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BWIP Repository Project

Working Draft
Understanding Socioeconomic
Aspects of Risk Perception
Progress Report FY-1987

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November 1987

Prepared by
Battelle Human Affairs Research Centers
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WORKING DRAFT

UNDERSTANDING SOCIOECONOMIC ASPECTS OF
RISK PERCEPTION PROGRESS REPORT FY-1987

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EXECUTIVE SUMMARY

This report summarizes progress to date in understanding the issue of risk perception and its implications for the suitability of the Hanford Site in eastern Washington as a location for an underground radioactive waste repository. It presents some observations about the causes, consequences and processes of risk perception gained from a review of the professional literature. It also contains an extensive working bibliography of useful reference materials, and a compilation of abstracts from selected articles that are felt to be of particular relevance to the BWIP licensing and institutional support efforts.

Among the lessons learned from this effort to date are the following:

- The term "risk" has different meanings in different research contexts and for different interest groups; misunderstandings may arise when various parties use the same term but mean something different in their discussions with one another.
- Many members of the general public base their judgments of risk associated with a given facility on the credibility of the agency responsible for managing the facility as well as the facility's engineered systems.
- Differences in perceptions of risk result from: (1) differences in knowledge base or expertise; (2) differences in values and definitions; and (3) disagreements about facts.
- Although labeled by risk assessment specialists as "inexpert," there is little research to suggest that the general public regards itself in such terms.
- Although risk managers and members of the general public may perceive risks differently, this does not make the public's view "wrong" or in need of change. The general public's viewpoint needs to be taken into account in risk management planning.
- It is difficult to establish an empirical link between expressed preferences and concrete economic or political choice-making behavior.

- To incorporate information about risk judgments into discussions about mitigation of potentially significant repository-related effects, this information needs to be obtained from the affected population, and not from laboratory or classroom experiments.

TABLE OF CONTENTS

1.0	Introduction.....	1
2.0	The Literature on Risk Perception.....	2
2.1	Sources of Differences in Risk Perception.....	2
	Knowledge Base, or Expertise	3
	Values, Beliefs, and Social Organization.....	5
	The nature of the cognitive processes by which these perceptions are formed.....	6
	The process and content of risk communications.....	7
	Contributions from Other Research Specialties.....	8
2.2	Processes of Differential Perception of Risk	9
2.3	Consequences of Differential Perception of Risk.....	11
2.4	Lessons Learned and Future Directions for BWIP Risk-Related Work.....	13
3.0	Working Bibliography	14
4.0	Selected Abstracts	41

1.0 INTRODUCTION

The Nuclear Waste Policy Act of 1982¹ establishes federal responsibility and policy for the permanent disposal of spent nuclear fuel and other high-level radioactive waste. The Act authorizes construction of an underground repository within a geologic formation suitable for permanent burial of this waste, after such a site has been located. Three sites--the Hanford Site in eastern Washington, the Nevada Test Facility, and a site in Deaf Smith County, Texas--are currently being examined closely to determine their qualifications as the first repository location.

An assessment of the sites' suitability for development will include an evaluation of the repository's potential socioeconomic impacts. The issue of risk perception and possible impacts has been raised by several of the NWP Act-designated "affected parties,"² and the Department of Energy (DOE) plans to respond at first to the affected parties' concerns by examining the issue in detail. Based on this examination, the DOE's Office of Civilian Radioactive Waste Management (OCRWM) will determine whether perceptions of risk regarding BWIP are sufficient to cause significant adverse impacts that can be quantified and linked to repository activities.

This report summarizes our progress to date reviewing the professional literature regarding risk perception issues. The remainder of the report is divided into three sections. Section 2.0 presents some observations about the causes, consequences and processes of risk perception gained from a review of the professional literature. It also summarizes some lessons learned that form the basis of a preliminary understanding of risk perception issues. Section 3.0 contains an extensive working bibliography of reference materials. This bibliography contains citations from professional journals as well as technical reports from the period 1969 to 1987. The bibliography will be updated periodically, hence its designation as a "working" bibliography. Section 4.0 contains a compilation of abstracts from selected articles that were found to be particularly relevant to the BWIP licensing and institutional support efforts.

¹42 U.S.C. 10101 - 10226 (1982).

² For the purposes of the Act, "affected parties" include states within whose boundaries a repository is to be located and Indian Tribes within whose reservation boundaries or "whose federally defined possessory and usage rights to lands outside the reservation boundaries arising out of Congressionally ratified treaties may be substantially and adversely affected by the locating of such a facility; provided, that the Secretary of the Interior finds, upon petition of the appropriate governmental officials of the tribe, that such effects are both substantial and adverse to the tribe" (42 U.S.C. §10101(2)(B)). For the Basalt Waste Isolation Project (BWIP) at the Hanford Site, the State of Washington has been designated as an affected party, along with the Nez Perce Tribe, the Confederated Tribes of the Umatilla Indian Reservation, and the Confederated Tribes and Bands of the Yakima Indian Nation.

2.0 THE LITERATURE ON RISK PERCEPTION

The literature on risk perception is drawn from a variety of disciplines. As a testimony to the interdisciplinary nature of interest in risk perception issues, our review to date has covered books, journal articles, technical reports, and papers presented at conferences in the fields of psychology, sociology, cultural anthropology, economics, and the decision sciences. Research is frequently conducted by teams of collaborators drawing on several of these fields at once.

Because of the diversity of disciplinary backgrounds that inform the literature on risk perception, the writings in this area include an eclectic array of highly specialized reports from laboratory or field research, encompassing theoretical frameworks proposed to account for a number of different phenomena all taken to be risk-related, as well as practical advice addressed to policy-makers and program-implementers who have to try to apply these findings in the real world of large-scale bureaucracies, competing interest groups, and national politics. At the risk of rendering the literature barely recognizable, this review is written for people who occupy positions that earn them the title "risk manager."

The term "risk manager" refers to people who are responsible for protecting the environment and the public welfare while supervising the operation of complex technological installations. To meet their responsibilities, risk managers set design and performance standards for the technologies and for the institutions that operate them. Conventionally, these standards are based on a notion of risk as a function of the magnitude of potential consequences of an event and the probability of the event's occurrence. People arrive at remarkably different judgments, however, regarding the magnitude of risks, what can and is being done to decrease the risks, and the costs and benefits of risk-reducing measures. The differences in judgments of risk among members of different social groups need to be understood to better anticipate public response to hazards and to improve the communication of risk information with these different groups. Without such understanding and communication, implemented policies that may be highly effective might be ignored or rejected by the public.

2.1 Sources of Differences in Risk Perception

According to the professional literature on risk perception, differences observed in the perception of technological risks are associated with:

- differences in knowledge base, or expertise;

- differences in values, beliefs, and social organization;
- the cognitive processes by which these perceptions are formed; and
- the process and content of risk communications.

Knowledge Base, or Expertise

Perhaps the greatest difference in risk perceptions noted in the professional literature is the contrast between "experts" and the general public. Although experts frequently express their risk estimates for accidents and even routine operations of large-scale facilities in terms of the number of expected fatalities, the public is said to use other considerations. Probabilistic risk assessments assume a "real" risk is "out there" that can be calculated, if one acquires a certain technical expertise. The "inexpert" public, by contrast, is described as distorting the "real" risk with their less analytical approach to risk estimation (Slovic 1987b).

The distinction between risk judgments made by lay persons and experts gained salience with Starr's (1969) effort to answer the question, "How safe is safe enough?" He postulated that society, by trial and error, arrives at a balance, or "revealed preference" between risks and benefits. Starr and Whipple (1980) contrast an "intuitive" approach to risk judgment used by lay persons with an "analytical" approach used by experts. They characterize the "intuitive" approach as focusing on the controllability of hazards and their catastrophic consequences, while the "analytical" approach "methodically takes in data, anecdotal cases, and statistics" to form simplified models. Starr argues later (1985) that lay persons also take into account their regard for the reliability of risk management in forming risk perceptions. Although he does not make explicit any contrast with risk experts, Starr implies in this most recent piece that experts are more narrowly concerned with the calculation of statistical probabilities. Hohenemser et al. (1983) are guided in their development of a hazards classification scheme by the assumption that key differences in the knowledge base of lay persons and experts leads to differences in judgments regarding the riskiness of technological hazards. Doderlein (1983) argues that people often judge facts and values to be equally reliable, possibly accounting for the fact that many times less threatening hazards are overvalued and relatively more hazardous risks are comparatively downplayed.

Even among experts, however, variation in risk judgments is introduced through the use of different estimating approaches. As summarized by Lave (1987), risk managers are typically faced with the "safe enough" decision that Starr noted, but also a type of decision he terms "risk-risk." The "safe enough" decision will determine how much should be spent to reduce risk by a

given increment. The "risk-risk" decision will result in trade-offs between two types of risks; that is, a choice of which risk-reducing measures to implement at the expense of others. Both types of decisions are informed by a variety of estimating approaches, including "cost-benefit" analysis, the use of "revealed" and "expressed" preferences, the application of "natural standards" (Fischhoff et al. 1979), and the extrapolation of laboratory results to field settings (Ames et al. 1987). Depending on which approaches are used, the resulting "expert" risk judgments may not be consistent with one another.

Cost-benefit analysis is particularly effective at informing "safe enough" decisions, but limited in its application to "risk-risk" decisions, as cost comparisons between different risk-reducing measures may be based on different accounting categories. The examination of revealed preferences allows one to learn about public perceptions based on market trade-offs, aiding in risk-risk evaluations. The examination of expressed preferences is helpful in identifying changes that may take place over time, and the natural standards approach is said to be consistent with peoples' thinking (Fischhoff et al. 1979). Ames et al. (1987) summarize a large body of work indicating that the results of laboratory tests--especially those involving the use of rodents to determine carcinogen levels in substances to which humans are exposed--are not easily extrapolated to estimate human health risks, although they serve to alert people to potentially hazardous substances.

The difference in judgments based on different levels of expertise is important because if the general public judges a development to be risky, it may not be considered acceptable, regardless of the risk specialists' probabilistic assessment. Thus, it is possible to have different levels of public acceptability for proposed developments with similar levels of calculated risks. The public's expressed preference for acceptable levels of risk has been reported to differ depending on the risks' sources.

Fischhoff, Slovic, and their colleagues have sought to understand the public acceptance of risks by developing a "psychometric" paradigm that places characteristics of hazards into two dimensions: "dread" and "unknown" (e.g., Fischhoff et al. 1981, 1982; Slovic 1987a). At its extreme, "dread" is characterized by a lack of control over the risk, the risk's potential for catastrophic or fatal consequences, and an inequitable distribution of risk. The "unknown" extreme is characterized by the newness of the hazard, the degree to which its dangers are invisible or otherwise unobservable, and the delayed manifestation of harm. These dimensions can be scaled as the axes of a factor space representing peoples' evaluations of a variety of hazards. The event's location within the factor space reflects the event's "signal potential," or potential for ripple effects (Fischhoff et al. 1982, Slovic 1987a). Slovic (1987b) suggests that

Draft Risk Perception Report

"dread" and "unknown" dimensions, along with an event's "signal potential" indicate whether the region that hosts the potential source of risk may become "stigmatized." If a stigma were imposed on the region, Slovic argues, there could be adverse economic effects as a result.

Values, Beliefs, and Social Organization

Differing cultural backgrounds constitute another source from which divergent risk judgments are said to be derived (Douglas and Wildavsky 1984, Rayner and Cantor 1987). Douglas and Wildavsky argue that one's understanding of technologies as "risky" is rooted in a deeper and more encompassing set of values, meanings, and beliefs. An analysis of the prevailing cultural systems is necessary to understand differing judgments and standards of acceptable risk.

Covello and Mumpower (1985) describe historical trends traced back to Mesopotamia and Classical Greece and the antecedents of increased public interest in risk analysis and risk management. They argue that a mistrust of large-scale technologies has led, in the 20th century, to a pervasive sentiment that the safety of proposed technological developments be much more closely scrutinized than in earlier historical periods.

Rayner and Cantor assert that Starr's original question of "How safe is safe enough?" is less to the point in understanding differences in judgments of acceptable standards of risk; more to the point are issues of consent, liability, trust, and equity embodied in the question "How fair is safe enough?" (1987: 3). In this view, differing judgments of risk are not derived from disputed estimates of the probability and magnitude of events. Instead, they are derived from differing views of how equitably distributed is the burden of coping with potential hazards accompanying the installation.

Some observers point to divergent group interests and ethical orientations as sources from which differences in risk judgments are derived. Cames et al. (1984) argue that, when confronted with the prospect of restarting the undamaged reactor at Three Mile Island, "pro" and "anti" nuclear group members purposefully maintained "selective" perceptions of the undertaking's riskiness because of their vested interests. Kneese and Schultze (1981) suggest that the expert's cost/benefit approach to risk assessment is actually an expression of a particular ethical orientation--utilitarianism--and that this approach should be modified to acknowledge that individuals with different ethical orientations (e.g., egalitarian, elitist, and libertarian) might weigh costs and benefits differently.

Values and beliefs are also seen as resulting in divergent risk judgments when they are at the basis of assumptions regarding whether a risk is built into the technology or, alternatively, a product of the social process by which information concerning the technology is exchanged. Perrow (1984) argues that the structure of the technology is a source of risk. He characterizes the structure of nuclear power plant technology as so complex and "tightly-coupled" that an accident may be inevitable, in fact, normal. The technology has not been able to isolate events sufficiently to prevent a malfunction from escalating into a disaster.

On the other hand, Kasperson et al. (1987) describe a process they term the "social amplification of risk," arguing that the interaction between risk and social setting can increase the impacts of a technology. Significant impacts of a technological installation--beyond those calculated by the risk assessment specialists--may occur as information about the installation is exchanged. People receive information about risks either through word of mouth or through the mass media. The media are assumed to have their own agenda, and are regarded as a filter through which information is selectively passed. This approach is distinctive in that it does not assume a "risk" to be "out there."

The nature of the cognitive processes by which these perceptions are formed

Another line of research has demonstrated that when people are faced with decisions to make in complex or uncertain conditions, they often use mental short-cuts, or heuristics (e.g., Tversky and Kahneman 1973, 1974, 1981). The use of such heuristics often leads to judgments that are at odds with the expected outcomes that probabilistic risk calculations would yield. For example, the problem solving method called "representativeness" is used to describe how the mind first matches a situation with a mental model that is similar and familiar to it, and then concludes that the event is more likely because of the match. The "availability" heuristic is used to describe how people regard an event as more likely to happen if they can easily recall other examples of that event. The "anchoring" heuristic is used to describe how an individual's estimate is biased by selecting an initial value and then making adjustments to arrive at a final estimate. Lopes and Ekberg (1980) demonstrate how subjects use this anchoring process when asked to make certain gambling decisions. People have also been found to typically focus more on the magnitude of an event's consequences and less on the probability of the event's occurrence. Peoples' judgments can also depend on the "framing" of a problem, that is, whether the problem is stated in terms of loss or benefit.

Research by Cole and Withey (1981) indicates that people may take another simplifying approach to decision-making in uncertain and complex situations that they term "elimination by

Draft Risk Perception Report

aspects." This approach, like the use of heuristics, may also result in judgments that differ from probabilistic risk estimates. Cole and Wifhey argue that individuals accept different levels of risk than would a group. They also suggest that decisions are made either by focusing on one noticeable attribute of a complex situation, and rejecting out of hand other complex alternatives if they do not also include this attribute (elimination by aspects), or by the order in which one selects a given attribute (elimination by trees).

Physical distance from an intensive technological installation is found to be a powerful influence on the psychology or risk judgments. Earle and Lindell (1983) contend that the distance from a large industrial facility that people report as "acceptable" is linked to the degree to which they feel the facility is "controllable" and whether they feel they have given their consent to having the facility developed. Marks and von Winterfeldt (1984) also report that opposition to nearby installations (the "Not In My Back Yard" syndrome) is the result of selective judgment, depending on affect and cognitive availability (i.e., imaginability, vividness, and salience) among those who would become a given installation's neighbors.

The process and content of risk communications

A large body of literature examines how risk judgments are influenced by information about possible sources of risk and the way such information is exchanged. "Risk communication" refers to an exchange of information between risk managers and the general public about the nature and extent of a particular hazard, what can be done, and what is being done to manage the hazard and its consequences. Risk managers and policy makers are said to be frequently frustrated by the difficulties in communicating about risks and risk regulation with public groups and the media. Researchers regard these difficulties as resulting from selective, sensational, and sometimes inaccurate media reporting of risks and regulatory actions to control them. Difficulties with risk communications are also said to arise from limits in the ability of lay persons to understand technical information and their intolerance for scientific uncertainties (Keeney and von Winterfeldt 1986). On the other side of the communication problem, public groups and individual citizens find difficulties with the apparent remoteness of regulatory analysis and action from their real concerns, and about the impenetrable technical language with which analytical results are often presented.

Overcoming these difficulties to make more effective risk communications requires a better understanding of the nature of the risk communication problem itself (Otway 1986, Covello et al. 1986). The regulatory alternatives are highly complex, involving multiple (and often conflicting) objectives, drawing on a breadth of interdisciplinary knowledge, with a fair amount of

Draft Risk Perception Report

uncertainty inherent in the scientific evaluation of available data. Otway argues that in the past, a manipulative approach was used in an effort to convince people to accept a certain level of risk. He recommends a more informative approach designed to provide people with the information necessary to form their own opinions; specifically, he recommends communicating information about the nature and extent of potential risks, and also about what is being done to manage the risk. Crouch and Wilson (1987) suggest that it is important to present information concerning risks in as many different ways as conceivable and, where possible, to include comparisons between two risks. Edelstein (1986) claims that in the course of assessing social impacts of technology, the excessively technical nature of communications excludes ordinary people from representing their views. Edelstein invokes Habermas' four criteria for "valid communication" (truth, clarity, believability, and appropriateness), arguing that a failure of institutions to hold to these standards will distort communications and prevent citizens from exchanging information about risk judgments.

Contributions from Other Research Specialties

The same issues that have occupied researchers in the perception of technology-related risks have been prominent in other specialty areas, such as research on urban crime and fear of being victimized. Some of this research may, by analogy, prove useful in understanding risk judgments in the realm of technology. Of particular interest is a distinction made between the perception that something is hazardous, and the fear of that hazardous object. For example, Hartnagel (1979) shows that satisfaction with one's neighborhood decreases with higher levels of fear of crime, but does not change because of perceptions of crime. Warr (1984) examines the paradox that women and the elderly fear victimization more than other groups although their actual rates of victimization are lower. Varying levels of perceived seriousness of offenses and the potential for more serious offenses to follow explain the difference in relation between fear and perceived risk in those groups. Liska (1982) contends that "structural characteristics" of cities, such as population size, percent non-white population, amount of segregation, and amount of interracial crime were the most significant factors causing variation in the level of fear between residents of different cities. Toseland (1982) lists gender, size of place, satisfaction with the neighborhood, and age as the best predictors of a respondent's fear of crime.

The term "risk" is defined in a number of ways, and there are considerable differences in judgment about risks associated with a given technological installation. Researchers have focused on several dimensions of a complex and multifaceted problem concerning the sources of divergence in risk judgment. Included among the sources are differing knowledge bases or

expertise, differing assumptions about whether the risk is inherent in the technology or in the institutional and cultural setting in which the technology is embedded, the nature of cognitive processes by which these divergent risk judgments are formed, and the process and content of risk communication.

2.2 Processes of Differential Perception of Risk

A more narrowly focused body of research has sought to explicate the processes by which risk judgments are formed, both individually and collectively. Cognitive psychologists, in particular, have applied their understanding of basic mental functioning to explain the judgment of risks. In general, people have been found to be relatively accurate in their rank-ordering of hazards but relatively inaccurate in their estimates of a hazard's calculated magnitude; people take a number of mental short-cuts when they are faced with complex decisions or decisions surrounded by a relatively great amount of uncertainty; and people have been found to be swayed in their judgments by the way they are asked to form their judgments.

Daamen et al. (1986) reviewed studies measuring the accuracy of lay people's individual estimates of annual fatality rates in an average year. Once certain problems are overcome in accurately characterizing lay persons' risk estimates, they found that lay persons are relatively poor judges of estimating the numbers of deaths from specified hazards in an "average year," but relatively good at rank-ordering hazardous activities in terms of "high" or "low" numbers of annual deaths.

Borcherding et al. (1986) analyzed the cognitive structure of risk evaluations. They found that differences in sources of risk and value orientations lead to different risk judgments, while differences in professional status do not appear to be closely linked to different judgments. This finding leads to the general suggestion that it is something inherent in the process by which judgments are formed that leads to distinctive judgments.

Vlek and Stallen (1980) argue that acting under increasing levels of risk may affect an individual's information processing and decision strategies. They regard aspects of risk as situationally determined rather than personally determined. They also contend that "accident probability" and "utility" may be too abstract to form the basis of decisions concerning the acceptance of risks, and that risk acceptance decisions seem to depend more centrally on value-orientations and less on factual information and inference. Nealey and Radford (1987) argue that a large number of U.S. residents have an unjustifiable level of fear that nuclear power is a threat to their security, resulting from a "cognitive dissonance" in processing conflicting information, and

from characteristic biases affecting the accuracy of individual judgments. They argue that values do not vary significantly between individuals, but that risk communication methods do, and that conflicting information leads to distortions in judgment.

Although the research on cognitive processing of risk information suggests many reasons why risk perceptions of lay persons may differ from those of experts, these results should be interpreted and applied with some caution. Beach et al. (1987) note that researchers assessing human judgment may be influenced by biases and conditions that lead them to conclude too easily that human judgment is poor. Human judgment and reasoning may actually perform quite well, using the subject's frame of reference. According to Beach et al., researchers (especially less experienced ones) cite a disproportionately high number of studies of "poor" judgment performance. Researchers are said to often use word problems that are not generalizable to the world outside the psychology lab. A subject, typically a non-expert (e.g., an undergraduate psychology student), often uses a different frame than that of the researcher, thus answering a different problem. Using the subject's frame, his or her answer often seems appropriate and reasonable. Researchers were also found to judge a subject's response as incorrect if the subject used a different type of logic than the type of logic thought to be correct by the researchers. The subject's logic may have been appropriate given the subject's familiarity with the problem. Research on affected populations, rather than in laboratory settings, is regarded as essential to solving problems in "real world" settings.

Lay persons may appear to lack specialized knowledge on some risk-related issues, but that appearance may be due to how they have been asked what they know. Fischhoff and MacGregor (1983) observe that in survey research, the clarity of questions could be greatly improved. They argue that a "natural mode" exists such that the question's wording is consistent with the wording of desired responses.

Just as experimenters may be biased and survey questions misleading, Kahneman and Tversky (1982) warn of biases that result from the method of eliciting information concerning judgments. They caution that survey items often contain presuppositions in the question, make it difficult for respondents to sort out irrelevant information, and that surveys rely on the respondent to be cooperative. They conclude that the "experimental conversation" that takes place in the course of survey research may bear little resemblance to the judgments that people make in the normal world.

2.3 Consequences of Differential Perception of Risk

Research clearly shows that what people think about risks does not necessarily indicate what type of response, if any, they will make on the basis of such judgments. To the extent that perceptions are discerned from eliciting attitudinal data, a thoroughly convincing recent review concludes that behavior is generally difficult to predict from attitudes (McGuire 1985). In addition, research tells us very little about how peoples' behavior is related to how they have defined the risk situation for themselves relative to their central interests. Fiske (1987) shows that in matters where people have a low sense of political efficacy (e.g., preventing nuclear war), they generally do not act in response to their beliefs and feelings. People do not feel that their actions will have much of an effect, so they choose not to take action. Activists, as a group, have a higher sense of political efficacy; it is this heightened sense of being able to accomplish something that Fiske argues is the basis for engaging in political actions like letter writing and organizing. Similarly, Tyler and McGraw (1983) compared the general public with groups of activists and survivalists, and found that people with a high degree of "efficacy," a belief that nuclear war is preventable, were most likely to act on their beliefs. This comparison also suggests that, in the case of nuclear war, "moral" attributions (i.e., people are motivated by moral convictions to prevent war) are more closely linked to actions than are "causal" attributions (i.e., people are motivated by war's danger to prevent it).

In general, the successes researchers have had in linking behavioral indicators with risk judgments have been with indicators in the following categories:

- Stress and stress-related consequences
- Changes in property values
- Changes in economic development
- Changes in (use and structure of) public services and fiscal status.

Research indicates that people who believe they may have been exposed to hazardous substances (whether they have or not) may experience elevated levels of stress, and that such stress can have detrimental effects. For example, Baum, Fleming and Singer (1982) found chronic stress in people living near the Three Mile Island nuclear power plant following the 1979 accident. Further changes in the situation itself, such as a "venting" procedure,³ induced acute

³ This "venting" procedure was conducted to release radioactive gas trapped inside a containment building. It received a considerable amount of local media attention at the time.

short-term stress. This research on stress and stress-related consequences indicates that there are competent psychobiological assessment techniques for measuring stress and its relationship to perceived risk so that such strategies may be developed.

Some survey data suggest that effects of technology on regional economic characteristics may be due to perceptions of technological risks. To measure the economic effects of risk one needs to first assess the value of the potential physical impacts (Dunford et al. 1986). In turn, the value of potential physical impacts is affected by the changes in valuation as a result of people's perceptions (e.g., a stigma effect on the region's agricultural products). Fleishman et al. (1987) produced survey results suggesting that the environment and the agricultural economy were the primary factors in opposition to a repository and site characterization in Deaf Smith County, Texas. Siemrod's (1984) argument that the threat of nuclear war may measurably affect the national savings rate leads to the suggestion that the proposed repository's potential effects on financial decisions may warrant monitoring.

Economic changes related to risk perceptions are often difficult to separate from other economic changes, and credible institutional responses addressing economic changes in general may, in the process, address specific risk-related concerns as well. Peelle (1987) argues that by creating a citizens' task force to specify mitigation, compensation and incentive measures the "net local impact balance" of DOE's proposal to site a Monitored Retrievable Storage facility in Tennessee changed from negative to positive.

Divergent perceptions of risk may result in a lack of agreement over levels of acceptable risk, or a disagreement over whether the risks associated with a particular facility are acceptable. Such a lack of agreement can be costly. Edwards and von Winterfeldt (n.d.) claim that recent development proposals for intensive, large-scale installations have more difficulty gaining public acceptance, and are subjected to a longer, more expensive planning and public examination period and more exacting performance standards than were past developments. They argue that the emergence of regulatory agencies is a consequence of heightened risk perceptions, and that these agencies account for much of the increased difficulty that new technologies now face in gaining public acceptance. A contrasting view, of course, is that these regulatory agencies have emerged to protect public interests, and to look carefully before leaping onto a path that irretrievably commits valuable resources. Wildavsky (1979) argues that risk reduction measures are costly both to individual freedom and to a productive, growing economy. If we allocate our resources to prevent possible disasters, according to this view, we may have fewer resources at our disposal in the future. Wildavsky contends that we must make trade-offs between the safety of citizens and sustained economic growth.

2.4 Lessons Learned and Future Directions for BWIP Risk-Related Work

The literature reviewed in this preliminary fashion suggest a number of lessons that may be useful to bear in mind if risk-related concerns become a subject for further examination:

- The term "risk" has different meanings in different research contexts and for different interest groups; misunderstandings may arise when various parties use the same term but mean something different in their discussions with one another.
- Many members of the general public base their judgments of risk associated with a given facility on the credibility of the agency responsible for managing the facility as well as the facility's engineered systems.
- Differences in perceptions of risk result from: (1) differences in knowledge base or expertise; (2) differences in values and definitions; and (3) disagreements about facts.
- Although labeled by risk assessment specialists as "inexpert," there is little research to suggest that the general public regards itself in such terms.
- Although risk managers and members of the general public may perceive risks differently, this does not make the public's view "wrong" or in need of change. The general public's viewpoint needs to be taken into account in risk management planning.
- It is difficult to establish an empirical link between expressed preferences and concrete economic or political choice-making behavior.
- To incorporate information about risk judgments into discussions about mitigation of potentially significant repository-related effects, this information needs to be obtained from the affected population, and not from laboratory or classroom experiments.

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4.0 SELECTED ABSTRACTS

Ames, Bruce N., Lois Swirsky Gold and Renae Magaw
1987 Ranking Possible Carcinogenic Hazards. Science 236: 271-277.

Certain substances are more carcinogenic than others, and this article describes tests using rodents to determine carcinogen levels in substances and products that may affect people. These inferences from rodent to human populations, however, are not highly reliable. In addition, comparisons between natural and synthetic materials suggest that certain natural substances are carcinogenic to a higher degree than their synthetic counterparts. The tests, however, are not to be taken as absolute estimates, as the procedures are not all approved. Given the degree of uncertainty in the study, it serves to alert one to potentially hazardous substances, particularly natural materials that may be carcinogenic.

The data collected from rodent studies are manipulated before parallels are drawn to human subjects. The steps involve comparisons of carcinogenic potencies between people and animals, and extrapolation from high to low doses. The authors openly admit that the extrapolation process is not scientifically sound, and offer few details as to how comparisons between carcinogenic potencies are ascertained. The system used to compare the potency between humans and rodents is referred to as HERP (Human Exposure dose/ Rodent Potency dose). Difficulties in the system arise from uncertainties in the relationship between dose and response. In fact, relatively high doses of a substance intrinsically may cause problems that might not readily develop with smaller portions. This may cause the data to be overestimated. Also, differences in sensitivity within rodents were found (that is, rats v. mice). Rats show adverse effects from some substances that do not appear to affect mice. This leaves plenty of room for large variation in sensitivity when comparing these animals with humans.

Keeping these uncertainties entertained, a table comparing the carcinogenic level of substances is presented and is of interest. The table allows for comparisons between natural and synthetic substances. Surprisingly, certain natural substances are just as harmful, if not more, than their human-made counterparts. Certain plants, (e.g. celery) while attacked by mold or insects, were observed as producing a carcinogenic substance. Other naturally occurring substances such as alcohol, radon gas, and formaldehyde, sometimes present in food, have carcinogenic components.

The incidence of cancer in humans is high and many of the causes are unknown. Perhaps through increased awareness of possible carcinogenic agents, potentially hazardous substances may be avoided to reduce the number of cases.

Bachrach, Kenneth M., and Alex J. Zautra

1984 Assessing the Impact of Hazardous Waste Facilities: Psychology, Politics, and Environmental Impact Statements. in Lebovits et al. (eds.) Advances in Environmental Psychology. Volume 6 Exposure to Hazardous Substances: Psychological Parameters. Hillsdale, NJ: Lawrence Erlbaum Associates. pp.71-88.

Psychologists can use survey research to assess the psychological impacts a hazardous waste facility has on a community, and that survey process can help to build a trusting relationship between the involved citizens and governmental agencies. In addition to surveying, psychologists can also address factors contributing to stress by facilitating meetings between citizens and governmental officials, training officials in communicating and suggesting alternatives to large community forums.

A 1982 survey of 99 Rainbow Valley residents, the locale of a proposed Arizona hazardous waste site, showed that a resounding majority were concerned or upset (85%), thought the decision was either unfair or very unfair (82%), with water safety as the single highest area of concern (43%). The respondents in general ranked higher in a demoralization scale than Three Mile Island survey respondents, and respondents had a high level of distrust of facility management. Desired forms of compensation that people ranked highest were health monitoring for residents and better medical facilities.

To establish baseline data in assessing psychological impacts, the authors recommend conducting surveys during the EIS stage, as was done in this study. The surveyors went into peoples' homes, questioned alternatively both men and women heads of households, asked 187 open and closed ended questions with a section of more sensitive material filled out by the respondent and included an "involved" sub-sample. The survey included a Ways of Coping Scale, measures of self-efficacy, a test for level of community involvement, and Dohrenwend's demoralization scale used to assess people at TMI. The survey confirms that the credibility of institutions is an important issue in siting hazardous technological installations, and psychological stress has been measured in at least a limited way.

Beach, Lee Roy, Jay Christensen-Szalanski, and Val Barnes

1987 Assessing Human Judgment: Has it Been Done, Can it Be Done, Should it Be Done? in G. Wright and P. Ayton (eds.), Judgmental Forecasting. New York: John Wiley & Sons Ltd. pp. 49-62.

The recent view that human judgment is generally poor may not be appropriate. Actually, human judgment and reasoning may perform well given the subjects' frame of reference. Four areas affect experimenters' conclusions that human judgment is inappropriate: (1) the citation bias; (2) research tasks; (3) framing; and (4) the criterion problem. The citation bias shows that researchers, especially the less experienced, cite studies of poor performance more often than the actual ratio between studies of poor and studies of good performance. Under the area of research tasks, the authors explain that word problems often used in studies of human judgment are not generalizable to problems one faces in the "workaday world." With framing, a subject, typically a non-expert (undergraduate), often uses a different frame than that of the experimenter, thus answering a different problem. Using the subject's frame, his/her answer often seems appropriate and reasonable. The criterion problem shows that an experimenter judges a subject's answer to be inappropriate because subject's logic, aleatory or epistemic, differs from the logic the experimenter thought correct. The logic may be appropriate given the subject's familiarity with the problem.

Formerly, if a subject's answers in studies of human judgment did not match the given model, the experimenter discarded the model as inaccurate. Now the experimenter's tendency is to judge the subject's reasoning as having poor performance. Research in the quality of reasoning should examine how the outcome served the function for which it was used.

Carnes, Sam A., Emily D. Copenhagen, E. Jonathan Soderstrom, and John H. Sorenson
1984 Risk Perception in an Interest Group Context: An Examination of the TMI Restart
Issue. Risk Analysis 4(3): 231-244.

A clearer understanding of factors contributing to perceptions of risk among interest groups would enable more effective policy-making and risk management to take place. The authors argue that diverging views frequently develop between different interest groups in response to shared events. The authors try to account for this variation by analyzing contrasting attitudes existing between "pro" and "anti" nuclear groups confronted with the prospect of restarting the unharmed reactor at Three Mile Island.

The authors sought to determine the origin for each group's perception of the Restart project. A cross-section of group members were surveyed to obtain data concerning attitudes toward the project and how restarting the reactor might potentially affect their families and community. At the individual level, the "pro-Restart" group felt that there would be no psychological or stress-related impacts. Conversely, the "anti-Restart" group felt that stress and anxiety would be prevalent. Both groups anticipated impacts for the community: the pro-Restart group felt the economy would benefit in terms of reduced state taxes and energy costs, and the anti-Restart group felt the area in which they lived would lose its appeal as a "stigma" would develop, and therefore decrease real estate values.

The authors account for this difference in perceptions with the observation that the initial interpretations of the accident had been different. Pro-Restart group members perceived the accident to be a sign that an already safe technology had just become safer, as new regulations were developed. In contrast, the authors have speculated that those in opposition to Restart interpreted the accident as a warning of what could easily happen again.

Selective perception is yet another possible factor discussed by the authors that perhaps has impacts on judgments. Those who are closely tied to nuclear energy, that is, those who work for or need the energy provided by the nuclear industry, tend to be in favor of nuclear-related activities, and focus only on positive aspects. In addition, groups in general may intrinsically have a powerful influence over people. As an example, the authors suggest that even though some people living in the area of TMI were concerned for their families' safety in the event of another accident, the fact that other people within the group were going to continue to live in the area caused them to either change these feelings or simply block them out and not act on them.

Cole, Gerald A., and Stephen B. Withey
1981 Perspectives on Risk Perceptions. Risk Analysis 1(2): 143-163.

Cole and Withey evaluate research approaches designed to analyze perceptions of risks and benefits. They suggest that before "acceptable" levels of risk may be determined for a given population, one must gain a better understanding of how risks and benefits are weighted, by focusing on such things as: (1) understanding the perceptions of the population at large, (not simply by questioning some experts and a few lay people in a given community); (2) devising a system for evaluating or assessing the perceptions of benefits; (3) determining how to interpret decisions formulated with limited information; and (4) accounting for changes in attitudes that may take place over time.

An individual's perceptions of risk are subjective, relying on heuristics and biases. In particular, lay persons are said to rely less on objective probabilities than risk analysts. While the lay persons' views are valid, they are perhaps not the "optimal choice." The authors encourage future study in cognitive psychology to better understand how people formulate decisions. It is suggested that more useful information could then be provided to the public, perhaps allowing for more calibrated responses.

Cole and Withey argue that perceived benefits are more difficult to assess than perceived risks. A benefits assessment technique presently used is psychometric scaling: assessing perceived convenience, reliability, and comfort, as a means of attaining individuals' perceptions of benefits. The authors, however, suggest a technique be developed to account for changes in values that might take place over time.

As alternative means of better understanding peoples' reactions to perceived risk, the authors evaluate three models: "prospect" theory, "portfolio" theory and "elimination by aspects and by trees." Kahneman and Tversky discuss the first approach, explaining that people will overweight those situations that are considered to be "certain" in relation to those considered "probable." It is said that the "certainty effect" will cause people to become risk averse when prospects are considered gains, and risk seekers when the prospects are considered as losses. Coombs discusses, in the portfolio theory, that choices people make are often choices between greed and fear. In other words, people will face certain levels of risk to receive certain amounts of benefit, but fear or greed will alter responses eventually if it becomes too expensive or too dangerous.

The authors suggest that whereas these approaches yield limited insights, the elimination by aspects and by trees theory is the favored approach for future use. Cole and Withey suggest that future research involve the analysis of peoples' preferences toward activities involving technological risk. They recommend the EBA (elimination by aspects) approach, which suggests that a risky situation be broken down into parts. The authors suggest decisions are made using the process of elimination, instead of adding the total amounts assigned to every aspect of a situation, picking the one with the most benefits. The theory suggests that people focus on one particular aspect and rule the other situations out initially if they don't have this aspect. In the elimination by trees, the choice is based on the order in which one selects a given aspect or part. The authors suggest that the elimination by aspects and by trees is adaptable to many specific contexts and generalizable for future use.

It has been suggested that the levels of risk individuals accept are different than those a group of individuals would accept. That is to say, when an individual is faced with such factors as possible economic growth or national well-being, perceptions may change. Few approaches to determine "social acceptability" have had much success. Starr suggests that estimates of acceptability be drawn from historical data, but relying on such data is often unhelpful when comparisons can't be made between a past and present day technology. The authors suggest that analytical approaches such as risk/benefit analysis are valuable in that they address the complexity within a situation, but fail to forecast such things as public opinion and reaction to safety issues, again stressing the importance of changes that possibly take place over time.

Covello, Vincent T., and Jeryl Mumpower

1985 Risk Analysis and Risk Management: An Historical Perspective. Risk Analysis 5(2): 103-120.

The authors present an historical account of risk analysis and management practices, prior to the 20th century and across all cultures, for comparison with contemporary approaches. Past approaches and attitudes are said to play an important role in making future predictions concerning risk analysis and management.

The first indications of quantitative risk analysis were traced back to the 4th century A.D., when a proposed theory of a "2 x 2 matrix" reflected the "dominance principle," an aid to choices by weighing and comparing possible outcomes. During the 17th and 18th centuries, developments occurred in probability theory and mathematics, more closely resembling quantitative analysis used today.

The establishment of causality was traced as far back as the 1st century B.C., but did not re-emerge until the 17th and 18th centuries, perhaps due to a lack of knowledge in science. Prior to this time, causality was often attributed to tradition, as when disease or catastrophe was said to be caused by supernatural events.

Current ideas on societal risk management are said to have originated from four basic traditions: insurance, common law, government intervention, and private sector self-regulation. Insurance was traced to Mesopotamia. Common law was traced to the Old Testament. Government intervention was found in the 5th century B.C., but few historic precedents were found for private sector self-regulation.

The authors suggest nine changes in society that have altered and will continue to alter the course of risk management and analysis in the future: (1) changes in the nature of risks; (2) an overall decrease in mortality rates; (3) increases in "new" risks; (4) increases in the ability of experts to identify these risks; (5) increases in the number of scientists; (6) increases in the number of quantitative risk analyses; (7) increases in the role of the Federal Government in management and assessment; (8) increases in interest group involvement; and (9) increases in the interest of the public. The authors suggest implications will be visible in an overall increase in public interest, but with a continued mistrust of new technology. In addition, the authors suggest that in spite of improvements made in ability to control risks, the system will be overcome by more rapid identification of new risks, creating a "Hydra effect" (e.g., in terms of risk, a situation in which one risk might be effectively controlled, only to be replaced by two more).

Covello, Vincent T., Detlof von Winterfeldt, and Paul Slovic
1986 Communicating Scientific Information About Health and Environmental Risks:
Problems and Opportunities from a Social and Behavioral Perspective. in V.Covello,
A. Moghissi, and V.R.R. Uppuluri, (eds.) Uncertainties in Risk Assessment and Risk
Management. New York: Plenum Press.

Analysis of risk communication, the exchange of scientific information between interested parties, is placed in the more general framework of a communications model that has four major components: source, channel, message, and receiver. Problems for risk communication specialists are associated with each of four tasks. These tasks are: information and education; behavior change and protective action; disaster warnings and emergency information; and joint problem solving and conflict resolution. Solving these problems involves informing and educating people about risk and risk assessment in general, encouraging personal risk-reduction behavior, providing direction and behavioral guidance in disasters and emergencies, and involving the public in risk management decision making and in resolving health, safety, and environmental controversies.

Covello et al. advise risk communication specialists to: know the risk communication problem; know the risk communication objectives; use simple and non-technical language; and to listen to the audience and know their concerns. The roots of most risk communication problems lie in the complexities of the problem. Communication problems can be viewed as decision problems. "The public" does not exist, but there are many publics with their own interests and needs. Government officials and individual citizens hold different views of risk problems. Given these differing views, interactive and participatory approaches offer better, less controversial, or less divisive decisions. Although not much research exists on risk communication, the recommendations designed to improve risk communication offered to date are frequently violated.

The authors treat "risk assessment" as a means of quantifying or estimating the likelihood and impacts of an incident or "risk". Risk assessment is looked to as an aid in the decision-making process to resolve questions concerning risk management, reduction, and avoidance. The authors observe that the source from which risk assessments are drawn and the means through which risks are communicated have important effects on risk perception.

The authors note that historical data are a particularly reliable source. Historical data are easily understood and well documented; therefore regarded as believable. The authors argue that historical data can be applied to an evaluation of new technologies for which there is little precedent, providing that the new technology can be divided into segments for which historical data are available. It is asserted that if a technology is divided into separate parts, the probability of each event may be drawn from historical data taken from prior situations and combined to project possible assessments for the technology as a whole.

Tests are conducted to determine carcinogen levels in products using animals. The results from such tests are used to draw inferences as to how these substances might affect people. Animals exposed to excessive amounts of a substance are tested for cancer so that the suspect products may be avoided by humans. These types of studies are referred to as "analogies." Analogies are also made between similar chemicals. That is, if one chemical were thought to induce cancer, inferences would be drawn about chemicals similar in composition.

The authors postulate that risk "presentation" is equally important as risk assessment in increasing peoples' understanding of a risk. Comparisons between two risks, as an example, are valuable in enabling a lay person to compare a less familiar risk to one with which they are more accustomed, such as car accidents. Conversely, techniques exist that contrast risks to inform the public. In contrasting risks one is able to illustrate how risks of similar magnitude are sometimes perceived and treated differently, as in the case of nuclear plants and hydroelectric dams. Both are said to be equally harmful to the environment, yet nuclear plants receive much more attention.

The authors suggest that peoples' perceptions of risk are influenced by their regard for the reliability of the risk communication's source and by the terms in which the information is presented to them. The authors recommend that when informing people about a risk to the point where they can make an educated decision, it is important to present the risk in as many different ways as is conceivable.

Derby, Stephen L., and Ralph L. Keeney

1981 Risk Analysis: Understanding "How Safe is Safe Enough?" Risk Analysis 1(3): 217-224.

The authors discuss the complexities associated with determining "acceptable risk," and argue that the question, "How Safe is Safe Enough?," proposed by Starr, is too general. The problem of assessing acceptable risk should be addressed by defining and choosing between alternatives for specific situations. It has been inferred that risks associated with the chosen alternative are "safe enough." This optimal decision involves the "best" combination of costs and benefits.

The authors suggest the following five steps to effectively determine acceptable risk: (1) define alternatives; (2) specify the objectives; (3) estimate values of consequences; (4) quantify values of consequences; (5) and select the best alternative from the available data.

The authors point out that perceptions of acceptable risk levels are dependent on experience, and changes that take place over time. Different people and groups have different interests (e.g., whether more importance is placed on maintaining low costs or increasing safety). Trade-offs must often be made between these conflicting interests.

The authors discuss unsuccessful approaches to determine acceptable risk levels. In the past, people have made suggestions that a risky technology altogether be discontinued. The authors argue, however, that the alternatives may be risky and that the absence of the technology itself may create hazards. Suggestions have also been made that risks be completely reduced. However, in most cases this is impossible and would increase costs tremendously.

The problem of determining acceptable risk levels is complicated by technical, social, political and ethical considerations. The technical considerations are often too complex for the lay person, or the information about a given technology doesn't become effectively distributed. In addition, social, political and ethical considerations may be assigned varying degrees of importance by different people, therefore creating contrasting ideas of acceptable risk.

Doderlein, Jan M.

1983 Understanding Risk Management. Risk Analysis 3(1): 17-21.

Doderlein argues that risk assessments are often unreliable due to confusion among people concerning differences between "objective," "subjective," and "perceived" risk. In addition, individuals often judge facts and values to be equally reliable. Doderlein mentions concepts of probability and risk that contribute to misconceptions in risk assessment, and argues in favor of objective probabilities that provide more accurate estimates.

Doderlein defines objective risk and probability as that which is "real" or a "property of real physical systems." Subjective risk and probability refer to the degree to which one believes a statement, and perceived risk and probability are described as being more dependent on the individuals' feelings. In other words, subjective probability refers to the degree in which one believes in a statement, and the perceived concentrates on feelings, usually measured in terms of recorded levels of fear or dread.

Doderlein mentions that confusion results most frequently between subjective and objective risk and probability. As a result, individuals often treat both types of assessments as though they were equally valid or depend more on the subjective estimates. This is regarded as a problem, as subjective risks may be overestimated and objective or "real" risks comparatively downplayed. The objective risk is potentially more dangerous, as this estimate is based on statistics, therefore objective probabilities should be used in conducting assessments.

The author discusses conceptual differences that exist between objective and subjective assessments. The objective probabilities are or must be empirical and "intersubjectively" testable. In contrast, the subjective probabilities tend to reflect personal attitudes and are therefore not testable across subjects as are the objective estimates. Doderlein emphasizes that in pursuit of saving lives and making technologies more safe, objective estimates of risk and probability become the focus.

Douglas, Mary, and Aaron Wildavsky

1982 How Can We Know the Risks We Face? Why Risk Selection Is a Social Process. Risk Analysis 2(2): 49-51.

Society chooses the risks it wants to deal with by how it organizes itself socially. Since no one person can possibly know all the risks to which he or she is exposed, individuals rank the risks in choosing which ones to address. Douglas and Wildavsky argue that this ranking is performed according to a social bias. Groups have common fears and often hold common values which indicate how they chose to deal with risks. As societal consensus is necessary to keep an issue from being a risk; risk perception is a social process.

Psychology's subjective approach to risk is said to be inadequate in that it addresses either laws of cognition processes or personality traits (personalities being risk-avoiding or risk-taking), but does not address how some risks are chosen as acceptable and others as not acceptable. The analysis of what goes on "in there," the study of risk perception, and the empirical assessment of the risk physically "out there" in the environment are actually parts of a whole, a cultural bias towards risk. According to Douglas and Wildavsky, "The cultural theory of risk perception sees the social environment, the selection principles, and the perceiving subject as all one system." Identifying cultural biases is not simply showing the "irrationalities" of the pro-industry or anti-industry factions. It shows how values and beliefs may emanate from the positions people take and their behavior. According to the authors, our society currently emphasizes pollution risks not economic, war, and religious, or racial risks. They attribute this emphasis to current sectarian views that value goodness, equality, and purity, and interpret technological hazards as contamination and infiltration. As people may be afraid of death without honor, certain risks may be all the more difficult to accept. The issue of social grouping and risk acceptance leads to questioning of the credibility of the institutions that are chosen to be responsible for risk management and regulation.

In this guest editorial, the argument of sectarian values influencing society's current emphasis on pollution related risks is not fully elaborated. The approach, more fully described in the authors' 1984 book Risk and Culture, uniquely addresses the issue of risk associated with technological hazards from the question of social biases, rather than the more conventional approaches to understanding risk judgment formation or risk assessment.

Earle, Timothy C. and Michael K. Lindell

1983 How Close Is Close Enough: Public Perceptions of the Risks of Industrial Facilities.
Risk Analysis 3(4): 245-253.

The authors suggest that public response to technology is better understood by assessing not only risks and benefits associated with a technology, but also the allocation of these risks and benefits. In some instances, risks are concentrated in one area, while the benefits are felt in another. Public opinion polls reveal that people oppose nuclear power plants if the plants are to be located in their community, but a greater number of people support the idea of building nuclear plants and using nuclear energy when site location is unspecified. The authors suggest that "perceived risk gradients" (e.g., the relationship between the amount of support a technology will receive and the specificity of the location) account for peoples' decisions on "acceptable" distances they would live from a given technology. The authors argue that to determine "How close is close enough?" for a nuclear facility, one must make comparisons between proximities accepted involving other industries. The authors' found variation in the perceived risk gradients by facility and group, and also found that these results were relatively consistent over time. In addition, "dimensions of risk perceptions" must be determined, that is, whether the risk is considered to elicit feelings of dread, whether it is familiar, or how many people might be affected if an accident were to occur. It has been suggested by the authors that dimensions of risk perceptions also contribute to distances one may want to remain from a given plant.

The authors' data were drawn from two prior surveys, the first conducted in 1978, involving 229 members from established groups that had some interest in nuclear activities (e.g., either being "pro" or "anti" nuclear). The second survey was conducted in mid-1980, with 369 respondents selected on the basis of membership in groups that have an interest in industrial related risks.

The studies were not identical, yet both asked subjects to report, based on health and safety aspects, the minimum distance they would agree to live from each of the following industries: natural gas burning power plant, coal burning power plant, oil refinery, storage area for liquified natural gas, nuclear waste storage site, insecticide factory (toxic chemical disposal facility in the 1980 survey), and an oil-burning power plant. The subjects in the second group were also asked to rate each of the industries based on 13 risk dimensions such as: who is affected, who is in control, how familiar is the technology. The samples from both years were cross-tabulated using six groups of respondents and eight distance groups. Environmentalists and urban residents objected more to living near a facility (e.g., within 3 miles), than did nuclear technologists, residents of a hazardous facility, science writers or chemical engineers. When each group was presented with the possibility of living within a distance of 30 miles, differences between groups were still very large. The only groups without a significant difference were the science writers and the residents of the hazardous facility community.

When given a choice of different industrial facilities at a specified distance (10 miles), people would live close to natural gas before any other facility. The lowest percentage of short distance judgments was for the nuclear waste disposal facility. The results obtained from the perceived risk characteristics reveal three distinct groups. The technologies rated as most harmful were nuclear reactors or nuclear waste sites. This is attributed to the technology being more recent and therefore people are said to know less about it. Respondents also said that future generations would be harmed by such activities. At the other extreme were the industries that seemed more familiar and less of a threat to future generations and workers (e.g., natural gas burning plant, coal and oil refineries). The intermediate level were the liquefied natural gas. It was inferred by the authors that people realized that hazards were possible, but felt that the industry was well understood. Four facilities were profiled: toxic chemical disposal facility, nuclear power plant, LNG storage area, and the natural gas plant. Questions were asked to determine attitudes concerning how these facilities would affect the worker and future generations. The ratings were consistent with the results from the ranking, yet some variation was found.

Overall, the responses recorded from both groups were similar. In both cases natural gas was rated as the least harmful and nuclear waste sites were considered the most harmful in that most would not want to live in close proximity to one. The authors also point out that the other technologies mentioned were approximately in the same positions when ranked between both groups.

Edelstein, Michael R.

1986 Disabling Communities: The Impact of Regulation Proceedings. Journal of Environmental Systems 18(2): 87-110.

By using overly technical proceedings that distort the communication process, social impact assessment (SIA) can "disable" citizens from effectively representing their views. The market place, technology, and regulatory roles are not neutral but have built-in assumptions that have structural implications for society. As large-scale government intervention was developed to promote private enterprise and the fact that regulators are most often experts, regulators often function to insulate the market from the effects of full citizen participation. Edelstein states that the SIA process resembles Dickson's "technocratic" paradigm of regulatory action, one of concentrating on profits, the market place, and experts as opposed to Dickson's "democratic" paradigm, which stresses safety and the view of the victim. Edelstein contends that an analysis of institutional communication should use Habermas' four criteria for valid communication, those being truth, clarity, believability, and appropriateness.

An analysis of excerpts from a public hearing in Waywayanda, New York, over the spread of solid wastes at a sod farm show communication being distorted and a reliance on experts (lawyers and technical experts) effectively "disabling" the lay participants, the local farmers. The hearing officer was said to be inconsistent and not clear on procedure. The regulator was described as not trusted and therefore not believable. The experts disagreed and focused on different aspects of the waste effects. The state and the citizens had a different view of appropriateness in regard to the focus of the meeting, the decorum at the meeting, and actions taken by the farmers as a result of their frustration. Four steps can be taken by the SIA practitioner to correct this disabling effect: (1) enable citizens to clarify social impacts; (2) provide feedback and criticism to regulators about distortion in the communication process; (3) advocate for citizens helping them understand the technical procedures; and (4) critique new technologies. Risk communication, like SIA, can be less detrimental to citizens if it adheres to communication principles. The article is a plea for regulators to value communication in considering the trade-off between "getting the job done" and consideration of social impacts.

Edwards, W. and D. von Winterfeldt

no date Public Disputes about Risky Technologies. Stakeholders and Arenas. Unpublished manuscript.

Risk has become a major factor in the debate over recent technologies. Recent technologies have more difficulty gaining public acceptance than previous technologies because the scale of risk is larger (risk production), risk is perceived as greater (risk perception), values have changed to emphasize risk more than benefits (risk evaluation), and most regulatory agencies and single-issue groups are now involved with regulatory and legal arenas as opposed to legislative bodies (risk management).

In comparing disputes over the steamboat, automobile, Zeppelin, Supersonic Transport (SST), Liquefied Natural Gas (LNG) Terminals, Bullet Trains, DNA research and nuclear energy, the authors see more similarities than differences. Risk, specifically the risk to human health and safety, became the central concern and focus in the public debate for each of the technologies. Similar to the opposition to gene splicing, the opposition to nuclear energy is said to have grown larger because of "faulty institutional arrangements" and "inadequate response to publicly expressed fears." In another comparison between gene splicing and nuclear power technologies, the benefits of gene splicing have been seen as tangible, most notably to an individual's health, where as the benefits of nuclear power are more difficult to measure. The development of regulatory agencies is the major institutional change that accounts for much of the recent technologies increased difficulty gaining acceptance. New technologies have long planning processes fought by proponents and opponents as adversaries in the arena of these regulatory agencies. The agencies have their own agendas, values and rules. Further study over the increased role of regulatory agencies is needed. The article gives us an historical perspective on risk, highlighting the increased role of the regulatory agency.

Experts and policy-makers tend to become frustrated with lay people as they are often perceived as unknowledgeable on some issues. In assessing peoples' depth of understanding on a topic, it is important that one formulate questions that have clarity and that are written in terms that effectively address the problem at hand.

The article describes two experiments run to determine questioning techniques most effective in assessing individuals' perceptions of maladies in terms of lethality, by testing consistency in response across subjects. The authors inferred that a question stated in a "natural mode," that is, one set in terms most related to the desired response, make it easier for respondents to readily retrieve information as opposed to a question set in terms inconsistent with the desired response. As an example, responses concerning lethality would be more similar to the actual recorded data if the questions were posed in terms of mortality versus survival. The degree of consistency within a group suggests whether a question is in a natural mode. The greater number of people that respond in a similar fashion reinforces the effectiveness of the question in eliciting the same representation.

The first experiment involved 158 subjects who were divided into four groups and each asked a question that was formally equivalent, but worded to possibly elicit different representations. The subjects were asked to give their estimates of the rate of deaths, number of deaths, number of survivors or rate of survivors, depending on what group they were in, for 20 listed maladies.

The results suggest that there weren't significant differences in the way the questions were posed, as "perceived lethality" was consistent within each of the groups, except for those asked the rate of survival. There was less agreement in the responses recorded for this group. This was attributed to the wording of the question, in that perhaps the information or answer could not be expressed in those terms.

The second experiment involved 143 individuals who were asked to repeat the steps in Experiment One, but limit the number of maladies to 10. Following these steps, the subjects were told the correct answer for each malady. An hour later they were unexpectedly asked to recall the correct number given them. The authors suggest that the more "natural" representation should have been remembered with greater ease. Following this, these subjects and 87 new ones were asked to rate each question in terms of which was most effective or natural. The findings for each step suggest that there was no recorded difference in the questions asking for number or rate, but that it was more effective if questions addressing maladies were worded using terms such as "death" or "fatality" instead of "survivors." Designing the question using words such as "death" and "fatality" were more natural, as suggested by the authors, in that people tend to associate disease with these terms instead of survival.

Fischhoff, Baruch, Sarah Lichtenstein, and Paul Slovic
1979 Weighing the Risks. Environment 21(4): 17-38.

Fischhoff et al. compare advantages and limitations of several approaches to technological risk assessment, concluding that the most effective approach combines elements of: cost-benefit analysis, revealed preferences, expressed preference, and natural standards.

Cost-benefit analysis weighs advantages against disadvantages to determine whether one should build a given technology, for instance. Advantages of this approach are that the data are readily changed, and one may trace what components contribute to the costs or benefits. A drawback is that the figures are merely estimates and impossible to assign with accurate values. In addition, the authors argue that in cost-benefit analysis, values need to be assigned to human lives, which often leads to controversy.

The "revealed preference" approach, supported by Starr, suggests that the public arrive at conclusions concerning risks and benefits by trial-and-error learning. This approach suggests that acceptable levels of risk for new technologies are determined by safety levels accepted for similar activities. Trade-offs have been made throughout history, as suggested by Starr, between risks and benefits. These trade-offs may be looked to as guides to what would be acceptable for new, related technologies. In addition, Starr discusses "laws of acceptable risk," which suggest that: (1) risk acceptability is proportional to the third power of the benefits; (2) the public is willing to accept more risk in voluntary activities than in those that are involuntary; and (3) risk acceptability is inversely related to the amount of people exposed to a given risk. This approach assumes that the lay person has access to necessary information and the ability to effectively apply and interpret this information. In addition, the authors stress that this approach is perhaps unrealistic as it assumes that past behaviors may effectively determine future behavior.

The "expressed preference" approach attempts to ask people what they feel is an acceptable level of risk. The authors suggest benefits of this approach: it assesses peoples' current values and represents changes in values over time. A drawback is that the approach is often presented in terms too complex for the lay person. In addition, people are often not articulate in their answers.

The final approach, referred to as "natural standards," suggests that instead of looking to the general public and society for answers concerning acceptable levels of risk, that natural historical standards should be used. The authors refer to this as "biological wisdom." This approach is based on the assumption that the environment was optimal during the time in which a given species evolved. Therefore, the level of a particular substance should be made to be equivalent to the level of the same substance as it existed during evolution of a species, or at the "geologic" time. As an example, a technology might be allowed to produce as much radiation as what existed or what exists naturally in the environment. This practice is thought to be advantageous as the authors feel it is consistent with the way people think. In addition, the approach doesn't discuss risks in terms of money, and avoids use of small probabilities that are said to confuse people. One drawback is that nature is thought to balance things in the environment. This approach could tip the balance by altering the amount of substance one technology emits, and possibly increasing the emission level of another technology, therefore, upsetting the delicate balance. In addition, some technologies create relatively new substances so that conceivably there could be no way to determine the optimal level of a particular substance from referring to historical data.

Fischhoff, Baruch, Sarah Lichtenstein, and Paul Slovic
1982 Why Study Risk Perception? Risk Analysis 2: 83-92.

Fischhoff et al. argue that understanding the public's perceptions of risk, in addition to those of experts, plays an important role in successful policy-making and risk management. Experts (e.g., economists and policy-makers) are said to become frustrated with lay people and their "unfounded" fears of risky situations (e.g., new technologies). It has been suggested by a small number of experts that public opinion be ignored, as it doesn't offer educated or rational information; rather it delays policy making. The authors cite examples supporting the study of risk perception in general, and information concerning the public resulting from these studies that potentially benefit the world of policy-making and risk management. The perceptions of risk held by experts and lay people are not mutually exclusive. The combination of both can provide information necessary for effective policy-making and predicting responses to new technologies. The study of risk perception is an important means to attaining information about peoples' reactions and providing alternative ways of presenting risk.

Lay people are often left to their own intuitions to arrive at decisions concerning risk. At times, however, experts have also been found to rely on intuition when data are unavailable. The authors suggest that lay people contribute to risk assessment as they often have a more eclectic approach, in that they take more factors into consideration, such as implications for the future. The expert may focus solely on the number of annual fatalities or cost-benefit analysis. Fischhoff et al. conclude that both the expert and the lay person have valuable information to contribute, but that only through the study of risk perception will these contributions be recognized.

The Psychometric Paradigm has been useful in enabling one to make predictions as to how people will respond to a given risk. The authors suggest that the use of accidents as signals has reinforced the effectiveness of the Psychometric Paradigm. An accident, such as Three Mile Island, didn't cause any deaths, but the ramifications were great. That is, the owner, industry and society at large were affected. The actual phenomenon triggered a "ripple" effect that was unexpected. Fischhoff et al. suggest this was an aspect of the problem overlooked by the expert and economist. The paradigm suggests risk situations perceived as being unfamiliar, such as new technologies, may create similar ripple effects if accidents were to occur.

Another example suggested in support of studying risk perception involves the sale of insurance. In an experiment, the cost of insurance policies for earthquakes was reduced in price to induce buying. The results revealed that people were not interested as they perceived the risk to be very low. Economic theory couldn't account for such behavior, whereas studies of risk perception offer explanations for responses such as these and may often predict their occurrence.

Another example has to do with automobile seat belt usage. In one particular study attempts were made to promote seat belt usage. Individuals were confronted with statistics that stated the chance of becoming involved in an automobile accident every time one entered a car. After being exposed to the statistics, there was no significant increase in the number of people using seat belts. The probability of an accident seemed so low that people ignored it completely. In the second situation, this same probability was used, but projected over a period of time, such as 50 years. This did not change the number of accidents, but presented the same risk in a different way, attracting more attention and increasing seat belt usage.

Fiske, Susan T.

1987 People's Reactions to Nuclear War: Implications for Psychologists. American Psychologist 42(3): 207-217.

Based on a review of about 80 articles on the psychology of political activism, Fiske concludes that most people do not act in response to their beliefs and feelings toward nuclear war because of a low sense of political efficacy. Activists have a higher sense of political efficacy, they think about nuclear war much more than others, and they receive social support for their actions. Fiske argues that psychologists in general support the nuclear freeze movement and can contribute to the movement by giving people a sense of political efficacy and by keeping the issue salient. She also argues that psychologists need to and are capable of providing more research but are hindered by limited funding. People's beliefs about nuclear war have not changed much in the last forty years. They do not perceive it likely to happen, but if it occurs they think it would be horrific. They envision its consequences in the abstract. People's feelings on the subject of nuclear war are evident in their policy choices (77% support for a mutual freeze), but people do not think much about nuclear war. One's family, friends and the mass media are psychosocial sources for people's reactions to nuclear war. Although the effects of showing the movie The Day After on television (November 1983) lasted only a few weeks, it did increase the salience of the issue to some, especially the young and the less educated. The movie had little impact, however, on people's policy choices and political behavior.

Hartnagel, Timothy F.

1979 The Perception and Fear of Crime: Implications for Neighborhood Cohesion, Social Activity, and Community Affect. *Social Forces* 58(1): 176-193.

Satisfaction with one's neighborhood decreases with higher levels of fear of crime, but does not change because of perceptions of crime. Social activity and cohesion do not change significantly as a result of perception of crime or fear of crime. A survey of 341 Edmonton, Alberta residents in 1977 tested whether perception of increased crime or fear of crime inversely affects neighborhood cohesion, social activity, and affect for the community and whether experience with victimization affects those two relationships. The survey asked residents how much change in violent crime had occurred in the last five years (measuring perception of crime), to rate the degree of safety they felt in their neighborhood (measuring fear of crime), how often they gathered with neighbors "to chat" and how many names of adult neighbors they knew (measuring social cohesion), how often people went out for entertainment and how often they spent an evening with friends outside of the neighborhood (measuring social activity), for the degree of satisfaction with the neighborhood (measuring community affect), and whether someone had illegally entered their residences or if they had been robbed within the last year (measuring experience with victimization). Demographic data were also collected. Zero-order correlation coefficients show no significant correlation between perception of crime and neighborhood cohesion and social activity. Going out for entertainment showed some effect (-.135), but disappeared when social characteristics and residential factors controls were introduced. Surprisingly, there is a positive effect between perception of crime and the two measures of community affect (.127, .097) which cannot be explained by the data. No significant effects exist between fear of crime and cohesion or activity, but there are significant effects in the relationships between the fear of crime in both the city and neighborhood community affect (-.387, -.117, -.225, -.413). This effect continues even when controls for social characteristics and residential factors are introduced. A test for first-order partial correlation between variables, a hierarchical F-test, and a path model of the variables with path coefficients show no significant change in those relationships resulting from victimization. Fear of crime suppresses age, sex, and education factors that might appear to affect community satisfaction.

Hartsough, Don M., and Jeffrey C. Savitsky.

1984 Three Mile Island. Psychology and Environmental Policy at a Crossroads. American Psychologist 39(10): 1113-1122.

Court-awarded compensation for psychological injuries has been restricted due to a concern that such awards would lead to an overwhelming number of cases and also due to the Supreme Court decision (Metropolitan Edison Co. v. PANE, 1983) that NEPA requires an agency to assess only the direct impacts of major federal actions on the physical environment. Five principal studies have measured the psychological effects of the Three Mile Island (TMI) accident. (1) The President's Commission found that a significant level of distrust for authority declined only gradually, perceived threats to physical health existed, and there were reported psychological and psychosomatic distress. (2) Houts surveyed area residents by telephone and compared residents living close to the site to those living forty miles away. The study found that stress tended to decrease with distance from the site, that 10-20% of those close to the site still suffered from higher stress levels 9 months after the accident. The Langner Index of Psychological Stress was used, however, and showed no correlation with distance. (3) Bromet et al. compared three subgroups: mothers with pre-schoolers, nuclear power plant workers, and community mental health workers with control groups. The study found that compared to a control group, the mothers had high levels of subclinical stress, were five times more likely to have clinical episodes of anxiety or depression, and maintained elevated but within normal levels of symptoms up to a year after the accident. (4) Baum et al. studied catecholamine levels in urine and used a proofreading task and an embedded figures task with self-report symptom measures to conclude that some anticipatory stress response in the TMI population did exist prior to a "venting" procedure. There might be chronically higher levels of distress in population adjacent to TMI. (5) Mileti et al. measured alcohol sales, cardiovascular deaths, criminal arrests, psychiatric admissions, suicide rates, and automobile accidents prior to and following the accident to find that with crime, psychiatric admissions, and suicide rates there were no observable changes. Accidents increased slightly, and there was a pronounced increase in alcohol sales but not as high as during seasonal highs like Christmas. The rate of cardiovascular deaths increased dramatically, but the total number of deaths from all causes was too low to consider this increase as statistically significant.

Hohenemser C., R.W. Kates, and Paul Slovic
1983 The Nature of Technological Hazard. Science 220: 378-384.

The authors present a framework to categorize technological hazards that aspires to simplify hazard analysis and management. The authors suggest that a "new" hazard, one not reported, does not need to be assessed as an isolated issue, but using their system, may be grouped with similar hazards and managed in a similar way. The authors' system breaks a hazard down into 6 causal events or phases (e.g., from the initial need of the service, to the potential energy or material release, to possible adverse consequences). "Descriptors" or 12 categories were then developed to classify the hazards. The descriptors were matched to one phase, and scores were assigned, based on scientific literature or input from experts, determining the degree in which a descriptor applied to a given phase. In addition, the authors collapsed the 12 descriptor categories down to five categories into which the hazards, after determining their characteristics, may be grouped. The framework was tested using experts and lay people, to determine if the descriptors were effectively representing aspects that concerned the public, if the values assigned to them were valid, and whether terms used by experts may be conceptualized by lay people. There was a high correlation between the response of the lay people and the scores assigned, and the descriptors seemed to effectively represent public concerns, although mortality did not influence perception as many experts thought. The authors suggest that in the future, more effective weights be assigned to the descriptors.

The authors define a hazard as anything threatening to people. A risk is considered a quantitative measure of a hazard, and expressed as a probability. The authors view a technical hazard as a series of "causally" connected events, and therefore chose to describe hazards by breaking them down into separate parts. The 12 descriptors used by the authors as dimensions of contrast include such features as: "Intentionality," "Spatial Extent," "Population at Risk," and "Human Mortality." Using the "Intentionality" descriptor, for example, the scores assigned by the authors would determine the degree to which a technology was intending to harm people and the environment.

Another way to differentiate between hazards, as discussed by the authors, is to break them down according to "release class," that is, what type of substance would be released in the event of an accident, energy or materials. Studies comparing a number of hazards found significant differences between those resulting in a materials or energy release. Duration, population affected, incidence of transgenerational consequences, and nonhuman mortality were some diverging areas found between both types of risk, with the material's release hazard being more severe in every aspect.

The authors, based on their knowledge of release type differences, then decided to group the hazards according to "causal structure" or the five following categories: biocidal, delay, catastrophic, mortality, and global. These factors were then matched to the 12 descriptors (e.g., intentionality was matched to biocidal, persistence was matched to delay). The five factors are related to the descriptors and are, as argued by the authors, supposed to aid the thought process. Hazards (93) were compared using both measures, and outcomes were about the same, that is both approaches effectively described the hazard. The authors tested these hazards using a group of scientists and they found that responses across subjects were consistent. The next step involved comparing responses of lay people with judgments made by experts. Often experts use terms that are unfamiliar to those not well versed in science, therefore the authors were interested in whether the descriptors would be representative of the lay persons' concerns.

When the authors tested their system using 34 college students, the correlations between the mean estimates of the lay people and the scientific data were relatively high, except for mortality, which helps to explain why some more serious hazards were downplayed and why some less serious hazards were comparatively overvalued. The authors were pleased that the descriptors represent some of the lay persons concerns, but emphasize that a more effective system to weigh the descriptors must be developed to provide an effective system to aid in the management and analysis of hazards.

Kahneman, Daniel, and Amos Tversky
1982 On the Study of Statistical Intuitions. Cognition 11: 123-141.

Errors in judgment, especially those made under conditions of uncertainty, can more accurately be studied by identifying types of errors, the limitations of the research context, and by performing a "negative" analysis as well as a "positive" analysis. There are two types of judgmental errors: error of application and error of comprehension. An error of application is not using a rule or intuition one knows or accepts for some reason other than lack of comprehension. An error of comprehension is the inability to understand the rule to be used in solving a problem. These errors are tested by either eliciting a response from the subject or having the subject endorse an argument or rule that is for or against a conclusion. The question-answer format often used in surveys provides for more interpretations than the experimenter had intended. Some limitations of the question-answer method are: presuppositions placed in the question; the inability of the respondent to sort out irrelevant information; assumptions by the respondent that the speaker is "cooperative," that is, informative, truthful, relevant, and clear; and finally anchoring values that affect a respondent's answers. These limitations refer to the inability of the "experimental conversation" to simulate the judgments people make in the normal world. To understand judgment-making more completely, it is useful to perform both "positive" and "negative" analyses. A positive analysis identifies what produced an incorrect response. A negative analysis identifies why a correct response was not produced. This article reviews several studies done on intuition and does not offer research results of its own. As Beach et al. (1987) show that experimenters may be biased, this article warns of biases that may result from the method of questioning.

Kasperson, R. E., J. Emel, R. Goble, C. Hohenemser, J. X. Kasperson, and O. Renn.

1987 Radioactive Wastes and the Social Amplification of Risk. Paper presented at Waste Management 1987. University of Arizona, Tucson, AZ.

Some significant social impacts of risk events are not adequately measured by the traditional methods of social impact and risk assessment. The significance of these impacts is not adequately measured because the amount of risk that people associate with a risk event can be amplified beyond the calculated consequences. This amplification may occur as a result of a process called "the social amplification of risk," that is, the interaction between risk, risk events and the social setting. Note that deamplification is possible as well as amplification. The authors argue that environmental assessments of the Yucca Mountain site have neglected the interaction between risk and the social setting. The source of the amplification emanates from how a person experiences risk, either directly, or indirectly through information flow. Kasperson et al. list the following characteristics of information flow that affect the social amplification of risk: the volume of information; the extent of dispute; the extent of misinformation; and the extent of rumor. The mass media and interpersonal networks operate as channels through which the information flows and also affect the amplification or deamplification. The paper lists five mechanisms by which the social impacts of risk may get amplified: information flow heightening peoples' awareness; the issue may enter the agenda of social groups; the information may serve as signals or clues about the effectiveness of management; stigmatization of a region; and reactions or demonstrations to events, labeled here as positive feedback, may cause further accidents. Kasperson et al. presume here that something, namely site characterization, may not be inherently risky and that the public incorrectly perceives this risk, causing the social amplification of risk.

Benefit-cost analysis is described as a "special case" of utilitarianism, and other ethical views (e.g., egalitarian, elitist, and libertarian) are said to perceive benefit-cost analysis differently. Contrasting ethical views will inevitably differ in the relative importance they accord to individual rights v. rights of the "whole" or collective group. Kneese and Schultze discuss linking "weights" in decision-making to safety and ethical views, and suggest that benefit-cost analysis be expanded to include different weighing of benefit-cost to satisfy a wider selection of ethical views.

Utilitarianism, as described here, seeks to benefit all within a society. The egalitarian view suggests that a society is measured by the well-being of the least well-off person in the group, and in terms of income redistribution, would give to the worse off until that person or those people were financially equal with the others. A "totally" elitist view holds that a society is measured by the most well-off person. Income redistribution involves giving to the most well off, but providing a subsistence level for others. The libertarian view holds that individual freedoms are most important, if they don't hurt anyone else. This view does not call for redistribution, yet stops any that could potentially adversely affect others.

The authors focus on perceptions of the four views to the issue of "uncompensated risk." The equity of imposing uncompensated risk on individuals would be judged differently by adherents of these contrasting ethical standards. Utilitarianism and traditional cost-benefit analysis would find equity in the circumstances where individual "A" gains an amount greater than or equal to the amount that individual "B" loses, when utility is linear. However, the utilitarian view rejects this distribution when "B" initially has less to begin with than "A", as when utility is concave. Egalitarianism would find equity only in the circumstances where individual "B" is compensated for losses incurred; it is not sufficient in the egalitarian's view that "B" is compensated by the knowledge that "A" has gained while "B" has lost. The elitist, is just the opposite, accepting uncompensated risk and rejecting compensation for the affected. The libertarian rejects both, as in each case someone within society is getting hurt. All groups reject uncompensated risk part of the time as the authors suggest, which they take as implying that no trade-off exists.

Lave, Lester B.

1987 Health and Safety Risk Analyses: Information for Better Decisions. Science 236: 291-295.

Risk management is a collective decision process that improves with the quality of information provided by risk analyses. Because these decisions ultimately need public consent, they can best be made by bringing the process out into the open. There are two types of risk decisions: "risk-risk" and "How safe is safe enough?" The "risk-risk" decision involves the trade-offs between two types of risks, that is, having to decide which risk alternative to address. The "how safe is safe enough" decision is how much should be spent to reduce risk. The latter decision implies a collective, societal decision. In quantifying risk, risk analysis has assisted in three areas: medical decisions; standards for food additives; and assessing frequencies of traumatic injuries. Risk analysis can quantify how risky certain modes of treatment are, and how successful they have been. Risk analysis can identify how risky food additives are, but there are difficulties in that process. Testing chemicals in rats does not necessarily apply directly to humans. The quantity of risk produced when two or more chemicals interact is usually unknown. The total risk may not be the sum of the individual risks. Different regulatory agencies may establish conflicting standards, and the linear dose-response relation assumption may not be accurate. The linear dose-response relation states that the relationship between the amount of exposure and the effect is linear. Decisions concerning which type of treatment to select can involve either "risk-risk" or "how safe is safe enough" decisions. Concerning food additives the "how safe" decisions are more frequent. The EPA's policy does not restrict additives that cause one fewer cancers per million lifetimes. With traumatic injuries it has not been risk analysis, but legal liability that effectively has decreased the number of safety precautions taken, implemented by company and consumer decisions. Despite his earlier warning that the uncertainties in risk analysis must be stated, Lave has assumed that the processes generating the statistics in this article are valid without examination. Unfortunately, these statistics provide the basis of the paper's argument.

Lazarus, Richard S.

- 1981 The Stress and Coping Paradigm. in C. Eisdorfer, D. Cohen, A. Kleinmen, and P. Maxim (eds.) Methods for Clinical PsychoPathology. New York: Spectrum Press. pp. 173-209.

Lazarus and colleagues view stress differently today than 30 years ago. The earlier view defined stress as a source of psychopathological adaptation resulting from certain personalities or personality traits. Stress now, by contrast, is viewed as a product of cognition as a person appraises his/her relationship with the environment. This view has implications for the method of study of stress and coping and leads to the following four tenets of the current theory: (1) the naturalistic emphasis- -people are to be studied in their ordinary environment and not the laboratory; (2) transaction and process- -focus on the adaptational relationship between people and the environment avoiding the limited linear relationship between the two; (3) multiple levels of analysis- -stress and coping research is to take place at social, psychological, and physiological levels; and (4) ipsative-normative ways of studying people- -in addition to developing statistically significant studies with a large number of subjects, also develop studies with fewer subjects functioning over more occasions.

In primary appraisal, a person judges whether a situation is to be irrelevant, benign, or stressful. The three sub-types of stressful judgments are: (1) harm/loss- -damage already done; (2) threat- -impending but not yet existing damage; and (3) challenge- -an opportunity for growth. If the person assesses the situation to be hazardous, that is, stressful, the secondary appraisal process is initiated. This adaptational process, called "coping," is used to select and evaluate resources and coping options in order to respond to a situation. Coping functions to either correct one's own action(s) or the environment (problem solving) or to manage somatic or subjective elements of emotion (palliation) by denial, avoidance or taking drugs, for example. Lazarus lists four modes of coping: (1) information seeking; (2) direct action; (3) inhibition of action; and (4) an intrapsychic mode. The coping paradigm challenges researchers to study what a person is doing or thinking as he/she encounters a situation. There may be a complex set of demands, and these may be occurring over time. Lazarus explains that he and his colleagues have either offered checklists of tactics for respondents to complete or have completed in-depth interviews with these people. The most difficult challenge, he claims, is to locate and agree on standards in order to evaluate the effectiveness of the coping strategy.

Liska, Allen E., Joseph J. Lawrence, and Andrew Sanchirico
1982 Fear of Crime as a Social Fact. Social Forces 60(3): 760-770.

Treating fear of crime as a social fact, structural characteristics of cities are observed to cause much of the variation in the level of fear of crime between cities. The level of fear is estimated by an equation with population size, percent non-white population, amount of segregation, and amount of interracial crime as the elements. Conducted in the early and middle 1970s with about 10,000 respondents in 26 cities, the National Crime Survey (NCS) provided the data. The survey measured fear of crime by answers to this question: "How safe do you feel or would you feel or would you feel being out alone in your neighborhood at night (during the day)?" The possible answers were: very safe, safe, unsafe, very unsafe. For whites (Caucasians and Hispanics) the elements listed above explain 59% of the variance in fear of crime between cities. For non-whites, those elements explain 42% of the variance. For whites, the crime rates and that proportion which is interracial are the most influential. "Cultural dissimilarity makes interracial crime appear uncertain, violent and dangerous." For non-whites, the percent of non-white population, the amount of segregation and population size are most influential. Crime rates did not produce a significant effect in the variance for non-white as they may be less sensitive to news reports and the proportion of interracial non-white victimizations to the total of non-white victimization is very low. For whites, segregation had a negative effect on the level of fear of crime, but for non-whites it had a positive effect. Cultural stereotypes of non-whites appear to affect both whites and non-whites. The cultural dissimilarity between whites and non-whites that makes interracial crime appear more dangerous may be vaguely similar to Slovic's unknown factor in peoples' perceptions of risks. The vague question used in the survey, though, may beg this conclusion.

Lopes, Lola L., and Per-Hakan S. Ekberg

1980 Test of an Ordering Hypothesis in Risky Decision Making. *Acta Psychologica* 45:161-167.

In making risky decisions, subjects can use a simplifying process called "serial fractionation" in which subjects start with an initial value, the anchor, and adjust "downward in proportion to the value of the information being integrated." Students in an introductory psychology course were asked to choose within five seconds either a "gamble" (e.g., a $2/7$ chance of winning 39 cents) or a "sure thing" (e.g., 11 cents for certain). The test was to see if the gamble serves as an anchor and the probability of winning serves to determine how far downward the amount should be adjusted. Twelve choices were presented along with forty-eight filler questions that included an equal number of higher expected values for the gambles and higher expected values for the sure things. A random number generator determined which questions would be played after the experiment with the actual amounts paid to the students. The probabilities for winning were $1/7$, $2/7$, $3/7$, $4/7$, $5/7$, and $6/7$ with an even amount of filler questions and experimental questions in each category. The experimenters asked the questions in one of two ways: either the probability of winning was presented first, then the amount to be won was presented (probability-primed), or the amount won was presented first, then the probability was presented (value-primed). Value-primed response times were found to be faster than the probability-primed response times by a mean difference of 103 milliseconds. The result was nearly the same when gamble choices and sure thing choices were analyzed separately: the difference was 97 milliseconds when gambles were chosen and 110 milliseconds when sure things were chosen. Using the F statistic the priming condition had no significant effect on the choice outcome either directly [$F < 1$] or with interactions with probability [$F = 1.54$] or value-level [$F = 1.05$]. Since no significant correlation exists between either the proportion of gamble choices and the absolute difference of the sure thing and amount to be won [$r = 0.33$] or the proportion of gamble choices and the ratio of sure thing amount and amount to be won [$r = 0.01$], the study concluded that the subject's choices were not based on a direct comparison of the amounts in the gamble and the sure thing. But since the choices were faster when amount information was presented first, the conclusion was that the amount information served as an anchor.

MacLean, Douglas

1982 Risk and Consent: Philosophical Issues For Centralized Decisions. Risk Analysis 2(2): 59-67.

The author suggests that centralized decisions involving risk should be justified, typically by obtaining the consent of those involved. In situations involving large numbers of people, consent is often impossible to obtain, thus posing an ethical problem of whether to proceed without the consent of those possibly exposed to risk. The author offers to help solve such ethical problems by describing a few indirect, and therefore, controversial models of consent. The author argues that as the means of obtaining consent becomes more indirect, rationality becomes increasingly important to render the approach legitimate or justifiable. The three models described are the following: implicit consent, hypothetical consent and nonconsent.

The author defines consent as involving direct contact with and approval by the people likely to be affected. Indirect consent, conversely, is often based on assumptions or generalizations made from past behavior. The problem facing many in government positions, or those who would be confronted with making decisions affecting other people, is that consent is difficult to obtain. One must try to choose those options that least threaten the safety of others and in addition, determine what levels of compensation would make up for being exposed to a potentially risky situation.

The first model discussed by the author is referred to as implicit consent. An example of this is "Revealed Preference Theory," which states that individuals' market decisions indicate their preferences, in the absence of other contradictory indicators. On a daily basis people are said to give their consent to different things through market trade-offs. For example, a person may purchase a smoke detector for five dollars, deciding that it is probably more effective than a less expensive model. This same person may, in addition, refuse to purchase a smoke detector for 10 dollars. From the consumer behavior, one may infer that safety is important to the person, but that cost is also considered as the person is willing to lose a degree of safety for the less expensive product. Many assumptions are made using such an approach. One must determine choices involving imposed risks from choices made about voluntary risks, therefore, the two situations are not wholly comparable. In addition, market data, revealing past decisions, will not necessarily reflect attitudes toward new and possibly hazardous technologies.

The second model discussed by the author is referred to as "hypothetical consent." Using this approach, people are asked how they would react or whether they would consent to a change under certain favorable conditions. This approach is illustrated by the Pareto optimizing principle. The Pareto principle suggests that allocations may be Pareto-superior to another if no one is made to be worse off as a result. In a similar way, an allocation is Pareto-superior to another if those who benefit can compensate the loser, so that no one is adversely affected and at least one person benefits. The author suggests that the Pareto principle would not allow for situations that would potentially expose people to risk, so the principle as stated must be altered somewhat. One must back up to the point to decide when, how, and where the risks will be imposed to achieve an "*ex ante* position." In this situation, the one destined to face the loss is unidentified and all involved confront the situation where only risks are involved. At this point possible compensation may be made determined using the Pareto principle. In other words, the theory divides the decision into two parts: the first devising a procedure that is equally fair to everyone; the second suggesting that a certain decision would result from such procedures. It is then inferred that if people, acting rationally, would agree to the procedures, that they would accept the decision. A drawback is that people are assumed to be rational in order to claim the approach is legitimate. An advantage of this approach, however, as the author suggests, is that it legitimates controversial issues.

The final model is referred to as "nonconsent." In trying to justify a decision, the author suggests that one must often "directly appeal to the values we seek to secure." As a result, this supports ranking and bias, as not everyone's values would be the same. Obviously this approach has many problems, but the author mentioned it to illustrate the range of approaches available.

The author concludes that certain levels of risk are more acceptable in some activities and less in others. As an example, those who engage in skiing are likely to accept more risk in this activity, which is voluntary, versus risk in an involuntary activity, such as the building of a nuclear reactor. The author suggests that people might be afraid of the means in which decisions are made, in addition to risks posed by certain technologies, causing people to oppose the institution of new technologies.

Marks, Gary, and Detlof von Winterfeldt

1984 "Not in My Back Yard"; Influence of Motivational Concerns on Judgments About a Risky Technology. Journal of Applied Psychology 69(3): 408-415.

The location of a technological development, especially one nearby, affects peoples' evaluations of risks, benefits, and overall utility of that development. Researchers sent a questionnaire to residents of Santa Monica, CA and Ontario, CA, the latter location selected specifically because of its distance from the coast, asking them to evaluate proposed developments in either Santa Monica Bay or off the coast of Mobile, Alabama. The response rate was not a representative sample of the general population as 70% of the respondents were male and 96% were Caucasian. The respondents were to indicate whether they were for or against the development. To evaluate the judgment of the risks and benefits, a seventeen point scale was used for half of the questions on the questionnaire. Respondents were also asked to rank order and evaluate the risks, benefits, and aggregate risks and benefits. The study found that an overall utility rating, generated from a multi-attribute utility model, correlated .70 with attitudes (for or against). Ratings of the risks and the aggregated weights of both benefits and risks were the most significant factors contributing to the correlation. The study documented the effects of location on peoples' judgments in that overall risk was consistently judged greater by residents in Santa Monica than those in Ontario. With each risk attribute (oil spill, chronic water pollution, and reduction of scenic beauty) in respect to a Santa Monica Bay development, the residents of Santa Monica perceived greater effects than residents of Ontario. With respect to a Mobile development no significant difference in perceived effects existed for residents from either Santa Monica or Ontario. Both overall benefits and individual attributes of those benefits to offshore development were judged to be smaller by residents of Santa Monica than those from Ontario. An analysis of the variance showed that the residents of Santa Monica weighted aggregated risk concerns over aggregated benefits (.79 vs .21) in regard to development in Santa Monica, but the weighted importance was nearly equal with regard to the development in Mobile. For those respondents from Ontario the weighted importance between aggregated risks and aggregated benefits were nearly equal for both sites.

Nealey, Stanley M., and Linda R. Radford.

1987 Public Fear of Nuclear Technology. Paper presented at Waste Management 1987. University of Arizona, Tucson, AZ.

According to Nealey and Radford, approximately 35 to 50 percent of the American public have "Excessive Fear of Nuclear Technology" (EFONT). This describes a lay person's apparently unjustified emotional response to nuclear technology. Experts, by contrast, are described as having a "healthy respect for radiation" and, thus, a healthy response to nuclear technology. The four components of EFONT are: fear; stress and anxiety; threat to one's security; and anger. Reactions from these components can result in behaviors such as associating nuclear power with nuclear weapons, blaming or mistrusting government or industry, moving away, physiological responses, or withdrawal behavior. The article cites survey data from DuPont in which 25-40 percent of the respondents were fearful of nuclear power and Cambridge Reports in which 56 percent of the respondents either oppose or strongly oppose the building of more nuclear plants. The authors define the term "cognitive dissonance" as incompatibility between behavior and belief and proceed to claim that people will strive to bring their behaviors and beliefs into consonance, assuming that information is available that shows their level of fear (beliefs) to be unjustifiable. Values are important not because they differ among people, but because most peoples' ultimate values are similar. People consistently rank family security, freedom, and a world at peace as their top three values. People will oppose nuclear power, however, if they perceive it as an impediment to achieving those values.

Three characteristic biases affect the cognitive process of judging something as risky, often rendering the process illogical. These are "event recall," "probability distortion," and "persistence of belief." Event recall is similar to Tversky and Kahneman's availability heuristic in that "it operates to make events that are easy to recall seem more frequent." Probability distortion refers to errors that occur from categorizing events into one of two groups: those considered likely to happen or those considered unlikely to happen. Persistence of beliefs refers to the shaping of incoming information so that it is consistent with one's current belief structure. To reduce EFONT, the authors suggest that risk communicators approach the situation with understanding, empathy, and patience and provide a lot of accurate information and, if possible, discredit misinformation.

Short, James F. Jr.

1984 The Social Fabric at Risk: Toward the Social Transformation of Risk Analysis.
American Sociological Review 49(12): 711-725.

Sociologists can contribute to risk analysis, a field that may undergo a social transformation much like that of medicine. Just as the field of criminology structures the study of management of crime, risk analysis similarly approaches the study of management of risk by emphasizing results while ignoring its causes. Short argues that risk analysis needs to address causal theory, the determination of risk (not merely safety levels) and the similarities and differences of hazards. He further argues that sociologists should consciously seek to make research contributions to our understanding of risky events. The sociology of risk could test whether the acceptability of risk is a function of the degree to which institutions handling risk are trusted. Sociologists could also study the nature and consequences of that trust or mistrust. Social sciences could demystify risk analysis, that is, identify risk managers and what they do.

Although sectarian voluntary associations display fragmentation of the common interest, research on special interest groups show possibilities for a collective response to scarcity and environmental dangers. Risk analysis needs to address the distribution of risks that, because of "the distributional boomerang," may be equitable. People's fears associated with risks may affect networks of personal relationships and the possibilities of a culturally pluralist society. Cognitive sciences challenge the belief in rational behavior by introducing cognitive limitations and heuristics in cultural contexts. This "social rationality," named by Charles Perrow, aids social bonding and makes us human. The distinguished anthropologist Mary Douglas claims that an analysis of the cultural system is necessary to determine acceptable standards of risk. The role of the media also needs to be studied in regard to the social fabric. Sociology may be seen as irrelevant if it does not seek to make a contribution.

Slemrod, Joel

1984 The Economics of Nuclear Fear. Bulletin of the Atomic Scientists 40(4): 42-43.

A relationship between the perceived threat of nuclear war and economic behavior can be measured by a savings rate, an indicator of how future-oriented people are. The only other measure of the threat of nuclear war, the atomic clock used by the Bulletin of Atomic Scientists, is not a direct measure of people's perceived threat of nuclear war, but it does show how "reasonably informed professionals" assess the level of threat. Slemrod measured the national savings rate as the ratio of net private saving to disposable income plus the retained earnings of corporations, which gives a "comprehensive definition of the savings of both households and corporations." Slemrod compared the atomic clock and savings rate indicators over the period since World War II, and found several periods where the savings rate was lower when the perceived threat was higher. Since other factors may affect the savings rate, a multiple regression analysis was performed to determine the amount of impact of a threat on the savings rate. The measure of nuclear fear was shown to have a "statistically significant" impact on the savings rate, if other variables are held constant. The greatest change in nuclear threat, a change from twelve minutes to midnight to two minutes to midnight, is associated with a reduction in savings by 1.7 percent. The average post-war savings rate is 10.2 percent with a standard deviation of 1.1. The perceived threat may affect other economic behaviors: the level of the stock market, other asset prices, level of interest rates, and the amount of education acquired. Although the clock used by the Bulletin of Atomic Scientists is not a sophisticated measure, the study might have some suggestions for finding tangible measures of economic effects of perceived risk.

Slovic, Paul.

1987 Forecasting the Adverse Economic Effects of a Nuclear Waste Repository. Paper presented at Waste Management 1987. University of Arizona, Tucson, AZ.

Theoretical concepts and research conclusions indicate that significant economic impacts are likely to result from building and operating a high-level nuclear waste repository. Those impacts include changes in short-term visits to the region, long-term residency in the region, the ability to attract new businesses, and the ability to market agricultural products. Three theoretical concepts are introduced to help forecast possible economic impacts. The first, perceptions of risk, is measured by a psychometric paradigm using two factors: dread and unknown. The next concept, accidents as signals, denotes social impacts beyond direct damage incurred from accidents. Accidents characterized as unknown and catastrophic tend to have higher social impact. The final concept, stigma, denotes how a host region could be viewed as generally undesirable as a result of a repository. A stigma attached to a region can have effects on the economy with possible effects on residential decisions. More characteristics and case histories of accidents will have to be compiled before our understanding of economics effects is complete.

Direct and indirect approaches of research are used to study the potential stigma effects. One direct approach suggested is to survey people about expected changes of behavior with regard to a potential host site. Suggested indirect approaches include: (1) having people evaluate a number of sites with differing attributes, with some sites located close to a repository, in order to evaluate how the presence or absence of a repository affects peoples' judgments; and (2) having people evaluate and characterize a nuclear waste repository and negative environmental features like pollution, earthquake proneness, and others in order to develop a spatial representation. The economic effects of a repository can be estimated, then, by knowing the spatial relationship between the feature and the repository in the space and assuming that a similar relationship is true for known data on economic effects of the feature and possible economic effects of a repository.

Slovic, Paul

1987 Perception of Risk. Science 236(4799): 280-285.

Lay people view hazards with intuitive risk judgments, in contrast to experts who, see the riskiness of hazards in terms of expected fatalities. To be effective, a risk communicator must understand how risks are viewed by non-experts. In the last ten years scientists in geography, sociology, political science, anthropology, and psychology have researched the area of risks. The psychometric paradigm approach presented here determines characteristics of hazards that affect people's assessment of those hazards. The approach evolved from Starr's work aimed at developing a method for weighing risks versus benefits. By factor analysis, groups of characteristics are condensed into higher order characteristics or factors. The first factor, "dread" risk, pertains to perceiving something as uncontrollable, dreaded, catastrophic, fatal, inequitable, involuntary, high risk to future generations, not easily reduced, and risk increasing. The second factor, "unknown" risk, pertains to risks that are perceived as not observable, unknown to those exposed, effect delayed, a new risk, and risks unknown to science. A factor space contains the graphing of hazards according to these unknown factors (vertical axis) and dread factors (horizontal axis). Accidents cause a greater social impact than just direct damage. Accidents, like Three Mile Island, will inflict great cost to businesses, industry and possibly government as people perceive those as signals of what is to come. An event's "signal potential" correlates to its characteristics and position on the factor space. According to risk perception research, people's anxieties about accepting nuclear power are linked to media coverage and the association between nuclear power and nuclear weapons.

To reduce the cost of conflict occurring as a result of differences between intuitive and analytical risk-benefit analyses, regulators can set quantitative criteria to establish risk acceptability standards. The social process of risk acceptance is linked to the process of an individual's risk perception and evaluation, the "intuitive approach." To manage risk in light of conflict over probability estimates, an understanding of the intuitive risk perception and evaluation process is needed as quantitative analyses of risk are inadequate. Analysis consists of methodically taking data, anecdotal cases, and statistics and forming simplified models. The intuitive approach, by contrast, consists of the psychological process individuals use to produce risk assessments often focusing on controllability and catastrophic consequences. Although cost-benefit analysis and decision analysis approaches try to incorporate values, values of groups are difficult to determine. The analytic approach, which equates risk with fiscal or physical cost, does not take into account methods for valuing lives other than equating the value as the potential earnings of the person. Physical risks distributed across time can be discounted like other costs, although others have questioned the validity of this approach. The expected value approach, based on the equation that expected cost is the product of the probability of an occurrence multiplied by the consequence, does not adequately incorporate the fact that the relationship between an individual's perception and the probability is not linear. Another limitation of this approach is that although differences of opinion about the probability of an occurrence are accommodated by the assignment of utility, the estimates of probability are assumed to be valid. The risk perception-risk benefit model best understands the intuitive process. In this approach subjective judgments about probability and consequence of a hazard are combined to produce the perceived risk. The perceived risk is then compared to parallel judgments of perceived benefit to produce the intuitive judgment of risk acceptability. Quantitative risk criteria provide levels in which a regulatory agency can address conflicts occurring over probability. There are three incentives for developing risk criteria: acknowledging the trade-off between risks and benefits and the impossibility of having zero risk, establishing a non-arbitrary standard, and allocating more equitably resources used in risk reducing measures.

Starr, Chauncey

1985 Risk Management, Assessment, and Acceptability. Risk Analysis 5(2): 97-102.

Starr argues that a factor contributing to an individuals' perception of risk is the perceived reliability of risk management. For example, a tiger at a zoo poses a potential threat, in that it could possibly escape. Starr points out that it is not the statistical probability of the event being so low that comforts people, but the fact that they trust the management, or those making sure the cage is locked. In addition, Starr argues that those involuntarily exposed to a risk or those not exercising much control tend to be more skeptical of management and demand more credibility from managers.

Starr suggests that experts tend to focus on the most damaging aspects of industry that might go wrong, for instance a core meltdown in a nuclear plant, instead of focusing on the many steps to prevent such an accident from occurring. Starr argues that the emphasis should be on the ability of those who manage or control the risk. Starr concludes that Environmental Impact Statements, as an example, concentrate on the worst possible event and don't consider risk management.

Starr points out that science intrinsically can't be proven until it is used. In this way technology must be allowed to experiment or progress would be impossible. Starr realizes that public fear may place constraints on industrial or technological growth, therefore, in order to encourage public acceptability, one must assure the public that management is "reasonably reliable." Emphasis must be placed on human intervention. In addition, the author argues that if people are made to feel more involved in the decision-making process, they would have more trust in those managing risks.

Toseland, Ronald W.

1982 Fear of Crime: Who is most vulnerable? Journal of Criminal Justice 10: 199-209.

Women, the elderly, urban dwellers, those unmarried, widowed or living alone are the groups most vulnerable to crime. The author used discriminant analysis on data from a 1976 General Social Survey consisting of 1499 nation-wide respondents with equal numbers of men and women by region, age and race. The analysis formed a linear model which could test the statistical significance of each variable by controlling all others so as to determine which factors, demographic, psycho-social or crime-related were best predictors of a respondent's fear of crime. The top factors were sex (male's 23.1% fearful, female's 60.9% fearful), size of place (large city residents 60.8% fearful, small city residents 50%, small town residents 23% and rural areas 27%), satisfaction with the neighborhood, and age (0-24 42.6% fearful, 25-44 39.1% fearful, 45-64 45.4% fearful, 65-74 50.6% fearful, 75+ 57.3% fearful). Forty-four percent of the respondents expressed fear of crime by answering yes to "Is there any area right around here - that is, within a mile- where you are afraid to walk alone at night?" Notably, race was not a significant factor with 43.6% of whites being fearful and 48.4% blacks being fearful. Education, income and social status also were not significant factors, but the analysis does not show that they may be correlated. This study does identify more factors than age and sex in contributing to fear of crime, but it lacks a more detailed analysis (cf. Warr 1984) in differentiating between "fear of" and "perceived risk" of victimization for specific offenses. Note that "burglary was the only crime-related variable with significance in respondents fear of crime," and not mugging, beating or being threatened with a gun. One's personal space has been violated (similar to Slovic's dread risk factor), and people fear repeat offenses (Slovic's accidents as signal).

Tversky, Amos, and Daniel Kahneman

1974 Judgment under Uncertainty: Heuristics and Biases. Science 185: 1124-1131.

When making complex decisions under uncertainty, individuals use three types of heuristics or mental shortcuts that can lead to systematic errors: "representativeness," "availability," or "anchoring." The representativeness heuristic occurs if subjects are asked to classify an object or event A as belonging to a class or process B, and their answers are biased by how much A resembles or is representative of B. Errors occur as people ignore the base-rate which may apply to an object, assume a small sample size to be accurate, or predict outcomes based on limited evidence of an object's similarity to another object whose outcome is known. A common error is to predict an outcome based on its similarity to the input. Misjudgments also occur by ignoring the regression of the mean, a principal stating that if two variables have the same distribution the average of one variable's scores will usually deviate less from the mean of its distribution than the deviation of the average score of the other variable from the mean of its distribution. For example, if the average height for males is six feet and a father is taller than this, his son will not usually deviate as much from the average of six feet.

The availability heuristic occurs in the situation where, in assessing an event's frequency or plausibility, people are biased by the ability to recall that event. Errors may result by estimating an event's likelihood based on the easy retrievability of particular instances and how easily elements of a search set can be obtained. Other errors occur as the judged frequency of a class is erroneously determined on the basis of the ease with which selected instances can be constructed and from the judgment that the frequency with which two events co-occur is based on the associative bond between them.

The anchoring heuristic occurs when an individual's estimate is biased by the process in which an initial value is selected from which adjustments are made to yield the final estimate. There is often insufficient adjustment from this initial value or an emphasis on the first few computations. The overall probability will often be overestimated in conjunctive problems and underestimated in disjunctive problems. In assessing subjective probability distributions, subjects often state overly narrow confidence intervals.

Warr, Mark

1984 Fear of victimization: Why are women and the elderly more afraid? Social Science Quarterly 65(3): 681-702.

Women and the elderly fear victimization (fear of a specific consequence as opposed to the more general fear of crime) more than other groups, although their actual rates of victimization are lower. A 1981 mail survey in Seattle addressed this seeming paradox and found that the difference in levels of fear between age and sex groups is attributable to the differences in relation between fear and perceived risk, the differential sensitivity to risk, within each group. Varying levels of perceived seriousness of offenses explain most of the differences in sensitivity to risk in age groups. When levels of seriousness were taken into account, 15 of 17 main effects of age became insignificant. Fear that more serious offenses will follow, perceptually contemporaneous offenses, account for differences in sensitivity to risk in both sex and age groups. Introducing an omnibus measure of fear eliminated sex effects in 5 of 10 models and eliminated age effects in 6 of 10 models. Perceived seriousness of offenses and perceptually contemporaneous offenses are not mutually exclusive, and when combined and controlled, the differences in relations between fear and perceived risk within the groups is insignificant. Only 5 of the initial 29 age and sex effects remained significant. The study did not measure in detail how fear of rape affects women's fear of other crimes, although for women, Warr argues, fear of sexual abuse is close to the "core" of fears of victimization.

Wildavsky, Aaron

1979 No Risk Is the Highest Risk of All. American Scientist 67: 32-37.

Risk reducing measures are costly both to individual freedom of choice and to a productive, growing economy. The source of risk lies within our culture and the values of those within society. When hazards involve some uncertainty, a trade-off exists between safety of citizens and impairing of the economy. If we allocate our resources to prevent potential hazards from occurring or to address possible occurrences, we may have fewer resources available to increase production and to clean-up future disasters. One risk reduction method used is to displace the risk, i.e., move the costs to another person or to let the government assume responsibility. For example, European markets often test risky drugs because U.S. regulations prohibit the testing of them here. Individuals also displace risk by giving government the power to decide who will bear the costs of change. A belief that events are closely related and highly dependent on each other combined with a high level of concern over the future contribute to the rise of numerous impact statements. The resulting type of government is called an "anticipatory democracy" which restricts citizens' present freedom in order to prevent potential disasters. Ironically, this may also be due to the lack of trust in other institutions and social relations. A process, "market socialism," distributes the costs of the risks, collectivized under an anticipatory democracy, by passing the cost indirectly to consumers through higher taxes and more regulations on producers. Market socialism's characteristics are low visibility (regulations on industry which pass cost on to the consumer are often hidden), capital intensity (money becomes the issue debated), and social selectivity (professional jobs, not blue-collar jobs, are created and taxes have a greater effect on the poor). Wildavsky defines freedom and productivity to be at risk, but does not adequately address other risks. The article lacks evidence for its claims and is full of generalizations making it seem more like an ideological statement than a scientific finding. The argument here that one can confidently believe that a future society will be able to handle damages is questionable. Possible harm to individuals may be great (as opposed to their gaining more freedom) if citizens are left alone to address risky issues without government help.

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