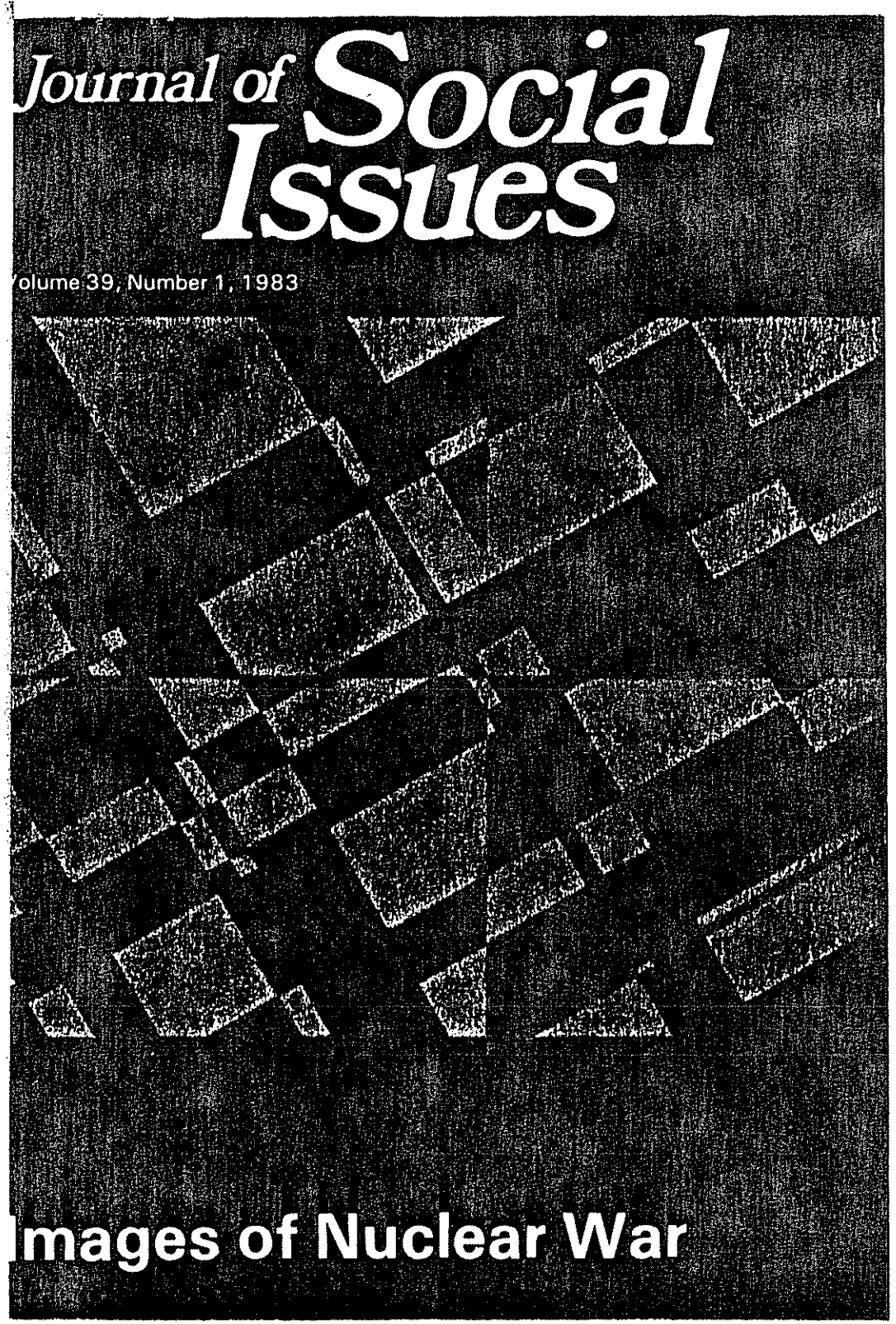

Journal of Social Issues, Vol. 39, No. 1, 1983, pp. 133-160

Strategic Policy Preferences: A Behavioral Decision Theory Perspective

Baruch Fischhoff
Decision Research, Eugene, Oregon

A decision theory perspective is used to analyze how individuals form preferences among competing strategic defense policies. It is argued that these preferences can be usefully conceptualized as the product of deliberative logical thinking. There are, however, a number of obstacles that may prevent people from making decisions in their own best interests or from reaching agreement with others who share those interests. Some of these obstacles are internal or psychological (e.g., difficulties in understanding probabilistic processes); some are external or institutional (e.g., limited access to relevant information). Some are encountered with even mundane problems (e.g., being overconfident in one's knowledge); some are particular to novel and consequential decisions (e.g., not knowing how to make tradeoffs among those consequences). Some seem restricted to the lay public (e.g., failure to understand technical terms); some may afflict technical experts (e.g., failure to acknowledge or question widely shared assumptions). The possibilities for research into the extent of these problems is discussed, along with the possibilities for action to alleviate them.

Few contemporary issues are as vital as strategic defense policy. Few are as difficult. There are conflicting claims to evaluate, technical analyses to digest, multi-party interactions to anticipate, and unprecedented consequences to contemplate. Yet despite these complexities, most people seem to have strong opinions. The "don't know" rates are no higher than

An earlier version of this paper was presented to the Conference on Defense and National Economy in the 1980's, Tel Aviv University Center for Strategic Studies December, 1981. Partial support was provided by the UK Medical Research Council and by the US National Science Foundation Grant SES-8213452.

Correspondence regarding this article should be addressed to Dr. Baruch Fischhoff, Decision Research, 1201 Oak, Eugene, OR 97401.

0022-4537/83/0300-0133$03.00/1

with more mundane issues (Kramer, Kalick, & Milburn, 1983; *Social Indicators*, 1980). Voter turn-out has been quite high in elections featuring nuclear freeze referenda, with politicians solidly lining up on one side or another (Tetlock, 1983). Academic and quasi-academic students of international conflict confidently espouse various positions (Fischer, 1983). A substantial number of citizens have felt strongly enough to sacrifice economic well-being and even to risk imprisonment in order to make their opinions known (Fiske, Pratto, & Pavelchak, 1983; Naughton, 1981; Tyler & McGraw, 1983).

Where, one might ask, do these opinions come from? How do people sort through the complexities to choose the policies that they prefer? How do they, for example, decide:

- whether greater expenditures are needed for defense
- whether conventional or strategic weapons provide a better investment for additional expenditures
- whether civil defense is served better by shelter buildings or by arms programs designed to reduce the probability of war
- whether a volunteer or a conscripted military is more in the national interest
- how conscientious objectors should be treated
- how extensive civilian control over the military should be.

Political and military leaders must make some choice on each of these questions if a country is to have a conscious defense policy. Citizens must make choices on them if they hope to affect the formation of that policy, through the ballot box, through lobbying, or through public opinion. An understanding of how lay people form their defense policy preferences can help leaders (a) to anticipate how they will respond to new information (e.g., world events, strategic analyses), (b) to develop policies that people will find acceptable, (c) to provide the information that people want, and (d) to know when lay people cannot be trusted to make decisions in their own best interest (e.g., because vital data are held secret). An understanding of how leaders form their defense policy preferences can help lay people (a) to follow policy debates, (b) to participate more actively in those debates, (c) to form preferences that are more consonant with their own best interests, and (d) to know when leaders are not considering those interests.

The present analysis treats the processes by which people choose among alternative strategic policies as special cases of the processes by which they make other decisions when confronted by conflicting alternatives, surrounded by uncertainty. The conceptual framework for the analysis is provided by behavioral decision theory, which offers a coherent set of primitives for describing decision situations and a standard for

evaluating the optimality of the decisions made in them (Einhorn & Hogarth, 1981; Fischhoff, Goitein, & Shapira, 1981; Kahneman, Slovic, & Tversky, 1982; Slovic, Fischhoff, & Lichtenstein, 1977; Wallsten, 1980). Its empirical base is provided in part by behavioral decision theory studies of how people form preferences regarding more mundane sets of alternatives (such as insurance policies, electricity generating sources, student appointments, and shades of gray), in part by studies of attitudes towards defense policies (such as those presented in this volume), and in part by anecdotal evidence gleaned from the literature on the formation of national strategic policies.

Two overriding presumptions underlie this analysis (and most research into judgment and decision making). The first is that, to a first approximation, the thought processes of most uninstitutionalized adults are quite similar. The content of those thoughts may be quite different; clearly, different people may want, believe, experience, and contemplate quite different things. The similarities lie in how they deal with those contents when appraising their validity, combining them in order to reach summary judgments, revising them in the light of subsequent experience, and storing or retrieving them from memory. Although it seems unlikely to hold up under detailed scrutiny, this presumption seems to be a useful rule for simplifying an overly complex domain. One particularly important detail to be considered is whether the thought processes of the ranking experts in a field have any distinguishing features.

The second metaprinciple is that there is some good reason for most things that people do (March, 1978; Newell, 1981). That is, even when people seem to be behaving irrationally or unreasonably, it is worthwhile assuming that they are honestly trying to solve some problem with the best resources at their disposal. By trying to divine the method in any apparent madness, investigators are less likely to dismiss capriciously the objects of their study as crazy, emotional, or otherwise inferior. They are more likely to discover that the individuals under study were actually solving a different problem than that initially presumed or that they faced some real (and perhaps removable) obstacle to making better judgments. Such obstacles may be *internal*, aspects of people's psychology that restrict their performance (e.g., failure to realize the limitations of judgmental strategies that are usually valid). Or, they may be *external*, constraints imposed by their world (e.g., limited access to necessary information).

Following from these metaprinciples, the present analysis asks first how entirely rational and capable individuals would go about establishing their personal preferences among competing strategic defense policies. It then considers the internal and external constraints that prevent this idealized rationality from being realized in practice.

RATIONAL DECISION MAKING

Although their details vary considerably (Bell, Keeney, & Raiffa, 1973; Fischhoff, Lichtenstein, Slovic, Derby, & Keeney, 1981; Howard, 1968; Raiffa, 1968), most formal approaches conceptualize decision making as involving the following four interdependent steps:

1. *Define problem.* List the complete set of decision options (e.g., defense policies) and the complete set of relevant consequences that may follow from them (e.g., changes in expenditures or in the probability of overt hostilities).
2. *Evaluate consequences.* Determine the attractiveness or aversiveness of each possible consequence.
3. *Assess the likelihood of consequences.* Ascertain the probability of the various possible consequences being realized, by a review of available evidence.
4. *Decide.* Choose a most attractive option, by combining all that one knows and feels about a problem.

Even at this rudimentary level of elaboration, this scheme affords some non-trivial observations on decision-making processes. One such observation is that decision making is properly thought of as a choice among alternatives. Thus, it makes little sense to ask whether a particular defense policy is acceptable without considering the relative attractiveness of the alternatives. Choosing one option means rejecting all others.

Once one has made a choice, it need not mean that the risks associated with that policy are acceptable in any absolute sense. Whenever one has considered other consequences (e.g., monetary costs, political repercussions), the most acceptable policy need not be the one with the least risk. Defense policy decisions are not just about defense.

The scheme also points to the sources of fundamental disagreements about defense policy. People may have different preferences because they disagree about what alternative policies merit consideration (perhaps excluding different ones as being "unthinkable"), or about what consequences are relevant (e.g., need one be concerned about impacts on civil liberties or income distribution—or should those issues be addressed separately?), or about the desirability of those consequences, or about the chances of their being realized, or about how all these features are to be combined. Because people have different desires and beliefs, they may have legitimate grounds for preferring different defense policies, even if they are strict adherents to and appliers of the principles of rational decision making. When disagreements do arise, diagnosis of their source should begin by assuming that the participants are entirely rational and by asking in what way they are solving different decision problems (Fischhoff, Slovic, & Lichtenstein, 1983).

The remainder of this paper is concerned with the next step in diagnosis, asking what internal and external factors might thwart these efforts at deliberative decision making. It is organized according to the threats posed to each step in the decision-making process. To the extent possible, it is grounded in evidence documenting the existence of these difficulties in other aspects of life. However robust this evidence, one always must consider the possibility that problems may be ameliorated or exacerbated by the particulars of making war-and-peace decisions.

DEFINING THE DECISION PROBLEM

The first step in decision making would seem quite straightforward. One simply sets out the set of relevant actions consequences, and facts that constitute the problem definition. Unfortunately, even this step carries pitfalls that can threaten people's ability to make sensible decisions as individuals or as collectives.

Ensuring a Complete Definition

The critical test for the definition used in a particular decision is that it be complete, in the sense of encompassing all alternatives and consequences that the decision maker considers relevant. The two obvious obstacles to developing such a definition might be called "failures of imagination" and "failures of motivation": not thinking hard enough to raise all relevant concerns and choosing to ignore concerns whose treatment is awkward or unpleasant. Flood plain residents may fail to insure their homes because they forgot that insurance (which is heavily subsidized in the U.S.) was an option or because they dislike thinking about unpleasant eventualities (Kunreuther, Ginsberg, Miller, Sagi, Slovic, Borkin, & Katz, 1978). Cost-benefit analysts may ignore a factory's impact on landscape because that consequence never occurred to them or because they do not know how to put a dollar value on it (Brookshire, Ives, & Schulze, 1976; Mishan, 1976).

Such omissions are made particularly dangerous by two other judgmental difficulties that affect many aspects of decision making. One is insensitivity to incompleteness, which leads people to have undue faith in the thoroughness of the problem representations they see and in the definitiveness of the decisions derived from them. Elements that are out of sight also tend to be out of mind (Fischhoff, Slovic, & Lichtenstein, 1978; Mehle, Gettys, Manning, Baca, & Fisher, 1981). The second judgmental difficulty is insensitivity to any systematic bias in what has been included. It is hard for people to tell when the representation that they receive is not

only incomplete, but also unrepresentative (Tversky & Kahneman, 1981). Thus, readers of a cost-benefit analysis might not only have an exaggerated feeling of its completeness but also fail to notice that the omissions are predominantly consequences that are not traded in the market place. Even (or especially) the producers of strategic analyses can forget the cumulative impact of the hard-to-model events that they leave out (Fischer, 1983; Lanir, 1983).

Once judgmental difficulties have been identified, the researcher's task becomes finding ways to eliminate them. A straightforward way to guard against omissions is to use a checklist ensuring that important options and consequences are neither forgotten nor pushed aside (e.g., Finsterbuch & Wolf, 1976; Hammer, 1980). Such checklists tend, however, to be either tightly tailored to a particular problem or very general (and vague regarding their application). Figure 1 shows a somewhat more flexible and creative scheme that has helped in deriving complete option and consequence lists for decisions about hazardous technologies (Burton, Kates, & White, 1978). It envisions the evolution of a hazard (e.g., an auto accident) as a causal sequence initiated by a human need (hunger) and culminating in an ultimate consequence (death), but with a number of stages or transitions (e.g., go

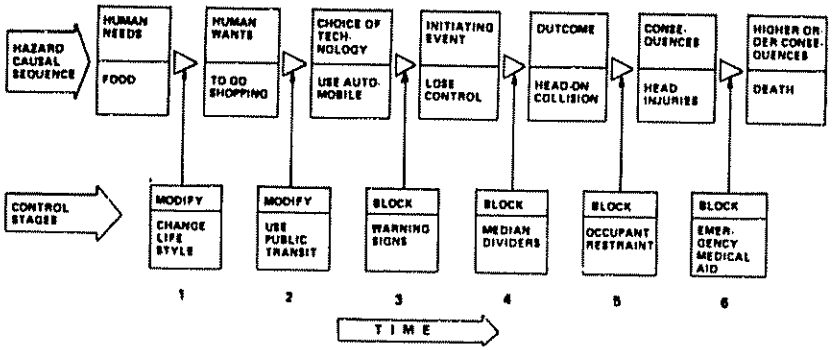

Fig. 1. Illustration of the causal chain of hazard evolution. The top line indicates seven stages of hazard development, from the earliest (left) to the final stage (right). These stages are expressed generically in the top of each box and in terms of a sample motor-vehicle accident in the bottom. The stages are linked by causal pathways denoted by triangles. Six control stages are linked to pathways between hazard states by vertical arrows. Each is described generically as well as by specific control actions. Thus, control stage 2 would read: "You can modify technology choice by substituting public transit for automobile use and thus block the further evolution of the motor-vehicle accident sequence arising out of automobile use." The time dimension refers to the ordering of a specific hazard sequence; it does not necessarily indicate the time scale of managerial action. Thus, from a managerial point of view, the occurrence of certain hazard consequences may trigger control actions that affect events earlier in the hazard sequence. Source: Bick, Hohenemser, & Kates, (1979).

shopping, use automobile, lose control, etc.). Each transition in the evolution offers some opportunity for intervention (or, in the language of decision making, an additional action option).

On the option side, the scheme reminds one that risky situations often have quite distant antecedents. Hunger produces trips to the store, some of which end in accidents. Because each transition in the causal model affords an opportunity for intervention, some change in food distribution is a policy option for reducing motor vehicle casualties. Of course, in reality, no one in the transportation field may be empowered to consider options such as government subsidy of the home delivery of food (which could reduce the number of miles driven and increase the proportion of miles driven in larger, hence safer, vehicles). Those options should, however, remain as logical possibilities. The act of deliberately and repeatedly rejecting them as institutionally impossible may eventually hasten the day when those institutional barriers are overcome.

On the consequence side, the scheme shows that identifying discrete states in the evolution of consequences may highlight otherwise neglected control options. In particular, it points to options for consequence mitigation that might be ignored as the result of focusing on prevention (which might be seen as a more active, hence more attractive, form of hazard management). It also prompts one to consider consequences that occur late in time, or as less direct results of the event. In this regard, the figure might be extended to include the grief of survivors, or higher insurance rates, or the incremental increase in pressure for expensive safety devices. Thus, for example, the most serious consequence of the incident at Three Mile Island may not have been the immediate health effects, or the subsequent loss of income from the plant during decontamination, but the ensuing loss of confidence in the nuclear industry. This tertiary consequence has resulted in cancelled orders, increased down-time, and licensing delays (Slovic, Fischhoff, & Lichtenstein, 1980b; Starr & Whipple, 1981; "U.S. Nuclear Industry Cries for Help," 1981). These effects, which may threaten the industry as a whole and not just a single plant and those around it, reflect a category of social consequences that has been relatively neglected by the industry throughout its development.

In this respect, the nuclear industry is not alone, Fischhoff et al. (1981) present one list of consequences that are germane to many, if not most policy decisions regarding hazardous technologies. They include ecological, political/ethical and psychological consequences, as well as economic and physical ones. Yet, it would be hard to point to any single risk assessment that has considered them all even cursorily.

Some decision problems are, of course, deficient on both the option and the consequence sides. A survey of flood-plain residents in the U.S. discovered that most were unaware that heavily subsidized flood insurance

was among their options or that coping with muck, rot, and materials shortages was among the consequences of flooding (Kunreuther et al., 1978). A study by the U.S. National Academy of Sciences (1975) on the effects of thermonuclear war was criticized for deliberately failing to consider options for avoiding war and inadvertently neglecting secondary consequences that followed directly from the primary consequences that it had discussed. For example, it observed that the growth of tubers would be relatively unaffected by the increased ultraviolet radiation due to disruption of the earth's ozone shield, but not that the radiation would hamper survivors attempting to work in the fields (Boffey, 1975). Official British civil defense plans have an extremely simplistic notion of events that shape people's behavior in crisis situations and the disruptive consequences that follow from them. By focussing on the time of nuclear war, they divert attention from the "upstream" events leading to it and ways in which the causal chain might be broken (Churcher & Lieven, 1983).

Once such omissions are noted, they often seem quite obvious, leading one to question the competence, carefulness, or integrity of those who ignored them. In that frame of mind, it is difficult to appreciate the internal and external obstacles to producing complete representations, and the usefulness of even such simple-minded schemes as those discussed above for overcoming those obstacles. If one started from scratch (i.e., as a lay person) to produce a problem representation, one would be hampered by having no systematic organization of one's thoughts on the topic. One's first thoughts are then likely to be strongly affected by how the issue was formulated in whatever stimulus prompted one to start thinking (Hogarth, 1982; Taylor & Fiske, 1978). That prompt could be a newscast, a homework assignment, or a nightmare; in any case, it is unlikely to point to all aspects of the problem. According to most theories of memory, one's subsequent thoughts are likely to wander in directions that are associatively linked to one's initial probes (Collins & Loftus, 1975). Thus, there is an inevitable collusion between internal and external factors to produce an impoverished and systematically biased representation. Matters could, of course, be made worse by deliberate attempts to restrict debate or focus attention on particular issues (Tetlock, 1983).

The relevance of these results to strategic policy preferences remains a topic for empirical research. On an anecdotal level, it is possible to point to people who seem to forget the role of hunger in fomenting world crises and the possibility that its control is an option in policy making. Whether this "forgetfulness" is due to malevolence or cognitive lapses is a topic for further research and a focal point of the North-South debate. Also anecdotally, one can point to policymakers who seem to have neglected social consequences of their proposals. The threats to the future of NATO

caused by civilian resistance to the deployment of nuclear weapons in Europe might be viewed in such a light (e.g., "Europe's Economic Malaise," 1981; Galtung, 1981). This "oversight," too, could be attributed to deliberate disregard, reflecting callousness, or to inadvertent omission, reflecting habitual ways of thought (Britten, 1983). A final example, showing insensitivity to omission of options and consequences, is the finding that decisions to build bomb shelters may neglect the possibility that more civil defense may be obtained by more active options (e.g., better air cover) and the effect that shelter construction has on the flexibility of future defense plans (Lanir & Shapira, in press).

Creating a Joint Definition

When individuals attempt to make decisions together, their efforts may be doomed to failure unless they can agree on a common problem definition. If they cannot agree on what the problem is, they are unlikely to agree about what course of action constitutes the best solution to it. A classic example of conflicts arising from lack of a shared problem definition may be seen in the virulent debates over nuclear power in many Western countries (Fischhoff, Slovic, & Lichtenstein, 1983; Otway & von Winterfeldt, 1982). Even if opponents and proponents held similar views on the facts of nuclear power (i.e., how risky and how expensive it is), they could still be poles apart when considering its desirability unless they also agreed on what are the relevant alternatives and consequences. Typically, however, the proponents of nuclear power insist upon much smaller sets in both respects. For them, the viable energy options are coal and oil, compared to which the risks of nuclear power do not seem out of line. Opponents, however, typically add radical energy conservation programs, as well as massive investment in solar and wind power; in this light, nuclear power's risks loom quite large. Regarding consequences, many opponents are concerned about the increased centralization of society and the inequitable distribution of risks and benefits that they believe will come with nuclear power. For many proponents, these consequences simply are not relevant to technology management. Even if proponents agreed with opponents that these consequences would come to pass and that they were undesirable, disagreement about their relevance could lead to disagreement about what decision to make.

Within the defense policy arena a sharp hypothesis is that deep disagreements about problem definitions are an important component of all intense policy debates. In Britain, for example, discussions about the country's role in NATO may be irresolvable unless the parties involved agree about whether to include civilian militias and territorial defense as

serious policy options (Roberts, 1982). In the U.S., current disputes may be traced in part to disagreement about whether the effects of defense spending upon the national economy are among the consequences about which defense strategists need to worry (Jackson, 1982; Zusman, 1983). Scientific analysis cannot determine what the proper problem definition is—that is a political question. It can, however, help to focus the debate and clarify for participants when their opponents are being stupid or contrary, as opposed to when they are simply solving different problems.

EVALUATING THE CONSEQUENCES

Assessing the attractiveness (or aversiveness) of the various possible consequences (should they occur) would seem to be the least problematic aspect of decision making. Just ask people what they want. Such judgments would seem to be a redoubt of unaided intuition. Unfortunately, such direct questioning can be misleading unless those who ask the questions and those who use those answers have thought carefully about the problem. The "users" may be the respondents themselves trying to assess their own values or policymakers attempting to satisfy the public's desires.

The Meaning of Risk

A first step toward understanding people's values is understanding the terms in which they are couched. For example, although people agree that "risky" technologies are undesirable (all other things being equal), they may use the term "risk" in quite different ways. To some, it means just expected casualties. To others, it means expected casualties, after giving extra weight to members of particular classes (e.g., the young, or those who receive little benefit from the technology). To others still, it involves various qualitative aspects of the risk, such as how voluntarily it is accepted or how much of a feeling of dread it evokes (Slovic, Fischhoff, & Lichtenstein, 1980a, 1983; Vlek & Stallen, 1980). Aside from confusing communication, these terminological differences embody quite different values and can lead to different decisions; technologies that are expected to take very few casualties may still evoke considerable dread, and so on (Fischhoff, Watson, & Hope, 1982).

Figure 2 shows the results of one attempt to clarify the meaning of this value-laden term. In it, people were asked to rate 90 technologies in terms of 18 different aspects of risk that various commentators have cited as influencing how people evaluate technologies (Green, 1980; Lowrance, 1976; Rowe, 1976). The factor analysis shown here has extracted two major

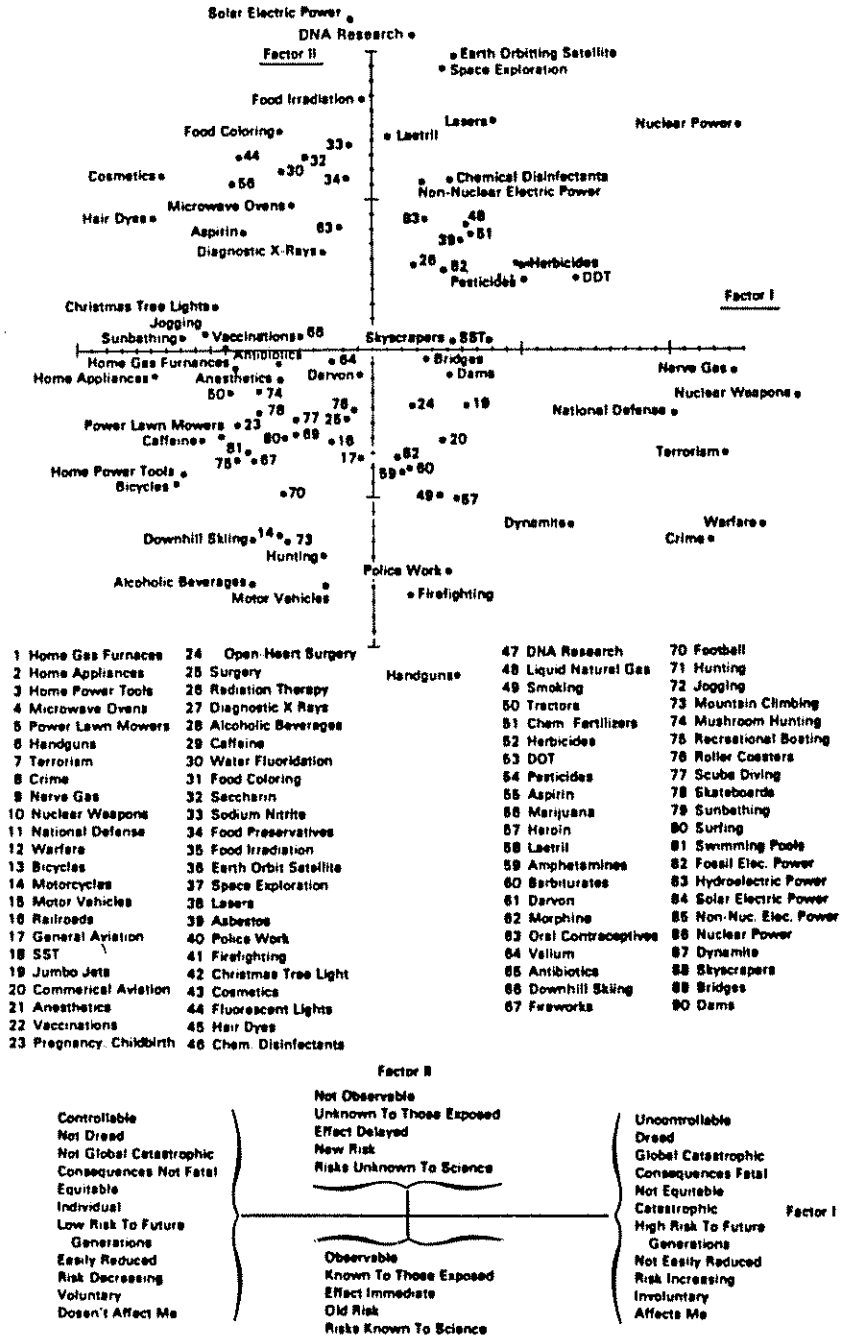

Fig. 2. Location of 90 activities and technologies on two dimensions of risk derived by factor analysis of ratings on 18 different aspects of risk. A third factor (not shown) reflects degree of exposure to the hazard. Source: Slovic, Fischhoff, & Lichtenstein (1980).

dimensions of risk that seem to underlie the 18 different aspects. This extraction has been possible because when people rate technologies on these aspects, ratings on many pairs of aspects are quite similar. This convergence simplifies decision making. Despite being conceptually distinct, the aspects of risk are empirically related. As a result, focusing on one aspect rather than another would have little impact on overall evaluations (as long as they were on the same dimension). Another encouraging empirical result is that these dimensions of risk have proven to be quite similar with rather different groups of raters and technologies (Slovic, Fischhoff, & Lichtenstein, 1980).

Less optimistically, the sheer proliferation of terms suggests that they may not be used consistently and carefully by non-specialists. Even in the professional literature one cannot find any comprehensive analysis of the normative status of these aspects. That is, should voluntariness or dread affect one's evaluation of the desirability of a technology?

The troublesome nature of thinking about risks seems to produce an aversion to thinking about them at all. When evaluating consequences, people have been found to attach particular importance to those that will be obtained with certainty (Kahneman & Tversky, 1979; Tversky & Kahneman, 1981). Thus winning $10 with certainty is more than twice as attractive as a .5 chance of winning $10; similarly, losing $10 with certainty is more than twice as bad as a .5 chance of losing $10. The fact that these certainty effects can be observed with gains as well as losses means that they are not just a matter of denial, unwillingness to think about unpleasant consequences. The extra weight given to certainty is sufficiently large that it may be possible to change the attractiveness of options simply by changing their presentation so as to highlight their certain consequences. For example, an insurance policy that covers fire but not flood could be presented either as full protection against the specific risk of fire or as a reduction in the overall probability of property loss. Often, people do not spontaneously see that the policy could be viewed from either perspective.

Measuring Labile Values

Such susceptibility to changes in the way that decision options are presented suggests a general problem for anyone interested in eliciting values from others (or even from themselves). If one has not thought through the implications of the various possible ways of evaluating consequences, then the values one expresses in response to a question may not represent one's own best interests (as those would emerge after more thoughtful deliberations). In fact, it may generally be the case that people do not have articulated values on many topics that arise in decision problems, particularly when the issues are novel and complex.

Practically speaking, there is no way that people could have thought through in advance every issue that the world, or a survey researcher, or a politician, or a journalist could throw at them. Rather, when confronted with an issue for which neither habit nor tradition dictates their answer, people must somehow infer what their values are (Rokeach, 1973). That inferential process might rely on analogy ("what have I said in similar situations") or analysis ("what basic values do I have that might apply to this specific case, what does each tell me, how relevant is each..."). The more detailed, exacting and creative that inference process is, the more likely it is to accommodate all germane considerations. As it becomes briefer, it will be increasingly influenced by what concerns are readily accessible. As with options and consequences, the accessibility of value considerations may be related to their importance, but it may also be influenced by ephemeral features of how the question is posed. To take four examples from survey-type studies: (a) The act of answering six items concerning political alienation reduced people's expressed confidence in national institutions (Turner & Krauss, 1978). (b) People judged the risks of technologies to be more acceptable after having judged the extent of their benefits than after having judged the extent of their risks (Fischhoff, Slovic, Lichtenstein, Read, & Combs, 1973). (c) People found insurance less attractive when it was brought to their attention that its premium constituted a "sure loss" (Fischhoff, Slovic, & Lichtenstein, 1980). (d) The attractiveness of a public health program may drop precipitously when its consequences are described in terms of the number of lives that will be lost rather than in terms of the number of lives that will be saved (Tversky & Kahneman, 1981).

The lability of these expressed values suggests that people are often capable of seeing issues in a number of perspectives with conflicting implications. Determining what they really like requires a deliberate effort first to evoke and then to reconcile these perspectives. Without such an effort, they may be prisoners of the particular way that they or their environment present the question. The low rates of "no opinion" reported by surveys that superficially address diverse, obscure, and even fictitious topics suggest that the values people express may not always be their own (Turner & Martin, 1982). Producing some opinion on every topic may reflect just a desire to be counted, or to feel involved, or to have a pleasant interaction with an interviewer. Having some opinion on every topic may mean having considered opinions on none (Ellul, 1968).

As elsewhere, these difficulties arise from ordinary judgmental processes and may be complicated by external factors. Advertisers make a living from highlighting particular evaluative perspectives. Propagandists try to alleviate value conflict by offering catchy, simple perspectives. Some observers argue that the consumer society is created by a multi-party

conspiracy designed to inculcate the perspectives associated with conspicuous consumption, fetishist attitudes toward commodities, and so on. A more subtle, and perhaps well-meaning, way of exploiting judgmental difficulties in the political arena is to advance one possible perspective as a comprehensive statement of "what the public wants." The partial truth of such claims and the difficulty of spontaneously retrieving alternative perspectives may account for some of the mileage that such claims often achieve.

Some economic procedures, such as those developed to implement cost-benefit analyses, are designed to avoid the problems faced by attempts to elicit values directly, by observing the expression of values in market behavior. The conceptual validity of these procedures, the susceptibility of market behavior to problems of value lability, and the extent to which all values find expression in market behavior are all important topics beyond the range of this essay (Fischhoff, Lichtenstein, Slovic, Derby, & Keeney, 1981).

Implications

Whether value assessment in the context of strategic policy evaluation is prone to such problems remains an empirical question. Intuition suggests that the problems might be substantial. "Risk" is obviously a key consequence, and there is no a priori reason to think that its meaning is any better articulated here than with technologies. The variability of American attitudes toward defense spending is some indication of how poorly those attitudes are grounded, especially when contrasted with the marked stability of attitudes towards other spending areas (*Social Indicators*, 1980). An inability to think about uncertain prospects may lead to a tendency to underrate the value of changes in the probability of war when compared with more concrete consequences. When territories are returned after a war, the physical loss may assume disproportionate importance when contrasted with the reduced probability of a next war. When new missile silos are installed, the weapon in hand may dominate the decrease in the enemy's trust (and the increased chance of war).

When people's values are poorly thought through, they are particularly subject to manipulation by the news media and the politicians featured in them. They are also particularly vulnerable to misrepresentation (malicious or inadvertent) by politicians ready to offer simple interpretations of "what the public wants." The current U.S. Administration has, for example, interpreted its election victory as a broad mandate for many policies that contradict the public's wishes, as represented in public opinion polls (Borrelli, 1982).

A final concern about values regarding consequences like thermonuclear war or massive environmental pollution or genetic damage is how well they ever can be articulated (Fiske, Pratto, & Pavelchak, 1983). Although people can think about the unthinkable, and even make precise computations about aspects of it, doing so may "anaesthetize moral feeling" (Tribe, 1971), making us into someone else than ourselves. A recurrent ploy of those opposed to nuclear weapons has been to create lurid scenarios about the suffering following nuclear war (Campbell, 1981; Naughton, 1981; Schell, 1982). Although readily decried as a propagandistic ploy, such scenarios may be a needed complement to formal analyses of the consequences of war.

ASSESSING THE LIKELIHOOD OF CONSEQUENCES

Kinds of Uncertainty

In some decisions, this stage poses no difficulty at all. The consequences associated with the different options are more or less guaranteed; one needs "merely" to balance their relative attractiveness. For example, many consumer decisions present a set of options each of which has one certain negative consequence, its cost, and a variety of ostensibly certain positive consequences, its selling points. If one believes the advertisers' claims, then purchase decisions represent decision making under conditions of certainty.

A highly studied complication arises when the consequences are incurred with some known probability (Edwards, 1954, 1961). Gambling involves such decision making under conditions of risk, whenever one can assume that participants know the probabilities prior to making their decisions. Considerable research (Peterson & Beach, 1967) has found that people do a fairly good job of assessing the likelihood of events when the relevant data may be found in the relative frequency of one kind of event in a concentrated series (e.g., heads in a series of coin flips). When information is distributed over time, performance may suffer. For example, estimates of the relative frequency of death from different causes have been found to be biased toward exaggeration of those that are disproportionately reported in the news media (Combs & Slovic, 1979). Quite similar biases were found with several different judgmental methods, indicating both that respondents had a robust cognitive representation of these frequencies and that its failings were reliable (Lichtenstein, Slovic, Fischhoff, Layman, & Combs, 1978).

Life becomes really interesting when the probabilities themselves must be assessed, thereby introducing an element of judgment into what is usually seen as the most fact-driven, or scientific, or objective, aspect of decision making. Discomfort with reliance on judgment has spawned a number of techniques for converting decision making under uncertainty to decision making under risk by "objectively" assessing the required probabilities. In the area of technology management, the most sophisticated of these procedures fall under the rubric of "probabilistic risk assessment." This family of techniques tries to assess the probabilities of untoward events in complex and novel systems (e.g., a melt-down in a nuclear reactor) by decomposing those systems into smaller and more knowable components (e.g., the failure of a particular valve) whose failure could lead to overall failure. Hopefully, one uses logical and computational methods to combine these components into an overall assessment (Green & Bourne, 1972; U.S. Nuclear Regulatory Commission, 1975, 1978, 1981).

These procedures have proven very useful for systematizing thinking about complex systems and making it more accessible to peer review. In the nuclear, space, and chemical industries, they have revealed numerous design flaws that would have otherwise gone undetected. They have not, however, removed the element of judgment from either the design or the assessment process. Judgment is still needed to identify the relevant components, specify their interrelations, anticipate the stresses that will be put on them, predict their performance under novel conditions, and assess their failure rates.

Informal Aspects of Formal Methods

The fallibility of such judgments may be seen most clearly in situations where entire "pathways to disaster" have been overlooked. For example, observers argue about whether the incident at Three Mile Island was among the accident sequences considered in the prior analyses of that plant. Table 1 offers a set of possibilities that may be prone to omission in analyses of technical systems. Some reflect surprises, physical or social processes that had not been observed previously. In such cases, all that one can do is assess the extent of one's uncertainty and, hence, the rate of surprises that can be anticipated, thereby making it possible to make decisions that prepare for the unexpected. Other problems are omitted because the system is too complex for anyone to anticipate all of the familiar events that will emerge from the interaction of its components. Others are problems that may simply fall between the jurisdictions of the different disciplines analyzing a system.

Table I. Some Problems in Structuring Risk Assessments[a]

Failure to consider the ways in which human errors can affect technological systems. Example: Owing to inadequate training and control room design, operators at Three Mile Island repeatedly misdiagnosed the problems of the reactor and took inappropriate actions.
Overconfidence in current scientific knowledge. Example: DDT came into widespread and uncontrolled use before scientists had even considered the possibility of the side effects that today make it look like a mixed but irreversible blessing.
Failure to appreciate how technological systems function as a whole. Example: The DC-10 failed in several early flights because its designers had not realized that decompression of the cargo compartment would destroy vital control systems.
Slowness in detecting chronic, cumulative effects. Example: Although accidents to coal miners have long been recognized as one cost of operating fossil-fueled plants, the effects of acid rains on ecosystems were slow to be discovered.
Failure to anticipate human response to safety measures. Example: The partial protection afforded by dams and levees gives people a false sense of security and promotes development of the floodplain. Thus, although floods are rarer, damage per flood is so much greater that the average yearly loss in dollars is larger than before the dams were built.
Failure to anticipate common-mode failures, which simultaneously afflict systems that are designed to be independent. Example: Because electrical cables controlling the multiple safety systems of the reactor at Browns Ferry, Alabama were not spatially separated, all five emergency core-cooling systems were damaged by a single fire.

[a]Source: B. Fischhoff, S. Lichtenstein, P. Slovic, S. Derby, & R. Keeney. *Acceptable risk*. New York: Cambridge University Press, 1981 (p. 18). Sources for examples appear there

Whether due to the complexity of a system or the ignorance of science, uncertainty about how a system operates sets an asymptote on how well one can anticipate the consequences of a decision (Brehmer, 1980). One can still make good decisions, in the sense of choices that make the best use of one's knowledge. However, one cannot assure their outcome. Reliance on experts is the natural way to increase the predictability of outcomes. One danger it carries is that experts may inspire undue confidence in situations in which no one is able or willing to challenge the quality of their judgment.

However much one knows, deliberative decision making usually requires translating knowledge into some sort of summary judgment: How likely is a coup d'etat? How severe would the illness be? What proportion of cases are treatable? How often will operators forget to close the valve? How

many jobs will be open when I need them? One of the most robust results in experimental psychology is that the way in which estimation questions are posed can markedly affect the estimates produced.

Early psychologists discovered that different judgments may be attached to the same *physical* stimulus (e.g., How loud is this tone?) as a function of whether it is presented in the context of increasingly intense or weak alternatives, whether the set of alternatives is homogeneous or diverse, and whether the respondent makes one or more judgments. Even when the same presentation is used, different judgments might be obtained with a numerical or a comparative (ordinal) response mode, with instructions stressing speed or accuracy, with a bounded or unbounded set, and with verbal or numerical response labels (Kling & Riggs, 1971; Poulton, 1977, 1982). If such effects are observed in the judgment of physical sensations, then their presence might reasonably be expected in judgments of more intellectual quantities. Knowing a lot about a topic is no guarantee of being able to make that knowledge useful for decision making (Fischhoff & Whipple, 1981).

Pooling Knowledge

With complex problems, extant knowledge is typically distributed over a variety of individuals (or disciplines). For that knowledge to be shared, it must be introduced into some common forum and expressed in some compatible fashion. Probabilistic risk assessment is one vehicle for such sharing. Coordination means little, however, unless one first assures that a full complement of views are solicited. The disciplinary hierarchy in engineering circles, for example, often leads to the neglect of human factors information. The result is technical systems that cannot accommodate human operators with their natural (and known) physical and cognitive limitations. For example, Sheridan (1980) lists some of the omissions in the highly designed nuclear power plane at Three Mile Island.

Familiar social and institutional pressures often bias the sampling of information toward individuals who hold quite similar views (Janis, 1972; Tetlock, 1983). Those who think differently seldom make it to the inner circle of power and seldom carry much weight if they do. However, when complexity and unfamiliarity mean that no one knows the right answer to a question, the best one may hope to do is to enlist a variety of views and thereby avoid the mistakes to which each is attuned. A biased selection of views leads to a biased correction of misconceptions and a bias in the resultant answers (Lanir, 1983).

Analogous issues arise in the efforts of single individuals to determine what they themselves believe about a particular question of fact. Habitual

thought patterns may lead them to go over and over a problem from the same limited perspective, which is but one of the views that they are capable of adopting. It has, for example, been found that computational errors in scientific data analyses are typically supportive of investigators' hypotheses. Although this bias could be due to malice, it may be the innocent result of double-checking only those analyses that produce unanticipated results (Rosenthal & Rosnow, 1969).

In addition to these difficulties in assessing the magnitude of the uncertainty surrounding particular events, there is considerable evidence suggesting that people may have difficulty with uncertainty itself. On the level of performance, they seem to be poor judges of the extent of their own knowledge, typically overestimating its definitiveness (Lichtenstein, Fischhoff, & Phillips, 1982; Wallsten & Budescu, 1983). On the level of understanding, some basic principles of probabilistic processes seem to be rather poorly developed in people's intuitions. For example, they often fail to appreciate how important sample size is in determining the value of information or how important the validity of a cue is for the role afforded it in judgment (Kahneman & Tversky, 1973). As both antecedent and consequent of these faulty intuitions, people seem to use deterministic strategies (or heuristics) in dealing with probabilistic events. These strategies are often quite useful but they can produce systematic errors. One such heuristic leads one to judge an event to be likely according to the ease with which one can imagine it happening or remember the occurrence of similar events (Kahneman & Tversky, 1973). Although the availability of examples is often a useful guide, it can lead one astray when some events are disproportionately available. It can, for example, account for the tendency to overestimate the likelihood of overreported causes of death (Lichtenstein et al., 1978).

Implications

Defense policy problems would seem to have most of the features that make judgments of fact most difficult, for both the casual and professional judge. Little is known for certain. Thus, for example, reasonable and informed people can (and do) disagree about whether increased armaments increase or decrease the probability of war (*Daedalus*, 1981; Freedman, 1981; Frei, 1983). Moreover, there is little unambiguous feedback and, hence, little opportunity for learning about the efficacy of past decisions. No one really knows, for example, what elements of American and Soviet strategic policy have moved the world closer to and further from the brink of war. In the absence of feedback, there is no opportunity to create

expertise (Fischer, 1983). From this perspective, some areas of strategic analysis belong more to the humanities than to the social sciences. Relevant information is dispersed over many individuals having differing degrees of access to various arenas of discussion. Information seems typically elicited from and shared with like-minded people. The periodic dearth of technical expertise about defense matters on the political left in the U.S. probably has meant that certain errors systematically escaped correction. Indeed, the sort of controversy that is essential to understanding defense issues is often forthcoming only when the interests of the different armed services clash (e.g., over the MX, Biddle, 1979; Korb, 1980; Richardson, 1981; or over Soviet military strength, Aspin, 1980; Lee, 1980).

It has also become increasingly clear that the complexity that reduces the predictability of new technologies is no stranger to defense options. Time and cost over-runs in the development of new weapons systems may be one symptom of complexity creating uncertainty about how and when systems will perform—as is worry about how those systems will interact with one another if they are ever put to the test (Zuckerman, 1982). For some people, sophisticated command and control systems are the way to reduce this uncertainty; for others, they are part of the problem, adding new layers of complexity and undetectable sources of vulnerability (Broad, 1980, 1981; Doubleday, 1980; Schemmer, 1981).

Finally, there is one obstacle to assessing the likelihood of different possible consequences that is inherent in defense policy making (although not unheard of in technology development and elsewhere). That obstacle is deliberate attempts to restrict understanding, through either withholding information or providing misinformation. Although deception can be devastating, it can also have unanticipated effects. Once lack of candor is suspected, the "deceived" may recalibrate their probabilities in a variety of unpredictable ways (Douglas, 1981; Stech, 1980; Young, 1981).

DECIDING

Optimal Decisions

The recommended solution for putting all of the pieces together and reaching a decision goes something like this: For each consequence of each option, multiply some measure of its attractiveness by its probability of being obtained, thereby deriving its expected attractiveness should the option be adopted. Summing these products over all consequences, produces the option's *expected attractiveness*. The option with the highest

expected attractiveness is the optimal choice, the one whose selection is in one's best interest.

It is in this stage that people seem most likely to reject the precepts of rational decision making—and to feel quite comfortable in doing so (Fischhoff, Goitein, & Shapira, 1981). On purely technical grounds, the scheme requires more capacity for and investment in computation than will be found in most everyday decisions. On social (or, perhaps, linguistic) grounds, the choices that emerge from such computations are often difficult to explain, beyond some variant of "I balanced everything and this option seemed best on the whole." Conceptually, people may feel that reliance on expectation imposes too long-term a perspective: the decision will, after all, be taken only once. Moreover, the "expectations perspective" allows good and bad features of an option to cancel one another out, whereas the decision maker may feel that being highly undesirable on a particular (or any) dimension of consequence makes an option simply unacceptable.

Adequate Decisions

Alongside the reformulations and counter-arguments designed to cope with these concerns within the expectations framework, one finds a variety of non-expectations decision rules (Lichtenstein, Slovic, & Zink, 1969; March, 1978; Simon, 1957; Svenson, 1979; Tversky, 1972). These range from such simple ones as "do as we've always done, unless it got us into big trouble last time" to fairly sophisticated techniques for efficiently screening large sets of options. One common feature of these competing rules is that they can be expressed in simple terms that provide a ready justification for the option chosen. Indeed, the decision-making process may actually involve trying out alternative problem definitions and decision rules until one succeeds in identifying a "dominating option," one that is arguably better than all competitors (Montgomery, 1983).

An extreme, but not uncommon way to circumvent these expectation and computation problems is to avoid analytic decision making altogether. In its stead comes some analogical process, such as trial-and-error learning or relying on the advice of the best available expert (March, 1978). Although less sophisticated, these methods should be more compatible with intuitive modes of thought. Instead of trying to think one's way through to a right answer, one hopes to shape that answer gradually by responding to flaws that appear in one's initial attempts (Newell & Simon, 1972). This hands-on experience might be particularly useful for discovering the higher-order consequences of particular options (by seeing what really happens when they are tried). The effectiveness of learning by doing may account in

part for people's failure to develop fully the analytical skills needed when one must get the decision right the first time.

One attractive feature of the expected-attractiveness principle for decision making is that it embodies a tidy separation between facts and values—until they are multiplied together. As may be apparent from preceding sections, this distinction is not always observed. It becomes a fiction, for example, when people emphasize the importance of options to be obtained with certainty. It is further blurred whenever, as is often the case, our view of the facts shapes our values or vice versa. When participants in political discussions despair of altering their opponents' values, they may be tempted to exaggerate the surety of their own view of the facts (Sjöberg, 1980). For example, virulent debates about how safe nuclear power is often seem to cloak deep disagreements about how safe it should be and what our society should hold as important. Such surrogate debates not only confuse the issues for observers, but also distort them for participants, as they become committed to particular positions and engage in a biased search for supporting evidence. Whenever resources are needed to create evidence (e.g., by sponsoring research), those who control the purse strings may impose their values on the debate by failing to create the facts that would make competitors' options into credible alternatives (Arditti, Brennan, & Cavrak, 1980; Churcher & Lieven, 1983; Fischhoff, Lichtenstein, Slovic, Derby, & Keeney, 1981; Ravetz, 1971).

When a decision is finally made, it may simply mean that time has run out and the decision maker has adopted whatever option seemed best at that point in the deliberations. Or, it may reflect an explicit decision to decide, aided perhaps by techniques akin to value-of-information analysis which consider the potential benefit of further research (Corbin, 1980; Raiffa, 1968). Whether conducted formally or casually, such analyses contain a large element of judgment. They, too, may be affected by tendencies to exaggerate the extent of one's knowledge, overlook alternative problem formulations, or obtain biased samples of information.

However thorough or casual the preparations for a decision, judgment of its adequacy is often withheld until its consequences have been realized. Although it is purported to benefit from the wisdom of hindsight, retrospective evaluation is fraught with difficulties. In hindsight, people tend to exaggerate the foreseeability of whatever events have transpired. As a result, they are overly critical of past decision makers (Fischhoff, 1975, 1982). Other retrospective biases are less systematically discriminatory. When people are uncertain of their values, they may find themselves liking the consequences of decisions rather more or rather less than they had anticipated. There may indeed be pressures to like whatever one gets (Festinger, 1957). Finally, there is often an equation of good outcomes with

good decisions and bad outcomes with bad decisions, without adequate appreciation of the ease (or difficulty) of obtaining fairly good (or bad) outcomes (Fischhoff, 1980).

Implications

Whether the act of choosing a preferred defense policy is prone to such difficulties is, again, an empirical question. Certainly the expectations principle may be hard to sell when lives hang in the balance and there is no long run. Much of the criticisms of "analysis run wild" at the U.S. Defense Department during the McNamara years (Kinnard, 1980) was directed at the purpose to which it was put. However, some reflected extreme discomfort with the notion of taking calculated gambles with people's lives.

The alternatives to analysis (and explicit reliance on the expectation principle) are as mixed an assortment of decision-making methods as is found anywhere in society. There is simple-minded sloganeering, which may represent anything from a marketable summary of thoughtful deliberation to the sloganeer's full understanding of the issue. There is trial-and-error learning, which can enable strategists to shape the perfect response to the next crisis or leave them perfectly prepared to fight the last one. There is reliance on traditional decisions, for past wisdom or unwillingness to admit that errors have ever been made (Dixon, 1975; May, 1973).

It is as hard to tell how well defense policy decisions are being made as it is to evaluate any decisions in a complex environment. Indeed, the stakes involved may heighten the need to judge harshly in hindsight those who have been unfortunate—in order to sustain the belief that these important processes are predictable (Betts, 1978; Lanir, 1983; Wohlstetter, 1962). One of the better diagnostic signs of how well decisions are being made is how thoroughly the decision-making process effects a separation between questions of fact and value. The importance of maintaining this distinction may wisely underlie the need that most countries see for civilian control over the military, with the former determining what the country wants and the latter what it can have.

CONCLUSION

Rational models of decision making are a useful point of departure both for describing and directing behavior. By assuming that people are purposeful, these models adopt a respectful attitude toward those under

study. By offering a comprehensive framework for organizing most intellectual aspects of decision making, they may offer a first approximation at what those reasonable objects of study are trying to do. When people do something different, then their behavior may still be described in terms of departures from the model. Moreover, such descriptions also point the way toward "returning people to the model" and helping them to make more rational decisions (if they so desire).

Exploiting this promise requires a detailed substantive understanding of both how people think and what problems they are facing. Only then can one hope to go beyond speculating about what they are doing and about what they should be doing.

In this essay, extant research on decision making in other contexts has been exploited to provide a first guess at how people make decisions about defense policies. It is buttressed by evidence more directly pertinent to strategic preferences; some of it is systematic, some anecdotal; some of it was conducted from a decision-making perspective, some of it not. All in all, the ratio of speculation to documentation regarding strategic preferences is quite high. Disciplining these speculations by empirical study is needed before we will know if there is anything special about the decision-making processes involved in choosing defense policies. Conducting those studies will benefit the study of decision making per se whatever the outcome: if existing results are replicated, then their robustness will be demonstrated; if they are not, then important boundary conditions have been identified. That research will ask questions such as: Does the importance of these decisions sharpen or frustrate people's attempts to understand? Are people better able here to detect the biases in the samples of information they receive? Are defense experts immune to the overconfidence that afflicts others? Are defense policy debates particularly conducive to (or adverse to) a balanced appraisal of the evidence? What opportunities do they provide to learn from experience?

REFERENCES

Arditti, R., Brennan, P. & Cavrak, S. (Eds.), *Science and liberation*. Boston, MA: South End Press, 1980.

Aspin, L. Debate over U.S. strategic forecasts: A mixed record. *Strategic Review*, 1980, *8*(3), 22-43.

Bell, D., Keeney, R. & Raiffa, H. (Eds.), *Conflicting objectives in decisions*. New York: Wiley, 1973.

Betts, R. K. Analysis, war and decision: Why intelligence failures are inevitable. *World Politics*, 1978, *31*, 61-90.

Bick, T., Hohenemser, C. & Kates, R. Target: Highway risks. *Environment*, 1979, *21*(2), 7-15, 29-38.

Biddle, W. The silo busters. *Harpers*, 1979, *259*(1555), 43-56.

Boffey, P. M. Nuclear war: Federation disputes Academy on how bad effects would be. *Science*, 1975, *190*, 248-250.

Borrelli, P. Shoot the messenger: Louis Harris. *Amicus*, Winter, 1982, 25-30.

Brehmer, B. In a word: Not from experience. *Acta Psychologica*, 1980, *45*, 223-241.

Britten, S. *The invisible event*. London: Menard Press, 1983.

Broad, W. J. Philosophers at the Pentagon. *Science*, 1980, *210*, 409-412.

Broad, W. J. Nuclear pulse (III): Playing a wild card. *Science*, 1981, *211*, 1248-1251.

Brookshire, D. S., Ives, B. C. & Schulze, W. D. The valuation of aesthetic preferences. *Journal of Environmental Economics and Management*, 1976, *3*, 325-346.

Burton, I., Kates, R. F. & White, G. F. *The environment as hazard*. New York: Oxford University Press, 1978.

Campbell, E. Deathtrap for city dwellers. *New Statesman*, September 25, 1981, 16-17.

Churcher, J. & Lieven, E. V. M. Images of nuclear war and the public in British civil defense planning documents. *Journal of Social Issues*, 1983, *39*(1), 117-132.

Collins, A. M. & Loftus, E. F. A spreading activation theory of semantic processing. *Psychological Review*, 1975, *82*, 407-428.

Combs, B. & Slovic, P. Newspaper coverage of causes of death. *Journalism Quarterly*, 1979, *56*(4), 837-843; 849.

Corbin, R. Decisions that might not get made. In T. Wallsten, *Cognitive processes in choice and decision behavior*. Hillsdale, NJ: Erlbaum, 1980.

Daedalus. U.S. Defense policies in the 1980s. Winter 1981.

Dixon, N. F. *On the psychology of military incompetence*. New York: Basic Books, 1975.

Doubleday, V. C. The C³ business. *Signal Magazine*, February 1980, 21-23.

Douglas, J. D., Jr. Soviet disinformation. *Strategic Review*, Winter 1981, 16-25.

Edwards, W. The theory of decision making. *Psychological Bulletin*, 1954, *51*, 380-417.

Edwards, W. Behavioral decision theory. *Annual Review of Psychology*, 1961, *12*, 473-498.

Einhorn, H. J. & Hogarth, R. M. Behavioral decision theory. *Annual Review of Psychology*, 1981, *32*, 53-88.

Ellul, J. *Propaganda*. New York: Knopf, 1968.

Europe's economic malaise: Widening the split with the U.S. *Business Week*, December 7, 1981, 50-54.

Festinger, L. *A theory of cognitive dissonance*. New York: Row Peterson & Company, 1957.

Finsterbuch, K. & Wolf, C. *Social impact assessment*. New York: Academic Press, 1976.

Fischer, G. W. Conceptual models and military threat assessment. *Journal of Social Issues*, 1983, *39*(1), 87-116.

Fischhoff, B. Hindsight ≠ foresight: The effect of outcome knowledge on judgment under uncertainty. *Journal of Experimental Psychology: Human Perception and Performance*, 1975, *1*, 288-299.

Fischhoff, B. Clinical decision analysis. *Operations Research*, 1980, *28*, 28-43.

Fischhoff, B. For those condemned to study the past. In D. Kahneman, P. Slovic & A. Tversky (Eds.), *Judgment under uncertainty: Heuristics and biases*. New York: Cambridge University Press, 1982.

Fischhoff, B., Goitein, B. & Shapira, Z. SEU: A model of decision making. *Journal of the American Society of Information Sciences*, 1981, *32*, 391-413.

Fischhoff, B., Lichtenstein, S., Slovic, P., Derby, S. L. & Keeney, R. L. *Acceptable risk*. New York: Cambridge University Press, 1981.

Fischhoff, B., Slovic, P. & Lichtenstein, S. Fault trees: Sensitivity of estimated failure probabilities to problem representation. *Journal of Experimental Psychology: Human Perception and Performance*, 1978, *4*, 330-344.

Fischhoff, B., Slovic, P. & Lichtenstein, S. Knowing what you want: Measuring labile values. In T. Wallsten (Ed.), *Cognitive processes in choice and decision behavior*. Hillsdale, NJ: Erlbaum, 1980.

Fischhoff, B., Slovic, P. & Lichtenstein, S. The "public" vs. the "experts": Perceived vs. actual disagreements about the risks of nuclear power. In V. Covello, G. Flamm, J. Rodericks & R. Tardiff (Eds.), *Analysis of actual vs. perceived risks*. New York: Plenum, 1983.

Fischhoff, B., Slovic, P., Lichtenstein, S., Read, S. & Combs, B. How safe is safe enough? A psychometric study of attitudes towards technological risks and benefits. *Policy Sciences*, 1978, *8*, 127-152.
Fischhoff, B., Watson, S. & Hope, C. *Defining risk*. Decision Research Report 82-15, 1982.
Fischhoff, B. & Whipple, C. Risk assessment: Evaluating air quality with subjective estimates. *Environmental Professional*, 1981, *3*(3), 277-291.
Fiske, S. T., Pratto, F. & Pavelchak, M. Citizens' images of nuclear war: Content, and consequences. *Journal of Social Issues*, 1983, *39*(1), 41-65.
Freedman, L. *The evolution of nuclear strategy*. London: Macmillan, 1981.
Frei, D. *Risks of unintentional nuclear war*. Beckenham, Kent, U.K.: Croom Helm, 1983.
Galtung, J. Europe's balance of selfishness. *New Society*, Nov. 19, 1981, 327-328.
Green, A. E. & Bourne, A. J. *Reliability technology*. New York: Wiley-Interscience, 1972.
Green, C. H. Risk: Attitudes and beliefs. In D. V. Canter (Ed.), *Behaviour in fires*. Chichester: Wiley, 1980.
Hammer, W. *Product safety and management engineering*. Englewood Cliffs, NJ: Prentice-Hall, 1980.
Hogarth, R. M. (Ed.) *New directions for methodology of social and behavioral science: The framing of questions and the consistency of response*. San Francisco, CA: Jossey-Bass, 1982.
Howard, R. A. The foundations of decision analysis. *IEEE Transactions on Systems Science & Cybernetics*. 1968, *SSC-4*(3).
Jackson, H. U.S. defense policy threatens U.S. economy. *The Guardian*, February 19, 1982, 7.
Janis, I. *Victims of groupthink*. Boston, MA: Houghton Mifflin, 1972.
Kahneman, D., Slovic, P. & Tversky, A. (Eds.) *Judgment under uncertainty: Heuristics and biases*. New York: Cambridge University Press, 1982.
Kahneman, D. & Tversky, A. On the psychology of prediction. *Psychological Review*, 1973, *80*, 237-251.
Kahneman, D. & Tversky, A. Prospect theory. *Econometrica*, 1979, *47*, 263-292.
Kinnard, D. McNamara at the Pentagon. *Parameters*, 1980, *10*, 22-31.
Kling, J. & Riggs, L. *Woodworth & Schlosberg's experimental psychology*. New York: Holt, Rinehart & Winston, 1971.
Korb, L. J. The case for the MX. *Air University Review*, 1980, *31*, 3-10.
Kramer, B. M., Kalick, S. & Milburn, M. Continuity and change in nuclear attitudes: 1945-1982. *Journal of Social Issues*, 1983, *39*(1), 7-24.
Kunreuther, H., Ginsberg, R., Miller, L., Sagi, P., Slovic, P., Borkin, B. & Katz, N. *Disaster insurance protection: Public policy lessons*. New York: Wiley, 1978.
Lanir, Z. *Fundamental surprise*. Tel Aviv, Israel: Kibbutz Hameuchad, 1983.
Lanir, Z. & Shapira, Z. Analysis of decisions concerning passive versus active defense of rear areas. In Z. Lanir (Ed.), *Defense and national economy in the 1980s*. Ramat Aviv, Israel: Tel Aviv University, in press.
Lee, W. T. Debate over U.S. strategic forecasts: A poor record. *Strategic Review*, 1980, *8*(3), 44-57.
Lichtenstein, S., Fischhoff, B. & Phillips, L. D. Calibration of probabilities: State of the art to 1980. In D. Kahneman, P. Slovic & A. Tversky (Eds.), *Judgment under uncertainty: Heuristics and biases*. New York: Cambridge University Press, 1982.
Lichtenstein, S., Slovic, P., Fischhoff, B., Layman, M. & Combs, B. Judged frequency of lethal events. *Journal of Experimental Psychology: Human Learning and Memory*, 1978, *4*, 551-578.
Lichtenstein, S., Slovic, P. & Zink, D. Effect of instruction in expected value on optimality of gambling decisions. *Journal of Experimental Psychology*, 1969, *79*, 236-240.
Lowrance, W. W. *Of acceptable risk*. Los Altos, CA: Kaufmann, 1976.
March, J. G. Bounded rationality, ambiguity and the engineering of choice. *Bell Journal of Economics*, 1978, *9*, 587-608.
May, E. R. *"Lessons" of history*. New York: Oxford University Press, 1973.
Mehle, T., Gettys, C., Manning, C., Baca, S. & Fisher, S. The availability explanation of excessive plausibility estimates. *Acta Psychologica*, 1981, *49*, 127-140.

Mishan, E. S. *Cost-benefit analysis*. New York: Praeger, 1976.
Montgomery, H. Decision rules and the search for a dominance structure. In P. C. Humphreys, O. Svenson and A. Vari (Eds.), *Analysing and aiding decision processes*. Amsterdam: North Holland, 1983.
Naughton, J. Anti-war warriors. *The Observer*, October 18, 1981, 35.
Newell, A. The knowledge level. *AI Magazine*, Summer 1981, 1-20.
Newell, A. & Simon, H. A. *Human problem solving*. Englewood Cliffs, NJ: Prentice-Hall, 1972.
Otway, H. J. & von Winterfeldt, D. Beyond acceptable risk: On the social acceptability of technologies. *Policy Sciences*, 1982, *14*, 242-256.
Peterson, C. & Beach, L. Man as an intuitive statistician. *Psychological Bulletin*, 1967, *68*, 29-46.
Poulton, E. C. Quantitative subjective assessments are almost always biased, sometimes completely misleading. *British Journal of Psychology*, 1977, *68*, 409-425.
Poulton, E. C. Biases in quantitative judgments. *Applied Ergonomics*, 1982, *13*, 31-42.
Raiffa, H. *Decision analysis*. Reading, MA: Addison-Wesley, 1968.
Ravetz, J. *Scientific knowledge and its social problems*. Oxford: Clarendon Press, 1971.
Richardson, O. MX missile—Reagan's Maginot line? *New Scientist*, November 26, 1981, 609-612.
Roberts, A. The alternative, non-nuclear way to defend ourselves. *New Society*, February 4, 1982, 175-177.
Rokeach, M. *The nature of human values*. New York: Free Press, 1973.
Rosenthal, R. & Rosnow, R. (Eds.) *Artifact in behavioral research*. New York: Academic Press, 1969.
Rowe, W. D. *An anatomy of risk*. New York: Wiley, 1976.
Schell, J. *The fate of the earth*. New York: Knopf, 1982.
Schemmer, B. F. Pentagon planners hope for better year in 1981 than 1980 was for C³, electronic warfare/intelligence and ASW programs. *Armed Forces Journal International*, February 1981, 22-28.
Sheridan, T. B. Human error in nuclear power plants. *Technology Review*, 1980, *82*(4), 23-33.
Simon, H. A. *Models of man*. New York: Wiley, 1957.
Sjöberg, L. The risks of risk analysis. *Acta Psychologica*, 1980, *45*, 301-321.
Slovic, P., Fischhoff, B. & Lichtenstein, S. Behavioral decision theory. *Annual Review of Psychology*, 1977, *28*, 1-39.
Slovic, P., Fischhoff, B. & Lichtenstein, S. Facts and fears: Understanding perceived risk. In R. Schwing & W. A. Albers Jr. (Eds.), *Societal risk assessment: How safe is safe enough?* New York: Plenum, 1980. (a)
Slovic, P., Fischhoff, B. & Lichtenstein, S. Perceived risk and quantitative safety goals for nuclear power. *Transactions of the American Nuclear Society*, 1980, *35*, 400-401. (b)
Slovic, P., Fischhoff, B. & Lichtenstein, S. Characterizing perceived risk. In R. W. Kates & C. Hohenemser (Eds.), *Technological hazard management*. Cambridge, MA: Oelgeschlager, Gunn & Hain, 1983.
Social Indicators III. Washington, D. C.: U.S. Government Printing Office, 1980.
Starr, C. & Whipple, C. Risks of risk decisions. *Science*, 1981, *208*, 1114-1119.
Stech, F. J. Intelligence, operations and intentions. *Military Intelligence*, 1980, July-September, 37-43.
Svenson, O. *A vulnerable or resilient society? Some reflections on a problem area*. Report No. 19. Stockholm: Swedish Council for Social Science Research, 1979.
Taylor, S. & Fiske, S. Top of the head phenomena. In L. Berkowitz (Ed.), *Advances in experimental social psychology, Vol. 11*. New York: Academic Press, 1978.
Tetlock, P. E. Sources and consequences of policy makers' images of international conflict. *Journal of Social Issues*, 1983, *39*(1), 67-86.
Tribe, L. H. Policy science: Analysis or ideology. *Philosophy and Public Affairs*, 1972, *2*, 66-110.
Turner, C. F. & Krauss, E. Fallible indicators of the subjective state of the nation. *American Psychologist*, 1978, *33*, 456-470.

Turner, C. & Martin, E. *Survey measures of subjective phenomena*. Washington, D.C.: National Academy of Sciences, 1982.
Tversky, A. Elimination by aspects: A theory of choice. *Psychological Review*, 1972, *79*, 281-299.
Tversky, A. & Kahneman, D. The framing of decisions and the psychology of choice. *Science*, 1981, *211*, 453-458.
Tyler, T. R., & McGraw, K. The threat of nuclear war: Risk interpretation and behavioral response. *Journal of Social Issues*, 1983, *39*(1), 25-40.
U.S. National Academy of Sciences. *The effects of thermonuclear war*. Washington, D.C.: Author, 1975.
U.S. nuclear industry cries for help. *Business Week*, August 31, 1981, 70-71.
U.S. Nuclear Regulatory Commission. *Reactor safety study*. Washington, D. C.: Author, 1975.
U.S. Nuclear Regulatory Commission. *Risk assessment review group*. Washington, D.C.: Author, 1978.
U.S. Nuclear Regulatory Commission. *Risk assessment review group*. Washington, D. C.: Author, 1981.
Vlek, C. A. J. & Stallen, P. J. M. Rational and personal aspects of risk. *Acta Psychologica*, 1980, *45*, 273-300.
Wallsten, T. (Ed.) *Cognitive processes in choice and decision behavior*. Hillsdale, NJ: Erlbaum, 1980.
Wallsten, T. & Budescu, D. Encoding subjective probabilities: A psychological and psychometric review. *Management Science*, 1983.
Wohlstetter, R. *Pearl Harbor: Warnings and decision*. Stanford, CA: Stanford University Press, 1962.
Young, H. CND and the perils of nuclear secrecy. *The Observer*, November 1, 1981, 32.
Zuckerman, S. *Nuclear illusion and reality*. London: Collins, 1982.
Zusman, P. The dynamics of economic growth, technological force buildup—some strategic tradeoffs. In Lanir, Z. (Ed.) *Defense and national economy in the 1980's*. Ramat Aviv, Israel: Tel Aviv University, 1983.

Journal of Social Issues, Vol. 39, No. 1, 1983, pp. 161-180

Social Science and the Politics of the Arms Race

Baruch Fischhoff
Decision Research, Eugene, Oregon

Nick Pidgeon
University of Bristol, Bristol, England

Susan T. Fiske
Carnegie-Mellon University, Pittsburgh, Pennsylvania

Folks don't often try to mix psychology and politics. When they do, there are a number of reasons, including the hunt for interesting data, the wish to be useful to society, and the desire to influence political events. Political involvement itself can assume a number of forms, including helping to shape a political program, helping to sell the program, uncovering the subtle ways in which the opposition has structured public discussion of the issues, and doing battle with opposition experts. Often, political involvement is viewed as the irreconcilable enemy of good science. Yet, the two seem to be very intertwined, with political considerations shaping science in many ways and science helping to shape society in return. By confronting the interdependence, it is possible to create a more deliberate science and one more effectively applied to social problems. In the context of studying people's images of nuclear war, several of the key issues are the degree of respect that psychology implicitly affords to the judgments of experts and of laypeople, as well as the role that it envisions each filling in the determination of defense policy.

We wish to thank John Churcher, Nancy Collins, Lita Furby, Elena Lieven, Joseph McGrath, Joshua Menkes, Michael Milburn, Alan Russell and Tim Shallice for helpful comments on previous drafts. Partial support was provided by the National Science Foundation under Grant 8116925 and by the U.K. Medical Research Council.

Correspondence regarding this article should be addressed to Dr. Baruch Fischhoff, Decision Research, 1201 Oak, Eugene, OR 97401.