Objectives and themes

Extreme Event Decision Making Workshop

Objectives

The workshop focus is the development, organization, prioritization, and exposition of two lists:

List A: What do we know about decision making that we can apply to extreme event decision making (XEDM), i.e., what are the most promising transfers from decision research to XEDM?

List B: What do we need to know, and what are the most important topics for XEDM research?

It is important to keep in mind that the audience for this workshop product is NSF and our fellow researchers. We are not advising policy makers or emergency managers or citizens on how to make better decisions about extreme events. We are advising NSF regarding the kinds of research projects that need to be undertaken, and informing our colleagues about research needs in this area.

In addition to general research topics and research strategies, we would like to see a few specific project ideas, possibly appropriate for an SGER grant, emerge from this workshop. (You will find a description of SGER grants at the end of this document.)

Themes

Upon reading the statements submitted by workshop participants, some major themes emerge. Busemeyer's statement, in particular, is very helpful in identifying those themes. The following is an attempt to organize important themes embodied in the statements, as well as themes from other literature, in a way that will be useful for structuring the workshop discussion. This brief outline is sketchy, surely has gaps, and does not do justice to the statements themselves. It is offered here as a point of departure for exploring relations among ideas.

1. Research design and research method

1.1 Research methods and strategies

To what extent can the results of laboratory studies be applied to XEDM? Can experimental analogs (Mellers) be developed? If it is necessary to leave the laboratory (Kirlik), how should studies in the field be designed?

1.2 Structure/taxonomy

Categorization can facilitate generalization, so long as it does not obscure important differences. Several statements stress the importance of developing a taxonomy of extreme events (Busemeyer, DeKay, Hammond, Herrick, Kirlik). DeKay asks whether the categorizations used in traditional risk analysis work can be useful. Hammond calls for a theory of extreme events that describes how they evoke different cognitive responses.

Several important distinctions have been proposed:

1.2.1 Stakeholders/Decision makers

Different stakeholders face different choices, different constraints, and different opportunities. Faragó describes categories of stakeholders: general population, government agencies with the aim to prevent and act during catastrophic events (firefighters, military), media, and local self forming groups. Hammond distinguishes among citizens, command and operational personnel and policy makers. Table 1 proposes a taxonomy of stakeholders that has elements of both.

Table 1. XEDM Stakeholders

Stakeholders that are organized informally	**Stakeholders that are acting within formal organizations**
• Individuals and households • Groups and communities that form due to a common interest or geographic proximity.	• Local government • Businesses • NGO's • Regional government • National government • International bodies

1.2.2 Rapid onset (e.g., earthquake) vs. creeping change (e.g., global climate change)

Differences in the time that it takes an extreme event to develop have profound decision making implications. The participant statements generally addressed rapid onset events, although many of the concepts apply to creeping change as well. It is likely that this will also be true at the workshop, and we must be clear about which type of event we are talking about.

1.2.3 Event phase

Svenson distinguishes among three phases: before the event, during the event, and after the event. Wallace also distinguishes between strategic risk management (before and after) and operational risk management (during). These are compelling distinctions because different phases create different decision contexts and require different decisions. Nevertheless, some themes cut across phases.

1.2.4 Geographic scale and uniqueness

We face some truly unprecedented global events (e.g., global climate change or massive communications failures). These are not only rare, they have never happened before (at least in human history), and their effects are global in scale. Are there useful analogs that will help us study such events?

On the other hand, we face local and regional events (earthquake, power grid failures, hurricanes) that are rare and may be unprecedented in any particular place, but have occurred often in various locations. For these events, there is knowledge and

experience that is geographically dispersed. The problem is to make it available when and where it is needed.

The role of experience in learning to prepare for and cope with events differs dramatically for these two kinds of events.

2. Improving the decision process

2.1 Norms and normative methods (decision analysis)

What is the role of normative methods in the evaluation and choice of alternatives (Busemeyer, Krantz, DeKay, Kirlik)? Kirlik argues that actions are often taken for other reasons than maximizing utility, and decision theory often is not based on an adequate domain model. DeKay proposes the use of the "precautionary principle" as a norm for decisions under uncertainty that have potentially irreversible consequences. Krantz proposes a list of norms for decision making.

2.2 Use of decision support and decision aids

Decision aids can encode experience gained in other locations and can implement advance planning. Arkes says that professionals are reluctant to use them, and cites liability as one possible reason. Wallace discusses the use of decision aids in emergency management.

2.3 Learning and training

Herrick asks how we can learn from professions where extreme events are routine (firefighters, rescue units)? Svenson discusses the importance of post-event learning. Mumpower suggests that judgmental performance in situations involving rare events will be improved by finding means to improve cognitive control through practice in simulated conditions. Krantz discusses training for extreme event response.

3. The nature and context of the decision making process

3.1 Dynamic context of decision making

Both Kirlik and Weaver describe the dynamic nature of the decision process within a decision context that is changing over time.

3.2 Importance of the systems, environment, and context for decision making

Hammond, Kirlik, and Weaver emphasize the importance of studying the environment for judgment and decision making. Arkes has found that, in hind sight, people are more willing to blame the person than the system, even though the system is a major part of the problem.

3.3 Uncertainty and duality of error: False positives and false negatives

Mumpower describes the two kinds of error that can result from decisions under uncertainty. False alarm effects discussed by DeKay, Herrick, and Zimmerman. DeKay argues that "false alarm effects" may not be as important as some think they are.

3.4 Value tradeoffs and moral decisions

Irwin raises the question of the value tradeoffs and moral decisions involved in preparing for and preventing (if possible) extreme events.

4. Decision making activities

4.1 Problem detection (Busemeyer), prediction, and forecasting

How do we become aware of the possibility of an extreme event? How do we assess the uncertainty involved? How does that awareness spread to various stakeholder groups?

4.2 Problem representation and problem solving

"The decision maker tries to understand what has happened and this understanding forms the initial conceptual representation of the problem. The initial conceptualization of the event or perception of the event may also have far reaching impact on how the problem is attacked (Herrick, Kirlik), and the problem solving methods that are brought to bear." (Busemeyer, p. 2).

Herrick discusses problem definition, framing, and sense making, which can facilitate or inhibit problem solving. The creative process of generating new alternatives that solve problems (see, for example, Hammond's stress book) is critical to successfully coping with extreme events.

4.3 Analysis, planning, and policy making

This is a major theme in many of the statements. Clarke talks about organizational planning for worst cases, and the positive and negative outcomes of such planning. Krantz discusses planning and planning horizons.

Kirlik points out that preparation is critical and some organizations have a strong preference for "off-line decision making." The decision support and decision aids (Arkes) that may be useful during the event can only be developed prior to the event, when there is sufficient time.

4.4 Communication

Communication among stakeholders during all phases of the event is critical. Communication between experts and policy makers and the general public (risk communication) clearly applies here (Zimmerman, Faragó). Communication within and between organizations is also important.

4.5 Time pressure, emotional reaction, and stress

Events that involve uncertainty, high consequences, novelty, and time pressure are likely to produce strong emotional responses that may interfere with effective decision making ("emotions play havoc with plans," Busemeyer).

Several authors discuss these topics (Busemeyer, Faragó, Mellers, Svenson, Hammond). Faragó points out the interaction between information provided to the public and stress. More information does not always reduce stress.

4.6 Implementation

"It is one thing to choose a strategy, but quite a different issue to implement it. Both Arkes as well as Svenson raise this issue. Kirlik points out that decisions may fail to be implemented if they are based on abstractions into irrelevance, which often tends to happen in decision analysis. Implementation requires public and political support, technological means, and investment of resources, forming a causal chain that is easily broken (Clarke and Herrick)." (Busemeyer, p. 3)

NSF Small Grants for Exploratory Research (SGER)

Proposals for small-scale, exploratory, and high-risk research in the fields of science, engineering, and education normally supported by NSF may be submitted to individual programs. Such research is characterized as preliminary work on untested and novel ideas; ventures into emerging research ideas; the application of new expertise or new approaches to "established" research topics; having extreme urgency with regard to availability of or access to data, facilities, or specialized equipment, including quick-response research on natural disasters and similar unanticipated events; and efforts of similar character likely to catalyze rapid and innovative advances.

NSF strongly encourages investigators to contact the NSF program(s) most germane to the proposal topic before submitting a Small Grant for Exploratory Research (SGER) proposal. This will make it easier to determine whether the proposed work meets the SGER guidelines described here and the availability for funding, or whether it would be more suitable for submission as a fully reviewed proposal.

The project description must be 2 to 5 pages long. It should include a clear statement that explains why the proposed research should be considered particularly exploratory and high risk and the nature and significance of its potential impact on the field. In addition, an explanation should be included as to why an SGER grant would be the best means of supporting the work.

Brief biographical information is required for the principal investigator (PI) and co-PI(s) only, and should include a list of no more than five significant publications or other research products. The box for "Small Grant for Exploratory Research" must be checked on the cover sheet.

These proposals will be subject to internal NSF merit review only. Renewed funding of SGER awards may be requested only through submission of a non-SGER proposal that will be subject to full merit review. The maximum SGER award amount will not exceed $100,000. Although the maximum award amount is $100,000, the award amount usually will be substantially less than a given program's average award amount. The project's duration will normally be one year, but may be up to two years.

For participating directorates and at the discretion of the program officer with the concurrence of the division director, a small fraction of especially promising SGER awards may be extended for up to 6 additional months and supplemented with up to $50,000 in additional funding.

These award extensions will be possible for awards with an initial duration of 2 years or less. Requests for extensions must be submitted 1 to 2 months before the expiration date of the initial award. A project report and an outline of the proposed research (not to exceed 5 pages) must be included.