Naturalistic Decision Making and Decision Analysis

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Congratulations to Lipshitz, Klein, Orasanu, and Salas (LKOS) for their review article in this issue. Naturalistic decision-making (NDM) research is somewhat ethnographic in nature, based on careful descriptions of how experts actually make choices in complex, real-world situations. As such, this work adds an important perspective to our knowledge of human decision making.

My view of decision making (and hence my evaluation of NDM) reflects my background as a decision analyst. My comments below focus on a few key issues from LKOS's article: concepts of decision making, comprehensiveness, errors in decision making, and prescriptive advice. These topics highlight important differences among decision analysis (DA), behavioral decision theory (BDT), and NDM.

WHAT IS DECISION MAKING?

LKOS take decision making to be the commitment to a course of action. The context is typically that of experts making high-stakes choices in field settings that they know well. In this sense, NDM is similar to work in expert systems, where the idea is to create a computer system that models expert behavior.

Although the expert context is sensible, questions nevertheless remain. For example, how do experts become experts? How did they acquire their expertise in the first place, and how do they learn as their decision-making environment changes? How do experts proceed when they encounter a new type of situation? Presumably, the expert's knowledge includes an understanding of the elements or building blocks of situations, thus facilitating analysis and choice when new types of situations arise. But how far beyond the boundaries of the field of expertise can the expert's knowledge take him or her? At what point must the expert resort to more fundamental analysis in order to develop understanding and insight in order to make a choice?

As LKOS note, DA's objective is not to describe unaided individual decision behavior. DA does, however, provide prescriptive advice, and it is useful for those occasions when an individual's expertise is not adequate for the situation at hand. In Ron Howard's words, 'Decision making is what you do when you don't know what to do' (Howard, 1980, p. 5). From this perspective, the experts in NDM studies are implementing already-made choices; to understand their fundamental decision-making behavior and abilities (in the DA sense), the researcher would have to put them into new situations that are more or less removed from their specific expertise.

DA's prescriptive approach harks back to Raiffa's original textbook, where he wrote that DA is '... an approach designed to help us erring folk to reason and act a bit more systematically — when we choose to do so!' (Raiffa, 1968, p. 128). The objective is to help real people think through and understand difficult real-world decision situations when the appropriate choice is not clear. Thus, we find prescriptive DA most useful in complex decision problems often characterized by uncertainty and multiple objectives. Examples include research-and-development (R&D) portfolio and new product management, strategic asset management, facilities siting, capital budgeting, and others. Such situations appear to be quite different from the typical NDM context.

MODELS AND DECISION ANALYSIS

The fundamental activity that characterizes DA practice (and by contrast is typically absent in BDT and NDM studies) is the creation and analysis of a model that represents the decision situation. Although it is tempting to think that analysts strive for comprehensiveness in their models, this view largely misses the point of prescriptive DA. Indeed, Savage (1954) expounded at length on the 'small world' problem, or the matter of creating a model with the appropriate bounds.

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Likewise, Philips (1982) discusses the idea of a 'requisite model' that captures the essential elements of the decision situation but no more. The ability to construct an appropriate model is a key element of the analyst's art.

Good DA practice further requires that the model actually be useful to decision makers to obtain insight and understanding. Thus, the notion of feasibility is important in DA practice, as it is in NDM research, and it has two important attributes. First, creating and analyzing the model given the time and resources available must be feasible. Second, generating insight and understanding for the decision maker must be feasible. Much of the art of DA practice lies in the analyst's ability to create a model at an appropriate level for the problem and interpret the model and analysis results in a way that generates insight for the decision maker. The more complicated the required model relative to the analytical sophistication of the decision maker, the more crucial is this ability on the part of the analyst. (Indeed, one could argue that an analyst can develop NDM-like expertise by learning how to effectively model and analyze a particular type of problem in a specific domain.)

ERRORS IN DECISION MAKING

Along with the notion of a model comes an important *ex-ante* perspective on errors in decision making. From an *ex-ante* point of view, the notion of an error can be conditional on the model used (i.e. Does the decision maker choose the appropriate action given the model and analysis thereof?), or an error can be in terms of the model itself (Did the analyst create an appropriate model for the situation?). Much of the discussion in the literature relates primarily to the former. Specifically, BDT tends to compare performance to the normative standard, as LKOS indicate. Consider inference tasks, where a participant in an experiment makes a probability judgment, which is subsequently compared to a 'normative' answer calculated according to the laws of probability. Note, though, that the researcher had to create what he or she believed to be a suitable probability model on the basis of which to calculate the normative answer. Reasonable researchers may disagree on what an appropriate model might be. A sophisticated subject may think about the problem in a way that reflects a probabilitistic model different from the researcher's, in which case his or her responses may vary substantially from the researcher's 'normative' answer. In this case, does the subject make an error?

PRESCRIPTIVE ADVICE

As described by LKOS, NDM prescriptions stem from observing the choice behavior of experts in their domains. For example, the STEP process was developed specifically to help non-experts perform better. In contrast, a DA prescription would presumably be based on the analysis of an appropriate model. As indicated above, DA prescriptions are best used to address new or atypical decision situations, whereas NDM prescriptions may be best used to train novices in fields populated by acknowledged experts. Further, the fact that DA typically requires some degree of model building means that it is often a more deliberate process than that used by experts in high-stakes and fast-moving environments. A challenge that DA faces is to develop techniques that can help decision makers in situations where conditions change rapidly and decisions must be made very quickly.

Some further questions to ask are: (1) With an appropriate model and analysis, would a non-expert be able to perform as well as or better than the experts? (2) Can the experts' knowledge be used to assist in the creation of such a model? (3) If the experts used an appropriate model, would their performance be better or worse? These questions are reminiscent of questions asked in comparing expert system prescription with DA prescription, and are motivated by the observation that expert performance sometimes can be improved upon by models (and sometimes relatively simplistic models at that; see Dawes, Faust, and Meehl, 1989). Recent work at the interface of artificial intelligence and DA attempts to capture and use expert judgment in a normative framework; such systems are called 'normative systems' (e.g. Abramson *et al.*, 1996) to distinguish them from more conventional rule-based expert systems. Could normative systems benefit from NDM research? Finally, perhaps NDM prescriptions could be improved through the use of a normative-systems approach.

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Pursuing an Integrated Decision Science: Does 'Naturalistic Decision Making' Help or Hinder?

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In the words of chaos theory, decision research as a discipline has reached a critical bifurcation point in its history. Lipshitz, Klein, Orasanu, and Salas (this issue) have shown that a range of emergent alternative approaches and sub-disciplines have punctuated this 50- to 60-year history. Even within sub-disciplines, such as JDM, to which Lipshitz *et al.* refer, we have seen the emergence of a diversity of approaches such as prospect theory, social judgment theory, information integration theory, attribution theory, signal detection theory, fuzzy decision theory, and many others. Each specific approach comes armed with its own preferred methodologies and strategies for theorizing.

The newest emergent variant is naturalistic decision making (NDM), which encompasses a number of related approaches such as recognition-primed decision models, image theory, and explanation-based decision theory. (Interestingly, Janis's, 1992, most recent development, Constraints Theory, is not encompassed under the general rubric 'naturalistic decision making' despite its features and methodologies being reasonably congruent with those earlier listed constituent approaches.) As Lipshitz *et al.* have clearly argued, NDM is distinguished by its focus on research in naturalistic settings, a preference for the qualitative rather than the quantitative, a renewed emphasis on the value of expertise and experience, and a concern with much 'messier' decision tasks.

Since its advent, NDM has adopted a generally confrontational position against the more positivistic, quantitative, and traditional decision approaches, especially eschewing highly controlled laboratory experiments involving artificially contrived tasks and 'naïve' participants. We see, in NDM, a concern for the 'real world' as if somehow this has been invisible to decision research until now. We should not forget the contributions of Brunswik, over 45 years ago, who developed a coherent and consistent psychological perspective that demanded both a theory of cognition as well as a theory of tasks to be complete (see Hammond and Stewart, in press, for a comprehensive review of Brunswik's contributions). The theory of tasks embodied both *formal task characteristics* (abstract measurable task properties) and *substantive task characteristics* (content- and context-related task information). Further, the Brunswikian concept of *representative design* provided a more precise and actionable way of sampling the 'real world' for research purposes than NDM has typically done. NDM has yet to harness the power of these ideas for far more precisely specifying what is meant by the rather empty term 'real world,' although the growing NDM focus on cognitive task analysis goes some way toward rectifying this.

We come then to the question posed in the title of this commentary: Does NDM help or hinder us in the pursuit of an integrated and unified decision science? First, is an integrated decision science even desirable? Hammond and others have argued in the affirmative. Cooksey (2000), for example, has argued that an integrated approach to understanding

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