

Extreme Event Based Decision Making

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What are the Processes?

As a cognitive scientist, I try to imagine the process that occurs from start to end of an extreme event. Of course, different processes are involved in different types of events, and that is one reason why categorization of extreme events (stated by *DeKay*, *Hammond*, *Herrick*, *Kerlik*) is important. However a common and general view is summarized as follows.

Problem Detection. To start, there must be some problematic state of the world that is brewing trouble, but often goes undetected before it blows up allowing the extreme event to manifest its ugly head. On this point, I agree wholeheartedly with *Svenson* that decision scientists know very little about problem detection, and we need much more research on this issue. The only formal that work I can recall is methods developed in operations research for failure detection or detection of change in manufacturing and quality control. False alarm effects discussed by *DeKay*, *Herrick*, and *Zimmerman* have a serious impact on this initial part of the process.

Emotional Reaction. Given the catastrophic consequences that usually follow an extreme event, panic is aroused as pointed out by *Fargo*. Government awakes to an alarm, and decisions must be made about information and prescriptions for the public. What information to convey (*Fargo*) and what information to use (*Herrick*) becomes a critical question at this point. *Clark's* social liquefaction starts its meltdown. Clearly, research on

emotions advocated by *Meller's*, and research on time pressure reviewed by *Svenson*, and research on stress reviewed by *Hammond* are critical for this stage.

Problem Representation. 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, Kerlik*), and the problem solving methods that are brought to bear.

Generation of Alternatives. The problem solving process starts to kick in. The decision makers begin generating a list of potential strategies for dealing with the event. Expert and highly experienced decision makers (such as the red cross workers, rescue operators, firefighters, police, ect) may be able to rely on the recognition primed process described by *Klein* (see also *Herrick's* statement). Government leaders may not be quick to come up with good solutions. *Krantz* provides a potentially useful set of norms for generating options including construction of decision trees, generating multiple (possibly redundant) solutions. *Hammond* outlines research for assessing people's intuitions for solutions to some well-known events. There is a vast literature on problem solving (means ends analysis, problem solving by analogy) in cognitive science that may help inform this stage.

Decision Making. Choosing a strategy for implementation is quite a different matter. Once a few options are on the table, they need to be evaluated with respect to probabilities of success and multiple conflicting objectives; both are sources for serious disagreements as pointed out by *Clark* and *Fargo*. Research on how people actually make these decisions under extreme event conditions is hard to find due to the rare nature of the

events and the legal or politically sensitive nature of many events. However, *Hammond* has made some progress on this in his research. One provocative issue concerns normative methods for dealing with this stage. On the one hand, *Arkes* recommends and seeks ways to encourage use and implementation of current decision aids based on multi-attribute expected utility theory, whereas *Krantz* seems to question the applicability of these methods except for a very limited domain, and *DeKay* seems to lie in the middle of this issue (I may be overstating here to raise the controversy). *Krantz* provides a provocative new list of norms that entail much weaker decision making assumptions.

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. *Kerlik* 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 (*Clark* and *Herrick*).

Feedback and Learning. After the event and the actions to ameliorate its consequences, it is time for learning from experience. *Arkes* points out that identifying the true cause is critical here, and he points out that often hindsight bias gets in the way of this process. Stewart (in the proposal) questions whether learning is of any use for extreme events because of their rare and unique nature. I challenge this and argue (as did *Herrick*) that learning remains crucial. However, learning is based on generalization or analogy from similar rather than identical experiences. Case based models of learning or exemplar based models of categorization, which rely on similarity rather than identity, may play an important role in this process.

Planning for Future Events. Learning from the past supports plans for the future. Planning for events as opposed to reacting to events seems to be a bifurcation point in the analysis of extreme events (*Clark, DeKay, Kerlik, Krantz, Svenson, Mellers*). *Clark's* worst-case analysis provides one effective way to think about this, however, he also points out drawbacks with this approach. I would like to make an important contribution to this part of the discussion. Emotion can play havoc with plans. Plans are usually made under a calm, intellectual, rational, unmotivated state. Whereas action must be taken under panic, highly motivated, stressed, states. The same nominal individual may make the plan and be responsible for carrying out the plan, but psychologically, there are two completely different people involved (sharing only the same body), and quite often these two are in complete disagreement. The planning person focuses on one set of objectives and values different goals than the person responsible for carrying out the action (see Busemeyer, et al. 2000). Emphasis suddenly shifts, attention switches to new features, and the plans are changed midstream. Moreover, it is difficult to stand outside and decide which of these two people (sharing the same body but disagreeing about the decision) are correct. Which one should we follow -- the cool headed planner far removed from the event or the hotheaded actor in the middle of the event?

Reference

Busemeyer, J. R., Weg, E., Barkan, R., Li, X., & Ma, Z. (2000) Dynamic and consequential consistency of choices between paths of decision trees. *Journal of Experimental Psychology: General*, 129, 530-545.