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New Technologies: The Public is Listening But are Scientists Talking?

by
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Last week, a science journalist from a major West Coast newspaper telephoned me. She was looking for background information for an article she was writing about nanotechnology. She had read Bill Joy's "Wired" magazine piece, and the *New York Times* story last year proclaiming that the "great Gray Goo debate" had begun.[1]

She had seen British newspaper reports with headlines like, "Prince launches crusade against 'grey goo' science" -- about Prince Charles's alleged concerns over nanotechnology after reading Michael Crichton's book, *Prey*.[2] She also knew that Prince Charles had been a major figure in igniting the debate about genetically modified food – also known as Frankenfood.

She had looked at the interview by UK Science Minister Lord Sainsbury where he emphatically declared that the British government was determined to prevent nanotechnology from becoming a media scare story to rival the controversy over agricultural biotechnology.[3]

And she had read the ETC Group's "The Big Down" study, and the more recent Greenpeace report about nanotechnology."[4] And she knew that both groups played a major role in Europe's GM food debate.

The question she posed to me was, "is there a real a problem here?" Are significant numbers of people around the world genuinely concerned about the possible negative consequences of nanotechnology – for human health, the environment, worker safety, and for the "have nots" in our globalized economy? Or, were all these media stories and NGO reports simply old-fashioned scaremongering and hype -- generated to sell newspapers and to raise organizational donations and boost NGO membership numbers?

Because I am from the National Science Foundation (NSF), I of course told her that there was no easy, straightforward, "yes" or "no" answer, to anything. First, you had to look at the data.

The only publicly available nanotechnology polling results I know about are from surveys funded by NSF and the European Commission. These surveys asked representative samples in both America and Europe whether nanotechnology would help contribute to a better future or to a worse one.

The not surprising finding was that large numbers of people said they don't know. In Europe, the "don't knows" made up over 50 percent of those sampled. In the US, about one third. But the pollsters conducting the surveys believe the actual number of "don't knows" on both continents is probably much higher. People questioned in polls don't want to show their ignorance, so they'll often give the questioner the answer they think makes them look smart.

So, based on limited data, I can say that there is no popular revolt or groundswell of concern amongst the citizens of America and Europe over nanotechnology.

But the fact that large numbers of the public "don't know" about nanotechnology is not necessarily good news. Crichton's *Prey* was a *New York Times* best seller, and he has already sold the movies rights to Twentieth Century Fox for $5 million. If the book, movie, video and DVD sales are only half as successful as his other blockbusters like *Jurassic Park* then tens of millions poeple, even hundreds of millions worldwide – including the Prince of Wales – will gain their seminal knowledge about nanotechnology and form their first impressions about nanotechnology based on the imaginative work of science fiction writers -- and not on the findings of scientists.

My remarks tonight are entitled, "The Public is Listening But are Scientists Talking?" to make the point that today, it's largely journalists, science fiction writers, environmentalists and anti-globalization NGOs who are talking to the public about nanotechnology. It is not the science and engineering community.

If that fact does not alarm the people in this room, it should. I know that it's a situation that's very distressing to the British government, who in response to Prince Charles's concerns quickly established the official Royal Society and Royal Academy of Engineering study on nanotechnology's benefits and risks that the Prince had called for.

This state of affairs also is disturbing to me because over the past three years, I have been writing a book on the genetically modified food debate. It is the story of how agricultural biotechnology went from a dream technology promising the "doubly green revolution" that would end world hunger in an environmentally sustainable way, and how it became the great Frankenfood nightmare – threatening US-European trade, reducing public and private investment in promising areas of agricultural research, and potentially depriving poor and rich countries of major crop improvements in the future.

My research asks whether the GM food debate is an exceptional event? Or, do new science and technologies like stem cell research, xenotransplantation, and nanotechnology potentially face the same public resistence and political reluctance as agricultural biotech? My own answer is an unequivocal "yes." Virtually all technologies are in the same boat with Frankenfood.

The march of technological innovation is not inevitable. Genies may not easily go back into bottles but the GM controversy in Europe shows that popular objections about possible adverse health and environmental impacts, or social and ethical concerns, can

create substantial barriers to a technology's widespread adoption, use, and profitably.

In my view, the forces that shaped the GM debate aren't going away. A brave new world exists for scientific and technological progress where public concerns and questions about a technology's consequences will play a more central role in national and international decision-making.

Let me highlight just a few important factors in this age of globalization which were critically important in creating the Frankenfood dispute and which remain with us today.

First, political and economic change since the Cold War's end allows the world's peoples – especially the affluent – to be more discerning about the use and application of new technologies, and more exacting about their benefits, risks, and controls.

Globalization means technology – and its impacts – recognize no borders. The pace of technological change is ever more rapid, and the scale and impact of change is massive. This is especially true when scientists look out into the future and see the increasing convergence of biotechnology, nanotechnology, and cognitive and information science.

When faced with this accelerating and monumental change, everywhere citizens are calling for a higher level of health, environmental, and social safeguards, and for maximizing individual choice. And they are demanding greater accountability and liability from their governments, industry, and from science, when technologies invariably lead to unintended and unwanted consequences.

Second point. The information revolution of the past decade enables nongovernmental organizations (NGOs) to scrutinize science and technology as never before. E-mail and websites empower relatively small, poorly funded NGOs and public groups to challenge the agendas of huge, multinational corporations and government institutions. New information technology, with its 24/7 media reporting cycle, means that issues and news spread swiftly, moving rapidly from local and national to international debating arenas, and polarizing quickly.

The enormity of this transformation is always brought home to me by former White House press secretary Joe Lockhart's remark that:

> In 1993, when Bill Clinton took office, there were 50 websites in America. When Clinton left office, there were more than 2½ million.[5]

This "faster, cheaper" but not necessarily "better" information climate means that public concerns about technological innovation and scientific discovery are less likely to be overcome by better risk communication or creative marketing maneuvers that were used in the past.

Third point. The general erosion of public trust in government – and Europe's fears about the growing commercialization of science – mean that officials, businesspeople, and the science community have to work in new ways to gain and maintain public

confidence in society's ability to manage and mitigate technological risk.

Building greater public trust -- horribly lost in Britain in the area of food safety after the mad cow disease crisis in 1996 -- means regulatory systems must address genuine public concerns as well as science and safety imperatives. Decision-making processes need to be more open – involving stakeholders and the public at early decision points, delineating more clearly a new technology's potential benefits and risks, and offering strong consumer, environmental and public interest protections.

In addition, as Monsanto Corporation's GM battle-scarred president recently stated, it is imperative in the 21st century that companies – and decision-makers – "listen more." Some of my research examines that new process of listening, exploring new avenues and techniques for dialogue and cooperation between industry, government, and NGOs that include citizen juries, dispute settlement and dialogue groups, and public participation in science advisory bodies.

So given this new context for 21st century science and technology, what can be done to prevent nanotechnology from turning into what the *New York Times* calls a dreaded "Great Gray Goo" debate or another Frankenfood war?" My answer is plenty.

It use to be that people were generally optimistic about the contribution science made to their quality of life, and welcomed of new technologies they perceived as beneficial and useful. Regulatory systems encouraged innovation. And if a company played by an established set of government rules (which usually lagged behind and not in front of technological change), then patents were granted, new products approved, new brands appeared on the market, and consumers bought them.

The benefits of any new technology were always presumed to be greater than the risks. And any long-term problems – if they occurred – were dealt with in a clumsy game of regulatory catch up.

This world – what academics call the old "diffusion of innovations" theory of technology acceptance – is largely gone. The public is now more skeptical about allowing a major new technology onto the marketplace, and seeking a regulatory context that combines science-based risk assessment with a better system of checks, balances, and public consultation.

Understanding this new era for S&T, and the new model for public acceptance of new technologies, is critical for the success of nanotech. It also is vital for achieving the improved quality of life and economic growth that 21st century science and engineering promises.

Build public trust

So, what's the first step in ensuring nanotechnology's – or any other new science's – acceptance? In my view, it's important to begin by recognizing that the public isn't dumb, irrational, or that easily led. People largely know the difference between empty

bureaucratic gestures and public relations "spin," and what they perceive as genuine measures to improve their quality of life, and to protect public health, security, and the environment.

The general public has a long memory for regulatory mistakes like mad cow disease. The attentive and interested public recognizes when a regulatory system relies too heavily on corporate vs. publicly-funded safety research, inadequate environmental impact testing, and a jumble of multi-agency oversight responsibilities. And the public knows the difference between voluntary and mandatory regulatory compliance standards for industry.

The genetically modified food debate shows how important building and maintaining trust in government regulatory systems can be. European and American consumers hold very similar views toward agricultural biotechnology. Two years ago (June 2001), an ABCNews.com poll found that 52 percent of Americans believe that GM food is unsafe. Ninety-three (93) percent want the federal government to require labels on food noting whether it has been genetically modified.

These results are not so different than polls throughout Europe. The key factor in continued consumer acceptance here is that Americans largely trust the Food & Drug Administration to keep our food and pharmaceuticals reasonably safe, and our drug prices unreasonably high.

So when FDA said in the early 1990s that GM products were "substantially equivalent" to conventionally-bred and grown food, then most Americans believed them. And we continue to buy and eat GM products to this day.

In Europe -- especially in Britain after the mad cow disease crisis in 1996, with admissions of bureaucratic ineptness and its early projections that as many as 500,000 Britons would die over the next 30 years from the disease – food regulatory agencies were seen as largely beholden to industry and agribusiness. Scientists were perceived as more interested in "cashing in" on their research than in contributing to improved quality of life.

So this means that even after 15 years of European government supported research costing over $60 million and showing that GM crops pose no greater health risks and may even be better for the environment than conventionally grown food, the public isn't buying it.

When organizations which the public has grown to trust more than their governments – groups like Greenpeace – continue to insist that GM plants may pose a catastrophic threat to the environment, and when these NGOs hint at another potential catastrophe like mad cow disease, then who does the public believe? They believe Greenpeace.

In my opinion, US industry, the government and the science and engineering community have been woefully deficient in educating the public about nanotechnology. This is beginning to change. NSF's recent grant-solicitation on education that includes

funding for informal math and science education programs is a great start. But such efforts cannot come soon enough.

Manageable risks and perceived public/consumer benefits

The next critical factor in technology acceptance is perceived direct benefits. This is why so-called red or medical biotechnology is accepted in Europe, while green or agricultural biotechnology is not.

When the public doesn't trust government regulators to keep them and their children safe even from the most remote risk, and when they see no direct benefits to them, and when they feel they are being subjected to any risk involuntarily for the sole purpose of bettering corporate bottom-lines, then public acceptance of a new technology becomes problematic.

While genetically modified soybeans, cotton, and corn were extremely useful to farmers and reaped huge profits for corporations, processed food products with GM derivatives on supermarket shelves didn't benefit the average consumer. They weren't cheaper. They didn't make your thinner, or offer you an allergy-free peanut.

Agricultural biotechnology also suffered from the "yuck factor." A cell phone is "cool" [HOLD UP CELL PHONE] – even though some research indicates heavy usage, especially among young children, could eventually promote brain tumors or cancer. But let's face it, plant genes are "yucky." And there are studies which show the more a person learns about how genetic engineering moves pieces of genetic material from one organism to another, then the "yuckier" people feel about the technology. And the easier it is for an organization like Greenpeace to demonize or "Frankenstein" it.

Depending on the use you select, nanotechnology can be either "yucky," or "cool," or better yet, "life-saving." I think if there's one piece of advice Monsanto could give the commercializers of nanotechnology, it would be to market the "cool," the "life-saving," or environmental clean up and protective products first. Leave the "yuckier" stuff for later.

Voluntary

Another lesson from the Monsanto experience is to be mindful of consumer choice. Farmers could choose to buy or not to buy GM seeds. But when GM derivatives were insidiously substituted for conventionally-grown products in almost three-quarters of all processed food, there seemed to be no chance to label products and to give consumers the freedom to decide whether they wanted to adopt a new technology, or not.

To compound this problem, one of Monsanto's many public relations missteps was to tell European consumers that the technology was perfectly safe. It had been approved by all the relevant national and international regulatory bodies. And in the absence of tangible safety concerns, Monsanto and U.S. trade officials would consider any attempt to label GM products an unfair trade practice. And they would fight labeling – which

they see as putting a skull-and-crossbones on their products -- to the death.

Essentially, Monsanto was telling European consumers that their freedom of choice didn't matter. So Greenpeace and Friends of the Earth didn't have to work hard to demonize Monsanto as literally trying to ram this food down the European public's unwilling throats.

If you look at the latest L.L. Bean clothing catalogue [HOLD UP CATALOGUE], the makers of Nano-Care trousers seem to have learned this lesson. They are marketing their chino cotton pants treated with microscopic synthetic fibers called "nano-whiskers"-- that give the fabric its stain and wrinkle resistance – as a premium consumer benefit and they are clearly labeling their product.

Image

Image, culture and ethics play a part as well. If your self-image includes being an environmentalist, then when it comes to genetic engineering or nanotechnology you want to stand with Greenpeace and Friends of the Earth – and not with a corporation like Monsanto who produced saccharin, PCBs, and Agent Orange.

The lesson here is that nanotechnology scientists and industry need to make friends and allies with environmental groups, consumer organizations, health care providers, and other trusted elements in society.

Scale

Another factor in the GM controversy in Europe is the scale of the technology. As a rule, large-scale technologies are rated less favorably by the public than small-scale ones. Nanotechnology is potentially the most transformative technology of this century. This means that the science community needs to be more and better engaged in public debate over nanotechnology and more respectful of citizen concerns. In Britain, in the early stages of the GM debate, the science community largely sat on the side-lines, or opined that the public was dumb, or that the anti-GM factions were Luddites. As Lord Sainsbury now states, they don't plan to make the same mistake with nanotechnology.

NGOs – be they environmental groups, patient advocacy groups, consumer representatives, industry lobbyists, or religious organizations – are here to stay. Mechanisms need to be put in place to ensure that they play a role in decision-making, and that an avenue exists for governments, the science community and corporations to listen to and act on citizen concerns.

In the US, a historical example of how the science community set up a system for "listening" is the ethical, legal, and social issues program – better known as ELSI -- connected to the Human Genome Project.

In Europe, multinational corporations like Unilever and Shell are engaged in dialogue programs and in reshaping corporate responsibility policies that take this new way of

doing business into account.

Research into potential harmful effects

Another important piece of advice is to acknowledge, as Eric Drexler did in his 1991 book, that:

> Almost any technology is subject to use, misuse, abuse and accidents. The more powerful a technology is when properly used, the worse it is likely to be when abused...Nanotechnology and molecular manufacturing will be no exception.[6]

So, this means that the US government investment into research to explore the potential hazardous side effects or negative environmental impacts of nanotechnology must continue to grow. This workshop and the research of many you in this room are an important part of that effort.

Like Rick [Richard] Smalley recently said in a interview with *smalltimes*, "I don't see any problem [with nanotechnology], but let's look."[7] The "looking" alone by scientists is a public confidence-building measure. It also offers an opportunity, as Smalley's colleague (at Rice University) Vicki Colvin has often said, to save money now by directing research away from areas and materials that have potentially expensive environmental or grave occupational health effects. It's cheaper in the long run, and more efficient, to find problems early before industry makes a major commitment to nanomaterials or processes with dangerous side effects.

Poll the public

It's hard to engage the public and to build public trust and confidence in this new technology when we know so little about public knowledge and attitudes toward nanotechnology. We desperately need in depth research that goes beyond the kind of quick-and-dirty, "up" and "down" polling questions that form the basis of so many news stories. What I am calling for is research that rigorously measures levels of public understanding, and examines the fundamental risk-and-benefit perceptions and societal concerns that the public holds.

Closing

If I still haven't convinced you that nanotechnology is potentially in danger of becoming a "nano-Frankenstein" controversy, let me close by leaving you with one final image.

It's Spring 2004. It's a presidential election year, and about a decade or more before the time when the NSF predicts that nanotechnology will begin to play a central role in our lives.

It's a time when the public's strongest imagine of nanotechnology is Michael Crichton's devastating swarms of "nanobots."

Picture me as the the executive director of a new NGO called the "Coalition for Nano-Free Kids." It's late spring, just when families are planning their summer vacations to the beach. And I'm launching the "Is small beautiful or deadly?" advertising campaign about the possible human health and environmental risks of nanotechnology.

My principal target audience is "soccer Moms" who have become fanatical about putting sun screen on their children to protect them from skin cancer. The poster for this campaign is the picture of a young, 30-something mother slathering her very blond, fair skinned toddler in sun tan oil at the beach. The caption on this poster reads, "Is she protecting her child from skin cancer or subjecting her baby to a potentially larger danger?"

The bad guy in this campaign is a consumer products giant like Procter & Gamble or Johnson & Johnson.

I am able to enlist a widely trusted politician like Senator John McCain – who's a war hero, who represents a high solarization state, and who suffers from skin cancer and is personally dependent on sun screens.

At my urging, Senator McCain calls for hearings on the quality of federal oversight of nanoparticles currently found in products like sun screens, deodorants, eye creams, and paint.

Now the success or failure of this campaign to stir public opposition to nanotechnology will not depend on my PR skills, or the quality of the media's reporting of the science involved, or even on John McCain's many political talents.

It is dependent upon whether or not responsible government agencies, industry, and members of the science and engineering community like you can demonstrate that it has taken the steps necessary to manage this technology for the public good.

With that final food for thought, I'll open up the session for questions.

(9/15/03; 3691 words) (3500 words=24 minutes)

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