# Emergency Decision Making and Metacomplexity

**Siegfried Streufert**

SUNY Upstate Medical University, Syracuse, NY, USA
e-mail address

**ABSTRACT**

It is important to understand the cognitive processes underlying emergency decision-making. Cognitive/behavioral complexity theory has successfully predicted human decision making characteristics on a number of dimensions and for a variety of settings. Moreover, theory based training technologies have been successful. The advent of meta-complexity theory as well as the increased stressor levels generated by terrorism and other contemporary challenges, however, require that we review and extend theoretical predictions for decision processes. This paper provides a series of meta-complexity based predictions about the impact of stressor events upon nine primary decision making areas that vary from simpler trough highly complex thought and action processes.

**Keywords**

Complexity, decision-making, emergency, measurement, meta-complexity, training.

## COMPLEXITY AND DECISION-MAKING

Decision-making and the dilemmas imposed by the necessity to decide have been a human problem for millenniums. Psychologists have studied the decision-making process since the inception of their science (e.g., Merton, 1936; Janis and Mann, 1977; Weiss, 1980). Much emphasis has been placed on specific individual decisions at given choice points wherever the outcome cannot be entirely predicted [e.g., work based on Bernoulli's Utility Theory and Savage's (1954) Subjective Expected Utility Theory; Van Neumann and Morgenstern's (1947) Expected Utility theory, Coomb's (1964) Risk Preference Model as well as related conceptualizations of human decisions and their underlying thought processes (cf. also Sevenson et al., 1990)]. Considerable research based on a number of models of human functioning has emerged from that approach. Many among those efforts are concerned with predicting or explaining the single most likely decision (or the decision made by a person or group who tends to have specific choice tendencies) or with training toward more rational decision-making. These approaches are far removed from decision making under emergency conditions.

A quite different approach has been taken by theorists and researchers who base their approach upon complexity theory. Initially, complexity predictions focused only on impressions and interpersonal choices (as well as decisions drawn from those choices). Interpretations were based on perceptual characteristics of individuals (e.g., Asch, 1946; Berkowitz, 1957; Bieri, 1955, 1961; Scott, 1963; Witkin et al., 1962). Complexity theory was extended to encompass decision-making *per se* by Schroder, Driver and Streufert (1967). In contrast to other approaches, complexity theorists have been less interested in the specific decision outcome in response to some dilemma or in response to uncertainly. Rather, complexity theorists focused on the cognitive processes underlying any decisions that would be made, and on training that would improve decision processes. Recognizing, for example, that excess environmental information input (e.g., during an emergency) is a stressor that can overwhelm the available processing capacity of a decision-maker or of a decision-making team (e.g., Buner, Goodnow and Austin, 1956; Miller, 1956, Osgod, Suci and Tannenbaum, 1957), these scientists chose to analyze the interactive impact of environmental conditions and of the indvidual's cognitive capacity as they jointly affect the decision making processes and decision outcomes. Moreover, these theorists realized that decisions made are sequential, i.e., that any choice of a particular decision that has been made will have future consequences that can restrict subsequent choices and may generate additional but different choice options.

Research efforts based on the complexity theories of Schroder et al., 1967) and Streufert and Streufert (1978) have been primarily carried out between 1965 and 1985. The obtained data have shown that increases in environmental information load result in an initial improvement in strategic (integrative) decision making and, once higher stress levels are reached, for example in emergency settings, in a subsequent decrease and final collapse of strategy. Individual differences in cognitive complexity determine the highest performance level that is attained when independent information reaches the decision maker at a rate of one significant information item every three minutes (Streufert and Schroder, 1965). The capacity to apply greater breadth (differentiation) to decisions follows the same inverted U-shaped pattern as the capacity to apply strategy (integration), however the levels attained at optimal loads tend to be somewhat higher (Streufert, 1970).

Equivalent results are generated when perceptual competency is measured (Streufert and Driver, 1965). Cognitively complex individuals try to adjust their information search activity in an attempt to attain optimal load levels (Streufert, Suedfeld and Driver, 1965) and try to avoid information that does not generate novel conceptualizations of the situation at hand (Suedfeld and Streufert, 1966). Cognitively complex individuals, moreover, develop more initiative with less dependence on environmental information input (Heslin and Streufert, 1968). The capacity to effectively handle emergencies is also greater where a decision maker's cognitive complexity is present.

Similar results are obtained as a consequence of failure experience. Limited failure generates better performance, while high levels of failure result in deterioration of strategic thought and action (Streufert, Streufert and Castore. 1969). However, high failure experience does not necessarily generate a decrease in responsive (contextual) activity (Streufert, 1969). Cognitively complex individuals also engage in less direct search as failure reaches high levels (Streufert and Castore, 1971). Information relevance has its own effects on decision-making. It is interesting to note that people base their decisions on incoming information, no matter whether that information is directly relevant to task demands. Information relevance and importance are overestimated when information flow is normal but relevance is low, and is underestimated when relevance is high (Halpin et al., 1971; Streufert and Streufert, 1970).

Risk taking in decision settings also increases with incoming information load and decreases somewhat as load levels become super-optimal (Streufert and Streufert, 1968). Risk taking appears to be greater when decision makers perceive that their control of the task environment is limited (Higbee and Streufert, 1969). Training technologies permit improvement in the thought processes underlying decisions and, of course, in the quality or the decisions themselves (e.g., Streufert, Nogami, Swezey, Pogash and Piasecki, 1988).

In sum, complexity theory based research has analyzed the effects of a number of stressor conditions (e.g., load, failure and emergencies) upon the information processing characteristics that lead to decisions. Researchers have shown that decision-making response rates (divided into strategy, breadth and contextual one-to-one responding) vary with (a) incoming information characteristics (load, failure, success, relevance) and with the cognitive complexity of the decision maker. While competencies that require more sophisticated thought and action processes (strategy and breadth) initially generate greater output as stressor conditions (load, success, and failure) are optimal, these processes tend to diminish as stressor conditions exceed optimal levels. In contrast, simpler responsive one-to-one decisions that deal directly with contextual demands increase with stressor conditions and reach an asymptote at the limit of the decision maker's capacity (Streufert, Driver and Haun, 1967).

With the advent of the 1980s, most of the decision-making propositions of complexity theory had been supported by research and training to improve decision-making had been shown to be effective. Theory based efforts turned to other phenomena. Two developments, however, suggest that we once more need to deal with the interrelationships between environmental/cognitive phenomena and decision making: (1) complexity theory has been updated and expanded into meta-complexity theory (Streufert, 1997), and (2) dangerous emergency conditions with high impact (such as nuclear accidents and terrorist attacks) have vastly expanded the range of conditions that need to be considered when we with to analyze and predict decision making. This paper will extend predictions to begin to cover that range.

## NEW DEVELOPMENTS

### Meta-complexity

The casual reader of cognitive/behavioral complexity theories may conclude that employing strategy (integration) and/or breadth of approach (differentiation) is "good" and that engaging in simpler responsive actions (contextual functioning) is "bad," i.e., ineffective. Complexity theorists (e.g., Streufert and Streufert, 1978), however, did not intend to communicate an evaluative judgment; they merely suggested that certain task demands are better met with greater breadth and strategy. The meta-complexity approach (Streufert, 1997) not only states that different competencies are needed to optimally handle different specific task characteristics; it also lists a number of separate competencies and sub-competencies that, depending on the task at hand, are required to achieve success. The competencies can be assessed via a simulation technology (Satish and Streufert, 1997) and can be trained (Ramachandran et al., 2004; Satish and Streufert, 2002; Streufert et al., 1988). Contemporary theory, then, should trace the impact of environmental stressors such as dealing with serious emergencies (including excessive load, failure and more) upon at least the primary decision-making performance measures discussed by the meta-complexity approach.

### Contemporary environmental stressors

As suggested above, research based on complexity theory utilized various stressor conditions (e.g., load, failure, relevance and more) that varied from mild deprivation via optimal conditions to mild overload levels. However, war, nuclear disasters and terrorist attacks provide stressor levels that vastly exceed "mild overload." Even in some medical settings, stress upon personnel can be severe (e.g., World Health Organization, 2004). In other words, we must develop predictions and, in the long run, develop research projects that test decision-making characteristics under more severe stressor conditions. Some scientists argue that decisions in such settings might be more effective if they are made by digital computers (cf. the work of Caro, 2000; Slap, Hillman and Moore, 1998). However, the possible effectiveness of computer generated (or assisted) decisions may apply more to complicated rather than to complex settings. Computer based decision-making will not likely work where VUCAD (volatility, complexity, uncertainty, ambiguity and delayed feedback) are present (cf., Streufert and Satish, 1997), i.e., in settings that take the decision maker to the edge (Kauffman, 1995) of, or even beyond "chaos" (Gleick, 1987). For such settings, computer programs that attempt to match human decision-making are difficult to devise. For that matter, the highly successful decision-maker's "intuitive holistic approach" that has been described by Mintzberg as "far too complex for rational analysis" (cf., also Isenberg, 1984) does not lend itself to transcription into computer software.

In other words, crisis decisions are most effectively made by humans. Unfortunately, however, human decision-makers are, at times, less than perfect. As Belanger (2001) has pointed out, the majority of disasters (e.g., in aircraft crashes) are due to human error (not due to mechanical failures) and in some cases, e.g., the Three Mile Island accident, the stressor levels (such as information load) far exceed the response capacity of human decision makers as well as their available knowledge.

Concerns about approaches to crisis decision-making have been discussed, and recommendations have been made by a number of authors (e.g., Caro, 2000; Cohen, Freeman and Wolf, 1996). Again, most approaches of that nature do not focus upon (or spend only limited time on) the processes underlying decisions. The present article will amend those writings. Based on metacomplexity theory (Streufert, 1997), a number of testable propositions are presented below. They necessarily will include findings of past research that was based on low to moderately high stressor levels. Those findings will be extended by predictions for a range that range from the absence of stressor levels to severe stressor conditions:

## PROPOSITIONS

*Activity (Overall Response Rate).*

Under complete deprivation of information, some activity (at least initially) is expected, although that activity cannot be conceived as response rate. As incoming information increases, activity is likely to rise, producing a response line that parallels the input level until the maximum response capacity of the decision maker (or decision making group) is reached. If information input increases further, output will for some time be relatively constant and flat but, at extreme information flow levels, will collapse. Overall response rate to information load and other stressors will, however, consist of a number of diverse components that are described in the sections below. Note that some of those components may at times be common, i.e., the total of all components may add to a value higher than total maximum response capacity.

Cognitively complex individuals are likely to be more selective in focusing on relevant information than their less complex counterparts. Training toward selectivity of incoming information and (in the case of groups) toward meaningful and partly overlapping distribution of incoming information among team members may delay both the maximum capacity flat response line as well as the final collapse of responding until even higher stressor levels are reached.

*Speed*

Optimal speed of performance is generally found at intermediate response speed levels: i.e., slow enough to allow considering available relevant information and fast enough to respond meaningfully in time (i.e., not to miss the boat).

In the absence of incoming information, speed of response is an irrelevant concept. As minimal information is obtained, speed of responding is likely to be (too) rapid, normalizing toward more optimal or beyond optimal functioning levels when incoming information has not reached levels that are excessive. At high load or failure levels, speed of responding slows down – in part because more issues need to be addressed, in part due to stressor overload. At extremely high stressor levels, speed will become unreliable.

During emergencies, speed of responding (specifically to emergency relevant information) will increase (decisive decision making). As an emergency becomes severe, speed of responding will be unreliable. In general, speed of responding during emergencies will be a bit too slow for optimal functioning, but somewhat better for cognitively complex then for less complex individuals.

Training toward optimal speed of responding, both under normal and under emergency conditions, can be highly effective.

*Responsiveness*

Whenever decision-making responses are contextual, i.e. based on the desire to deal with specific incoming information, the quantity of responsiveness varies directly with incoming information. To the extent to which responsiveness is task content specific (including the plans and intents set by the decision maker), it will increase with incoming information but at a lower rate than the information itself. Responsiveness will level off to a constant or close to constant value as the limit of the decision maker's capacity for maximum decision output is reached. Responsiveness will cease when stressor levels have become extreme. The decision maker's maximal output is, consequently, reached at a higher stressor level. Cognitively complex individuals will be less contextual in their responsiveness than cognitively less complex individuals. Responsiveness and the focus of responsiveness can be trained.

*Initiative*

Initiative will be moderately high in the absence of incoming information, drop somewhat as moderate levels of stressors are presented, increase again as super-optimal loads are obtained and drop once more as stressor levels become excessive. Cognitively complex individuals will show higher initiative levels at moderate super-optimal stressor levels than less complex decision makers. Initiative is likely absent under extremely high stressor conditions. Training toward initiative is possible but, in most cases, requires repeated efforts.

*Information Orientation*

Information search will be (initially) high in the absence of information and other stressors, and will decrease (at a lower rate for cognitively complex decision makers) as more and more input is received. Near, or at the point where the maximal response level of decision makers is reached, information search will be minimal or absent. At super-optimal (and somewhat higher) levels of input, cognitively complex individuals will engage in more search activity than less complex decision makers. Search by less complex individuals will focus on specific facts or events; search by more complex individuals will in part be search for opportunities. Information utilization, especially at higher stressor levels, will be greater for cognitively complex than for less complex individuals. Training in both search orientation and information utilization can be highly effective.

*Emergency Responsiveness*

As an emergency occurs, decisions will be made more rapidly and will be more "decisive" in nature (persons who have considerable difficulty coping with stress will be an exception to this prediction). Emergency responses will increase with the seriousness, multiplicity and information frequency related to emergency conditions. However, they will proportionally decrease as the emergency becomes very severe. Emergency responses by untrained groups will tend to be uncoordinated. At highly severe levels, emergency responsiveness will decrease or cease and escape tendencies may become more frequent. Again, training to improve the processes underlying emergency responsiveness is effective. In addition, training to overcome the stress impact of emergency experience is needed.

*Breadth of Approach*

Breadth of approach (differentiation) can be present (related to initiative) in the absence of stressor conditions (creativity). Breadth in applying multiple task components and information antecedents in decision-making will be moderate at low stressor levels, will increase to high levels as optimal stressor (e.g., load) conditions are reached and will diminish with super-optimal stressor levels. Breadth will disappear at highly severe emergency and/or stressor levels. Cognitively complex individuals will generate more breadth than persons of lesser complexity and may reach optimal functioning at slightly higher stressor levels. Breadth can be effectively trained.

*Planning*

Planning activity, except as related to initiative (see above) is likely to be low in the absence of stressor information but will rise rapidly with increases in low levels of stressor. Even slightly super-optimal stressor levels will see the beginning of a decrease in planning activity, with planning decreasing rapidly or ending as stressor levels continue to increase. By the time maximum response capacity is reached, planning will no longer be present. Cognitively complex decision makers will engage in considerably more planning than less complex persons and cognitively complex decision makers will maintain some planning activity further into higher stressor levels. Training can improve the frequency and quality of planning activity and can optimize the length over which plans are made.

*Strategy*

Strategic thought and decision-making (integration) will be low or absent in the absence of stressor levels (except as related to initiative) and will become moderate at low stressor levels. Strategic action will reach optimal levels when stressor loads are optimal (e.g., at an information load level of one item of incoming [independent] information every 2.5 to 3 minutes). At higher stressor levels, strategic activity will begin to decline and will reach zero levels as the maximum overall responsiveness capacity of the decision maker(s) has been reached. Cognitively complex individuals will engage in more strategic decision- making than less complex individuals. The maximal value of strategic decision-making will remain below the maximum value of attained breadth (see above). Training can improve the quantity and quality of strategic functioning and can extend that capacity into higher stressor conditions.

As suggested above, some of the predictions listed for nine primary categories of decision implementation are drawn from prior research; others – both related to absence of stressors and to considerably higher stressor conditions - are in part based on observation and in part upon theoretical derivation. Information about training effectiveness for the various categories are based on efforts with the Strategic Management Simulation developed and implemented by Streufert and by Satish (cf., Ramachandran et al., 2004; Satish and Streufert, 2002). In addition to the nine decision-making processes discussed above, two or more validated subcategories exist for each of them. Due to the lack of space, they cannot be covered in this paper but are likely of considerable value to efforts that deal with decision making in crisis and emergency settings (for more information, see the entire issue of the Journal of Applied Social Psychology, Volume 27 # 23, 1997 as well as relevant publications by Satish and by Streufert.

Some of the primary predictions considered in this paper are represented in Figure 1. The figure does not cover emergency conditions *per se* (except as represented by high stressor levels. Moreover, individual differences between cognitively more or less complex individuals are not included in the graph

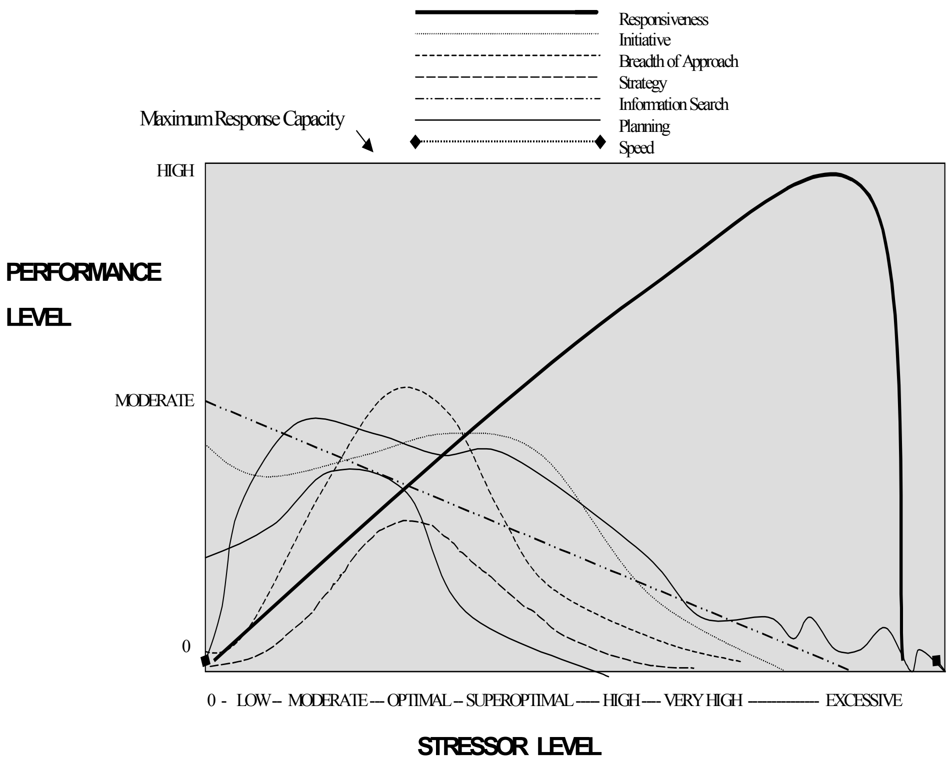


**Figure 1. Stressor Effects on Decision Performance Attributes**

## SUMMARY

If we wish to deal effectively with emergencies, we must be able to approach each task requirement during an emergency optimally, yet we should also recognize the interrelationships among events and the interplay among our task components. We should be able to understand, and where possible predict, the outcomes of our own actions/responses upon the fluidity of the task environment. For example, in many decision making settings, including those where we must deal with serious emergencies, greater breadth of approach and appropriate strategic functioning will help to diminish or even resolve problems. In other cases, however, decisive contextual (directly responsive) action at an optimal point in time will likely lead to greater success. Yet other concurrent conditions may yet require still other optimal responses (as described in the propositions, above). In sum, both the capacity to function in the currently most appropriate way, as well as the comprehension of *which among various possible responses is required*, is needed. Assessment of emergency responders' capacity to employ metacomplexity, even under highly stressful task demands, is of considerable value. Training toward the capacity to utilize greater cognitive and performance complexity and training toward the application of metacomplexity is equally useful.

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