Constructing Reality: A Comparative Analysis of Print Media Interpretations of Messages Regarding Technological Risk

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Abstract

Print media stories arising from three perceived risks to human health and safety are analyzed in the context of risk communication theory. Relationships between public, regulatory and scientific communities are examined, and the challenges to developing accurate and comprehensive risk messages are explored. The study confirms the idea that uncertainty in scientific assessments is often translated into apprehension in the public arena.

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Introduction

Documents are intended to convey meaning, to impart some message or knowledge. However they often fail, cloaking the message behind a veil of technical competence or untested assumptions. By examining how messages about technological risk are interpreted and transmitted through the filter of print media, designers of documents can gain insights into message development and delivery.

Nelkin (1987) has noted that public understanding of science and technology is critical in a society increasingly affected by the impact of technological change, one in which policy decisions are determined in large part by technical expertise. Yet in her analysis of science journalism in the print media, she has concluded that imagery often replaces content, with little discussion of the scientific questions being posed, that issues are covered as a series of dramatic events, that different message providers are intensely competitive with one another, and that scientists themselves are increasingly seeking favorable press coverage as a means to enhance research support. Science has become politics, and politics has become a series of media events and photo ops.

The use of metaphors in science writing is particularly important in the explanation of technical detail, to define experience, to evoke shared meanings and to allow individuals to construct elaborate concepts about public issues and events. Nelkin has shown that the metaphors used by science writers in general has cycled over the past five decades, with the notion of progress resurrected as innovation, and the celebration of technology present once again as high technology promotion.

Public communication about issues of technological risk often involves messages from diverse individuals or communities—including but not limited to representatives from industry, academic, government, advocacy and public communities—that are translated and synthesized by various media outlets to create a newsworthy story. At each step, message providers and journalists are framing a specific event using their own value systems and constraints. Stories that appear in print media may then be read by individual members of many publics, again with each interpreting the information using the filters of experience and expectation in the way that makes the most sense to a particular individual. Feedback loops based on responses may alter future message content. Over time, a technological risk may become viewed as a reality, with the public often exercising its will through government (in)action or (non)regulation, whether the specific risk involves video display terminals, nuclear energy, chemical emissions or genetically-engineered food.

In this study, print media coverage of three recent, newsworthy events is analyzed and compared using the framework of established risk communication theory to provide insights into message development, the journalistic process, political decision-making and the ambivalent nature of societal interactions with technology. First, North American print media coverage of outbreaks of Escherichia coli 0157:H7 in the food supply—also known as hamburger disease—from January 1993 to the present are analyzed in terms of the metaphors employed, the messages of individual players in these outbreaks and how they are translated into public perception, and the resulting political action. Second, North American print media coverage of the potential risks involved with the commercial availability of genetically-engineered food and food products from 1992 to the present is analyzed in a similar manner. Finally, these national stories are contrasted with local coverage of a risk to human health and safety, the outbreak of a parasite, cryptosporidium, in the Kitchener, Ontario, water supply in the spring of 1993.

An introduction to risk communication and the perception of risk

Risk communication, the science of understanding scientific and technological risk and how it is communicated within a socio-political structure, is a relatively new scientific endeavor, dating back to Starr's 1969 paper which attempted to offer a scientific basis for thresholds of risk which would be accepted by the public. As public concerns regarding nuclear power gained prominence in the 1970s, investigators tried to establish general principles of public risk acceptability, usually based on mortality statistics. Such an approach was uniformly unsuccessful.

In the 1980s, several groups developed models that incorporated the value systems of individuals, peer groups and societies into risk communication theory (Vlek and Stallen, 1981; Douglas, 1986; Slovic, 1987) resulting in broad agreement that risks are viewed according to their perceived threat to familiar social relationships and practices, and not simply by numbers alone. According to a U.S. National Research Council committee on risk perception and communication (1989), risk communication is now defined as, "An interactive process of exchange of information and opinion among individuals, groups and institutions. It involves multiple messages about the nature of risk and other messages, not strictly about risk, that express concerns, opinions, or reactions to risk messages or to legal and institutional arrangements for risk management." In essence, risk communication must be treated as a reciprocal process—not simply those with a vested interest in a message developing more effective techniques to sell their side of the story.

A body of knowledge has been created over the past decade which helps to understand how the public perceives risk, how the media translates this information, and how government, industry and other organizations can better relate risk information over a wide range of disciplines. This approach to communicating technological risk has been successfully applied in a number of sectors, especially in the chemical industry (Covello, et *al.* 1988).

The growth of interest in risk communication is driven by four motivations:

- a requirement for—or desire by—government to inform, beginning with the U.S. Administrative Procedures Act of 1946, through to the Community Right to Know provisions of Title III of the Superfund Amendments and Reauthorization Act of 1986, all of which are intended to emphasize the government's responsibility to be accountable to the people;
- desires to overcome opposition to decisions;
- a desire to share power between government and public groups, such as the need to inform public debate in a legislative decision on siting of a hazardous facility, or to provide that information to fuel public discourse, and then use the ensuing debate to inform a decision;
- a desire to develop effective alternatives to direct regulatory control (National Research Council, 1989).

Underlying these motivations is a general recognition that the old ways simply no longer work. Decision-making in democratic societies is becoming more public and is increasingly driven by non-experts. Thus the need for a paradigm or system, such as the risk communication framework, which acknowledges this transition.

Sandman notes that the public generally pays too little attention to the hazard side of risks, and experts usually completely ignore the outrage side. These are two very different starting points and not surprisingly, experts and consumers often rank the relative importance of various risks very differently. (Sandman, 1987; Slovic, 1987). Food safety is no exception. According to food producers, bacteria in the food supply represent the most significant threat to human health and safety (FMI, 1991, 1990). Yet according to consumers, bacteria are but a trivial concern, ranking at the bottom of surveys aimed at elucidating the health and safety concerns of North American shoppers. Consumers generally perceive environmental contamination, pesticide residues and drugs or hormones used in animal production as greater health risks than other microbiological foodborne illness and nutritional imbalances (FMI, 1990, 1991; Smallwood, 1989; Consumers' Association of Canada, 1990).

Despite this need for new models, there is a dearth of scientific studies applying proven risk communication concepts to issues of food safety. There is, however, an abundance of academic, industrial and government pronouncements on how to improve communications activities related to food safety, based on anecdotal evidence and almost always citing the need for "educated consumers" or "a better-educated public" (for example, see Bruhn, 1992; Harlander, 1992; Acuff, et al., 1991; Lee, 1989). Such proposals invoke a one-way, authoritarian model of communication that is characteristic of scientists and engineers in general (Howard, 1986). Further, exactly how this mythical consumer will become "better educated" remains a mystery. What is known is that the traditional approach of scientists clearly explaining the facts is "naive—and probably a recipe for failure. ... Effective communication requires a grasp both of the nature of such debates and of consumer reactions to them" (Groth, 1991). As Jasanoff (1992) has noted with regard to the introduction of new biotechnologies, "Official efforts to provide reassurances about biotechnology frequently fail to address the public's real sources of concern. A tendency to underestimate the public's sophistication about the social dimensions of science and technology further impedes communication." This is equally applicable to issues of food safety.

A key to understanding the perception gap between consumers and scientists with respect to food safety is the different way these two groups view risk itself. Scientists, in general, define risks in the language and procedures of science itself. They consider the nature of the harm that may occur, the probability that it will occur, the number of people who may be affected (Groth, 1991). Most ordinary citizens, in contrast, seem less aware of probabilities and the size of a risk, and much more concerned with broader, qualitative attributes, such as whether the risk is voluntarily assumed, whether the risks and benefits are fairly distributed, whether the risk is controllable by the individual, whether a risk is necessary and unavoidable or whether there are safer alternatives, whether the risk is familiar or exotic, whether the risk is natural or technological in origin, and so forth (Sandman, 1987).

Further, research conducted by IBM in the late 1960s on public perceptions of computers and automation reveals that apprehension about a technology can exist independently of a recognition of the benefits of a technology (quoted in Rabino, 1991)

According to Covello (1992a), psychological research has identified 47 known factors that influence the perception of risk. For example, control can vary the perception of a risk by a factor of 1,000; voluntariness can vary the perception of a risk by a factor of 1,000; benefit can vary the perception of a risk by a factor of 1,000; and trust, the most important factor, can vary the perception of a risk by a factor of 2,000. These factors can help explain why consumers are concerned about food safety issues that scientists deem trivial. The actual risk does not change, but the perception can; and in the domain of public policy, perception is reality (Covello, et *al.*, 1988; National Research Council, 1989). People also judge risk according to their perception of its controlling agents: if these controlling agents have a track record of secrecy, or they dominate supposedly independent regulatory bodies and the public policy process, then people magnify the perceived risks (Hamstra, 1992; Covello, 1992b).

These differences in risk perception are exacerbated when science is confronted with a skeptical public (Durant, 1992). Often, the scientist will resort to the SOB words, subjectivity, objectivity and bias (Ball, 1992), talk of the low level of scientific literacy among the public, and dismiss the concern. Many scientists and administrators will describe public fears as "emotional" and "unfounded," yet all opinions are based on individual interpretations of the data at hand, taking into account one's own experiences, values and expectations. For example, Pramer (1992) states that "biotechnology cannot flourish in ignorance. To be supportive, the public needs only a better understanding of modern biology's applications to the public's well-being." Such pronouncements acknowledge the need for change but still miss the point. Human values enter scientific pronouncements of risk through the choice of numbers used to summarize the magnitude of a risk, and through the weighting of different attributes of hazard (Groth, 1991; Brunk, *et al.* 1991). All public concerns should be taken seriously because in a democratic society, at least in theory, the mandate for science to operate comes from the public, in terms of financial and political support. More pragmatically, the public can now stop operations that pose a threat—whether real or perceived—to health and safety through enhanced regulatory powers.

The task of clear communication is further compounded by the presence of not one, but many publics, characterized by a public mood which fluctuates, a public perception which is not consistent throughout the population, and a public view which is difficult to measure (Middlekauf, 1989). Despite these constraints, a democratic society must find ways to place specialized knowledge into the service of public choice. Moreover, it must be perceived to do so. It is no longer good enough to be good; social institutions must be perceived as honest providers of public knowledge lest they become the basis of power for an elite. Even providing information without first asking people what they want to know puts across a powerful, if unintentional, message: the organization knows best. Survey and focus group research serves to better understand and perhaps even legitimize the concerns and motivations of interested groups and individuals (Martin and Tait, 1992).

Covello and Allen (1988) have summarized Seven Cardinal Rules of Risk Communication, as follows:

- Accept and involve the public as a legitimate partner;
- Plan carefully and evaluate performance;
- Listen to your audience;
- Be honest, frank and open;
- Co-ordinate and collaborate with other credible sources;
- Meet the needs of the media; and,
- Speak clearly and with compassion.

Message development

Developing accurate and comprehensive risk messages is one of the most difficult and time consuming aspects of risk communication (Arkin, 1989). According to Covello (1992a), most communicated risk in the U.S. involving science and technology issues is targeted at a 12-year-old level of comprehension. This raises a fundamental question: Can the world be run by 12-year-olds or, more importantly, are there ways to make better 12-year-olds?

Key to effective message development is the recognition that individuals are unique, and that each is going to respond to a message using their own filters of knowledge and experience. Risk messages need to be personalized enough to provide a framework for individual action, recognizing the practical constraints of tailoring a message to each member of a target audience. The message should also be repeated, using a variety of media (Needleman, 1987).

The use of risk comparisons in which the statistical risk of an unfamiliar risk is compared with that of a familiar risk is the subject of continued research, much of it controversial. While comparisons can be a useful communication shortcut, critics note such comparisons can trivialize, fail to recognize the filters of each individual, and reduce risk to a single dimension, usually death (Roth *et al.* 1990; Slovic, *et al.*, 1990). The lesson is to test messages, rather than presume what the public needs to know; a two-way rather than a singular communication process.

Further, a credible spokesperson is required to deliver a credible risk communication message. Research has shown that in low-trust, high-concern situations, credibility is assessed using four measures: empathy and/or caring (50 per cent, and usually assessed in the first 30 seconds); competence and expertise (15-20 per cent); honesty and openness (15-20 per cent); and commitment and dedication (15-20 per cent). An additional 77 non-verbal cues have been documented to influence perceptions of trust and credibility (Covello, 1992a).

The role of print media in generating risk perceptions

In 1985, Nobel Prize winner Kenneth Wilson helped convince the National Science Foundation to spend $200 million to help establish four, university-based supercomputing centres (as recounted in Nelkin, 1987). The most crucial factor, said Wilson, was a single newspaper article quoting a scientist who said that such a program was necessary for the U.S. to retain its lead in supercomputing technology. "The substance of it all (supercomputing research) is too complicated to get across—its the image that is important. The image of this computer program as the key to our technological leadership is what drives this interplay between people like ourselves and the media and forces a reaction from Congressmen" (New York Times, March 16, 1985).

This is a powerful statement, one that opens the way for serious abuse and manipulation of the decision-making process. Yet the role of the media in shaping public perceptions must be acknowledged; the eventual ban in 1989 of the agricultural chemical daminozide, marketed as Alar, is another such example where media coverage of the issue was crucial to the outcome.

According to the U.S. National Research Council (1989) there are several ways that messages can reach final recipients, including face-to-face conversations (physician to patient, friend to friend, etc.), in groups (work sites, classrooms), within organizations (professional or volunteer), through the mass media, and within the community (libraries, malls, fairs, and local government). This study will focus on the role of print media in transferring risk messages relating to the safety of the food and water supply.

Different people use different sources to collect information related to issues of scientific and technological risk. It is therefore incumbent on the provider of risk messages to determine how a specific target audience receives and perceives risk information. These differences can be dramatic, reflecting variations in cultural practices. For example, a 1991 survey of 12,800 people in the 12 countries of the European Community (Marlier, 1992) concluded that sources of information vary widely among countries: Portuguese use newspapers as a principle (52 per cent) source of information; 35 per cent of Luxemburgers and 37 per cent of Danes use TV, while television is the primary source of information for Italians (54 per cent) and Greeks (57 per cent).

For North American consumers, most knowledge of food safety issues is transmitted and translated through modern media outlets. Hoban and Kendall (1992) found that at least nine out of ten respondents reported receiving a lot (28 per cent) or some (63 per cent) information about science and technology from television, with newspapers next in importance at 80 per cent. The same study identified dietitian/nutritionists as the most credible spokespersons on issues of food safety, followed by farmers and farm groups, university professors and environmental groups. Representatives of government, food processor and biotech companies had very little credibility.

The 1990 Consumers' Association of Canada food safety survey found that while most Canadians get information about food safety issues from the media, those same media outlets rate poorly in terms of trust and credibility. Health professions top the list, followed by the Consumers' Association, friends and family, food producers, the producer association and government. Retailers and clerks, and food processors score lower than media in terms of trust and credibility of the source of information on food safety issues.

A recent study of 1,250 American adults, commissioned by the Scientists' Institute for Public Information (1993) concluded that the number of American adults who want serious scientific news is substantial, and that science news provides basic, functional information necessary for living in the modern world, especially in the areas of personal health and the environment. Although a majority (56 per cent) say they are regular viewers of TV programs on science, technology, and nature, roughly 40 per cent of the public are solid followers of science news. For example, 38 per cent are weekly readers of science news in the newspaper; 43 per cent read books or magazines on science every month; and 40 per cent say they discuss issues related to science with someone else approximately once a week. An interest in health issues is leading the way for interest in other kinds of science news.

While more North Americans appear to be receiving more news about health and safety issues through television than print media, Witt (1983) argues that it is a great leap of logic to claim that Americans get most of their news from television. Most Americans, says Witt, get their news from a variety of sources, and that many regularly rely on both television and newspapers. Such studies also ignore the agenda-setting role of major daily newspapers in both Canada and the U.S., outlets that have full-time science reporters on staff.

Schanne and Meier (1992), in a meta-analysis of 52 studies of media coverage of environmental risk, concluded that journalism constructs a universe of its own, a "media reality" which does not mirror actual reality. Specifically, the journalistic construction of environmental issues and environmental risk mirrors, only partially, or not at all, the scientific construction of environmental issues and risk. While the professional isolation of both scientists and journalists presents an on-going impediment to communication, it is mistaken to view journalists and the media always as significant, independent causes of problems in risk communication (National Research Council 1989). Further, many of these media analysts, who may never actually write for public media, often fail to recognize the chaos of everyday life (especially that of a newsroom), fail to acknowledge the constraints imposed by a media industry which is geared for profit, and fail to acknowledge the critical faculties of any particular reader. Rather, the assumption seems to be that an uncritical public is waiting to be filled with educational material from a variety of media, and that media is more influential than common sense and practical experience may suggest. Many problems in scientist-journalist interactions and pronouncements can be traced to the myth of objectivity resident in both disciplines. Scientists and journalists who acknowledge that a degree of bias is normal are likely to be better prepared to distinguish facts from value judgments in both expert statements and media accounts of food safety debates (Groth, 1991).

The importance of metaphors

Both scientists and journalists use explanatory devices to convey the meaning of their work. Science is about models, explanation and representation, while journalists often resort to metaphors. According to Layoff and Johnson (1980), a metaphor is not just a rhetorical flourish, but a basic property of language used to define experience and to evoke shared meanings. Nelkin (1987) states that metaphors are especially important in science communications. "Metaphors affect the ways we perceive, think, and act, for they structure our understanding of events, convey emotions and attitudes, and allow us to construct elaborate concepts about public issues and events." Journalists convey values through metaphors, the way stories are selected, the choice of headlines and leads, and the selection of details; in short, journalists equip readers to think about science and technology in specific ways.

"Metaphors in science journalism," says Nelkin (1987), "cluster and reinforce one another, creating consistent, coherent, and therefore more powerful images which often have strategic policy implications. When high technology is associated with frontiers that are maintained through battles or struggles, the imagery of war implies that the experts should not be questioned, that new technologies must go forward, and that limits are inappropriate. But if instead the imagery suggests peril, crisis, or technology out of control (as in the case of certain risks), then we seek ways to rein in the runaway forces through increased government regulation and control. Calling the weakness of science education a 'problem of education policy' implies the need for considered, long-term policy intervention; defining it as a 'national crisis' implies the need for an urgent, if short-term, response. If science is incredibly complex and arcane, and the scientist is a kind of magician or priest, this implies that the appropriate public attitude is one of reverence and awe. But if science is simply another interest group seeking its share public resources, this implies the need for critical public evaluation."

Case Studies

1. Hamburger disease

On Jan. 11, 1993, two-year-old Michael Nole ate a cheeseburger as part of a $2.69 Kid's Meal at a Jack in the Box restaurant in Tacoma, Washington. The next night, Michael was admitted to Children's Hospital & Medical Centre in Seattle. Ten days later, Michael died of kidney and heart failure (Grover, 1993). Two more children have since died after being exposed to someone who ate at Jack in the Box, and the number of confirmed and probable cases of foodborne illness related to Jack in the Box restaurants now stands at 500. Of these, 144 people had to be admitted to hospital, and at least 29 suffered kidney failure (of which 21 were forced to undergo kidney dialysis).

Dean Forbes, a spokesman for Children's Hospital in Seattle summarized public sentiment in the wake of this outbreak, and underscored public perception of the North American food supply in general. "This has been a nightmare for the parents," he said. "To think that something as benign as hamburger could kill a kid is just startling to most people" (Egan, 1993). Hamburgers and apple pie at the heart of American food traditions and mythology, yet in the past decade, the wholesomeness of both has been called into question through hamburger disease and the use of alar on apples.

Hamburgers, to the food microbiologist, are anything but "benign." Instead, they are teeming with microorganisms that, under certain conditions, can led to significant health problems, if not a session of penance at the porcelain goddess of foodborne illness. The hamburger eaten by Michael Nole and thousands of other patrons of the Jack in the Box fast food chain in the western U.S. was found to contain Escherichia coli 0157:H7, a variant of normal human intestinal bacteria that has been found in rare hamburgers, municipal water and even apple cider. First discovered in 1982, the Jack in the Box incident (as it is now known) is now the largest and most serious outbreak of E. coli 0157:H7.

In 1977, researchers at Health and Welfare Canada in Ottawa first identified a subset of the E. coli family that produces a poison called verotoxin, one that can lead to diarrhea and serious illness in humans; hence the name verotoxogenic E. coli or VTEC. In 1982, a particularly nasty strain of VTEC, called E. coli 0157:H7, was found to be responsible for outbreaks of human illness in Oregon and Michigan after patrons at McDonald's outlets ate contaminated hamburgers. There have since been 16 documented outbreaks of E. coli 0157:H7 in North America, primarily in hamburger, but also in other types of meat, water, unpasteurized milk and even apple cider. E. coli 0157:H7 is not the only one of the 70 known VTEC strains to cause human illness, but it seems to be the most devastating. E. coli 0157:H7 has resulted in 16 deaths in the U.S. since 1982 (Altman, 1993). In 1991, an outbreak of VTEC in the North West Territories resulted in 521 cases, 23 of which developed hemolytic uremic syndrome (HUS), and two deaths.

Two to 10 days after eating food contaminated with VTEC, people may experience severe stomach cramps, vomiting and a mild fever. Some will develop a watery or bloody diarrhea; most people recover seven to 10 days after the start of the illness, but about 10 per cent of those with hamburger disease will develop HUS, especially children, the elderly or people who have a suppressed immune system. Fifteen per cent of those children with HUS will need permanent dialysis or a kidney transplant.

At the heart of the E. coli 0157:H7 outbreaks is a simple question that is almost impossible to answer: has the food supply become more hazardous? Although some 4 million cases of food poisoning are reported annually in the U.S., there are few deaths, which is one reason that cases of E. coli 0157:H7 infection are particularly worrisome. In 1991, a U.S. Food and Drug Administration (FDA) official stated that E. coli 0157:H7 may become recognized in the 1990s as the cause of the greatest incidence of severe food-related illness of the known food-borne pathogens (Wolf, 1992).

A total of 82 print media reports in the wake of the Jack in the Box incident were reviewed for the purposes of this paper, from Jan. 20, 1993 through to July 9, 1993. Primary sources were the New York Times, the Seattle Post-Intelligencer, the Toronto Globe and Mail and the Kitchener-Waterloo Record, a local daily that ran a number of Canadian Press wire copy stories. In general, the coverage highlighted the risks posed by E. coli 0157:H7, and how the deaths of three children and massive illness could have occurred. While the reports may be deemed superficial by scientists, they were generally accurate and ultimately helped create the political pressure necessary to catalyze reforms to the meat inspection system.

These stories need to be contrasted with the complexity of the food supply in general. In the U.S. alone, 7,400 inspectors examine the carcasses of 81 million pigs, 30 million cows and 6.6 million chickens that roll off slaughter lines per year, as well as and 161 million pounds of processed meat and poultry products, but examinations are limited to visual inspection rather than laboratory analysis (Adams and Sachs, 1991; Egan, 1993). Canadian inspectors employ similar techniques.

Dangerous bacteria in meat and poultry have killed 150 people and caused 150,000 serious illnesses in the U.S. in the last 10 years, according the Federal Centres for Disease Control in Atlanta (Schneider, 1993). And although some 4 million cases of food poisoning are reported annually in the U.S., there are few deaths. Determining the safety of a substance requires both a scientific assessment of risk and a judgment as to the social acceptability of the risk (Lowrance, 1976). With respect to food-related risks to health, scientists rank microbiological foodborne illness and nutritional imbalances as the major risks (Hotchkiss, 1989; IFT, 1990; Roberts, 1981).

Wolf (1992) notes that microbiological hazards top the concerns of almost every U.S. agency charged with some aspect of food safety responsibility. Campylobacter is the leading cause of acute bacterial diarrhea in the U.S., primarily through poultry, and there have been 189 outbreaks, with 6,604 cases and 43 deaths from 1985 to 1989, caused by Salmonella enteritidis, related to inadequately cooked shell eggs. The U.S. Centres for Disease Control (1990) report that 2 million cases of salmonellosis and 100,000 of trichinosis per year are attributable to inadequately cooked or improperly treated food products. The social cost of foodborne illness is tremendous. Although Shin *et al.* (1992) caution that while little is known about the true costs of food-borne pathogens because it has not been possible to measure the cost of morbidity, estimates of the annual cost of foodborne illness in the U.S. alone range from $4.8 billion (Roberts, 1989), to $8.4 billion (Todd, 1989) to $23 billion (Garthright, *et al.*, 1988), including the costs of medical treatment, productivity loss, pain and suffering of affected individuals, food industry losses, and losses within the public health sector (Roberts and van Ravenswaay, 1989).

Scientific assessments of foodborne—or any other—risk to human health and safety are fraught with controversy. The Institute of Food Technologists' Expert Panel on Food Safety and Nutrition (1991) notes that "the ability of scientists to detect minute quantities of chemicals has outstripped their ability to interpret the findings." A recent report from the U.S. National Research Council Commission on Life Sciences Board on Environmental Studies and the Toxicology Committee on Risk Assessment (1993) highlighted the controversy within the scientific community related to risk assessment of potential carcinogens (including those in the food supply, such as saccharin). The committee split over the continued use of tests in which animals are exposed to massive doses of a chemical in an attempt to determine if the chemical causes cancer, with a majority of the committee recommending that such tests continue to be used as part of an overall strategy for testing possible carcinogens. However, about a third of the committee recommended that such testing be replaced with a new testing approach, one that focuses on understanding the mechanisms by which more moderate doses of a chemical affect animal physiology and health.

Jack in the Box, a division of Foodmakers Inc., has 1,170 outlets in the Western U.S., and represented two-thirds of Foodmakers 1992 revenue of $1.29 billion. After the first reports of foodborne illness were traced back to Jack in the Box, subsequent analysis by state and federal health scientists led Jack in the Box to voluntarily recall 28,000 pounds of frozen hamburger patties from a batch of meat found to be heavily contaminated with E. coli 0157:H7; in the meantime, some 40,000 contaminated patties were consumed in Washington, Nevada and Southern California. It seems that only certain hamburgers were contaminated due to variations in cooking procedures. Although the U.S. Food and Drug Administration has a national minimum internal cooking temperature for ground beef of 140 F, Washington state raised its standard to 155 F in 1992, in response to earlier outbreaks of E. coli 0157:H7 (McDonald's, the world's largest fast-food restaurant, has long cooked its burgers to 157 F, again related to earlier outbreaks of E. coli 0157:H7 in burgers served at McDonald's.

Robert Nugent, president of the company, said Jack in the Box outlets cooked its meat below the 155 F Washington state standard, because it was not aware a change in the regulations had been made. It took the company one week to publicly admit its responsibility from the initial establishment of a link between foodborne illness and Jack in the Box hamburgers. Mr. Nugent initially blamed others—regulators and suppliers. However, once responsibility was admitted, the company responded by trashing 20,000 pounds of frozen patties, changed meat suppliers, installed a toll-free number to field calls and told employees to turn up the cooking heat. An offer to cover victims' hospital costs came two weeks after the news of the first poisoning.

But were these actions enough? No, according to the Four Hit Theory of Belief Formation (Covello, 1992a), in which consumers will transform an opinion into a virtually unshakable belief after an average of four credible hits—such as media reports and conversations with friends. A single hit can be negated, but only within 48 hours. Once a belief is formed, individuals will rationalize away information that conflicts with that belief. In short, risk communication theory would predict that Jack in the Box did some of the right things, but five days too late. Recently, a young Quebec girl with a peanut allergy bit down on a granola bar contaminated with peanuts (she spit it out immediately and suffered only mild symptoms). After a phone call from the girl's mother, Quaker Oats, based in Peterborough, Ont., immediately announced a national recall that will cost over $1 million. "But you've got to do it," said company spokesperson Donna Mackey. "With something like this, (peanuts), consumer safety is first and foremost" (Kitchener-Waterloo Record. Feb. 18, 1993).

In contrast to Jack in the Box, the U.S. National Live Stock and Meat Board sent regular memos to meat board directors, state beef council executives and constituent organization executives, continually updating them on E. coli 0157:H7. Information packages also included sample letters to the editor, a list of meat board-sponsored research on E. coli 0157, fact sheets, a copy of the meat board's press releases outlining their position, sample question and answer sheets; a list of resources for further information, and the testimony of Dr. H. Russell Gross, administrator of the Food Safety and Inspection Service with the USDA, and that of Secretary of Agriculture Mike Espy to the Senate Committee on Agriculture, Nutrition and Forestry Subcommittee on Agriculture, research conservation, forestry and general legislation, dated Feb. 5, 1993. In short, everyone knew the message.

These contrasting approaches to risk communication were recently highlighted in Hong Kong. When one journalist complained of potential food poisoning to McDonald's, he received a sympathy phone call and a personal apology with flowers the following day. By contrast, another journalist complained of food poisoning about the same time to Oliver's Super Sandwiches and received a written reply stating, "the company would not take responsibility until receiving proof of illness, that is, a stool sample" (Asian Advertising and Marketing, 1993).

Because of the severity of the Jack in the Box incident, congressional hearings and continual media investigations, the U.S. FDA raised the national recommended cooking temperature to 155 F. Newly-appointed Secretary of Agriculture Mike Epsy announced immediate plans to implement organic acid sprays to kill germs on meat, coupled with increased inspection (Seattle Times. 1993). "If any child dies as a result of something we have done or haven't done, it's just not good enough," said Epsy. "As a parent and a consumer, I can well understand the fears and anguish this has caused." This establishment of care and empathy, used to evaluate 50 per cent of a risk communicator's credibility, helped cast the federal government in the role of protector of the public good. Epsy also announced safe handling label for packages of hamburger, plans to fill the now vacant 550 meat inspector positions, and an acceleration of research into the use of irradiation on hamburger.

These initial actions were followed in mid-March with announcements that the entire meat-inspection system in the U.S. would be overhauled. "We can't inspect meat in 1993 the same way we inspected it in 1933," said Mike Epsy. "We have to change to a system not based on sight and touch but one based on microbiology" (Schneider, 1993). Highlights of the proposals include the temporary stationing of scientists and some federal inspectors on farms and feedlots, to collect data and determine whether modern mass-production techniques are tainting the meat supply; new research to develop quicker diagnostics; more careful processing of meat; and mandatory safety labels to teach restaurants and home cooks how to safely handle meat. These changes "would affect every level of the $80-billion U.S. beef. pork and poultry production system, from the farm to the kitchen" (Schneider, 1993). On April 2, 1993, the highly influential New York Times (1993) ran an editorial hailing Mr. Epsy's willingness to confront this problem as "a refreshing break from Agriculture's traditional laxity in consumer protection." Epsy's plan was praised as the most ambitious updating of the nation's meat inspection system since it was established 87 years ago.

Genetically engineered food

Hamburgers are easy to visualize and are familiar to the North American public. Future regulations governing meat inspection and cooking guidelines are a reshaping of the past. But what about public involvement in shaping a not fully glimpsed future? In May 1992, the U.S. Food and Drug Administration released draft procedures to regulate foods produced through biotechnology (Food and Drug Agency, 1992) in anticipation of commercial products reaching the marketplace in 1993. Health and Welfare Canada, followed with their proposals in August, 1992. Both proposals built on the recommendations of the World Health Organization (1991). For the purposes of this study, 55 stories from May 1992 to July 1993 in the North American print media were evaluated, again primarily using the New York Times, the Washington Post, wire services, the Toronto Globe and Mail, and the Kitchener-Waterloo Record.

Determining how to best communicate with the public about issues of biotechnology has been the focus of numerous studies (US-EC Task Force on Biotechnology Research. 1992; Hoban and Kendall, 1992; Industry, Science and Technology Canada, 1993). The coverage of genetically-engineered food, and biotechnology in general, is polarized: safety versus risk; science moving forward versus science out of control; competitiveness versus safety. Several opinion pieces have been published by all of the dailies surveyed, again emphasizing the polarized aspects of the debate. In Genetic Engineering: Cause For Caution (Lippman and Bereano, 1993), the credibility of those promoting the industry is undermined. "Substantial conflicts of interest exist in which the development of science and technology is increasingly bent to the service of private and government interests. ... Thus, agricultural plants are genetically engineered to make them tolerant to herbicides so that corporations can continue to sell pesticides along with the new seeds." Compare this with Dennis (1993), who cites the need for biotechnology as the basis for a new, clean industry, one where "biotechnology will transform the way we live, but Canada faces stiff international competition."

Films and novels have a long history of feeding the public an image of science out of control (Weart, 1988). When this is coupled with Western society's tendency to attach unrealistic expectations to technology, an ideal environment for public apprehension is created. Many reports raise the spectre of science out of control, as best exemplified in the movie Jurassic Park, where recombinant DNA technology has replaced nuclear energy as the latest science to fail society. Research Skewed: Bioengineered Food Serves Corporate, Not Public, Needs (Dubey 1993); Science Is Playing With Our Food (Murray, 1993); Invasion Of The Mutant Tomatoes (Powell, 1992); Genetics Expert Fears Mutant Monsters (K-W Record, March 24, 1993) provide ample fodder for editorial cartoonists, who almost invariable draw upon the Frankenstein (Frankenfood) metaphor.

These metaphors are based in the deep ambivalence many individuals express toward any technology that manipulates deoxyribonucleic acid—DNA, sometimes referred to as the code of life. John Durant (1992) notes that while there are many science-fiction books which border on science fact, the portraits painted of biotechnology are almost always unflattering. This is exemplified in a quote from Michael Crichton's 1991 novel, Jurassic Park. "The late twentieth century has witnessed a scientific gold rush of astonishing proportions: the headlong and furious haste to commercialize genetic engineering. This enterprise has proceeded so rapidly—with so little outside commentary—that its dimensions and implications are hardly understood at all."

Much of the coverage raised a number of issues, reflecting the uncertainty of the new science. For example, do genetically-engineered food products taste the same? No, say 1,200 New York city chefs, who earlier this year vowed to boycott genetically engineered foods (Burros, 1992). Consider the Flavr Savr tomato being developed by Calgene, which has been genetically-engineered to stay riper longer on supermarket shelves. "Vine-ripened, soft-walled acid-flavored summer-grown tomatoes are an inalienable right" writes Molly O'Neil in the New York Times (1992). "The genetically-altered tomato is a potential heretic. To change the tomato is to rend the social fabric." Yet over the past 200 years, the tomato has been bred to be big and juicy, or thick-walled and pulpy, or round or oval or even oblong for the ease of mechanical harvesting. Industry argues that quality has not suffered and has in fact been enhanced; otherwise they would not continue to be in business.

Will genes from different species create allergic reactions in unsuspecting consumers? For instance, if genes are transferred from highly allergenic foods such as peanuts or wheat, will they also transfer components of a protein molecule which are responsible for the allergic reaction? This issue is forming the basis of organized consumer opposition to genetically-engineered food in the U.S. under the leadership of Jeremy Rifkin's Washington-based Foundation on Economic Trends, which is launching both consumer appeals and legal action against the U.S. Food and Drug Agency (Erickson, 1992).

In response to the media coverage of genetically-engineered food, more than 3,000 people, most identifying themselves as consumers, wrote to the FDA to comment, one of the largest consumer responses in FDA history (Goldburg, R., 1993). The FDA has now announced that it is willing to significantly alter portions of its proposed regulatory regime for genetically-engineered foods.

Nelkin (1993) suggests that efforts to convince the public about the safety and benefits of new technologies like genetically-engineered food, rather than enhancing public confidence, may actually amplify anxieties and mistrust by denying the legitimacy of fundamental social concerns. She also argues that the focus on economic competitiveness (for example, see National Biotechnology Advisory Committee. 1991) has polarized the biotechnology debate, leading to increased mistrust. Certainly this view is reflected in the stories reviewed here.

Contaminated water—cryptosporidium

Along with a safe food supply, people demand a safe source of water for drinking and food processing. The water supply in Waterloo Region in Ontario, Canada, has several unique characteristics and a checkered past that provide a recipe for a risk communication disaster. Continual population growth and suburban sprawl through the 1980s stretched existing groundwater supplies to the limit. Several proposals for alternative water sources were presented to Regional government throughout this period, including the construction of a pipeline to the Great Lakes, a water supply which retains an image of pristine purity to many residents. Alternative proposals focused on groundwater conservation, or treating water from the local Grand River, colloquially referred to as the "Grand Sewer." There is a long tradition of local skepticism regarding the quality of the water in the Grand, including this staple of bathroom graffiti, "Please flush the toilet, Brantford needs the water" (Brantford is a community about 4040 km downstream on the Grand from Kitchener). Nevertheless, amidst controversy and a difficult to follow reasoning process, the Regional government decided in the late 1980s to augment existing groundwater resources with water from the Grand River treated and pumped into an underground reservoir. Given the local imagery associated with the source, this was a psychologically unsettling decision. Uneasiness about local water quality was increased even more in 1989 when a water boil advisory was issued after a bacterial outbreak. Later that year, the industrial contaminant NDMA was found in the water tables of nearby Elmira, Ont., "dashing any notion that groundwater supplies were not vulnerable" (Burtt, 1993). A 1989 survey of local residents concluded that 54 per cent were dissatisfied with the quality of the drinking water; more than one-third were not drinking tap water; and 82 per cent said water supply was of greater concern to them than other issues such as housing, roads, and overall environmental quality (Burt, 1993).

Against this background then came word on April 22, 1993, from the Waterloo Region medical officer of health, Dr. Ron Sax, that the new, $95-million Mannheim water treatment plant was closed after investigators decided that it could be responsible for 37 cases of a waterborne illness—several more than expected—in residents of Kitchener-Waterloo, Ont. Two days later, the local daily, the Kitchener-Waterloo Record (K-W Record), reported the news after a press conference was called on April 23, 1993 by Dr. Sax. Over the next two months, 39 stories about water contamination appeared in the paper, primarily related to the waterborne illness, and several about other water contaminations. By mid-May, 146 confirmed cases of cryptosporidiosis, characterized by diarrhea and abdominal cramps and caused by the parasite cryptosporidium, had been reported. One story quoting a professor at the University of Quebec pegged the number of afflicted at 1,400. This was a serious outbreak, following on the heels of a similar but more deadly outbreak of cryptosporidiosis in Milwaukee in early April 1993, where the parasite was linked (but not causally) to the deaths of nine residents, caused more than 1,800 to seek treatment, and resulted in an advisory for 48,000 residents to boil tap water for cooking and drinking for several days (U.S. expertise sought over K-W water concerns, Burtt and Goodwin, 1993)

After the outbreak of cryptosporidiosis, a reader survey conducted by the K-W Record revealed an almost total lack of confidence in the K-W water supply. A local politician in a downstream community said, with respect to cryptosporidium, that "if I can't say it, I don't want to drink it or eat it," a statement which gained headline prominence. Such statements and widespread perception also reflect a complete lack of confidence in expert systems (the regulatory officials and water engineers). The Mannheim treatment plant did not reopen until June 25, 1993.

Several of the articles attempted to explain why the parasite was present, and the risks associated with any water supply. Health and engineering officials were generally portrayed positively, and the message that "public health is our primary concern" was repeated on many occasions. Nevertheless, there were also claims after the fact that had the water supply been looked at in terms of biological systems, from the outset, then something like an outbreak of cryptosporidium was inevitable, given the nature of the ultimate source—the Grand River. Here the argument was based not solely on water quality and pollution, but on rate of water flow and the predictable creation of ideal conditions for cryptosporidium growth, most likely originating as runoff from local farms. Underlying this is a series of events, images and memories all combining to create a high level of mistrust in expert and regulatory officials.

Discussion and Conclusions

Food presents a special application area for risk communication theory, particularly because of the rituals, mythologies and cultural significance associated with meals. According to Busch (1991), food has always had both sacred and secular aspects; some foods are exalted while others are spurned. "One need only consider the significance of bread and wine in Christianity or the prohibition of pork in Judaism and Islam as examples."

Waltner-Toews (1992) agrees, noting that, "Eating is one of the great sensual pleasures of life, the place where mystical at-oneness with the world meets, demystifies and celebrates biological necessity. ... Eating is more than bodily nourishment, and a meal is more than food. ... Eating is an essential ingredient in our understanding of ourselves, a literal coming to our senses. For this reason, eating is intimately bound up with our sense of being, individually and culturally. Not only eating: the food poisonings we suffer are direct reflections not only of hygiene and agricultural practices, but, at a very deep level, of who we are and who we are not. You can tell who a person is by what she chooses to make her sick."

While many scientific communities are looking to risk communication techniques to understand and bridge the gap between scientific and lay perceptions of risk, several criticisms of risk communication have also emerged. Based on studies of the Alar controversy in the 1980s, Jasanoff (1987) states that risk communication is a "dangerously misleading term" because it suggests that communication by experts is the key to trust. She argues that the experts themselves need to be educated about their own biases and about the existence of competing cognitive systems for evaluating risk.

Further, does risk communication pay enough attention to recent historical developments and their influence on attitude within a specific socio-political setting? For example, many Kitchener-Waterloo residents remember being told not to swim in the Grand River because of its suspect quality. Now the experts say drink from the "Grand Sewer."

In the case of hamburger disease and genetically-engineered food, public outrage, reflected in media coverage, led government authorities to reconsider their positions and welcome comment. This confirms what Protess, *et al.* (1987) found when examining the impact of reporting on toxic waste controversies: that media disclosures had limited effects on the general pubic but were influential in changing the attitudes of policy makers (in the current scenarios, the effect on the public will have to be determined through opinion surveys).

In all three cases presented here, scientific uncertainty (we're not sure how to detect E. coli 0157:H7 in the food supply; we're not sure if genetically-engineered foods will have any detrimental effects; we don't know how cryptosporidium entered the water supply), regardless of how minor, was highlighted and often a focal point of print media coverage. Kraus et al (1992) in a study of how individuals and scientists differ in their assessments of toxicological risks through air, food and water, found large differences between the so-called experts and lay-people, but also significant controversy among the experts. Their results suggest that controversies over chemical risks may be fueled as much by limitations of the science of risk assessment and disagreements among experts as by public misconceptions. Sharon Begley, the science editor at Newsweek (Begley, 1991), writes that if journalism is history on the run, then risk assessment is often science on the run. More often than not, it falls to the journalists to interpret that uncertainty.

Hilgartner and Nelkin (1987) examined four controversial dietary recommendations, how the results were communicated through the media and the resulting action. In all four cases, debates centred on the validity of technical evidence, on the reliability of public statements, on the dangers of 'undue' alarm or anxiety, and on the public's right to know. The authors conclude that technical issues "often serve as surrogates for even more contentious questions of political and social control." Conflict, they argue, is natural in such debates because different players approach risk communication with different economic and professional interests, and competing political and ideological concerns. They question the usefulness of general prescriptions for risk communication.

Which leads to another question. What is the purpose of risk communication? Lacey (1992) charges that many statements issued by the U.K. Ministry of Agriculture and Food, either personally through Ministers or scientists, or through press releases, are intended to "reassure" the public, even if there is a real problem. "It is as if the intent to reassure has become the only public policy of MAFF." Others, such as Ellen Silbergeld, a senior scientist with the New York-based Environment Defense Fund have charged that risk communication is a "shield for inaction." It should be stressed that risk communication is no substitute for risk management. The goal of risk communication is policy decisions and public discussion based on the best information available, rather than a process for manipulation of public opinion.

The result then is a challenge which has been posed by several historians of technology in society: how do scientists and citizens alike become more public about the confusion, ambivalence and limitations which characterize technological change (Staudenmaier, 1993; Ball, 1992)? If the science of risk assessment contains a number of uncertainties, as has been demonstrated here, how can society engage in meaningful discussions about risks to human health and safety? Carefully constructed risk messages, created in an open and honest manner, offer a beginning. But, as demonstrated, general prescriptions for risk communication often fail to adequately consider the subtle historical and cultural factors that influence risk perception.

Acknowledgments

The authors are grateful for support from Monsanto Canada Inc., the Ontario University Research Incentive Fund, Agriculture Canada, and the Natural Sciences and Engineering Research Council.

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