Participant Notes

Tim McDaniels
Professor,
Institute of Resources and Environment
and School of Community and Regional Planning
University of British Columbia
Vancouver, BC, Canada
timmcd@interchange.ubc.ca

Risk Management for Extreme Events:
A Role for Adaptive Learning?

My professional orientation and my ongoing work in policy contexts color my perspectives on extreme events such as terrorism. My training is in decision making, risk management and public policy. My professional orientation over the last few years has been in global environmental change, water resources, value elicitation and decision-aiding, all with an emphasis on decision processes to foster informed and relevant citizen input into complex policy choices. From this experience, I have developed an ongoing interest in adaptive management, or active experimentation and learning over time, as a means to foster better policies. These perspectives form the basis for my statement below.

Overview: the relevance of the SEU paradigm

One interesting theme on bulletin boards and in the academic writing on extreme events is questioning the role of the subjective expected utility paradigm. Are low probability/high consequence extreme events, ranging from terrorism events, to natural disasters, to industrial system breakdowns, so different from other kinds of decisions that they require a different conceptual framework for decision making under uncertainty? If we accept the current framework, do these kinds of events require different kinds of policy responses?

My own view is that the subjective expected utility framework is conceptually suitable, in normative terms, for addressing all kinds decisions, including extreme events in which probabilities may be highly ambiguous, and the range of threats is vast. By this, I mean to say that SEU is a conceptually appropriate **normative** framework in situations in which there is a single decision-maker or when we can generalize its precepts to help inform a pluralistic decision process. But providing the norm for how to mathematically compare the probabilistic

performance of alternatives is a far cry from giving us clear direction on how to proceed to make better choices. In fact the SEU paradigm says nothing about "how to do it". It simply states the conceptual underpinnings used to define the notion of optimality, given multiple objectives and uncertainties.

How we use this conceptual foundation to help make better choices in practice is the concern of the under-explored field of prescriptive decision making. A prescriptive view of decision process, with an emphasis on some particular kinds of adaptive learning and adaptive response, seems to me to be our best hope for creating better policies toward terrorism and other kinds of extreme events.

Under the SEU paradigm, the underlying orientation of the decision process is predictive instrumentalist. That is, we attempt to forecast the uncertain consequences of alternatives, and then articulate our preferences for those consequences as basis for selecting a preferred alternative. Hence the orientation is on prediction and evaluation of outcomes. SEU decision-making is often seen more as a one-shot event than an ongoing process, simply because of how the framework is articulated. While value-of-information concepts are important in SEU, how those concepts are applied in practice and become part of the institutional framework has not been fully considered for extreme events.

Instead of proposing an alternative paradigm to replace SEU, I think we should consider how to implement its precepts in much more incremental and adaptive ways, with greater emphasis on learning about vulnerabilities, threats and creating adaptive and informative responses.

Learning and Adaptive Response for Terrorism Policies

The writing on adaptive management and social learning originated with efforts to manage complex renewable resource systems like fisheries. It became clear that attempts to "optimize" resource harvest levels when so little is known about the dynamics or underlying science of the systems, and when there are strong political forces pushing in one direction, were steadily leading to resource management disasters. Hence, building on the original work of Holling, Walters, and others, the notion of *adaptive management* became well recognized in concept and has seen growing practice. Adaptive management essentially says that all our policies are experiments, given the uncertainties of the real world. In that case, we should do things that capitalize on the experimental nature of our policies. These steps include: (i) making policy choices that are designed to provide more information for better choices over the long term, (ii) monitoring carefully, (iii) recognizing that experiments can go wrong and so be ready to accept small policy failures, (iv) using experimental designs where relevant, (v)

and viewing any current policies as the initial steps in a series of recurring policy choices stretching over decades.

With an adaptive management orientation, the conceptual emphasis is on trying something (including different things in different places), monitoring, and then adjusting to better reach a defined target, or a set of policy objectives. In a sense, a comparison between an adaptive management approach to policy design and standard SEU-based policy analysis is like the comparison between fuzzy set theory and probability. Both fussy sets and probability are means of addressing uncertainty. However, fuzzy sets are in practice more adaptive, while probabilities are in practice more oriented towards prediction. Your hand-held video camcorder with a fuzzy logic chip is constantly taking in information, updating its understanding of the external world (the image) and adjusting to new information to refine its representation of the image and be in focus. If you can imagine it, a probabilistic video camcorder would predict the expected value of what should be in focus, consider the value of collecting more information on focus, and probably leave it at that. The former is more adaptive, while the latter is predictive.

This distinction begins to suggest ways to rethink our policy approaches to terrorism and other extreme events. Part of the process has to be experimentation and learning over time. Developing blanket national policies about, say, how baggage is handled at airports gives us little opportunity to try different policy instruments, different technologies, or different levels of security. As a result, we have little means to actually learn how to achieve the policy objectives we are trying to pursue.

Part of learning over time could be devoted to issues of screening vulnerability. As policy experiments, we could consider different approaches to learning about vulnerability, and different policy regimes that may lead to different kinds of vulnerabilities. Perhaps methods could be adopted from computer security to help in this regard. In that context, computer security firms hire hackers to see if they can penetrate a given computer system. Perhaps constant probing, and experimentation with hired testing agents would give us more information about vulnerability in our broader security systems.

Another way to foster creative thinking about vulnerabilities is to consider systems of critical infrastructure, and develop scenarios about how that infrastructure could possibly be attacked at weak points. This kind of thinking leads managers to reconsider possibilities as a first step, and reframe thinking out of the status quo. It also emphasizes the system-wide features of our vulnerabilities, and the interconnected nature of our critical infrastructures

Aside from looking for vulnerabilities, there also is the possibility of screening behavior on a massive scale. One of the main reasons terrorism is so surprising, perverse and dangerous is that the participants are willing to do things others are not, such as sacrifice their lives to threaten or harm others. Hence, these actions are by definition not predictable by following our own logic, constrained by our norms. We may therefore be wasting time trying to predict the frequency with which terrorist activities of a given kind will occur.

In that case, screening behaviors on grand scales, and developing rapid, incremental responses when hints of potential danger is detected, may prove to be a more fruitful strategy than prediction of events. It may be that using the whole population to help screen for the beginnings of strange and threatening events, and empowering nearby citizens to help respond to crises in some cases, may prove highly valuable as mechanisms to reduce vulnerabilities, and the severity of consequences if an event does occur.

Objectives and Value Tradeoffs

To intelligently discuss policies about extreme events like terrorism, or mechanisms to provide learning about these policies and the events, we need to be clear about objectives. The objectives for controlling terrorism may seem obvious: we do not any repeats of the September 11 crisis. Yet the surest way to absolutely guarantee that the September 11 events will never recur is to ban commercial air travel. We do not consider that prospect because the costs to the economy, and to personal freedom would be too high. Another way to help forestall any recurrences would be to send every person of Arabic descent out of North America. We do not do that because the effects on human and legally enshrined rights would be too great. Hence we have some sense of the multiple objectives that should guide our policies, but they are not well-articulated.

One of the most useful steps that could be taken is to clarify the multiple objectives that should guide the development and evaluation of policies regarding control of terrorism. Approaches for clarifying multiple objectives for policy questions from diverse viewpoints are well developed, and could be readily applied in this context.

A clearly articulated and widely-supported set of objectives for policy decisions regarding issues like terrorism would be useful in many ways:

(i)   it could serve as the basis for defining information requirements to responsibly compare alternatives;

(ii)   it could help provide the basis for creating new, more widely supported alternatives, that stand a greater chance of implementation;

(iii)   it could serve as the basis for either qualitative or quantitative evaluation of alternatives, both ex ante and ex post. For example, how will we know if current policies are a success?

One crucial point in creating objectives for policy decisions regarding terrorism would be to clearly recognize the importance of learning over time as a fundamental objective for current policy decisions. This emphasis would more squarely underscore the role of adaptive management in these issues, as a way to provide better alternatives, and better outcomes, over the long term.

A similar line of reasoning regarding objectives for global change issues is discussed in:

Keeney, R. and McDaniels, T., 2001, "A Framework to Guide Thinking and Analysis about Climate Change Policies," *Risk Analysis*. December.