Eureka! The Relationship of Good Science Writing to Risk Communication

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This paper investigates the importance of science writing in helping members of the public understand current scientific issues that affect their daily lives so that they can make informed decisions concerning risk. The knowledge gap that exists in the realm of communicating scientific concepts to general audiences is described, covering the effectiveness of the various modes in which scientific communication is delivered to the general public.

SCIENTIFIC COMMUNICATION AND THE PUBLIC

Science permeates modern life. While our daily lives are governed by the results of scientific research and its application, science is often viewed from the perspective of the *Scientific American* article, the short, amusing story on the newspaper's weekend science page, or the latest *Animal Planet* episode on the Discovery Channel.

Science writing isn't just an interesting genre, it fills the massive information gap between what scientists do and know, and what the public understands. While vast amounts of public funds are spent by governments on a multitude of research programs, only a small subset of the public is sufficiently knowledgeable about the science and technology that is involved in public policy debates to make informed decisions.

Scientific Literacy

Modern society begs for easily consumable scientific communication. Certainly, the type of scientific communication that we encounter on a day-to-day basis has a role to play in popularizing the important, yet often esoteric, basic scientific work that is performed to improve human existence or gain a greater understanding of the universe in which we exist. But clearly that is not enough. The rate at which scientific developments are occurring is expanding far ahead of the average scientific literacy curve.

This knowledge gap is extensive. For example, a study on scientific literacy by the Organization for Economic Co-operation and Development (OECD), whose members include 30 of the world's most technologically advanced countries, indicated that slightly over 10 percent of the population in industrialized countries has a good understanding of scientific concepts and methods (8). The implications of this knowledge gap are staggering. The OECD study shows that only one in ten citizens in the world's most technologically advanced countries would be able to follow, let alone participate, in a discussion about a controversy involving a scientific or technical issue. This knowledge gap is at its most critical when the public is expected to assess levels of risk to their own health and safety based on the scientific information they have at hand.

These considerations also extend to the closely related area of health illiteracy. A report produced by the Institute of Medicine indicates that almost half of the adult population of the United States—about 90 million American adults—have difficulty understanding and acting upon health information. Furthermore, about 40 million have difficulty finding information in newspaper articles, editorials, medicine labels, forms, or charts (7).

The Need for Science-Based Risk Communication

Exacerbating the problem is the fact that people are often exposed to quick bits of scientific information from many sources. There is no guarantee as to the accuracy of this information, and the pieces from different sources are often contradictory. Such widespread scientific illiteracy means that a huge percentage of adults lack the basic skills necessary to meet even the simplest demands of twenty-first century society.

For example, people are starting to make decisions about whether they should consume genetically modified foods, yet have all of the issues surrounding them been accurately and dispassionately conveyed? While political and economic interests always play a role, those who stand to gain from the acceptance of such technologies—as well as their detractors—should not be the only ones who provide information on which such determinations of risk are based. The information from such sources is often slanted to convince a worried public there is nothing to fear or, alternatively, to generate a backlash, or feed

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constant fear and concern (e.g., news reports on SARS, BSE, West Nile Virus). A key problem is insufficient explanation of technical, engineering, and scientific factors (5). Industry, along with public institutions, has an important role to play in communicating risk so that people understand facts in ways that are relevant to their own lives and values. This will allow them to put the risk in perspective to make more informed choices and decisions.

The modern health system makes complex demands on health consumers. Individuals are increasingly expected to assume new roles in seeking information, understanding a variety of risks, and making health decisions for themselves and those for whom they are responsible. What underlies such expectations, however, are broad and faulty assumptions about people's knowledge and skills (7). On the whole, most people are very capable when it comes to dealing with most aspects of their lives; many, however, may find science-based information difficult to obtain, understand, and use. For example, while farmers may be able to use fertilizers effectively, they may not understand the safety information provided with the fertilizer.

It has long been understood that without methods to mitigate scientific illiteracy, widespread and lasting benefits from scientific advances will be greatly diminished over the long run. This is also true for the public's ability to understand and manage risk effectively. Scientific and technical issues that involve situations that present even the smallest hazard require the communication of easily consumable information to allow people to make rational, supportable decisions. This, in a nutshell, is the basis of effective risk communication: scientists must communicate scientific evidence clearly, and government agencies or industry organizations must inform people about safety considerations, regulations, and policy measures (10). Somewhere along the line, concerned citizens decide to what extent they are willing to accept the associated risks.

RISK COMMUNICATION

Risk, like science, also permeates modern life. The public is bombarded with news about risk from all quarters on a daily basis. There are risks associated with food safety, infectious disease, and the use of technology. There are risks associated with our chosen lifestyles, including types of transportation, diet, engaging in dangerous sports, smoking, and so on.

What Is Risk Communication?

Good science-based risk communication provides the tools needed to make informed lifestyle decisions.

Risk communication is the process of communicating responsibly and effectively about the risk factors associated with industrial technologies, natural hazards, and human activities. When done well, risk communication builds mutual respect between an organization and the target groups with which it is communicating (4). It allows the messages that your organization releases to be respected, even if there is disagreement.

Risk communication is not a method to be used to convince a worried public that there is nothing to fear, a means to avoid conflict situations, or a way to end dialogue on risk situations as soon as possible and get them out of the way. Risk communication is also not a public relations exercise. Risks worry people; giving them "feel good" messages is not only an ineffective tactic, it may even be offensive depending on the seriousness of the situation. The long-term goal of effective risk communication is to ensure that your organization becomes a highly preferred source of reliable and believable information (4). Science-based risk communication cannot solve all problems or resolve all conflict, even if it is used effectively. However, if such communication is handled poorly, or is absent entirely, almost certain failure of any risk management initiative will result.

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How Risk Is Assessed

An important aspect of good science-based risk communication is understanding the differences between the ways experts assess risk and the way that the public perceives risk.

While experts rely on objective viewpoints and analysis to put hazards into the greater context of a situation, public assessment of risk often leads to outrage (9). Many factors influence a person's decision to accept or reject a risk. People perceive risks as negligible, acceptable, tolerable, or unacceptable in comparison to perceived benefits. But one of the most significant factors is an individual's perception of his or her ability to control the risk in question. When people feel that they do not have control, public response is generally shaped by the influence of external factors such as available scientific information, coverage in the media, other forms of information dissemination, the economic situation of the individual, and the structure of any associated regulatory processes (10). The scientific communicator has a key role to play in ensuring that information influences are not biased, and that members of the public have the tools required to make a balanced judgment.

Responsibilities for Risk Communication

Governments have a fundamental responsibility for risk communication when managing pubic health risks, regardless of the management methods used (3). This comes with the added responsibility to communicate information about risks at a level of understanding acceptable to everyone involved.

Industry and government routinely exchange information when setting standards or obtaining approvals for new products, technologies, or manufacturing processes. As a result, industry has a key role to play in all aspects of risk analysis, and should therefore be relied upon by government as a key source of information (3). Industry must also work closely with government to ensure that risk communication is carried out effectively; in fact, industry has an explicit duty to engage in good risk communication (4).

Governments at all levels also forge alliances with non-governmental and non-industry stakeholders. Membership in such alliances places responsibility on participating groups to be honest brokers of risk communication to the communities of interest that they represent.

Technical Content

While not always recognized from under the shadows cast by scientists, legal advisers, politicians, and public spokespersons, science writers have, by far, the most pivotal role in science-based risk communication. If communication efforts are to succeed, tremendous effort must be applied to render all of the scientific elements of risk communication messages into language that is understandable by the audiences that are targeted. Content developers must ensure that they communicate in a manner that will be easily understood and that will enable the public to gain the proper perspective on the issue at hand. If these aspects are not considered in the development of risk communications, organizations run the risk of cumulative damage to their institutional credibility resulting from warnings that fail to warn and advice that is discounted.

Scientific Translation

To engender trust in the general public, messages must be clear, consistent, and free of the pitfalls to understanding that purely technical language can create. A key element is ensuring that scientific information is translated into language that is understandable by a broad group of members of the general public. There is a threshold, however, beyond which the simplification of information loses its usefulness. Addressing this challenge may require a number of different approaches towards presenting information, since oversimplification will introduce problems that may negate the value of the messages and information being issued. For example, in the case where a regulatory body must issue an advisory to the public, the main directive to the target audience—the actions the audience is being warned to take or not to take—should be understandable by all audience levels; the detailed reasoning behind the directive should be understandable to at least an educated member of the general public. In keeping with this approach, uncertainties must be reported

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honestly in qualitative terms, quantitative terms, or both. Uncertainties should not be minimized, but presented in the overall context of the particular risk.

Messages may need to be communicated to audiences along a continuum that ranges from those with little or no ability to consume scientific information to those who can be termed as "educated laypersons." In the area of health, an educated layperson is an individual who attempts to maintain a basic level of awareness of issues that can affect his or her health, and who understands the basic principles of science.

Writing for any audience along this continuum is commonly misrepresented as "dumbing down" information. On the contrary, it involves a balance between simplifying a scientific concept while maintaining its technical integrity. Depending on the specific subject, its initial level of complexity, and the range of audiences to which the information must be communicated, achieving this balance can be a difficult but critical task.

Plain Language

Plain language principles should be adhered to whenever possible. Underlying plain language writing is the principle that information should be written and organized as clearly as possible without compromising its accuracy.

To engage readers of science-based risk communication materials, a conversational tone should be used. A tone that is too familiar or colloquial should be avoided, however, as this harms the credibility of the message. Short, simple sentences keep readers focused, but clarity should not be sacrificed to either sentence length or simplicity. Paragraphs should be focused on a single idea. Terms should be used consistently, and the clearest words possible used. Complex words, no matter how precise, may need to be replaced by several simpler words. Technical or specialist terms and complicated ideas must be explained.

Using Probabilities and Numerical Data

Probabilities associated with risk may be employed in risk communication materials. Experts and the public alike are subject to biases when assessing probabilities. When using probabilities, perceived messages will depend on whether they are presented in absolute or relative terms. For example, in absolute terms the probability of an event occurring could be expressed as increasing from 5% to 10%. In relative terms, the probability has doubled. Doubling the probability sounds much more alarming than an increase of 5%, when in fact the actual numbers are the same.

When new information is provided to a general audience, baseline probabilities are often forgotten; what the audience focuses on is the probability's rate of change. While relative risks can be made to sound more interesting, they can seriously mislead the reader if the baseline risk is not made clear.

Presentation can also influence the understanding of a message when numerical data is used. For example, data that is used to indicate possible numbers of illnesses that may occur in a population will be interpreted in a completely different way if presented in terms of the number of people who will not become ill.

Risk Comparisons

Sometimes, comparisons of risk are used to help target audiences gain a better understanding of the risk they are being expected to assess. The idea is that the risk comparison provides a familiar point of reference. There is much debate over the effectiveness of this approach and whether it falsely influences decision making. If risk comparisons are used, however, a voluntary exposure (e.g., smoking) should never be compared to an involuntary exposure (e.g., air pollution), as such comparisons will be offensive to most readers.

OBSTACLES

There are a number of obstacles that get in the way of effective science-based risk communication. The process itself, communicator's understanding of the makeup of their audiences, scientific uncertainty, and trust all present challenges for the risk communicator.

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The Communication Process

The process involved in communicating about science poses significant challenges for risk communicators. Policy-makers and scientists are often reluctant to present the public with complex, technical or scientific information, out of the firm belief that it will be misunderstood or misinterpreted (1).

Peer-reviewed journals may be primary sources of information on any given scientific topic, but such information is both physically and intellectually inaccessible to most people. As a result, without other alternatives, public consumers will rely on the media to obtain information on controversial issues. Depending on the history of industry/media interactions on a given topic, this may also lead to an overemphasis of some aspects and inadequate coverage of others.

Public information officers, particularly in government research and regulatory organizations, require sufficient training to deal with controversial issues that arise over science-based issues. An effective science communication infrastructure must be in place to support those who are on the front lines of an issue.

Understanding the "General Public"

The "general public" is frequently misinterpreted to be a homogeneous group. In fact, the public consists of a number of stakeholder audiences from various ethnic and language groups with varying abilities to consume scientific and technical information, different values concerning the perception of risk, and various biases. This can make the task of developing appropriate content for warnings and advisories challenging. An attempt should be made at the outset to gain some understanding of the makeup of the groups most likely to be affected by the information.

To meet the needs of a diverse group of information consumers, messages may need to be targeted appropriately. For example, if a detailed description of the reasoning behind a determination of risk is included and written in a manner that is understandable by educated members of the general public, key elements can be extracted and presented in a manner that will penetrate a wider group more deeply.

Scientific Uncertainty

How everyone involved in the process, from researchers to public consumers, understand various risks affects the job of the risk communicator. When risks are well understood, predictable, and measurable—and when the science behind the risk is clearly articulated in a manner that suits the intended audience—communicating about the risk itself can be fairly straightforward (2). However, as science advances and we encounter unforeseen situations, governments are called upon to inform the public about risks that are unpredictable, and about which there is disagreement among experts. Scientists are generally reluctant to provide the public with information when there is scientific uncertainty and expert disagreement.

Scientific uncertainty is nothing new; but increasing interest in this aspect of risk reflects a change in public attitudes towards science, risk assessment, and decision making about risk. The public has become increasingly critical and often cynical about science and its ability to estimate risk accurately. The public has learned from experience that science can be wrong. Sometimes science fails to provide the right answers. Scientists appear to be losing stature in the public perception, and public fear of scientists "playing God" can be seen in the ethical dilemmas around new technologies such as biotechnology (2). The prevailing view is that many modern developments and innovations have proven to be a two-edged sword; the public is tired of false reassurances of safety and of decisions presented as though they are relatively conclusive when fundamental uncertainties still remain.

Trust

Increasing public awareness of issues that involve risks to their health has been coupled with a decreasing sense of trust in public officials, technical and scientific experts, and industrial managers, especially in large private and public businesses. Also, there is a strong undercurrent that the pace of scientific and technological change is too fast for governments to manage (10).

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Objectivity and Bias

There are a number of ways in which biases exert themselves in risk communication and affect the real and perceived accuracy of messages. These include

- real or perceived advocacy of a position not consistent with careful assessment of the facts;
- reputation for deceit;
- misrepresentation or coercion;
- previous statements or positions that do not support the current message; and
- self-serving framing of messages.

This problem is compounded when audiences receive contradictory messages from other sources, and there is actual or perceived professional incompetence and impropriety within the organization (6). With new technologies, public concerns are often centred on issues of ethics rather than on risk.

Medical sources are generally seen as being more expert and knowledgeable about risk and having greater freedom to present information to the public. They are also seen to have greater concern for public welfare, and have a better record of providing good information.

SCIENCE-BASED RISK COMMUNICATION: THE WAY FORWARD

All organizations involved in risk communication must work towards a consistent and transparent approach to their communication activities. While communication strategies may differ for different issues and different target audiences—particularly with respect to economic, social, or cultural differences—it is the outcome that is most important; that is, effectively communicated risk information.

Openness and transparency in fact embody much more than just the transfer of information and facts. Partnerships with trusted sources to develop and disseminate messages are recommended as a means of improving the credibility of risk messages.

While no one form of risk communication will satisfy everyone, or every situation, organizations involved in risk communication should adhere to the following general principles:

- Analyze the audience to understand their motivations and opinions.
- Involve scientific experts to provide information on the process used in risk assessment, and to explain their data, assumptions, and the subjective judgments in which their assessments are based.
- Establish sufficient expertise in communication, since risk managers and technical experts generally do not have the skill to carry out complex risk communication tasks (e.g., preparing effective messages, responding to the needs of various types of audiences).
- Be a credible source of information.
- Share responsibility for making sure that the public understands risks and risk management options among all stakeholder groups, including government regulatory agencies, industry organizations, public advocacy groups, and the media.
- Separate facts from values.
- Ensure transparency through effective consultation and two-way communication.

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