Journal Title: International Journal of Mass Emergencies and Disasters

Volume: 10
Issue:
Month/Year:
Pages: 437-464

Article Author: Rogers, G.O.

Article Title: Aspects of Risk Communication in Two Cultures

Status: Undergraduate
Phone: 3616525159
E-mail: laupstud@archone.tamu.edu

Name: Keleigh Kotzur

Pickup at Evans

3137
College Station, TX 77843

Larry Browning and Judy Shetler also direct their attention toward communication. These researchers examine some implications the Exxon Valdez oil tanker spill has had on contingency planning within the impacted Alaskan community and, in the final section of their paper, for other sectors of the Pacific. In particular, they emphasize the importance of information communication channels and the need for inter-organizational coordination. They also illustrate the advantages of involving informal groups into the wider planning and preparedness process. While the paper contains multiple themes, one in particular is powerful in its message: "The most difficult question [on how to prevent future oil spills] was, how can we guarantee that these new systems do not degrade and become largely inoperative as they did between 1979 and 1989? ... The commissioners decided that the missing ingredient was a group of concerned local residents who would be given statutory mandate to provide citizen oversight of both the regulators and the regulated—government and industry." Citizen empowerment has always been regarded as *the* missing ingredient. It is a theme which runs through all of the papers in this special issue. However, unlike the other papers in this collection, Browning and Shetler's case study is the only one which can actually provide documented evidence that such an occurrence has taken place. One can only hope that other emergency management systems—world-wide—take heed of this momentously important message and employ the "missing ingredient" also.

Finally, the last paper examines the warning response behavior of Greek, French and Dutch residents near a hazardous chemical complex. The setting for the research was provided by a simulated warning scenario for an industrial accident. Based upon a quasi-experimental design, the intercultural team of authors—Wiegman, Komilis, Cadet, Boer and Gutteling—deal with the problem of predicting behavioral intentions to engage in both functional and dysfunctional actions in response to the warning. The general conclusion is that when issuing warnings to multi-cultural audiences, it is not sufficient to avoid dysfunctional behaviors on the part of warning recipients to just describe desired protective responses in a uniform way. Avoiding dysfunctional actions seems to be related to nationality. Encouraging functional behaviors, however, seems to be less related to distortion as a function of national origin.

Taken collectively, these papers extend the developing body of knowledge on the effects of cultural or national group membership on the interpretation of risk communication. As the study of disasters becomes more global, these pieces will no doubt serve to define the direction of future research.

International Journal of Mass Emergencies and Disasters
November 1992, Vol. 10, No. 3, pp. 437-464

ARTICLES

Aspects of Risk Communication in Two Cultures

George O. Rogers
Hazard Reduction and Recovery Center
Texas A&M University

When people from two distinct cultures attempt to communicate, they often fail to share the fundamental foundation upon which to establish meaningful two-way communication (e.g., language and belief). Risk communication under such circumstances demands special attention; extra effort on the part of people from both cultures to understand and appreciate the risks from a comprehensive perspective that accommodates both sets of interests. This paper examines the communication about risk between the U.S. Army and the native Polynesian cultures in the Pacific Ocean. Specifically, the article analyzes the written record of the proceedings to comply with the National Environmental Policy Act of 1969 that led up to the shipment of the European Stockpile of unitary chemical weapons to Johnston Atoll that was completed November 1990. The analysis indicates that while both the native cultures and the Army spoke the same language, the U.S. Army and the native cultures failed to communicate about the risks associated with the movement and destruction of weapons. They failed to establish risk communication dialogue, and never established a common framework for effective risk communication. The people involved from all groups did not establish a shared meaning, and no dialogue was established to clarify meaning as misunderstandings occurred. This condition contributed to increased distrust, and undermined the credibility of both perspectives.

Introduction

In December 1985, the United States Congress via Public Law 99-145 (Title 14, Part B. Section 1412) directed the Secretary of Defense to destroy the United States stockpile of lethal unitary chemical weapons stored in the Continental United States. The ensuing programmatic environmental impact statement (U.S. Department of the Army 1988), as well as the record of decision (Ambrose 1989), called for on-site disposal of the stockpile in the Continental United States. Meanwhile, at the Tokyo Economic Summit in May 1986, President Ronald Reagan and West German Chancellor

Helmut Kohl agreed that the United States would remove the unitary chemical stockpile from the Federal Republic of Germany by 1992. Secretary of State James Baker subsequently announced that the United States would explore ways to expedite the removal process, in hopes of having the stockpile removed by the end of 1990.

The Army proposed the movement of the stockpile located in Germany to Johnston Island in the Pacific Ocean. This action had significant appeal because of the existing stockpile at Johnston Island, and the previously approved environmental action (U.S. Army Corp of Engineers 1983) to build and operate a prototype high temperature incinerator called the Johnston Atoll Chemical Agent Disposal System (JACADS) that could be used to destroy both the existing and European stockpiles. This action also met with significant opposition (see chronology below) because of indifference to nonwhite people living in the area, lack of high-level consultation with potentially effected nations, long-simmering distrust, and fear that JACADS might become a permanent incinerator for toxic substances. The opposition seemed to center around issues related to risk communication and public participation. This paper will show that a significant risk communication dialogue was not achieved between the U.S. Army and the native cultures primarily because they failed to share a common framework for effective risk communication.

Chronology of Recent Events

The following is a brief chronology of events associated with the situation surrounding the controversy about the destruction of the European the unitary chemical stockpile at Johnston Island in late 1990. This listing is not intended to be a complete historical account of the situation. Rather it is a brief outline of key events that provides a significant historical background and summarize environmental actions relating to the shipment of the European Stockpile.

Nov. 1983	Final Environmental Impact Statement for Johnston Atoll Chemical Agent Disposal System recommends building JACADS prototype.
Dec. 1985	Congress mandates destruction of Unitary Chemical Stockpile.
July 1986	Chemical Stockpile Disposal Program Draft Programmatic Environmental Impact Statement issued.
Jan. 1988	Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement recommends

	on-site disposal of Stockpile in Continental United States.
Feb. 1988	Record of Decision opts for on-site disposal of Stockpile in Continental United States.
May 2, 1990	Finding of no significant impact on Global Commons to move European Stockpile to Johnston Atoll.
June 6, 1990	Second supplemental Environmental Impact Statement for JACADS recommends movement of European Stockpile to Johnston Island.
July 12, 1990	Record of Decision opts for movement of European Stockpile to Johnston Island.
June 26-Sept. 1, 1990	Stockpile removed from igloos in Clausen, Germany and placed in transport containers (ten small containers within one larger container) for shipment.
July 1990	German courts refuse to halt shipments on grounds of failure to demonstrate the government ignored compelling information required for a public decision.
July 26-Sept. 1, 1990	Stockpile moved from Clausen to Misiesau, Germany by truck.
Aug. 1, 1990	Greenpeace, the Sierra Club, the Institute for the Advancement of Hawaiian Affairs, and the World Council of Indigenous People file suit claiming violation of NEPA and that the facilities would become a permanent toxic substances incinerator.
Sept. 7, 1990	Greenpeace request for Preliminary injunction turned down in United States District Court of Hawaii.
Sept. 7, 1990	Pacific Island Forum, Prime Minister of Vanuatu, and the Governor and Senior Senator of Hawaii, criticize movement primarily because of indifference to nonwhite people living in the area, lack of consultation, long-simmering distrust, and fear that JACADS might become a permanent incinerator for toxic substances.
Sept. 9-19, 1990	Stockpile moved from Misiesau to Nordenhem, Germany by rail.
Sept. 13-22, 1990	United States Ships *Gopher State* and *Flickertail State* loaded with European Stockpile.
Sept. 22-Nov. 6, 1990	Stockpile shipped to Johnston Island via Cape Horn with only minor incidents not related to the cargo.

Oct. 8, 1990 Federal Judge for the Ninth United States Circuit Court, San Francisco, CA, rejects Greenpeace Coalition's suit because of (a) a failure to demonstrate NEPA violation, (b) the greater environmental health and safety risks associated stopping shipment in transit, (c) recognition that United States environmental law not applicable to Germany, (d) that an injunction would interrupt a carefully time operation—endangering German welfare, and interfere with a duly enacted foreign policy decision made by the President and concurred by Congress.

Oct. 28, 1990 United States President pledges JACADS will only be used for existing stocks, European stockpile and any munitions found in Pacific Basin.

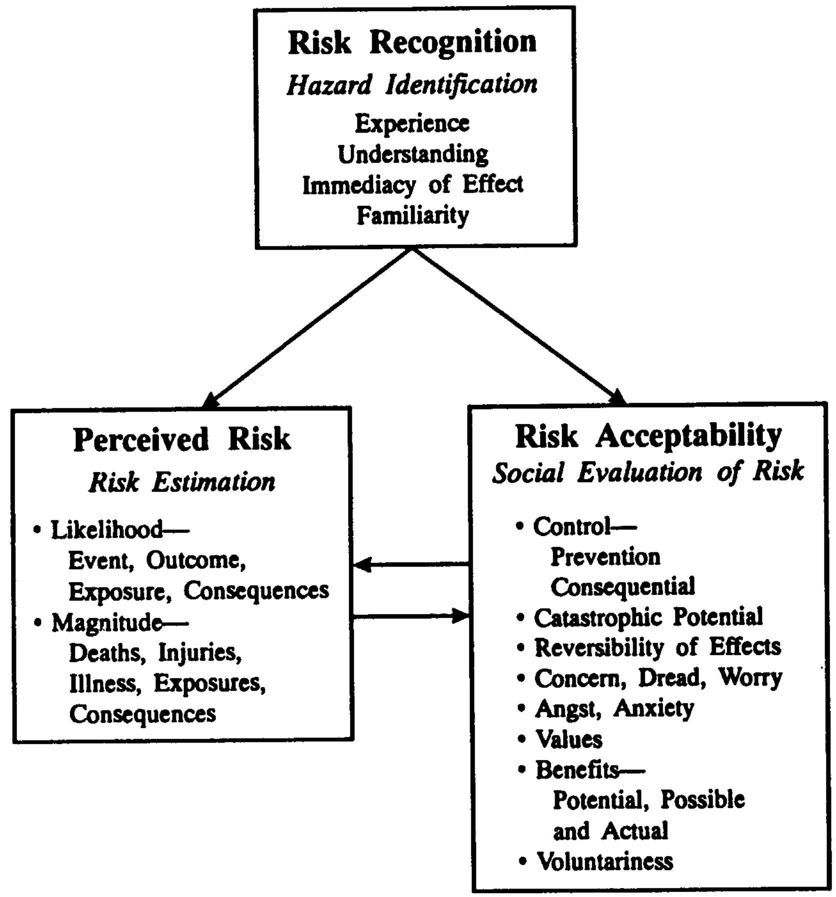
Nov. 11, 1990 Unloading United States Ships *Gopher State* and *Flickertail State* completed at Johnston Island.

Conceptual Theoretical Framework

It has been generally postulated that the public uses the same general process for evaluating risks as experts (Rogers 1983). While it is clear that the public and experts do not use these processes with the same precision, and that they seldom reach the same results, the process is comprised of the recognition of risk, the assessment of the amount of hazard potential, and the evaluation of the social consequences of the realization of risk (Figure 1). This section summarizes the parallels between risk recognition and hazard identification, risk estimation and perception, and the determination of acceptability of risk and the social evaluation of risk.

Risk recognition is similar to hazard identification in that they each initiate a process or analysis by which some risks are tolerated and others determined to be unacceptable; a process by which decisions regarding risk are made. While risk recognition is more passive than hazard identification, in the sense that experts identifying risks, seek out aspects of a problem that potentially bear risk, and people generally find out about risk more inadvertently, they each involve becoming aware of risk. This awareness involves experience in the broadest possible sense. While experts may be more likely to use the scientific method as a more systematic and objective approach to augment experience, and record objective data, all people rely on experience to become aware of risk. Because people generally rely on experience, understanding among the lay-public is biased by effects that are immediate and familiar. Risk experts are generally better equipped to isolate long-range impacts and those less obviously at the root of the familiar than the public.

Figure 1. A Conceptual Theoretical Framework of Perceived and Acceptable Risk



Because experts use the scientific method they may better able to predict or forecast impacts that could go undetected by the lay public.

Similarly, risk estimation for experts is paralleled by perceived risk for the public. They both focus, although with varying degrees of precision and intensity, on the likelihood or probability the occurrence of a risk and the magnitude or severity of the associated consequences. The likelihood or probability of occurrence involves the risk event-outcome-exposure-consequence sequence (Rowe 1977) being actualized. The magnitude or severity of the risk involves the estimation of consequences given that the event-outcome-exposure sequence is actualized. The estimation of the severity amounts to the summation of the total number of deaths, injuries, illness and other (e.g., long-term, or generational) adverse effects of exposure. While experts are more likely to use scientific models to determine the consequences and the language of probability to estimate the likelihoods, the public estimates both the likelihood and the consequences in less quantitative terms. The public may not be able to express the likelihood of a give accident in terms of chances per thousand population, but there is a sense of how likely an event is to occur. Moreover, the vivid detail with which consequences are understood and personalized by the public is qualitative compared to the systematic description of events used by risk analysts in risk analysis, like the descriptions of events considered as part of the programmatic environmental impact analysis (Fraize et al. 1989).

Experts have sought to quantify the acceptability of risk by determining what level of risk becomes acceptable. The has often taken the form of comparing a given risk to other risks that are already in the environment. The logic has been that if there is less risk associated with the given hazard than other already accepted practices then this risk must also be acceptable. This revealed preferences (Starr 1969, Lowrance 1976, Rasmusen 1975) approach has been soundly criticized because (a) it fails to consider additive effects (Kunruther and Slovic, 1978), (b) does not take into effect the way people cognitively think abut risk (Slovic et al. 1985), (c) take into consideration the cultural aspects of what makes risk acceptable (Douglas and Wildavsky, 1982), (d) relate the acceptability of risk to the values that guide the way the social processes operate (Rogers 1983). The experts have focused on a series of issues that are more or less quantifiable like voluntariness (Starr 1969), control, reversibility of effects, dread (Menkes 1981), and the degree of familiarity with the risk among others (Lowrance 1976, Slovic et al. 1985). Rayner and Cantor (1987) sought to adjust the discussion of acceptability to fairness, which is arguably value based, rather than safety. Kasperson et al. (1988) focus on the social processes that amplify risk as it is communicated. While the public tends to focus on the social values associated with risk, they do not seem to isolate one risk at a time. Their social evaluation of risk seems to focus more broadly on the complete spectrum of risks in a particular environment. While every child is taught a variety of values that deal both directly and indirectly with risk (e.g., never swim alone) (Rogers 1983), they also learn to keep track of their whole environment. This observation does not offer that they necessarily learn to observe the whole environment well, but rather that people learn not to ignore one element of the environment while attending to another. Imagine a person trapped in a confined space. They can either have water or air, but not both. If they choose water, they will quickly discover the need for air.

While it may take a little longer, choosing air will eventually let them discover their need for water. If the trapped person is allowed to switch between air and water, a schedule will probably be developed to accommodate the body's needs. Of course this implies that the closer the feedback, the more apt people are to learn the appropriate connections between actions and the consequences of the risk. The result of these cognitive and social processes is that the experts and the public seldom agree on the amount and meaning of risk (Slovic et al. 1985).

Risk communication is to some degree born of the basic disagreement about the likelihood and severity of risk. If risk analysts could only communicate risk more effectively, the differences between experts and the public perception of risk would be diminished (Covello et al. 1987; Needleman 1990), which would in turn ease controversies about various risk situations. Risk communication can be informative, but unfortunately it can also be manipulative. Comparing technological risks with smoking subtly eliminates some alternatives (e.g., having both sets of risks). Cognitive studies of risk perception have produced underlying principles for predicting public acceptability (Slovic et al. 1985). Risks tend to be feared the most when they at least appear to be uncontrollable, irreversible, or have unknowable future impacts. Risk communication seeks to reduce the potential public hysteria in response to risk information. Unfortunately, risk communication can be viewed as industry or government propaganda, designed to deceive the public. Counting public fears as legitimate prospect costs while communicating risk to reduce distortions can be a useful approach to anticipate and deflect public opposition to potentially risky situations (Kartez 1989).

Starr (1984, pp. 3-4) argued that "public acceptance of any risk is more dependent on the public confidence in risk management than on the qualitative estimates of risk consequences, probabilities and magnitudes." Hence, public confidence in risk management is more important than the probability or severity of the consequences, or the potential benefits associated with the action involving risk. Starr describes the analogy of a zoo. Parents have little hesitance in taking children to a zoo, because the risks are clearly managed, public confidence that the risks are managed are evident (e.g., the public can see the bars on the cages). But if the confidence erodes (e.g., dangerous animals escape), then the public is less likely to accept the risks associated with the zoo. Public confidence that risk management is effective may also depend of visible signs of protection, history of performance, and experience with similar situations. Conversely, it is difficult to convince the public of ongoing protection when previous experience indicates the contrary, or when there are no visible signs of protection, or when other similar situations are shown to be risky. Incidents at other similar facilities/situations can be overcome if there are clear differences (e.g., in procedures, processes or mitigation factors) that reduce the risk, and they are made apparent to the public. For example, the nuclear accident at Chernobyl was less problematic for the United States nuclear industry than the accident at Three Mile Island, because of the dramatic differences in safety design for United States nuclear plants.

Tendencies of Experts and the Public

Risk experts and the public may use similar processes to assess the degree of risk and evaluate its social meaning, but the often subtle and sometimes not so subtle differences in the way the public and experts think about risk leads to significant differences in risk perception. These subtle differences mean that there is seldom a common understanding of the risks presented by a given situation. Overcoming this less than sound foundation for risk communication requires a dialogue to first understand the subtle differences in the perspectives and second reach a share view of potential solutions. This section will examine the differences in the way experts and the public assess or perceive risk (estimation), and then examine the evaluation of its social meaning or determine its acceptability (social evaluation of risk).

Risk estimation for both experts and the public involves the determination of what can happen, and how likely it is to happen. The tendency among risk experts is to think and communicate about what can happen as a distribution of events and event sequences. These events are described as single, unique and unrelated events. The scientific underpinnings of the work are highlighted by the phrases used by risk experts, such as "range of events" or the "credible event," or the "worst case scenario" or the "conservative most likely event." Moreover, these terms often have very precise meaning in quantifiable terms. For example, a worst case accident is one that maximizes exposure. Worst case accidents often become the focus because no matter what sequence leads to the event's occurrence it is still the worst event in terms of, for example, exposure. The public tends to think and communicate about risk in quite different terms. They describe events that include vivid images of imaginable events or sequences of events. These descriptions are often graphic in detail. Images like those often portrayed in the media, particularly television, are very common. For example, the image of a mushroom shaped cloud are so vivid that the public, even after years of public education programs, often believe that nuclear power plants can experience nuclear explosions like those associated with

nuclear weapons. In addition, the public often links events, that are considered separate and independent by risk experts. This leads to events being imaginable by the public, but remaining explicitly unconsidered by risk analysis.

When it comes to what can happen, differences are also apparent. Risk experts focus on the probability distribution of described events. The experts often consider all individually described credible events in terms of the probability distribution they form when taken together. A credible event may be defined as having at least a specific probability of occurrence (e.g., one in a million or greater). The worst case analysis can be argued to capture the essence of the what can happen, because the consequences cannot be any worse than the worst accident. For example no greater amount of exposure could be anticipated. But the analysis of individual, independent events alone fails to consider the change in likelihood associated with the coupling among events and actions, as well as considering actions, even those intended to be remedial, as events that may engender risk themselves (Perrow 1984). In short, risk analysts often forget/ignore, or leave out as inconsequential, system interactions. The public tends to focus on possible events rather than probable events. Sometimes this takes the form of considering the linkages between events, but it also takes the form of concern about rare, though imaginable events.

Both experts and the public evaluate the social meaning of risk by determining what is at risk and how it is valued; however, there are significant differences in the way experts and the public evaluate what is at risk and how it is valued. Risk experts, at least in assessing environmental impacts of specific actions, tend to focus on acute impacts. These impacts are often limited and analyzed as resulting from singular events, without the accumulation from many similar events in the same area. Moreover, these impacts are often summarized in terms of premature deaths of a "distributional" man (e.g., the average man age 18-55 years). The emphasis is on the immediate effects (e.g., cancer patients are considered to have survived if they live five years after diagnosis). The public takes a more comprehensive view of risk. They include chronic illness and cumulative effects, and tend to focus on sensitive populations. It is common for the public to express concern about women and children or even generational impacts on the unborn. The public often would like assurances that the action(s) is (are) ecologically benign. The public are often concerned about ingestion pathway of exposure and contamination of the food chain.

The public and risk experts also differ in terms of how risk consequences are valued. Risk experts tend to characterize risk in terms of a depersonalized individual, usually a man. This "depersonalized man" is usually almost never named and is often referred to in categorical terms, like patient, victim, or occupant. In stark contrast, the public tends to associated the person with a face, a situation, and a name. Often the consequences are personalized in terms of a named family member, or perhaps a loved one left grieving. Once again the personalization is captured in vivid images of grief stricken loved ones, or burial rites.

Qualitative Methods and Data

This analysis qualitatively examines the written record of the situation surrounding the shipment of the European stockpile of chemical weapons to Johnston Island for storage and eventual destruction. The U.S. Army's perspective is derived primarily from the Final Environmental Impact Statement for the *Johnston Atoll Chemical Agent Disposal System (JACADS)* (U.S. Army Corp of Engineers 1983), as modified by the *Second Supplemental Environment Impact Statement for the Storage and Ultimate Disposal of the European Chemical Munition Stockpile* (U.S. Department of the Army 1990). The perspectives of the native cultures are gleaned from the testimony presented at the public hearings held in Honolulu, HI, in March 20, 1990, in compliance with the NEPA regulations leading up to the action. The author was not a participant in either the preparation of the NEPA documentation or the hearings. In addition, the author has never been to Johnston Atoll, and is not a part of the native cultures of the area. This qualitative analysis examines only the written record of the proceedings related to the transfer and destruction of the European chemical munitions stockpile at Johnston Island.

Findings

The final environmental impact statement for the Johnston Atoll Chemical Agent Disposal System (U.S. Army Corp of Engineers 1983) shows that the original island was expanded from a mere 60 acres in 1942 to 625 acres in 1965 via dredge and fill operations in the period. This amounts to over a 10-fold expansion of island acreage. Johnston Island is currently the largest island of the atoll, measuring approximately 2 miles in length and nearly .5 miles wide, and approximately 6 feet above sea level. Johnston Atoll is described as being located 717 nautical miles southwest of Hawaii or 2162 miles southwest of San Francisco, 820 nm southeast of midway, and 780 nm north west of Christmas Island. The closest neighboring atolls are the French Frigate Shoals at 460 nm almost due north of

Johnston Atoll. Located at 16°44′ north latitude, and 169°31′ west longitude, "...it is one of the most isolated atolls in the Pacific" (1983, p. 32). Jon Van Dyke at the public hearing notes (Yankee 1990, p. 66),

> Johnston was originally two separate islands, Johnston and Sand, which taken together constituted a total of approximately 46 acres.... They were both expanded, and the present acreage is approximately 700 acres.... [This change means that] Johnston is an artificial island...[and should be governed by international agreements governing ocean pollution] (the United States signed the The London Dumping Conventions), which declares ocean incineration, because of its risk to the marine environment, to be unacceptable.

"Johnston Atoll is an unincorporated territory of the United States, which means it is a territory to which the constitution of the United States has not been fully and expressly extended." (U.S. Army Corp of Engineers 1983, p. 37) The chronology of Johnston Atoll (Table 1) is extracted from the JACADS EIS (1983), and represents the U.S. Army's view of the Atoll's history. The island was, and is, primarily a military and scientific installation. As Jon Van Dyke put it at the public hearing (Yankee 1990, p. 64),

> There is strong evidence that [Johnston Island] was abandoned [by the United States] in the latter part of the 19th Century, and the international community appeared as of the early 1890s to recognize the claim of the Kingdom of Hawaii to this island. Hawaii, the Kingdom of Hawaii called it Kalama and had made an earlier claim as well...
>
> Great Britain was thinking of putting a facility on the Atoll at the time and was negotiating with the Kingdom of Hawaii in January 1893, just days before the United States assisted with the overthrow of the Kingdom here in Honolulu.

Comparing this perspective with that contained in Table 1 clearly shows a disputed territory, which has lead to considerable distrust among the people from the native cultures.

Table 2 presents the worst credible accidents for current and proposed activities at Johnston Atoll. These accidents are thought of as bounding the problem, no credible accident can lead to greater exposure. This analysis emphasizes large releases of chemical agent(s) via catastrophic events. A maximum release of large quantities of agent (17,000 lbs) are hypothesized in fully described accidents. For example, the largest accident for current activities consists of a large aircraft crash into a storage igloo releasing

Table 1. Johnston Atoll Chronology

Year	Event(s)
1796	Atoll discovery by the American Brig "Sally"
1807	Atoll visited by Capt. C.J. Johnston in HMS *Cornwallis*
1858-1860	Transient mining of guano for fertilizer
1925	Pres. Coolidge designates Atoll as Federal Bird Refuge under the Department of Agriculture
1934	Island placed under the jurisdiction of the Department of Navy
1940	Responsibilities for the Bird Refuge transferred to the Department of Interior and becomes known as the Johnston Island National Wildlife Refuge
1941	The airspace above the Island was designated as the Johnston Island Naval Airspace Reservation and water in 3-mile boundary was designated the Johnston Island Naval Defense Sea Area
1941	Japanese shell the Island
1944	Had become a major transport terminal serving the Pacific
1948	Operational control transferred to the Air Force with the Navy retaining technical control
1951-1952	Airstrip enlarged to support the Korean Conflict
1957	Coast Guard begins operating navigational transmitter
1958	Operational control transferred to Task Force Seven, a nuclear working group
1962	Three test missiles abort resulting in plutonium contamination
1963	Established as test site to be maintained under the Limited Test Ban Treaty
1963-1970	Advanced readiness to test capability was maintained and Akau and Hikina islets constructed
1971	Chemical agents and munitions move to Island from Okinawa
1972	Herbicide Orange moved to Johnston Island
1972	Personnel evacuated to Hawaii during tropical storm Celeste
1973	Commercial aircraft allowed to make refueling stops
1976	Defense Nuclear Agency facilities placed on reserve
1977	Herbicide Orange incinerated at sea on the Dutch ship *Vulcanus*

17,000 lbs of VX contained in 155-mm projectiles. The munitions detonate and start a fire that is not contained in the first 30 minutes. The largest accident among the proposed activities consists of a large aircraft crash into the shipping containers (MILVANS) as they are removed from the ship an put into temporary storage as they wait to be transferred to permanent storage facilities. Like the igloo accident the munitions detonate and lead to a fire that is not contained in 30 minutes.

These accidents are considered credible by the U.S. Army because the risk analysis indicates a probability of occurrence that is greater than or equal to 10^{-8}, or one chance in 100 million. To the people of the native cultures it is credible because it can happen. At the public hearings David Poe put it this way (Yankee 1990, pp. 50-51),

> You say things are safe. Well, people also said the Titanic was unsinkable.... What if a ship sinks? What if something leaks?... I am afraid for the future.

While the Army not only considers each action separately, but often considers each action in terms of it subparts, the native cultures tend to focus on a series of events that may not be as large or a catastrophic as those analyzed by the Army. Setso Okubo at the public meetings told of making a banner for a "Nuclear Free and Independent Pacific" in the mid-1980s. Decrying the repeated victimization of the area she itemizes a series of events in the South Pacific (Yankee 1990, pp. 100-101):

> ...Aleutian islands...where the United States tested a nuclear weapon.... Marshal Islands at Eniwetok for 43 bomb tests by the United States.... At Bikini, 23 bomb tests...and down to Australia, at Montebello and Marlinga, 12 tests by Australia and Great Britian.... To the Society Islands at Fangataufa and Mururua, they don't announce the tests but officials have detected as of now 163 tests [by the French].... Then at Christmas Island, there were 25 tests done by Great Britain...Johnston Atoll, 12 tests...by the United States.... In Hawaii we didn't have any tests but we have an arsenal. At least five years ago, about 3000 nuclear weapons.
>
> ...the best message for this audience might be...if it is safe, dump it in Tokyo, test it in Paris, or store it in Washington D.C. but keep my Pacific...[environmentally pristine].

These comments point out the stark contrast in the separation of individual actions or subactions and the comprehensive holistic approach expressed by the native cultures of the South Pacific in the public meetings.

Table 2. Worst Credible Accident for Current and Proposed Activities at Johnston Island

Activity	Estimated release[a]	Agent/ munition	Accident scenario
Present Activities/Proposed Action[b]			
Igloo Storage	7,600 kg (17,000 lbs)	VX/155-mm projectiles	A large aircraft crashes into a storage igloo. Munitions detonate resulting in a fire not controlled within 30 min.
Disposal[c]/ handling[d] operations	380 (830)	VX/ M-23 mines	A munitions vehicle accident results in fire and detonation of munitions
Proposed Action			
Interim storage	3,310 (7,300)	VX/155-mm or 8-in. projectiles	A large aircraft crashes into MILVANs in the temporary holding area resulting in fire and munitions detonate
Shipboard[e]			
Storage contingency plan	17,850[f] (39,300)	Mustard/ 105-mm projectiles	A large aircraft crashes into the temporary metal storage building resulting in fire and munitions detonations
MILVAN handling[g]/ transport	325[f] (700)	VX/155-mm projectiles	An accident with fire involves a truck carrying MILVAN

Source: Johnston Atoll Chemical agent Disposal System (JACADS) Final Second Supplemental Environmental Impact Statement for the Storage and Ultimate Disposal of the European Chemical Munition Stockpile, June 1990, pp. 5-11.

[a] Amount of agent released into the atmosphere. Each estimate accounts for agent either detonated along with an exploding munition, consumed by fire, retained in unexploded munitions, or evaporated from spills.

[b] After the European stockpile is placed in igloos the worst credible accidents will be no larger than for the present activities.

[c] Disposal of chemical agent is the incineration of agent at the JACADS facility.

[d] Handling involves unloading igloos, truck transport to JACADS, and handling at the demilitarization building.

[e] The largest shipboard accident would be no larger than the largest temporary holding accident due to the additional protection provided by the hull of the ship against an aircraft crash.

[f] Estimate based on similar accidents in the continental United States accident base.

[g] Includes unloading MILVANs from the ships with a crane.

The accidents described in table 2 are examined in terms of their likely consequences. These consequences are considered as a direct result of the maximum anticipatable downwind distance. The Army has developed a special air dispersion model for the unitary chemical stockpile. Table 3 presents the key results of that analysis. Both accidents are considered in terms of two meteorological conditions "worst case" and "conservative most likely." The worst case scenario consists of 2 m/s winds (4.5 mph) under a slightly stable air mass known as E stability (Pasquill 1961). The latter is consistent with an inversion condition in the atmosphere. The conservative most likely scenario consists of a 5 m/s wind (11.2 mph) with a neutral stability similar to what is experienced at midday known as D stability (Pasquill 1961). The igloo accident under worst case conditions might be expected to result in deaths as far away as 100 km (62 miles). This accident assumes that the weather conditions, in particular the stability conditions of an E stability, will continue for more than 12 hours. Because these worst case conditions are not likely to persist that long, conservative most likely conditions are assumed after 12 hours. Hence, a maximum downwind distance of 123 km bounds distance at which lethal doses may be received. Under faster wind speeds and less stable conditions (i.e., conservative most likely conditions) the Army estimates that the maximum down wind no-death distance is 23 km. The no-deaths downwind distance associated with the proposed action accidents are shorter, being expected to travel 83 km under worst case meteorology and 15 km under conservative most likely conditions. These results demonstrate the Army's focus on acute human deaths as the critical consequence.

The Second Supplemental EIS shows a wind-rose with more than 85% or winds greater than 8 knots per hour coming from the NNE to the ESE. Figure 2 presents the frequency of wind by speed and direction data as adapted from the EIS (1990). These data show that more than 55% of the 85% are winds with speeds greater than 12 knots per hour. Winds at these speeds are likely to considerably mix and dissipate any releases to nonlethal levels among humans. In addition, these directions are away from the most populated islands in the area. Winds in the area are very constant, and consistent with the east to northeast winds that occur between 5° N and approximately 30° N latitude (U.S. Department of the Army 1990, pp. 4-6). "Winds from the southwest to the northeast quadrants occur less than 5% of the time on" ...Johnston Island. The mean annual wind speeds are greater than 6.5 m/s (15 mph), and light winds that would lead to the greatest lethal down wind distances are very infrequent.

While we can all be thankful for greater mixing leading to less lethal exposure, immediate death is not the only consequence of critical impor-

Table 3. No-deaths Distances Predicted for Four Hypothetical Accident Scenarios on Johnston Island

		No-deaths distance[a]			
		Worst case[b]		CML[c]	
Activity	Agent	km	(miles)	km	(miles)
Present activities					
Igloo storage	VX	100-123[d]	(62-76)[d]	23	(14)
Disposal	VX	23	(14)	6	(4)
Proposed actions					
Temporary holding	VX	83	(52)	15	(9)
Shipboard	e	e	e	e	e
Storage contingency plan	Mustard	38	(24)	7	(4)
MILVAN handling/ transport	VX	20	(12)	6	(4)

Source: Johnston Atoll Chemical agent Disposal System (JACADS) Final Second Supplemental Environmental Impact Statement for the Storage and Ultimate Disposal of the European Chemical Munition Stockpile, June 1990, p. 5-13.

[a] The no-deaths distance is the maximum downwind distance at which doses of agent from an atmospherically dispersed plume would not be expected to result in human fatalities.

[b] Worst case conditions, consisting of a 2.0 m/s (4.5 mph) wind speed and a slightly stable (Pasquill category E) atmosphere.

[c] Conservative most likely conditions, consisting of a 5.0 m/s (11.2 mph) wind speed and a neutrally stable (Pasquill category D) atmosphere.

[d] Worst case conditions would not persist long enough to transport agent beyond 100 km (62 miles) from Johnston Island. CML conditions are assumed after this time. Therefore, distance is bounded by 100 km (62 miles) and the sum of 100 km (62 miles) and the CML distance.

[e] The largest shipboard accident could be no larger than the largest temporary holding accident.

tance to native cultures. Clearly all would agree that consequences involving immediate death are grievous, but the native cultures also recognize chronic exposures, more limited exposures, and pay closer attention to ingestion pathways of exposure. Marsha Joyner at the public hearing puts it this way (Yankee 1990, p. 48)

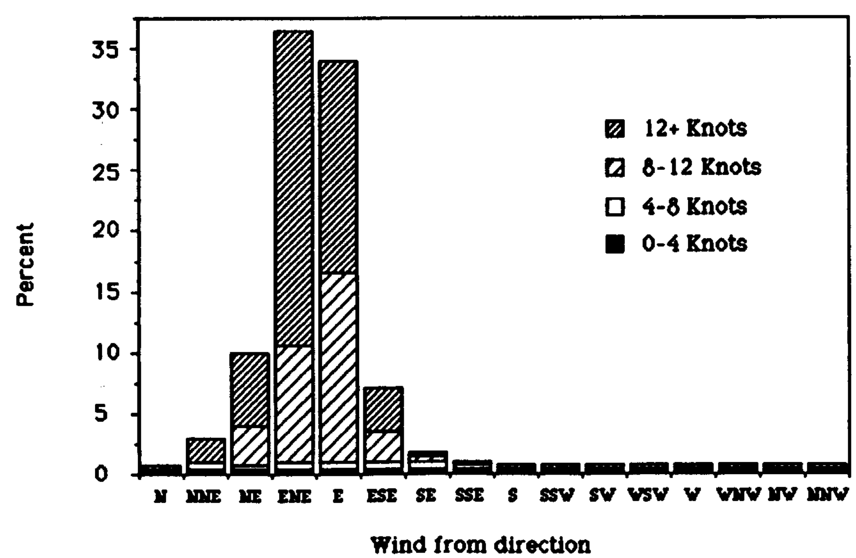
> There are about a billion people who live along the Pacific Ocean. If your contaminate the food source, who pays?... Have you ever been to Samoa and you watched how they prepare the food using ocean water?

The native cultures repeatedly expressed concern not just over the potential for acute deaths associated with large accidents, but also for smaller contaminations associated with less catastrophic events. This is not to say that the U.S. Army is not concerned about the smaller leaks and spills. They are! But the attention they focus on the bounding analysis communicates a degree of indifference to the people of the native cultures and their more holistic concerns.

Representatives of the native cultures point to apparent inconsistencies that they interpret as haste and a lack of preparation by the Army. These perceptions erode trust and credibility. For example Carl Young notes that (Yankee 1990, p. 58),

> We are told there will be 100,000 projectiles brought from Western Europe to Johnston Atoll... There are presently 72,000 projectiles on Johnston, which were brought from Okinawa.... The EIS says that...the incineration process, before the West German projectiles

Figure 2. Frequency of Winds by Speed and Direction



Based on hourly data from January 1, 1955 to December 31, 1964 for Johnston Atoll.

Source: adapted from JACADS Second Supplemental EIS, 1990)

> come, was expected to last three to four years. Three or four years, apparently to incinerate the 72,000 projectiles there. The EIS also says that the 100,000 projectiles are going to be incinerated in three and a half months. There's some inconsistency there as to how these new projectiles could be incinerated in a mere three and a half months if the others take three to four years to incinerate.

The Army could have addressed these concerns as they were raised, which clarifies responses, highlights agreements and disagreements, and has a tendency to lead to a dialogue about the risks associated with the action(s). Instead, the record shows the Army spokesperson simply introducing the next speaker. As a result the Army appears to be disinterested in the publics' concerns and point of view.

While some of the details of the shipment and disposal process are known, others are covered in a veil of secrecy. This sometimes leads to different interpretations of the situation. While the European stockpile started it trek to Johnston Island in the summer of 1990, the ocean voyage took place in the fall of 1990 (see chronology above). Partially due to secrecy, the native cultures viewed the situation differently. At the public hearing Jon Van Dyke addressed the potential for hurricane occurrence and its implications,

> The matter, apparently, is being done in serious haste because of an agreement that our Secretary of State, Mr. Baker, recently made with our German friends to get these products out of Germany by September 30th of this year. That means that the projectiles...will be moved sometime this summer or early fall, and could [we cannot know because of secrecy] very well arrive at Johnston Atoll during the hurricane season....
>
> It is public record that on two occasions in the last two decades the entire population of Johnston Atoll has been removed because of hurricanes.
>
> In 1972, hurricane Celeste passed through Johnston with 150 mph winds and 45-foot waves, and all 580 military and civilian personnel were evacuated.
>
> In 1984, Hurricane Keely passed through that area, and there were 100 mph winds and 35-40 foot waves and once again the entire population of the Atoll was evacuated.
>
> I think we could all just imagine the kinds of problems that might arise if we have one boat being unloaded, the other boat sitting out there waiting to be unloaded.... the hurricane comes through, everybody is evacuated, the nerve gas is lying there on Johnston Atoll unattended, and 45-foot waves are sweeping over this insular structure, which is only eight feet above sea level as it is now configured. (Yankee 1990, p. 60)

In fact the Army reports Johnston Island to be only 6 feet above sea level (U.S. Army Corp of Engineers 1983, p. 32).

At the public hearing in Honolulu Van Dyke points out the apparent conflict between the programmatic EIS and its decision to incinerate on-site, and the decision to move the European stockpile. Such conflicts are difficult to resolve in an atmosphere of distrust.

> ...the transportation risks have been determined to be far more significant than the incineration risks, and so the alternative that was rejected for all the gases in the United States has been accepted for these European gases, and I think it's logical to ask why with regard to the European gases our European friends are not being asked to accept the same risks that the citizens of the United states are accepting with regards to these gases being incinerated in the Mainland of the United States.
>
> The gases were in Europe to protect our European friends, and it's logical to ask them to accept the risk if, in fact, the risks of incineration at the site are less than the risks of transportation. (Yankee 1990, p. 62)

The reference to equity and fairness is clear; why should native peoples accept any additional risk associated with the destruction of a stockpile that was protecting someone else, in addition to the stockpile that protected them.

The atmosphere of distrust apparently is a long term problem from the perspective of the native cultures. Kawaipuna Prejean at the public hearings in Honolulu (Yankee 1990, pp. 147-148) said that when thinking about tonight,

> I am reminded about Hawaii's history, a very long history of invasion by the United States government.
>
> On January 17th, 1893, 97 years later, without our consent they continue to come up with ideas that are asinine. And what we really fear is that they are out of touch with humanity and very desensitized....
>
> Who is to protect us from people like you that come to our land. Now you claim it through some kind of trickery, swindle and fraud,

> and tell us that you have an idea of how to dispose of something that we never created.
>
> I looked at all in the front row [presumably where the Army representatives were seated], and I don't see anybody that I am related to....
>
> But I think what's really dangerous is again to pretend, make this pretense that you're doing it [on] behalf of national security, and yet *our* nation [the Kingdom of Hawaii] has been trampled under by the invader.

Many people at the public hearing complained about the lack of consultation with the public during the process. Even in the final moments of the public hearing, when the audience was allowed to speak spontaneously, Sylvia Krusenrak pointed out the hollowness of the public hearing facade,

> ...Who has the power among the military men here, who has the power to say: Okay, the people have spoken.
>
> That is madness, that is crazy. We have to think of something else or we've got to take another 3 months or 6 months, or whatever it takes.
>
> Or is this another one of those hearings that really doesn't result in anything? And it's all quieted down and the chemicals may well be on their way already, for all we know. (Yankee, 1990, pp. 165-166)

After demanding an answer, the public was told that Assistant Secretary of the Army for Installations and Logistics in the Pentagon has the authority to make the decision. The public was told that Army representatives present at the meeting will meet with the Assistant Secretary and fully consider each suggestion and comment. But this assurance takes some prodding by Ms. Krusenrak who eventually responds to the assurance by saying, "Thank you. I [am] really glad to hear that, because I've lost a lot of faith in our government and our military. I think it's gone mad" (Yankee 1990, p. 169).

Comparison and Discussion

Krimsky and Plough (1988, p. 306) compare technical and cultural rationality. They show that

(a) technical rationality places trust in scientific methods, explanations and evidence, while cultural rationality relies on political culture and democratic process;

(b) technical rationality appeals to authority and expertise, while cultural rationality appeals to folk wisdom, peer groups and traditions;

(c) technical rationality uses a reductionist approach that creates narrow boundaries around the analysis, while cultural rationality allow broad boundaries that include the liberal use of analogy and historical precedent;

(d) technical rationality depersonalizes risks and places emphasis on statistical probability, while cultural rationality personalizes risk by emphasizing family and community;

(e) technical rationality appeals to consistency and universality, while cultural rationality focuses on particularity with less concern for consistency;

(f) where there is controversy in science, resolution follows status, while popular culture does not follow the prestige principle;

(g) technical rationality considers impacts that cannot be specified as irrelevant, but cultural rationality views unanticipated or unarticulated risk as relevant.

It is interesting to note the similarity between Krimsky and Plough's (1988) list of basic differences from the cultural and technical perspectives and those found by comparing the Army and native culture perspectives in Table 4. While the author was aware of Krimsky and Ploughs work the author had not yet read the work when Table 4 was constructed. These serendipitous findings reinforce the limitations placed on the communication of risk among cultures that represent dramatically different cultural foundations for risk communication.

Similar to the reliance on scientific method versus political culture, is the perception of risk based on probability v. possibility. The reductionist thinking versus holistic approaches are highlighted by both sets of tendencies or characteristics. Certainly the underlying authority and trust issues associated with belief/trust systems are evident. There are also some differences associated with this specific instance. These differences often appear to be easily solved but often have tremendous subtle implications as a foundation for meaningful risk communication. For example, the native cultures must recognize that Johnston Island is nearly 800 miles southwest of Hawaii, but they continue to think about the island as part of the Hawaiian chain. An analogy might show the subtle difference; a man's foot is between 5 and 6 feet from his head on average, but if it is injured it hurts because it is part of the man's body; and if that foot is cut off, it makes it much more difficult to walk. Like the man's foot the native cultures think about Kalama

Table 4. Comparing Perspectives

Characteristic	U.S. Army	Native/Polynesian Cultures
Place Name	Johnston Atoll, JA Johnston Island, JI	Kalama Island
Location	800 miles southwest of Hawaii	Part of the Hawaiian Island chain
History	Military presence since 1940s; weapons stored since 1970s	Stolen from the Kingdom of Hawaii in late 1800s
Secrecy	Necessary for national security	Used to hide environmental & ecological risks
Planning	Reduces risk by decreasing chances & consequences of accidents	Arrive during hurricane season
Perceived Risk	Credible accidents w/probabilities greater than 10^{-8} per program	Accidents happen
Acceptable Risk	Minimal risks to dispose of chemical weapons—e.g., plane crash into barge	No risk—the Titanic sank, the Valdez spilled oil
Perspective	Deductive, linear, two dimensional, bounded	Inductive, nonlinear, multi-dimensional, expansive
Approach	Reductionist—examines detail, sum of segmented parts equals whole	Holistic—whole more than sum of parts
Environmental/ Ecological	Non-significant individual impacts	Significant combined impacts disturbances
Belief/Trust	Confidence in system safety	History of perceived insult
Spacial/Temporal Limits	Narrowed around performance period and location of proposed action(s)	Broadened to consider proposed actions as part of long history and areawide

(or Johnston Atoll) as part of the Hawaiian Island chain, not an island more than 700 miles in the distance.

Not only do these differences make it difficult to establish a risk dialogue at even a superficial level, but they also can lead to significant frustration among parties that find perspectives that fail to incorporate their belief systems to be insulting. These subtle differences yield a mistrust, and a breakdown of credibility to the point that some speakers found reason to doubt the intentions of the Army regarding the future use of the JACADS facility. Some speakers at the public hearing got so agitated that they resorted to the prolific use of profanity. When emphasis is placed on the military history of the Johnston Island (without mention of the cultural roots of Kalama Island as part of the Kingdom of Hawaii) the message can be taken as a subtle reminder of insensitivity to the cultural heritage of the native people. These subtle—and not so subtle—differences tend to breed contempt rather than consensus.

While the worst case analysis effectively bounds the problem by the maximum potential exposure, it does not examine the entire distribution of accidents. Specifically, by segmenting the problem into its various components, and assuming that the sum of the parts is equal to the whole, analysts fail to look at interaction effects. But as each part and subpart of the process is found to have negligible risk the whole process is found to have negligible additional risk. This thinking also ignores the potential for cumulative effects of accidents that happen to be more likely, though less catastrophic. The native people cannot know the extent to which the cumulative effects are anticipated because the risk analysis that deals with the complete distribution of accidents is classified for national security reasons. From the public's point of view this secrecy can easily be viewed as necessary to hide environmental dangers from those effected. Peter Rosti expressed concern about the secrecy as, "There's a great deal of public skepticism about the military and its activities because of the military's passion for secrecy" (Yankee, 1990, p. 116). Given the level of trust engendered by the process, it is not difficult to envision a skeptical interpretation of the need for secrecy.

Conclusions and Implications

The written record in the situation involving the shipment of the European stockpile to Johnston Island shows that the U.S. Army and the Native Polynesian cultures did not communicate about risk. This lack of communication was driven by the fundamental differences in the meanings behind the language used to express concerns arising from the shipment and eventual destruction of the stockpile. While the basic elements of the risk perception process are similar for risk experts and the public, at least in this case the fundamental differences in the way the process is implemented form a different foundation for risk communication. This differential foundation makes risk communication even more difficult than usual. Both the native cultures and the U.S. Army failed to establish a risk communication dialogue, and never established a common framework for effective risk communication. The people involved from all groups did not establish a shared meaning, and no dialogue was established to clarify meaning as misunderstandings occurred. This condition contributed to increased frustration and distrust, and undermined the credibility of both perspectives.

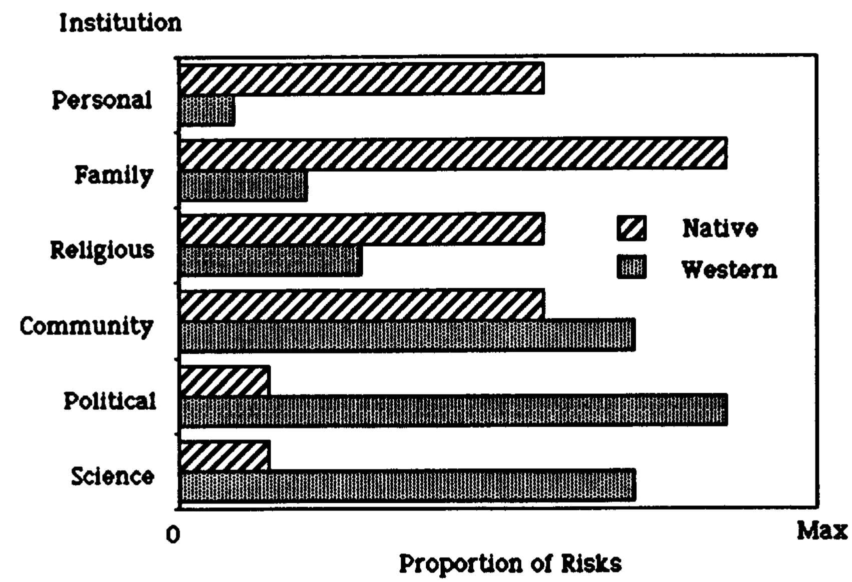
Krimsky and Plough (1988) point out that technical rationality relies on, and places faith in the scientific method, while cultural rationality relies on political culture and democratic process. They go on to point out that technical rationality relies on authority and expertise, while cultural rationality relies on folk wisdom, peer group approval and traditions. This describes the situation of two cultures communicating about risk as exemplified by the Army and the Polynesian cultures; however, this case has shown that for cross-cultural situations at least, the very foundation of communication, both in terms of language and its meaning, and in terms of the specific meaning associated with risk and its acceptability, have not been shared.

These conditions make risk communication extremely difficult. Without special actions being taken to overcome these significant barriers, communication is nearly impossible, let alone understanding, sensitivity or compassion among participants. Perhaps the most important mechanism that can be used to overcome these barriers is a dialogue about risk. This means both listening and speaking. Vigorously attempting to understand the perspectives of all concerned. This is more than allowing both cultures to speak and be heard. It involves time spent clarifying and restating perspectives so that both differences and similarities can be understood by all. It is only when the actual differences and similarities are fully understood, that risk communication can begin to resolve differences.

Moreover, consent or compromise on alternative solutions without understanding is superficial and by it very nature fragile. Direct communication is superior to communication by messenger or spokesperson for resolving differences. Messengers seldom have the power/authority to act, often leads to distrust about intentions and motives, and undermines the credibility of the communication process.

The implications of this work as it applies to risk management is more speculative in nature, but nonetheless important. It seems apparent that, at

Figure 3. Hypothesized Distribution of Risks by Responsible Institution



least in this bicultural case, the parties involved tend to rely on different social institutions to manage risk. Figure 3 presents one hypothetical representation of these institutional differences. Native Polynesian cultures tend to place more emphasis on institutions revolving directly around the individual, taking personal responsibility for risk, relying on the family, and turning to religion. Conversely, western cultures tend to rely on community and societal institutions, community intervention, regulation via political institutions, and scientific information and methods to make risk determinations. Plough and Krimsky point out that cultural rationality places trust in the democratic process, yet it is the western culture suggested here that relies on political institutions for risk management. Unfortunately, these speculations are not testable here, but they provide interesting fodder for future study. Are these institutional shifts associated with risk management only apparent in bicultural work? Krimsky and Plough (1988) seem to indicate similar differences between technical and cultural rationality. Does this indicate that risk experts and the public might have differences in preferred institutional arrangements for managing risk?

Classic communication theory indicates that communication consists of a source or sender, an encoding process, a message or signal to be sent, a decoding process, and a receiver (Dominick 1987). Feedback is essentially reversing the communication process from receiver to sender. Noise or interference in the system is considered anything that interferes with the delivery of the message. Dominick discusses three kinds of noise: semantic, mechanical, and environmental. Semantic noise is when people have different meaning for different words and phrases. Communication about risk between the Army and native cultures is full of semantic noise, to say the least. Mechanical noise is when communication is hindered by the mechanisms used to communicate. For example, if there had been serious typographical or printing errors or loud speaker equipment failure at the public hearing this would be considered mechanical noise. Mechanical noise was apparently at a minimum in this situation. Environmental noise refer to sources of noise that are external to the communication process. Here again they were predominantly held to a minimum. Dominick (1987) argues the similarity between the message sent and the message sent, fidelity, is inversely related to noise—the more noise the less fidelity.

The "noise" characterizing the situation discusses herein is primarily semantic noise under this schema; however, semantics fails to capture the essence and depth of the lack of communication about risk in this situation. Only the message or signal are shared by both sender and receiver (Schramm 1972). The sender or source of the signal or message can only encode the message as a function of the sender's experiences; just as the receiver can only decode the signal or message in terms of the receiver's experiences. If the sender and receiver have very different fields of experience, communication becomes difficult. This is certainly is the case of this cross cultural communication between lay-people and native cultures.

To effectively communicate, particularly in these situations, the sender must try to encode the message so that the receiver can decode it as easily as possible—relating it to experiences likely to be shared by both sender and receiver. Once communication is broadened to include more than a single message, a dialogue begins with a role reversal, where sender becomes receiver and receiver becomes sender. This return process is known as feedback. Feedback is extremely important in situations like this, characterized by two cultures and two rationalities, because it tells the sender how the message is being received. In addition, it provides the opportunity to clarify the message, puts it into terms that are more easily understood by the initial receiver, and reach a common (shared) understanding of the situation. This feedback was not evident in the written record of the NEPA process.

A message must not only be available, but also selected for receipt by the receiver. People choose messages to be received based on cues in the

messages that subtly let us get an impression of the nature of the message. Generally messages that contain cues that are needed or appeal to the audience, they are more likely to be selected for receipt (Schramm 1972). The stark differences between the Army's message and that of the native Polynesian cultures made it less likely for the messages sent by all parties to be received. Hence, while public participation was specifically sought as part of the NEPA process, meaningful dialogue about risk was thwarted through a number of failures associated with the experiential foundation of risk understanding, the failure to establish a dialogue to clarify and mediate misunderstandings, and the failure to use feedback effectively to overcome significant cultural and rational barriers to effective risk communication.

References

Ambrose, J.R. 1989. *Record of Decision: Chemical Stockpile Disposal Program*, Department of the Army, Under Secretary of the Army.

Covello, V., D. von Winterfeldt and P. Slovic. 1987. "Communicating Scientific Information About Health and Environmental Risks," in *Uncertainty in Risk Assessment, Risk Management, and Decision Making*, V. Covello et al. (eds), New York: Plenum Press.

Dominick, J.R. 1987. *The Dynamics of Mass Communication*, Random House, New York.

Douglas, M. and A. Wildavsky. 1982. *Risk and Culture: An Essay on the Selection of Technical and Environmental Dangers*. Berkley: University of California Press.

Fraize, W.E., R.M. Cutler and G. Flanagan. 1989. "The Probabilistic Treatment of Potential Accidents: What Are the Relative Risks of Lethal Chemical Agent Releases." *The Environmental Professional* 11(4):297-314.

Kartez, J. 1989. "Rational Arguments and Irrational Audiences." *Journal of American Planning Association* 55:445-456.

Kasperson, R., G. Rogers and I. Kasperson. 1988. "The Social Amplification of Risk: A Conceptual Framework." *Risk Analysis* 8(2):177-187.

Krimsky, S. and A. Plough. 1988. *Environmental Hazards: Communicating Risks as a Social Process*. Dover, MA: Auburn House Publishing Company.

Kunruther, H. and P. Slovic. 1978. "Economics, Psychology and Protective Behavior." *American Economic Association* 68(2):64-69.

Lowrance, W.W. 1976. *Of Acceptable Risk-Science and the Determination of Safety*. Los Altos, CA: William Kaufmann, Inc.

Menkes, J. 1981. "Risk or Amgst?" *Risk Analysis* 1:237-240.

Needleman, C. 1990. "Ritualism in Communicating Risk Information." Pp. 259-268 in *New Risks: Issues and Management*, edited by L. Cox and P. Ricci. New York: Plenum Press.

Pasquill, F. 1961. "The Estimation of Dispersion of Windborne Material." *Meteorological Magazine* 90:33–49.

Perrow, C. 1984. *Normal Accidents: Living with High-Risk Technologies* New York: Basic Books, Inc.

Rasmusen, N.C. 1975. *Reactor Safety Study*. Washington, D.C.: Nuclear Regulatory Commission, (NUREG-75/014). Also known as WASH-1400.

Rayner, S. and R. Cantor. 1987. "How Fair is Safe Enough? The Cultural Approach to Societal Technology Choice." *Risk Analysis* 7(1):3-9.

Rogers, G. 1983. *Toward a Sociology of Risk: Values, Experience, Perceived and Acceptable Risk*. Pittsburgh, PA: Univ. of Pittsburgh, PhD. Dissertation.

Rowe, W.D. 1977. *An Anatomy of Risk*. Malabar, FL: Robert Krieger Publishing Company.

Schramm, W. 1972. "How Communication Works." In *Mass Media and Society*, edited by Alan Wells. Palo Alto, CA: National Press Books.

Slovic, P., B. Fischoff and S. Lichtenstein. 1985. "Characterizing Perceived Risk." In *Perilous Progress: Managing the Hazards of Technology*, edited by R. Kates et al. Boulder, CO: Westview.

Starr, C. 1969. "Social Benefits versus Technological Risks." *Science* 165:1232-1238.

______. 1984. "Risk Management, Assessment and Acceptability," keynote address at the 1984 Annual Meetings of the Society for Risk Analysis, Knoxville, TN.

U.S. Army Corp of Engineers. 1983. *Johnston Atoll Chemical Agent Disposal System (JACADS), Final Environmental Impact Statement*, Pacific Ocean Division.

U.S. Department of the Army. 1988. *Chemical Stockpile Disposal Program Final Programmatic Environmental Impact Statement*, U.S. Army Program Executive Officer, Program Manager for Chemical Demilitarization, Aberdeen Proving Ground, Aberdeen, MD.

U.S. Department of the Army. 1990. *Johnston Atoll Chemical Agent Disposal System (JACADS), Final Second Supplemental Environmental Impact Statement for the Storage and Ultimate Disposal of the European Chemical Munitions Stockpile*, June.

Yankee, D.J. (Certified Shorthand Reporter). 1990. Public Hearing on the Johnston Atoll Chemical Agent Disposal System, Central Intermediate School, Honolulu, HI, March 20, 1990.

International Journal of Mass Emergencies and Disasters
November 1992, Vol. 10, No. 3, pp. 465-476

Cultural Gap and Public Involvement: The Case of Lan-Yu Radwaste Storage Site, Taiwan*

Juju C. S. Wang
Graduate Institute of Sociology and Anthropology
National Tsing Hua University
Hsin-chu, 30043, Taiwan, Republic of China

Undoubtedly, culture is a vehicle that helps people adapt to their environment. From the standpoint of cultural ecology, the unique culture embodied by the Yami people in Lan-Yu is actually composed of a set of adaptive strategies developed specifically for the sake of present-day survival. Even though Lan-Yu is an island known as "the last paradise for cultural preservation," acculturation has driven the Yami to confront selective elimination, particularly following the promotion of tourism by the Taiwanese government. Outside cultural influences as well as technology have gradually changed Lan-Yu's social structure in terms of people, space, and activities. On the one hand, technological advancement has brought a variety of positive improvements to the island, yet, on the other hand, it has also introduced some negative influences. The Lan-Yu Radwaste Storage Site (LYRSS) has become a much debated issue due to the conflict between traditional culture and modern civilization. Since the LYRSS was established through an inflexible and top-down decision-making process without following any consideration of cultural values or rituals, it has brought about social entropy in Lan-Yu. In other words, because of LYRSS, the Yami public seems to have developed cultural resistance rather than public acceptance. The article is an attempt to explicate the social entropy within the cultural context by looking into the anti-LYRSS movement. In particular, four issues are addressed: public involvement as it relates to limiting factors and promoting factors associated with the Yami culture; the cultural gap between the "etic" and "emic" perspectives; the underlying determinants of the Anti-LYRSS movement; and aspects of public involvement in Lan-Yu.

Introduction

Lan-Yu, a 45-square-kilometer island with approximately 2,000 Yami inhabitants, has gained the reputation of being "a biological and ecological

* The original version of this article was presented at the XVII Pacific Science Congress, in Honolulu, Hawaii, 12-16 July, 1991.