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PUBLICS' OPINIONS ABOUT BIOTECHNOLOGIES

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Surveys eliciting opinions about biotechnology applications suggest the following conclusions. (1) People distinguish among biotechnologies. (2) Different people have different views about biotechnologies. (3) People have limited knowledge about biotechnologies—and know it. (4) People have strong opinions about how biotechnologies are managed. (5) People have complex evaluative schemes—and respond to evidence. As a result, there is little place for sweeping statements regarding "the public's opinion about biotechnology." Such statements demean the public and distort policy making by promoting simplistic solutions. More focused research is needed to characterize current and possible views of different publics regarding different current and possible biotechnologies.

Key words: agricultural biotechnology; risk perception; risk communication; public opinion.

Policymaking regarding agricultural biotechnology poses significant cognitive challenges for all concerned. There are many forms of the technology, each with a variety of potential costs and benefits, each determined by a variety of biological, economic, and social factors. Scientific study of these processes requires conducting and coordinating research in diverse disciplines. Moreover, as with any innovative technology, these pieces are in flux, as the technologies, underlying sciences, and governing institutions evolve.

Any citizen paying close attention to these issues should have similarly complex (and evolving) opinions. Furthermore, there are many such citizens, potentially seeing and valuing different things. As a result, there can be no simple description of "the public's opinion about biotechnology."

Nonetheless, there is a strong and natural desire for simplifying summaries. In the short run, life would be easier for citizens if they could lump all biotechnologies together as good (or bad), known (or unknown), dread (or common), and so on—along whatever evaluative dimensions matter to them (Fischhoff *et al.*, 1978; Slovic, 1987). Similarly, it would be easier for industry professionals, if they could think of a single public with common properties—supporting (or opposing), informed (or ignorant), stupid (or educable), hysterical (or reasoned), and so on.

Over the long run, though, such summaries serve us poorly. Unless all biotechnologies are cut from a common cloth, citizens should distinguish among those varying in their current

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attractiveness and future promise. Unless all citizens are alike and undifferentiating, the industry should consider their varying concerns and sophistication.

As a result, saying anything about public perceptions of biotechnology carries the risk of oversimplifying the public and the technology. That risk adds to the usual risks of extracting responsible summaries of behavior from fragmentary observations of varying pedigree (peer-reviewed studies, gray literature reports, anecdotal observations, regulatory submissions, press releases). Sweeping summaries also support the natural tendency to stereotype others, reducing their humanity by ignoring the details of the decisions, emotions, and opinions that influence their choices.

With these trepidations, we offer five tentative conclusions, emerging from an ongoing review of studies of publics' perceptions of biotechnologies. Perhaps its explicit incompleteness will temper its contributing to any tendency to understate the complexity of people and technologies, as individuals and as groups.

Tentative Conclusion 1: People distinguish among biotechnologies.

When asked sufficiently clear questions, citizens distinguish among current and potential biotechnologies. For example, the 1996 Eurobarometer elicited evaluations for seven different applications, in terms of perceived risk, usefulness, acceptability, and support. It found a consistent ordering, in decreasing favorability, for "genetic testing for heritable diseases, drug production using bacteria modified to contain human genes, bioremediation using GM [genetically modified] bacteria, medicinal human cell or tissue cloning, use of plant genes in GM crops, animal cloning to produce drugs in their milk, and in producing foods to make them higher in protein, keep longer, or change the taste" (Gaskell, 2000). For example, the percentages seeing usefulness ranged from 83% to 54%, moral acceptability from 74% to 36% (European Commission, 1996).

Given these results, any survey that fails to specify its focal biotechnology leaves survey respondents guessing what question they are being asked. It leaves readers of the survey's results guessing what respondents have assumed. With luck, respondents will come from a population with enough social and linguistic homogeneity to interpret the survey similarly. With further luck, readers will intuit that interpretation. Both forms of luck may, however, be relatively uncommon with questions about novel technologies. Citizens will have had little chance to reach common understandings. Readers will often come from technical communities far removed from average citizens and therefore may have limited insight into what citizens are thinking about.

Even with the relatively precise Eurobarometer, critical distinctions may be missing. For example, it reveals positive overall evaluations for most biotechnology applications, with only two (animal cloning and food) having negative mean scores for acceptability and support, and only one (food) having a negative mean score for usefulness. Unfortunately, the interpretation of these means is complicated by the survey not distinguishing between commercialized and potential applications. If respondents inferred that all listed applications were in use (which was not the case), then they may also have inferred greater demonstrated benefit (and social acceptance) than was warranted.

Although it complicates researchers' tasks, such sensitivity provides modest cause for optimism regarding the possibility of reasoned debate over biotechnologies. These diverse technologies have not been lumped together in the public mind, as though cut from a common cloth and deserving of a common fate. Although the nature of these distinctions is not clear from the

research, they have emerged despite the chaotic character of the information that most citizens receive. Future communications could build on these cognitive structures—and benefit from focused descriptive research (Fischhoff, 1998).

Tentative Conclusion 2: Different people have different views about biotechnologies.

Surveys have found various demographic and socioeconomic factors correlated with opinions about biotechnology. For example, Grobe, Douthitt, and Zepeda (1997) surveyed respondents in the United States regarding the intermediate and long-term health effects of recombined bovine growth hormone (rBGH). Personal variables associated with greater concern included both health factors (e.g., family history of cancer, heart disease, lactose intolerance, or changing food habits for health reasons) and social factors (e.g., being a woman, minority, or older; self-identifying as an animal rights supporter or environmentalist). Looking across studies, more positive views were generally expressed by individuals who are young, male, politically conservative, wealthy, and generally supportive of science. Less readily summarized differences in opinion have been observed with education, religiosity, region, nation, party membership, and employment status.

Differences within a country raise political questions regarding technology designs that will attract winning (or losing) coalitions. They also raise ethical questions when these coalitions ignore unequal distributions of benefits and costs (including benefits lost when a biotechnology is rejected—or adopted, thereby supplanting a previous technology). Of course, ethical concerns may have political implications when deeply invested parties aggressively pursue their case. National differences raise analogous questions. A technology's success (and perhaps even viability) may depend on the openness of markets and flow of goods among them. These raise ethical issues regarding freedom of trade and national sovereignty, among other things. One person's desired regulatory harmonization is another's hated globalization.

Methodologically, these differences show the importance of seeking proper samples and candidly describing the limits to those that have been secured. Extrapolating from actual to desired samples becomes easier as evidence accumulates regarding stable correlates of attitudes toward biotechnology. The interpretation of such correlations must resist the stereotyping tendency mentioned earlier. Groups and countries differ along many dimensions, any (or many) of which could affect attitudes. For example, a series of studies by Slovic (2001) and others suggest that overall gender differences in attitudes toward technology largely reflect a subset of white males who have particularly great faith in them. Other studies implicate men's greater willingness to express anger, which tends to be associated with optimism (see references in Lerner *et al.*, in press). National differences in support for specific biotechnologies lend themselves to speculative claims regarding different peoples' precautionary tendencies (Löfstedt, Fischhoff, & Fischhoff, in press). However, such blanket explanations may obscure substantial differences in a given country's risk attitudes across technologies (Wiener & Rogers, in press).

Practically speaking, if people differ, it does them (and biotechnologies) a disservice to lump them together—unless the full range of their opinions leads to the same policy conclusions (e.g., if people of all stripes reject human cloning). Differing views on a biotechnology may reflect different beliefs about its risks and benefits, or different evaluative criteria. In the former case, suitable communications could clarify the degree of essential conflict among the parties. In the latter case, a struggle is warranted, unless it is possible to change the technology or the distributions of its costs and benefits. Unless the source of the disagreement is understood, policies and interventions will be misguided.

Tentative Conclusion 3: People have limited knowledge about biotechnologies—and know it.

Rational decision making requires understanding the limits to one's own knowledge. It creates the opportunity for learning and the caution needed for avoiding extreme choices. When asked, citizens have typically described themselves as having limited understanding and awareness of biotechnologies. With nuclear energy sources in spacecraft (another potentially controversial technology), the more people knew, the more favorable they were—among those people who seemed open to evidence (Maharik, Fischhoff, & Morgan, 1993). With biotechnologies, the evidence is mixed—familiarity sometimes breeds contentment and sometimes contempt (e.g., Einsiedel, 2000; Eurobarometer, 2000; Gallup, 1999).

Interpretation of these results is complicated by imprecision in how the technologies are described and interpreted in these studies. Furthermore, learning itself can change intuitive definitions. Greater knowledge may induce finer distinctions, as people become aware of the great variety of applications. Or it may eliminate distinctions, as people learn about the biological principles and engineering procedures common to applications (e.g., the similarities and differences between biotechnology and traditional breeding). Respondents face a puzzle, if they see finer distinctions among forms of a technology than survey questions provide. Respondents might judge the archetypal version of the technology, a weighted average of different versions, or a version that seems particularly relevant. When asked how much they trust the technology, they might judge the category as a whole by its most troublesome member. That way, they avoid signing an open-ended "contract," which might be construed as approving more doubtful versions (Fischhoff, 2000).

Even if attitude questions are well defined, attitude-knowledge correlations only matter to the extent that knowledge is measured appropriately. As all teachers (and students) know, it is not hard to write tests inflating or deflating scores. In tests of risk knowledge, a common tendency is to write questions from a curricular (rather than a practical) perspective. That is, test questions reflect issues central to scientific training (e.g., define "gene"), rather than to policy making (e.g., how extensively are new crops field tested?). The same logic should guide the content of questions and of communications. Using (and being seen as using) an audience's time respectfully means focusing on the things that its members need to know in order to make personal and public choices (Morgan *et al.*, 2001).

Typically, that means communicating and testing for understanding of the scientific community's uncertainty regarding a technology. Sensibly, citizens distinguish scientists' knowledge from their own and are less of accepting of technologies where the science seems inadequate (Slovic, 2001). Such concerns motivate various precautionary principles, often augmented by distrust regarding how the technical community manages its affairs (Cvetkovich & Earle, 1995). Generating trust through communication is challenging under any circumstances. What one says will be evaluated within a web of inferences, reflecting one's words and deeds, as well as those of other parties. For example, the opinions and deeds of eco-terrorists might provide pause for thought among ordinary citizens (Barcott, 2002; Fischhoff & Fischhoff, 2001).

Tentative Conclusion 4: People have strong opinions about how biotechnologies are managed.

If risk managers are sufficiently trusted, then citizens may feel the need to know little about a technology. Indeed, most technologies are far off their radar screen, and happily so—unless things are perceived as having gone awry. When that happens, citizens may wonder why they were not consulted—even when they showed little interest (or an active disinterest) in the proceedings. Drawing on their general knowledge of civics (and human behavior), citizens may

feel comfortable judging a regulatory process, without professing knowledge of the technology that it regulates.

These general processes are strongly reflected in the biotechnology context, as one would expect from technologies that appear poorly understood and can evoke a feeling of dread—as seen from the earliest risk perceptions studies looking at biotechnology (Fischhoff *et al.*, 1978). Across diverse populations, majorities believe that biotechnology requires strict regulation (e.g., Office of Technology Assessment, 1987; Hallman & Metcalfe, 1995) and that existing regulations are insufficient (e.g., European Commission, 2000; Mercer *et al.*, 1997). These desires should respond to the accumulating record of the technologies' words and visible deeds. Such changes are tempered by the general stickiness of beliefs, once formed. Thus, it is hard to erase an initial shadow of doubt.

For better or worse, these are ad hominem evaluations, for which trust is earned partly by specific deeds and partly by the legacy of past actions. Surveys have typically found that the medical and academic communities and nongovernmental organizations (e.g., consumer, environmental, animal welfare) have greater credibility than the public authorities that regulate biotechnology (e.g., Office of Technology Assessment, 1987; Hallman & Metcalfe, 1995; Mercer & Ng, 2000). As before, the relevance of particular results depends on the specificity of their questions. Asked vague questions about trust, respondents may worry about how much they are exposing themselves. Groups seen as knowing relatively little may be relatively trusted because they can do relatively little harm. If so, then industries should want strong, visible regulatory bodies, for the sake of their own credibility.

Tentative Conclusion 5: People have complex evaluative schemes—and respond to evidence.

The complexity of lay attitudes towards biotechnologies is seen in their sensitivity to the specific application and respondents' personal circumstances. It is also seen in their desire for strong regulatory bodies, as protection against their own ignorance. Survey results suggest greater acceptability for the risks of applications seen as more beneficial—appraisals that need not correspond to those of a technology's proponents or opponents (e.g., Fischhoff *et al.*, 1978; Pew, 2000; Slovic, 2001). Citizens who support biotechnology generally admit to potential problems. Citizens who oppose them generally acknowledge potential benefits. Thus, the technologies do not seem to be so stigmatized or glorified that citizens are deaf to the possibility of good deals or unacceptably large risks (Flynn, Kunreuther, & Slovic, 2001).

The change in beliefs over time shows another face of the sensitivity and complexity of citizens' evaluative schemes. For example, between 1997 and 2000, Europeans became more pessimistic about biotechnology's expected effect on quality of life, while their assessments of five other technologies remained stable (Boy, 2000). For biotechnology, there were similar declines in ratings of usefulness, moral acceptability, and whether applications should be encouraged. There was little change in perceived riskiness, suggesting that the other judgments are potentially independent.

Nonetheless, a minority of citizens (and perhaps experts) seems to see only one side of the ledger, viewing biotechnologies as entirely good or bad. Some of these citizens may be responding strategically—avoiding public concessions (even through the veil of a survey). Others may occupy roles that restrict their ability to say other things. When citizens fail to make distinctions among biotechnologies, industry members face a strategic choice, regarding how to group themselves. Blurring distinctions may yoke the fates of technologies differing in their social acceptability—were their details generally known. The result could be guilt by association for

some applications, innocence by association for others. As applications become better known, this aspect of lay perceptions will be less subject to manipulation. Until then, pooled biotechnologies will tend to have a common fate (Fischhoff, Nadaï, & Fischhoff, 2001).

Summary

The wealth of public opinion polls provides a rich empirical basis for understanding citizens' attitudes towards biotechnology. It constrains the speculations of those who would speak in the name of the public or make sweeping claims about citizens' competence to make public policy choices. Polls allow hearing the voices of many more people than one could observe anecdotally. Statistical analyses provide protection against the imprecise mental arithmetic of intuitive summaries.

The picture that emerges from these polls shows moderately orderly attitudes, responding in plausibly sensible ways to circumstances (e.g., differences in the technologies or the evaluators). These results suggest some reason for optimism that citizens will respond reasonably, should they receive relevant information, in comprehensible form, from trusted sources—then have appropriate opportunities to express their opinions. Achieving these goals will likely require concerted communication programs, with empirically evaluated materials coming from neutral sources. It will also require opportunites for more nuanced expression of values than opinion polls allow. Their highly structured questions inevitably leave respondents guessing about the meaning of the questions and investigators guessing about the meaning of the answers (Fischhoff, 2000). Identifying policies that are broadly acceptable, to diverse stakeholders, will need more direct interaction with the issues and, perhaps, with one another.

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