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COMMUNICATION PROFESSIONALS, THE PUBLIC UNDERSTANDING OF SCIENCE, AND ENVIRONMENTAL RISK

Edna F. Einsiedel
Communication Studies Program
University of Calgary
Calgary, AB T2N 1N4
Canada

The products or processes of science and technology have frequently been objects of controversy and, in most of these situations, this has been because these products have consequences that are both beneficial and risky. Most of the debates have invoked the public's understanding of the science behind these products and, in many instances, these debates have focused on elevating, limiting, if not manipulating, such understanding.

My goal in this paper is to discuss risk issues in the context of risk perception and communications with the view that this context provides one mechanism for better understanding the public's understanding of science.

Why risk issues? Some reasons readily suggest themselves. Risk is common in our everyday lives. We go through the day making decisions with occasional invocations of the risks involved in action or inaction: Do I use some sunscreen today? Should I go for this high-cholesterol dessert? Of course, these rather mundane examples do not often engage the complex schemata that might be called upon for weightier issues such as doing a regular breast self-examination or making a major lifestyle change for health reasons. On some of these issues, some "science understanding" or science learning may occur via proactive information-seeking, incidental learning (e.g., through a television program), or by force of circumstance.

Risk issues, unlike other kinds of science topics (e.g., the discovery of a new galaxy, the development of an even smaller microchip) sometimes involve certain dynamics – controversy, battles among experts, efforts to increase public awareness and understanding, the need for decision-making in the personal or public spheres – which make them a richer site for examining the public understanding of science as a social process.

We will examine two case studies in this paper that provide different opportunities to extrapolate about this social process.

Case Studies

Fluoridation. The city of Calgary, Alberta, until 1989, was one of three major cities in Canada whose water system remained unfluoridated. On October 16, 1989, the city held municipal elections which included two plebiscite issues on the ballot: water fluoridation and water metering. Provincial legislation required that a plebiscite be held in order for a community to adopt water fluoridation and, in addition, mandated simple majority support for passage. Fluoridation had lost in four previous plebiscites held in 1957, 1961, 1966, and 1971.

Between 1971 and 1989, the city's demographic make-up had changed considerably. The area was home to the Canadian oil and gas industry which had experienced a boom in the 1970s. By the 1980s, it had the largest number of residents with post-secondary education and the highest per capita income.

Calgary Health Services, the provincially supported municipal health service, endorsed water fluoridation after the city council received a request from students in one high school to have a fluoridation plebiscite in the civic election. A 1985 survey showed the majority of voting population in favor (Calgary Health Services, 1986) and it appeared to be a propitious time for the issue to be reconsidered.

The wording for the plebiscite was straightforward: "Are you in favor of the fluoridation of the city of Calgary's water supply? ___Yes ___No"

The local health agency mounted a two-pronged educational campaign. The first phase was aimed at health professionals in the city and a second effort was directed at the public, with the assistance of health professionals and via the mass media. The major elements of the message for fluoridation were that it was "safe, economical, and effective." The message delivery channels included a local hotline operating 12 hours a day and manned by volunteer professionals; (2) mall displays; (3) brochures delivered door-to-door by a local support group; (4) posters, brochures and buttons; (5) community presentations; (6) radio and newspaper ads; and a video news release for TV media.

Based on an extensive study of previous fluoridation campaigns in other locations in the U.S. and Canada, an important strategic decision was to mount the media campaign in the last three weeks prior to the election. One rationale for this was to try to keep the controversy in the media as minimal as possible. Literature about previous campaigns suggested that when opponents to fluoridation had time to organize and gain media attention, the greater the controversy generated the more likely the public was to take the cautionary approach to the technology (Mazur, 1973).

Surveys taken between 1988 and 1989 demonstrated that some learning indeed occurred. More people were aware that fluoride was a naturally occurring compound, that it was not linked to cancer or AIDS, that it can be found naturally in water and some foods, and that it can help reduce tooth decay. It was also evident that some cost-benefit estimation was proceeding in public evaluations of the technology. There was general consensus that fluoridating the water supply was a limitation of one's freedom of choice; clearly, for some people, this "fact" was not sufficient to overcome their support; for those opposed, this was one among several factors that contributed to their position.

The election result bore out the earlier survey results: a small majority (53%) voted in favor of fluoridation. However, our closer examination of the surveys demonstrated another interesting finding: from 1985 through 1989, while support for the technology remained stable, the number of opponents grew by drawing support from the undecided group. Had the elections been held several weeks later, it is quite possible that the contrary side would have carried the day.

It took the city another two years before it could fluoridate the water supply. This was because of growing opposition and legal challenges to prevent the city from carrying out the plebiscite mandate. Analysis of the case showed very clearly a number of attributes about the public perception: those who were supportive of fluoridation were generally young, well-educated, had young children, and had lived in another community with fluoridated water supply. The demographics of those opposed were generally in the other direction. Concluding that these people were "less-educated, older," and therefore knew less about the technology is too simplistic. In fact, the leaders of the opposition were just as well-versed, perhaps even more so, on research studies. They could just as easily point to "experts" as those who were supportive of fluoridation. Indeed, as the head of an opposition group observed,

> When two people who are supposed to be experts argue about something and you do not know which one is right, the best thing to do is nothing. (Calgary Herald, Oct. 15, 1989)

A Pulp Mill Controversy and Environmental Risk. Until recently, the main pillars of the Alberta provincial economy had been oil and gas, agriculture, and tourism. The significant fluctuations in the world market for oil led the provincial government to consider economic diversification and, in the early 1980s, a study indicated that the largest economic potential for forestry development could be realized if a use could be found for the province's forestry resources, which covered approximately 60 percent of the province's land area. The Alberta government established the Forestry Industry Development Division in 1986 to promote greater development of Alberta's huge timber resources.

Daishowa Canada submitted a proposal to the Alberta government in 1987 and, after a feasibility study, the proposal was quickly approved and construction begun. Two years later, in July, 1990, the pulp mill began operation.

A number of environmental problems are associated with pulp mills. The first is the cumulative effect of effluent discharges on the river systems and on downstream water quality. Among components of pulp mill effluent, toxic chlorinated organic compounds (organochlorines) are of particular concern. Two of the most toxic types of chlorinated organic compounds are dioxins and furans. The concerns are that these toxic compounds are persistent, will pass up the food chain, and consequently affect humans. There is general agreement in the scientific community that human exposure to dioxins and furans should be kept as low as possible (ALPAC Environmental Impact Assessment Review Board, 1990).

The second revolves around the issue of forest management: these include harvest planning, operations and reforestation practices. The area that Daishowa intended to develop was a mixed-wood forest, part of an ancient boreal forest that stretches across the northern hemisphere from Alaska to Labrador, through Europe and Russia to the Pacific. The Forest Management Agreement between the company and the government was based "on a perpetual sustained yield basis" (Alberta Forestry, Lands and Wildlife, 1989), which means forests can be cut down and perpetually regrown without damage to the environment. However, forest management practices are critical for this assumption to hold and, as one forest ecology expert cautioned:

> As the most northern forest type in the world, the boreal is one of the last to be tackled for full-scale forestry development. That means there isn't much known about how to regrow a mixed stand of trees in cold, often wet, soils. (McDonald, in *Edmonton Journal*, 1991)

This was a view supported by other forestry experts (Edmonton Journal, July 29, 1990), prompting a member of the Sierra Club to observe that the issue was going to be "a battle of the experts" (Edmonton Journal, Oct. 3, 1991).

In addition to the provincial government and Daishowa Canada officials, other major players in the controversy included the Lubicon Lake Band, an aboriginal group which, at the time, had an unsettled land claim with the provincial government. The forest agreement took into account the Band's claim by excluding the 65 square kilometers offered by the government to the Lubicons. In addition, the company declared it would not log in a 243 square kilometre area surrounding the 65 km^2 offered by the government, recognizing the band's claim for a reserve size that would correspond to its current population.

The fourth set of actors in this case included the Friends of the Peace, a group formed in direct response to the building of the pulp mill. The original issues emphasized by this group was the potential negative impacts of the project through air and water pollution. Later, their interests expanded to include the forest management practices of the company. Another environmental group called Northern Light was based in Calgary and rallied public support against pulp mills, river pollution, and unsustainable forest practices.

Finally, community leaders (including the mayor and the local newspaper editor) and the community itself consisted of another group of varied interests. Civic leaders were, not surprisingly, supportive of new investment in the town. Among town residents, there appeared to be interest in economic opportunities afforded by the mill although public meetings showed some concern for water quality, odor, and impact on wildlife.

It was clear that there were contradictory views between the Daishowa Canada and provincial government officials on the one hand, and environmentalists on the other. Daishowa's position has been consistent with their orignal commitment to equip the pulp mill with the Best Practical Technology required by the province's environmental arm, Alberta Environment. The condition, of course, was that the costs of installation and operation of modern equipment would not unduly impair the economic viability of the mill. These technologies included oxygen delignification, chlorine substitution and extended deliginification for effluent discharges. These procedures were all designed to reduce the harmful levels posed by the dioxins and furans. The company further instituted a detailed monitoring program to ensure that Peace River quality, fisheries, and downstream users would be protected.

Analysis of the company's communication efforts with the public showed that the company efforts were more reactive rather than proactive. This was most in evidence with the reliance on public meetings, knowing full well that attendance at these meetings was going to be limited. Furthermore, specific environmental problems were addressed after the fact. While the company warned in an early meeting in 1987 (prior to the building of the mill) that odor could be a problem, no other information was released until an odor problem surfaced in 1990.

There was also considerable skepticism about the environmental analyses conducted on the project. For example, the "scientific studies" conducted as part of the environmental impact assessment process were considered by environmental groups to be “tainted”. As one representative suggested, “scientists can be bought”.

In terms of its use of the Best Practical Technology, the disagreement revolved around the use of a chlorine dioxide substitute in the bleaching process versus a non-chlorine bleach process.

The Forest Management Agreement raised a host of environmental concerns as well. Not surprisingly, the public and environmental groups were more concerned about the destruction of wildlife and the loss of natural resources. The company’s position was that they were practising logging and reforestation based on sustained yield. However, the fact that there was no precedent and no tested regulatory procedures on how to manage and sustain the forest resource of northern Alberta attracted a wide range of opinions about forestry resource development and protection.

What do these cases tell us about the public’s understanding of science? First, these instances provide us some insights on the kind of learning about science that can occur around issues of risk. Such learning can occur through the following mechanisms:

a) Learning about a scientific concept and its associated elements, e.g., the nature of the hazard (what is fluoride?) or the nature of specific scientific processes (how does the use of particular technologies affect pollution levels?)

b) Learning about the risks and benefits of technological consequences (What is the risk of getting skin cancer? What are the benefits of protective behaviors? What are the risks of fluoridating the water supply? What benefits can accrue to which groups?).

c) Learning about the current state of knowledge about the issue. Is there disagreement among technical experts? What are the areas of disagreement and how significant are they?

d) Learning about generic processes of science. How do scientists collect evidence to address a particular problem? What does it mean to speak probabilistically?

In considering these various ways in which public understanding of science occurs, it is important to understand that there is differential learning about science concepts. For example, a study on the public understanding of Canadian adults demonstrated differential levels of understanding for such concepts as "acid rain", "computer software" and "DNA" (Einsiedel, 1990). Such learning can be mediated by whether risk is personalized (how closely I'm affected) and, in certain instances, knowledge by lay people can sometimes exceed, or be more "valid than", that of the experts (Wynne, 1992).

On the other hand, despite information availability, risk estimations do not always coincide with actual estimations. People often overestimate or underestimate severity of risks and this may have something to do with similar presentations by the media and such psychological factors as dread.

Second, people can learn about risks and benefits. What happens when I do X? This is tempered, on the other hand, by the finding that knowledge does not necessarily translate into "appropriate" behaviors. Knowing about AIDS does not necessarily ensure engaging in protective behaviors.

Third, risk issues afford an avenue for learning what the state of knowledge might be about a given scientific issue. There appears to be greater consensus on factors that correlate with heart disease, for example. In part because of the greater media attention to such issues, there is correspondingly higher levels of awareness of such factors. In contrast, general knowledge levels on such concepts as radioactivity is lower.

The problem becomes more complex, however, when there is considerable disagreement among experts. Such disagreement may result in increasing mistrust of science for some members of the public. For others, the scientific opinion may simply be set aside in favor of other factors. The debate then becomes a process of waging a contest for the public mind or for public support. Is water fluoridation safe or unsafe? Is the hole over the Antarctic increasing or decreasing?

Finally, risk issues afford the public an opportunity to learn about science in a generic sense: that science is an uncertain enterprise, that there is often disagreement among scientists, that it is a political enterprise and not always the pristine and noble search for knowledge it is often represented to be.

These dimensions about risk issues as an avenue for public understanding of science afford a different opportunity for communicating about science. Those who are in the business of communicating about science (including scientists themselves, the public affairs specialists working for scientific organizations, industries involved such as a pulp mill or nuclear plant, policymakers and those representing public interest groups) need to take into account the *process* and context within which public understanding may occur. There is, in essence, an information environment available to members of the public and, at the same time, there may be more active information-seeking among some segments of the more involved publics. Within this information environment, the individual members of the public negotiate their ways with differing degrees of activity and interest.

For those with interests in communicating about science, the first lesson is that science is often not *the* arbiter, nor is it the only arbiter, of public choices. Sometimes, public choices may be made on the basis of social and cultural values that may have little to do with scientific assessments.

The second lesson is that expertise is not resident only among experts. The public can be just as likely to be a fount of wisdom and is capable of developing expertise. For too long, the public has been treated with condescension by the larger group of communication professionals. As one committee astutely observed on the recombinant DNA research controversy:

> Decisions regarding the appropriate course between the risks and benefits of potentially dangerous scientific inquiry must not be adjudicated within the inner circles of the scientific establishment… We wish to express our sincere belief that a predominantly lay citizens' group can face a technical, scientific matter of general and deep public concern, educate itself appropriately to the task and reach a fair decision (in Nelkin, 1979, p. 18).

The third lesson is that scientific uncertainty ought to be recognized as part of the information mix. What's wrong with acknowledging that there are certain things we do not yet know about a given technology? What's wrong with recognizing the limits of our current understanding? How much do we now know and what do we lose/gain by postponing a decision until we know a bit more? What are the practical limits on how much can be known? Risk issues bring these questions to the fore in a way that other kinds of scientific topics may not.

The fourth lesson is that public participation processes ought to be part of the public-understanding-of-science mix and these processes ought to be seriously regarded by all concerned – policymakers, industry representatives, the scientific community, and the public itself. When people are meaningfully involved from the earliest stages of problem definition, when they actively participate in, if not follow, the process, and when they are provided with the technical and informational resources needed, the likelihood that the ultimate outcome will be of broader social benefit is greater.

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