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Risk communication in the internet age: The rise of disorganized skepticism

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Abstract

Communicating risks has become a core ingredient in the regulatory functions of government, interest group advocacy, public health, and corporate relations. The channels of risk communication have grown in complexity along with the development and expansion of the Internet and the birth of personalized blogging. This paper discusses three stages in the development of risk communication as an area of study and research. It examines the way risk is framed in three channels of communication, newsprint, the Expanded Academic Index, and Google using the example of the controversial chemical perfluorooctanoic acid (PFOA). The paper concludes that the Internet, as illustrated by the Google search engine, has created more opportunities for citizen learning and expanded the breadth and channels of risk communication, while also providing new opportunities for stakeholders to influence the message. Democritization of information does not necessarily create greater concordance between the cultural and technical assessment of risk.

Keywords: Internet; Perfluorooctanoic acid (PFOA); Risk communication; Risk perception; Scientific uncertainty; Teflon

1. Introduction

Information and its availability have expanded exponentially with the growth of the internet. Average citizens can access databases, journals, government reports, NGO sites and participate in "chat rooms," sign on to information networks and even contribute their own knowledge to an interactive encyclopedia called Wikopedia. Blogs give individuals an opportunity to question experts in fields of science, engineering and public health and also to witness debates over contested issues in public health, environmental hazards and medical treatments.

When a physician prescribes a medication, the skeptical patient can choose to explore its safety and efficacy by reviewing some of the same documents that are seen by the expert decision makers and government regulators. Because each of our interpretations of risk depends on so many cultural factors, the scientific, medical and/or engineering data may be only one of several determinants of people's choice.

How should professionals in the fields of science, environmental health, medicine and engineering, whose role is to assess and communicate risks to the general public, function in this new information rich environment? At the same time that the availability and variety of information has expanded, the boundary between good quality and poor quality information has become blurred. New electronic journals of unproven quality have begun to surpass the readership and the influence of traditional refereed journals. And from a cultural perspective, post-modern relativist thinking and social constructivist ideas have weakened the public's confidence in objective knowledge—including dependable risk estimates.

This paper explores how the new information age affects the tension between technical and cultural meanings of risk, and whether greater accessibility to information will bring convergence or divergence to these concepts of risk and risk communication. What can be done to establish integrity and public trust in the risk analysis, management and communication fields? What special challenges to risk communication arise from the growth of multi-vested science and the commercialization of research universities? What is the significance of the late sociologist Robert

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Merton's concept of "organized skepticism" in an age of "disorganized skepticism."

1.1. Theory of risk communication in 1980s and 1990s

The theory of risk communication advanced significantly in the 1980s, when the practice of risk communication became a subject of specialized study. The early models of risk communication characterized it as a linear process. The guiding framework for understanding risk communication was the Information Theoretic Model, which was designed to understand how signals, emanating from a single source—usually some authoritative source, travel through a medium and reach an audience. Signals, amplifiers, modulators, transducers all affect the quality and impact of the original message. That model was designed for hierarchical systems where a message enters an ambiguous, fragmented, and uncontrolled space. Today, this model is found most commonly in the public health construct of risk communication, where an authoritative and unambiguous message is delivered in order to bring about behavioral change.

Cultural and sociological models of risk communication brought a new lens to understanding what is communicated, how it is communicated, and how it is received by a target population. In the Cultural Theory, risk is socially selected and to some extent socially constructed (Raynor, 1992). Because of the way they define their role in society (i.e., competitive versus egalitarian), different personality types view risks differently. The notion that all risks can be reduced to a common currency or are the same for all people in society does not conform to Cultural Theory. We know that risk perceptions can be gendered, age dependent, generational, and vary across cultures.

In multi-stakeholder risk communication, all groups are competing for the media's attention and for garnering resources in an intensely political arena. Risk communication is inherently multi-directional and non-linear. Scientific uncertainty makes the expert less likely to succeed as a hegemonic source of knowledge. The risk communication environment of a multi-stakeholder universe consists of a manifold of non-linear signals competing for dominance and survival. The National Research Council (NRC) defined risk communication as "an interactive process of exchange of information and opinion among individuals, groups and institutions" (Committee on Risk Perception and Communication and National Research Council, 1989). The non-linear, multi-directional and multi-stakeholder approach to risk communication is consistent with a political landscape of contested knowledge where the only recourse is through negotiation and deliberative democracy.

In *Environmental Hazards*, Krimsky and Plough provided a schema for describing the narrow and broad definitions of risk communication (Krimsky and Plough, 1988). The categories of relevance are: the intentionality of the message, whether or not the message is goal oriented; content—whether the message is limited to health or social risks rather than technological risks; audience directed—whether a targeted audience, i.e., smokers, are integral to the communication; source of the information—whether it derives from experts or not; and the flow of the message whether it flows from expert to lay person or otherwise (Table 1).

1.2. Risk communicators' adaptation to early models

Elite risk communicators adapted easily to the linear theoretic models like "Social Amplification of Risk" (Kasperson, 1992). They learned to avoid false and patronizing analogies. Industry leaders acknowledged uncertainties, briefed CEOs on how to sound empathetic, and trained risk communicators on acting confident without appearing arrogant or self-righteous. Corporate and government communicators of risk made direct eye contact with their audience and the camera lens and learned to respectfully disagree with critics without treating their concerns as "infantile disorders" (Covello and Allen, 1988). The concept of two-way communication was embraced as a concession that the audience in the risk communication was an active participant in the decision-making process.

The US Environmental Protection Agency (USEPA) defined risk communication as "the process of informing people about hazards to their environment or their health. Communicating risks is a two-way exchange in which organizations inform target audiences of possible risk, and gather information from those affected by the risk"

Table 1
Definitional range of risk communication

Category	Broad	Narrow
Intentionality	Risk communication goal unnecessary	Intentional and directed; outcome expectations about the risk message
Content	Any form of individual or social risk	Health and environmental risks
Audience directed	Targeted audience not necessary	Targeted audience necessary
Source of information	Any source	Scientists and technical experts
Flow of message	From any source to any recipient through any channel	From experts to non-experts through designated channels

Source: Krimsky and Plough (1988).

(Environmental Protection Agency (EPA), 2002). One leading proponent of risk communication in the USEPA saw it as a necessity for sharing power when he noted: "…the question before us is not whether there is going to be sharing, whether we will have participatory democracy with regard to the management of risk, but how" (Ruckelshaus, 1987).

Ironically, it is often the community or the non-governmental organizations (NGOs) that initially communicate the risks to the public agencies and the media. That was the case with many toxic waste sites in the United States such as Woburn, MA, Love Canal, NY, and Times Beach, MO (Brown and Mikkelsen, 1990). The first responders to risk are community residents who smell, see, or taste something unusual or witness elevated disease levels in their community.

3. Three stages in the evolution of risk communication

The concept or risk communication grew largely out of reactions by government regulatory bodies and corporations in response to community activism over hazardous waste sites. Local environmental activists protested federal agencies over what they perceived to be under-regulating in the cleanup of hazardous waste sites. As a consequence, people in poor and underrepresented communities felt they were exposed to unacceptable risks. The idea for risk communication came about as regulators and corporate technology managers began to understand that the public was not responding to technical risk analysis. According to Golding, "Like many new ideas, risk communication was seen as the answer to many theory problems—most notably as a means to bridge the gulf between expert views and public perceptions of risk" (Golding, 1992). Elites embraced the idea of incorporating risk communication into the framework of "risk management" after they recognized that technical risk analysis was not sufficient to win over public support for a technological project or a toxic waste clean-up proposal. They faced two challenges before they could get general public acceptance. First, there was the technical debate over the risk analysis, which usually involved scientists reaching consensus over the *amount* of risk. Second, there was the battle over winning the "hearts and minds" of the public constituency on the acceptability of the risk, whether or not there was consensus over the risk estimate. This latter process came to be known as "risk communication" In its early stages risk communication was largely a euphemism for translating technical risks into a publicly accessible and digestable form, which eventually would be acceptable to the audience.

Fig. 1. Linear information model of risk communication.

During its evolution, the concept of risk communication went through three stages. In "stage 1" risk communication was conceived of as a top down linear process of delivering a message that addressed the public's potentially irrational or unrealistic response to a risk or that rationalized an agency or corporate risk management decision. I call this the linear information model of risk communication (see Fig. 1). This is illustrated by USEPA's 1988 publication of its seven cardinal rules of risk communication. Among the rules on USEPA's list were "Meet the needs of the media" and "Speak clearly and with compassion (Cohrssen and Covello, 1989). In "stage 2" of its evolution, risk communication was seen through the lens of scientific uncertainty, subjective and cultural aspects of risk, and the media's role in risk amplification. Roger Kasperson's "Theory of Social Amplification of Risk" was the dominant framework for studying how risk events become interpreted, exaggerated, and integrated into the public mind (see Fig. 2).

Finally, "stage 3" of risk communication is tied to the post modernist and social constructionist view of risk. It was not simply the issue of scientific uncertainty in setting risk estimates, but rather scientific bias and socially constructed hazards that shaped the public's understanding of risk. Better risk communication could not address these structural shaping factors. During this stage, conflicts of interests enter the public discourse about risk. There is more emphasis on the uncertainties and structural bias in science, especially on risk modeling. Ravetz and Funtowitz's idea of post modern science describes the role that

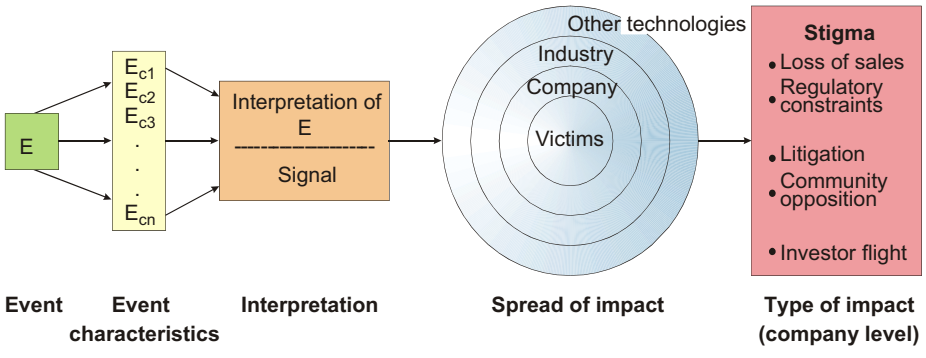

Fig. 2. Amplification of risk. Source: Kasperson (1992).

risk communication plays in the public arena during this third stage (Funtowicz and Ravetz, 1992).

4. The globalization of risk messaging

Before the Internet, it was the medium of TV that brought risk messages to the largest possible audience over the shortest time period. After the Natural Resources Defense Council (NRDC) issued its report on childhood cancer, highlighting 23 common pesticides, the organization hired a public relations company to communicate the results of the study (Natural Resources Defense Council, 1989). Instead of having a general news conference reporting the results, the PR firm negotiated an agreement with a leading US TV news magazine "60 min". The 20 min news broadcast focused on one of the chemicals called daminozide (trade name Alar), a growth promoter used on apples to control ripening. Within weeks of the airing of "A is for Apple" the country's consumers had spun into a national boycott of apples (Rogers, 1998). That process describes "stage 3" risk communication before the introduction of the Internet.

As the Internet grew, access to information by communities, public interest groups and ordinary citizens has been unprecedented up to this point in human history. Expertise on risk became secondary to the significance of trust and validity in the source of information. Public skepticism is fed and nurtured by new open forms of internet communication. All risk websites are potentially equal in Cyberspace, constrained only by the skill of the web designer. It levels the playing field to a public that does not understand the hierarchy of expertise (meritocracy). The poorest public interest group can have an internet site that matches that of a multi-billon dollar corporation. Perhaps these sites do not have an appreciable corporate influence on the electoral process (lobbying) but they may turn public opinion from "no concern" to "extreme concern" in a very short time. The form, frequency and sources of information people are exposed to has been revolutionized by the system of world-wide computer networks—the Internet. This has unforeseeable consequences for the public access and response to risk information.

5. Disorganized skepticsm

Organized Skepticism is a norm of science according to the late sociologist of science Robert Merton (Merton, 1957). We do not accept scientific results at face value. We question experiments , interpretation, generalization, alternative hypotheses, bias, possible scientific misconduct and the influence of money on scientific outcome. According to Merton:

> The suspension of judgment until 'the facts are at hand' and the detached scrutiny of beliefs in terms of empirical and logical criteria have periodically involved science in conflict with other institutions (Merton, 1957, p. 560).

Scientists have developed an elaborate peer review system to make corrections before a scientific write-up gets into print. Many scientific journals have added disclosure of conflict of interest to their list of author responsibilities (Krimsky and Rothenberg, 1998).

Expansion of the Internet has resulted in qualitatively new risk communication pathways, among which is the popular search engine Google. There is competition and cyberspace skill to gain a higher place on a Google search. Through such internet engines the public has greater access to published science and its interpretations. Beyond that, the public also has gained entry into the inner circles of scientific discourse through blogs, popular science websites, and online magazines in ways that were once too expensive or too cumbersome to achieve. Giddens described the role of the Internet in risk and crisis communication by the term "disembedding" or "the lifting out of social relations from local contexts of interaction and their restructuring across indefinite span of times" (Giddens, 1990). The Internet communication is virtually outside of space and time in the sense that location and time are irrelevant to the form of the communication. Moreover, quality control of information is self-imposed. Errors or exaggerations are easily duplicated. The only rule is *Caveat Leptor*. Bucher notes, "*All the news that's fit to print* is no longer a limitation on the Internet".

The Internet has provided citizenry with new sources of skepticism to fuel beliefs that they are prone to have had anyway and to accept risk communication when they believe the source of the evidence is dependable. Many of the NGO websites have become more trustworthy to the public than official government sites. For example, one of the most successful Internet sites for information about toxic substances is "Scorecard" a database developed by Environmental Defense (ED), (formerly the Environmental Defense Fund). Another popular site produced by the Environmental Working Group (EWG) publishes comprehensive studies on specific toxic substances that one cannot find in the websites of government agencies. The EWG's discussion of Teflon is such an example.

In a survey of environmental officers in every local authority (LA) in England and Wales, the investigators found that "although up-to-date information is freely available from a number of official Government sources, those official sources are not consulted as often as the media or as intensively as the Internet, despite being consistently regarded as much more accurate, credible, and appropriate to LA needs" (Demeritt and Langdon, 2004).

As for the Internet, most people do not proceed for more than 2–3 pages down on a search. Access to information is highly biased toward the top of the Google (or other search engines) results. Some of the idiosyncratic aspects of obtaining information on the Internet are as follows:

- A considerable body of unchecked, false or biased information appears on the web.
- Web sites that are not updated may provide outdated information.
- There are no quality controls on what appears on the Internet.

- Electronic blogs have become formidable competitors to newspapers and magazines.
- Chat rooms, which offer people opportunities to connect at a personal level, provide a powerful influencing effect on people's response to risks.
- Unlike the media, risk information on the Internet continues to circulate and persist. It has a long staying power.
- Websites have made risks visible to the public that, previously, would have fallen below the radar screen.

Thus, to understand the Internet as a major player in shaping risk information, we must acknowledge its potentiality as a universally accessible (with minimal technology) source of information, as providing an equal playing field to communicators with no quality controls, as offering individualized settings for risk messaging, including chat rooms, list serves, and blogs that function as an interactive, global and personalized communication system.

6. The internet's role in cultural risk perception

Does the existence of the Internet widen or deepen the gap between cultural and technical rationality of risk? Technical rationality may be measured by peer-reviewed publications and scientific consensus panels. Cultural rationality can be measured by stakeholder views, the media, or popular opinion polls.

Suppose we were to select a contested risk and track it through three sources: Newspapers, Expanded Academic Index, and Google. What will we learn about risk from these three sources? Newspapers represent the older, pre-Internet channel of communication. People typically subscribe to one newspaper, which offers sporadic and limited coverage of most technological issues and health risks. Moreover, the readership easily forgets what was in an article. And except for the libraries, retrieval of a risk event is not an easy task. Expanded Academic Index (EAI) is a database that permits scholars (mostly at universities), to access abstracts from journal articles. Retrieving the entire article (pre-Internet) often involves a trip to the library. And Google, the most popular search engine of the Internet age, gives users free accessibility to websites from all sources. Unlike The Web of Science (another electronic database) and newsprint journalism, there is no quality control over the information received through Google.

My goal in this exercise is to compare these three sources on the risk information they offer for a particular product in order to determine whether there are qualitative differences on what they communicate to an ordinary person about the risks of that product. I chose to investigate the substance Perfluorooctanoic Acid (PFOA), which is used in the manufacture of non-stick products such as Teflon, because it has recently been discussed in scientific studies and the American media as a health concern, although it has not been a blockbuster issue. How would we compare the risk communication from the three sources in terms of: (1) diversity of risk issues; (2) depth of issues discussed; (3) uncertainties; (4) guidance or recommended actions; (5) cultural risk expressed; (6) sources of information; (7) amplifiers and de-amplifiers.

After inserting "PFOA" in Google's search engine, I found that the first page had seven entries from distinct sources (one entry was inaccessible). In order of appearance the sources were: (1) Environmental Protection Agency (EPA); (2) Society of Plastics; (3) Environmental Working Group; (4) DuPont; (5) Wikopedia; (6) Unknown source: www.pfoa.com and (7) Fox News WTTG-DC (Table 2).

The lead citation, which came from EPA, stated that, based on the information the agency had, the routine use of household products containing PFOA does not pose a concern:

> At the present time, EPA does not believe there is any reason for consumers to stop using any products because of concerns about PFOA. EPA wants to emphasize that it does not have any indication that the public is being exposed to PFOA through the use of Teflon®-coated or other trademarked nonstick cookware. (www.epa.gov/oppt/pfoa).

The EPA site stated that "it [the agency] does not have any indication that the public is being exposed to PFOA through the use of Teflon coated or trademarked nonstick cookware." However, on a sidebar, another risk message states that the EPA administrator on January 25, 2006 has invited PFOA manufacturers to commit to reducing PFOA emissions and product content by 95 percent no later than 2010 and to work toward eliminating PFOA emissions by 2006. Thus, we get two very distinct risk messages from the EPA on the first page of its website on Perfluorooctanic Acid (PFOA).

The DuPont site claimed: "Extensive scientific testing shows that our products including those that are branded Teflon are safe for consumers." The Society of Plastics emphasized that PFOA is a fluoropolymer which has unique properties including great strength, versatility, durability and heat resistance and that has become integral to the nation's economy, the safety and security of the public, reductions in air and water pollution, and improvements in the quality of life. This site emphasizes the centrality of PFOA to the US economy:

Table 2
Google citations on PFOA (first page)

- 307,000 hits
- 7 distinct hits on the first page
- #1 Environmental Protection Agency
- #2 Society of Plastics
- #3 DuPont
- #4 Environmental Working Group
- #5 Wikopedia
- #6 Unknown source: www.pfos.com
- #7 FOX News WTTG-DC

> Though not widely known to the general public, PFOA is an important chemical, essential to the manufacture of materials that are used to make products that span the entire US economy…. Its primary use is to help manufacture high performance, heat-and-chemical-resistant materials known as fluoropolymers.''

The Environmental Working Group (EWG) is an environmental non-profit public interest organization that specializes in exposing the under-regulated risks of toxic chemicals. Of all the websites on Google's first page, EWG had the largest resources on PFOA, a subset of perfluorochemicals (PFCs), consisting of 15 pages of notes and references in one click. Here is an example of some of the text:

> EWG's Chemical Industry Archives include 50,000 pages of scientific studies and related documents from the EPA's regulatory docket for the two major perflurochemicals (PFCs) the agency has focused on to date. PFOS is the 3M Scotchgard ingredient that EPA forced off the market in 2000. PFOA, now made by DuPont and other companies, is the PFC used in the manufacture of Teflon. Hundreds of pages of internal 3M and DuPont documents, obtained through litigation underway in West Virginia, are also included in this collection. We will update the Scotchgard/Teflon collection with new documents from EPA and other sources as they become available.

The EWG website used risk information that was available through the EPA and from litigation sources to make the point that science has now learned that low doses of PFOA harm lab animals with estimated blood concentrations of the chemical lower than those found in some children. It also stated that government-initiated investigations from lab studies produced by 3 M in 2001 has led the EPA to promulgate requirements for expedited assessments of the compound, an action rarely taken by the agency.

From the EWG we get an unambiguous risk message that PFOA is dangerous to consumers and should be removed from the market immediately. In outlining the human effects, EWG emphasized:

- DuPont tested for and found PFOA in the blood of female plant workers in Parkersburg. The company followed and documented pregnancy outcomes in exposed workers. Two of seven children born in female plant workers between 1979 and 1981 had birth defects….
- In addition to causing testicular tumors, PFOA causes many other effects on the male reproductive system, including increased size of the testes, epididymides in the seminal vesicles and decreased prostate in rats in the female. PFOA causes mammary tumors and cellular effects on the ovary.

Getting a message about a product or chemical on the first page of Google is a highly desired outcome. The source of the information and the selection of scientific studies can be a significant factor in shaping public opinion about the product. A company that manufactures the product can cite scientific studies that support the product's safety. We now know from a growing number of studies that scientific research sponsored by for-profit companies produces results that tend to support the financial interests of the sponsor. For example, in a meta-type study Bekelman et al. concluded: ''Evidence suggests that financial ties that intertwine industry, investigators, and academic institutions can influence the research process. Strong and consistent evidence shows that industry-sponsored research tends to draw pro-industry conclusions'' (Bekelman et al., 2003). The Internet is an open access system. If private interests dominate the science presented in search engines like Google, we should expect results similar to those represented by the ''funding effect,'' when privately sponsored science is published in respected journals.

From Lexis-Nexis I was able to learn about the extent of newspaper reporting on PFOA. I used the term PFOA on national news sources and retrieved the first 25 sources from January 1, 2006 through March 30, 2006. The *Wall Street Journal*, *New York Times and Washington Post* were the leading national newspapers cited. The coverage comprised between 46 and 1600 words. A wide range of issues were cited in the research including studies on humans, birds and rodents. Among the three risk communication sources (Lexis-Nexis, Expanded Academic Index and Google), the newspapers (Lexis-Nexis) had the most public guidance recommendations. These included ''Don't heat Teflon pots above a medium temperature''; ''replace them frequently''; ''replace scratched pots''; ''implement enforceable consent agreements with manufacturers for replacing PFOA.'' The amplifiers were also prominent in the articles: PFOA is in the blood of 95 percent of Americans; it is linked to cancer and birth effects in animals; 8 companies agreed to eliminate PFOA by 2015; likely to be carcinogenic in humans. The sources of information cited were EPA, EPA's Science Advisory Board, and the Environmental Working Group.

I introduced the term PFOA into the database ''Expanded Academic Index,'' which yielded 30 citations covering the years 1998 to 2006. The citations were mainly from environmental and occupational health and chemistry journals. There were also articles from the news section of the journals. The range of issues covered was narrow compared to newspapers and the Google output. The depth of the science was greater than the other sources, but largely inaccessible to all but sophisticated readers. There was very little guidance and few amplifiers with the possible exception of discussions in the science news sections. For example, a report in *Science News* stated ''A study in mice finds that early-life exposure to the fluorinated chemicals used in nonstick products, such as fry pans, can rewire the brains that dramatically effect behavior'' (Science News, 2006).

In general, the volume and scope of risk messages were reported more extensively on Google than in the other two sources. Also, the sectarian nature of the messages by interest groups (private and public) represented in the first 10 Google sites was more obvious than it was in the other two sources. The type of risk issues cited was comparable for all three sources. The newspaper reports gave a greater accounting of public attitudes toward PFOA risks. Amplifiers of risk for PFOAs were mentioned more on Lexis-Nexis and the Expanded Academic Index than on the Google site. The de-amplifiers appeared least on Lexis-Nexis and most on the Expanded Academic Index, suggesting that scientific and scholarly sources tend to be more conservative about advancing risk hypotheses.

7. Conclusion

The Internet has created a revolution in the communication of and accessibility to information. It has been no less important in communicating risks as it has in advertising or in making public health information available to a mass audience. In contrast to the Internet, risk issues are treated as ephemeral events in news reports. Stories have a very short half-life and if they are revisited, it is usually in unpredictable time periods because of a new discovery, a protest, or a public health catastrophe. Accessibility to old newspaper articles costs money unless one has access to a database of newspaper archives. The Expanded Academic Index also charges fees and home access is rare.

Google is free for anyone who is "on line." In addition, there are layers of information with thousands of sites even for a topic as narrow as PFOA. In Google (or other free search engines) one has access to government documents, some limited scientific studies, and TV and radio interviews and commentaries. The grist for advocacy is far greater in Google than in the other channels of risk communication because the information flows faster, covers more sources, and is more accessible.

The potential for Internet advocacy has barely been actualized. An early example occurred during the 1990s in the US. Under the administration of President Clinton, the US Department of Agriculture (USDA) was given authority to set a national organic standard. As part of setting the standard the Secretary of Agriculture proposed to include GM food, irradiated food, and food grown with the sludge from solid waste incinerators under the organic label. The angry reaction from a segment of the public devoted to organic food was unprecedented. The channel for that public response was the Internet, which included websites, chat rooms, and a surge of e-mails directed at USDA. Eventually, the draft proposal to include GM, irradiated, and sludge-grown food was withdrawn. The Internet demonstrated its potential as a democratic technology for communicating risks and translating public concerns into political advocacy.

A second example that illustrates the potency of Internet risk communication is the terminator seed controversy. When Monsanto developed a genetically engineered plant whose seeds were infertile, the Rural Advancement Fund International (RAFI) labled the product "terminator seeds" and launched an international campaign to stop their production and distribution, especially in Third World countries where farmers typically save seeds from one season's plantings for the next season. The campaign to ban terminator seeds on the grounds that they represent an economic risk to small farmers was largely supported through the Internet.

The Internet can also be used quite effectively to mobilize public fear in the face of half-baked scientific information and speculative hypotheses. This is illustrated by the growing controversy over vaccines:

> …the rise of the internet as a means for communicating medical information has generated increased fear and uncertainty regarding immunization safety. Last year Robert Wolfe and colleagues published an eye-opening account of the content contained on a dozen antivaccination websites. All of the webpages examined stated that vaccines cause illnesses themselves, including autism, SIDS, immune dysfunction, diabetes, neurological disorders…. Over 90% reported that vaccines erode immunity, that adverse reactions are underreported…. A majority stated that homeopathy is a viable option to vaccination (Calandrillo, 2004).

Some anticipated that the Internet might have led to a fourth stage of risk communication, beyond post-modernism, where ordinary citizens can acquire, process, and evaluate scientifically grounded information leading them to a less-divisive and more rational consensus position on the risk. The openness, accessibility and transparency of the Internet will also allow consumers to weigh conflicts of interest in risk communication, question authority, and build networks of trust among affinity groups that may or may not be concordant with the perspectives of technical decision analysts. This fourth stage of risk communication could result in both a democratization of knowledge and greater convergence between cultural and technical concepts of risk.

It still remains to be seen whether the Internet will widen or narrow the divide between technical and cultural risk. It is also too early to tell whether the popular culture will find in the Internet a means to understand how corporations manufacture uncertainty in order to gain power over the regulatory process, how they bias studies, and how normative decisions that have social equity implications and are masqueraded as science get factored into risk assessment. One such normative decision is giving priority to reducing the probability of false positives (namely, claiming a product is more dangerous than it really is) rather than emphasizing the dangers of false negatives (claiming a product is safer than it really is) for products like PFOA. We certainly learned a great deal from the

Internet after the catastrophe in New Orleans, Louisiana from the hurricane Katrina. But there was no risk information available to the general public prior to the hurricane on the probability the levees would collapse from the rising sea waters. This is precisely the information that would have prevented so much of the human tragedy.

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