coverage de-emphasized the type of contextual scientific backgrounder favored by science writers, and instead the attacks on evolution were increasingly covered by political reporters through the lens of "he said, she said" political strategy. According to Mooney and Nisbet, the rise in media attention to the issue—and its reinterpretation by political reporters as a struggle between two "equal" warring camps—has helped widen the scope of participation in science education policy, aiding the ID movement's efforts to rewrite high school biology standards.

Despite the applicability to these two examples and others, we are limited in this study to formally testing our proposed model against data specific to a single issue. Regarding generalizability, then, a number of questions arise for future research. For example, can the model be generalized to Europe, where the distinction between administrative and overtly political policy contexts is less clearly defined than in the United States, where political and media agendas are more heavily centralized through the formalized structures of political parties, and where the professional orientations of journalists may differ? Also, does the model as presented apply only to a certain category of policy issues? For example, does the model fit best when tested against science, technology, and environmental issues that may exhibit comparatively greater variation in media attention over time, and slip between types of policy arenas? Or does the model, with modifications, still hold for other policy domains such as foreign policy?

Finally, does the model apply not only to national-level issues but also to coverage of state- and local-level issues? We hope that our study might serve as a "focusing event," mobilizing other researchers in the field to join us in examining these questions.

Notes

1. Genetic modification involves transferring genes and their expressed traits from other plants, bacteria, or viruses to food crops. Though some varieties of genetically modified (GM) plants involve novel traits such as improved shelf life, taste, or nutritional content, by the late 1990s, the market was dominated primarily by staple crops such as corn, soy, and cotton engineered to increase yield and reduce costs for agribusiness. In 2000, according to the General Accounting Office (2002), GM varieties comprised 26 percent of corn, 68 percent of soy, and 69 percent of cotton planted in the United States. In terms of food content, 60 percent or more of American processed foods—including baby formula, drink mixes, and fast foods—contained GM plant material.
2. The following day, the announcement was also covered on page one of the Life section of *USA Today*, in a news brief in the *Christian Science Monitor*, in the foreign section of *The Guardian*, in a wire story by Agence-France Press, and in brief mentions on CBS *Evening News* and on *Fox News Special Report* with Brit Hume.
3. The same day, news stories were also carried by the *Washington Post* (p. A09), the *Associated Press*, and CNN *Saturday Morning*.
4. As commonly applied in the social sciences, a model is inherently an aid to thought and consists of consciously simplified descriptions. Models provide an organizing function by simplifying otherwise complex and ambiguous social phenomena, an explicative function by defining and ordering variables of interest, a predictive function by leading to somewhat generalizable statements about events, and an expository function in explaining to other researchers how results and conclusions were reached (McQuail and Sven 1981; Shoemaker et al. 2003).
5. In this study, we look specifically at the debate over plant genetic engineering since starting in the early 1980s debate has focused primarily in this area of food biotechnology in comparison to animal genetic engineering. Although as we will discuss, there are notable exceptions in the form of Chymosin and rBST, most research on animal genetic engineering products remain experimental and are several years away from market approval (Vogt and Parish 1999).
6. We do not mean to suggest that decisions within administrative arenas go uncontested. Environmentalist Larry Bohlen's advocacy efforts detailed at the opening of this article were in reaction to a growing unease with administrative decisions specific to plant biotechnology. In other examples, a glance at the news over the past few years will reveal multiple claims of "politicization of science" emanating from various camps in society (Mooney 2005). Such claims are not new. For several decades, across issues, environmentalists, consumer groups, religious advocates, and scientists have all disputed the selective application of expertise within administrative arenas, alleging, for example, that peer-review rosters are stacked, that contrary evidence is ignored, or that nonscientific perspectives are left unconsidered (Nelkin 1975, 1992). In particular, high-stakes regulatory decisions about health or the environment often involve complex questions about emerging and uncertain science, with various actors competing to interpret evidence in ways that favor their preferred policies (Jasanoff 1987). In these cases, language serves as the key tool in

constructing authority and drawing boundaries between legitimate and illegitimate participants or claims. Despite the contested nature of administrative arenas, our central point, however, is that in comparison to overtly political policy venues such as Congress or the White House, decision making when centered in these regulatory contexts remains predominantly defined in highly technical terms and attracts less attention, with the scope of participation limited.

7. As in the case of administrative arenas, there are exceptions to these general characteristics. Whereas administrative arenas might be favorable territory for policy monopolies, limited participation can also occur within Congress, especially when an issue falls under the jurisdiction of just a single committee and is never taken up by a diversity of committees or debated on the open floor (Baumgartner and Jones 1993). Indeed, a recent policy study of biotechnology concludes that in comparison to medical applications such as stem cell research, attention to plant biotechnology within Congress has been distributed across a much narrower range of committees, generating fewer hearings. The focus of these hearings were predominantly on benefits and were overwhelmingly positive, with most testimony coming from industry members (Sheingate forthcoming).
8. Science writers have also been accused of often downplaying differences in opinion across disciplines about the impacts and risks of the biotechnology. In her analysis of biotech coverage, Priest (2001) observes that science writers often rely heavily on the voices of university-based plant biotechnologists who define risk narrowly in terms of short-term threats to human health or the environment, while leaving out views from other disciplines, such as those of ecologists, who might perceive risk in terms of the impacts on the ecosystem; or social scientists, who might discuss social, economic, and ethical risks. Indeed, surveys of university scientists and social scientists reflect the diversity in opinion about biotechnology that occurs outside of the discipline of plant genetics, including contrarian views that are likely to go unreported if science writers focus narrowly on plant scientists as their sources (Lyson 2001; Priest and Gillespie 2000).
9. Keywords used to identify plant-biotechnology-related articles included *plant biotech* or *plant biotechnology* or *crop biotechnology* or *crop biotech* or *food biotech* or *food biotechnology* or *ag biotech* or *agricultural biotechnology* or *genetically modified food* or *genetically modified crop* or *genetically modified agriculture* or *genetically engineered food* or *genetically engineered crop* or *genetically engineered agriculture* or *frankenfood* or *GM food* or *GM crop* or *GM agriculture* or *GMO* or *genetically modified organism* or *transgenic crop* or *transgenic agriculture* or *transgenic food* or *genetically altered crop* or *bioengineered food* or *bioengineered crop* or *bioengineered agriculture* or *genetically engineered corn* or *genetically engineered soy* or *genetically engineered cotton* or *genetically engineered potato* or *genetically engineered tomato* or *genetically engineered rice* or *genetically engineered bacteria* or *genetically engineered microbe* or *genetically engineered organism* or *genetically modified corn* or *genetically modified soy* or *genetically modified cotton* or *genetically modified potato* or *genetically modified tomato* or *genetically modified rice* or *genetically modified bacteria* or *genetically modified microbe* or *transgenic corn* or *transgenic soy* or *transgenic cotton* or *transgenic potato* or *transgenic tomato* or *transgenic rice* or *transgenic bacteria* or *transgenic microbe* or *transgenic organism* or *genetically altered food* or *genetically altered agriculture* or *genetically altered corn* or *genetically altered soy* or *genetically altered cotton* or *genetically altered potato* or *genetically altered tomato* or *genetically altered rice* or *genetically altered bacteria* or *genetically altered microbe* or *genetically altered organism* or *genetically modified plant* or *genetically engineered plant* or *transgenic plant* or *GM corn* or *GM soy* or *GM cotton* or *GM potato* or *GM tomato* or *GM rice* or *GM bacteria* or *GM microbe* or *GM organism*.
10. Authors or departments coded as *science writers* included Allan Coukell, Andrew Revkin, Boyce Rensberger, Carol Kaesuk Yoon, Gina Kolata, Gordon Graff, Harold M. Schmeck Jr., Health (Desk), Henry Fountain, Jane Brody, Keith Schneider, Richard D. Lyons, Warren E.

Leary, William Claiborne, William Stevens, Rick Weiss, Malcolm Gladwell, or Science Desk. Authors or departments coded as *business writers* included Andrew Pollack, B.J. Feder, Bloomberg News, Business Desk, Charles L. P. Fainweather, David Barboza, Edward Wyatt, Floyd Nannis, Justin Gillis, K. Schneider, Kurt Eichenwald, Larry Rohter, M. Lacey, Melody Peterson, Nell Henderson, Patrick J. Lyons, Paul Blustein, S. Rai, Sabra Chartand, Sandra Sugarwara, Business Desk, Sanna Siwolop, Stephanie Strom, Steven Pearlstein, Suzanne Kapner, and C.H. Deutsch. David Barboza and Justin Gillis have specialized in covering the biotechnology industry, contributing industry news with a heavy technical and scientific background emphasis.

Authors or departments coded as *foreign correspondents* included Alan Cowell, Anthony DePalma, Christopher Marquis, Craig Smith, Craig Timberg, Daniel Williams, Donald G. McNeil, Edmund Andrews, Elaine Sciolino, Elizabeth Becker, H.E. Cauvin, John Burgess, Joseph Gregory, Joseph Kahn, K. Tolbert, Lizette Alvarez, Michael Spector, Nora Bousrany, Business Desk, Roger Cohen, Sophia Kishkovsky, Stephen Buckley, Steven Erlanger, Suzanne Daley, T.R. Reid, Tony Smith, Warren Hoge, William Drozdiak, Foreign Desk, or International Desk. Authors or departments coded as *political / national / or general assignment* reporters included Elizabeth Olson, Ernesto Londono, Judith Lederman, Judy Sarasohn, M. Cooper, M. Tolchin, Marc Kaufman, Nodine Brozan, National Desk, Shankar Vedantam, or Metro Desk. Kaufman, given his experience and background as a political reporter, was classified in this category rather than as a science or business writer since in reviewing the range of his coverage of issues other than biotech, his coverage spans the political and science beat, specializing in the politics of science. Authors or departments coded as *wire services* included Associated Press, Agence-France, and Reuters. Authors or desks coded as *style or food writers* include Adrian Higgins and Marian Burros.

11. Keyword search for headline and lead paragraph included *human genome project* or *mapping the genome* or *mapping the human genome* or *decoding human DNA* or *mapping human DNA* or *sequencing human DNA* or *mapping human genes* or *genomics* or *deciphering the human genetic code* or *deciphering human DNA* or *understanding the human genome* or *understanding human DNA*.

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Biographical Notes

Matthew C. Nisbet (Ph.D., Cornell University) is assistant professor in the School of Communication at The Ohio State University, where he specializes in political communication and public opinion. His current research focuses on the communication dynamics of technical controversies, exploring the interactions between public opinion, mass media, and policy making. He blogs about these research topics at www.framing-science.blogspot.com.

Address: 3058 Derby Hall, School of Communication, Ohio State University, Columbus, OH 43215; phone: 614-292-4040; e-mail: nisbetmc@gmail.com.

Mike Huge (M.A., Ohio State University) is a research associate at The Ohio State University School of Communication and has previously worked for the Ohio Legislative Service Commission.

Address: 3058 Derby Hall, School of Communication, Ohio State University, Columbus OH 43215; phone: 614-292-4040; e-mail: huge.8@osu.edu.