A KNOWLEDGE SET-BASED TAXONOMY OF DECISION PROBLEMS AND DECISION STRATEGIES

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ABSTRACT

We propose a taxonomic scheme for characterizing decision problems. The taxonomy is based on three knowledge components that are important in the decision-making process: (1) knowledge about the availability of decision alternatives, (2) knowledge about the nature of the ideal alternative, and (3) knowledge about information on the different alternatives. In the proposed taxonomy, each type of decision problem is defined by different levels of knowledge for each of the three knowledge components. We propose that different decision strategies will be used for and that different factors will bear on each of the specific types of decision situations. We review and discuss the research findings relevant to the different decision-making problems and strategies. Finally, we discuss the utility of such a taxonomy for "real world" decision making situations.

People are constantly called upon to make decisions. These decisions can range from the apparently trivial, like choosing which pair of socks to wear or deciding how much *sampaloc* to put in one's *sinigang*, to the supposedly consequential, like choosing a partner in life or selecting which presidential candidate should be given the chance to make the important decisions about the country. Because of the pervasiveness and potential significance of such decision situations, it is not surprising that social scientists, cognitive and social psychologists included, have made decision making a major component of research efforts. The main objective of these undertakings is to arrive at an adequate understanding of the decision-making process as it operates in various settings and the range of factors that affect it. A more practical objective is to find out ways by which decision making can be "improved" towards specific goals of different institutions like government and policy-making bodies, the judicial system, the medical system, business, and so on.

If one looks at the range of theory and research findings generated by the efforts of economists, political scientists, management and organizational researchers, and of course, mathematical psychologists, cognitive psychologists, and social psychologists, the lack of convergence among these bodies of information becomes easily evident. This observation should not come as a big surprise knowing that each of these social science disciplines focus on different specific social and behavioral phenomena and they make different assumptions about the appropriate level of explanations and variables relevant to understanding these phenomena.

However, there are scientific and pragmatic demands for some form of integration of these seemingly divergent ideas. Decision making in any setting is, after all, decision making. At some level, there should be a way by which social scientists can piece together

the various ideas about decision making. With the growing influence of the social sciences in the world beyond the academic community, there is also a need to present a coherent picture of scientific knowledge about decision making that can be of use to planners and policy makers of different groups at different domains and levels of operation. In this paper, we address this demand by proposing a taxonomic scheme by which the divergent ideas about decision making can be integrated. In particular, we propose a taxonomy of decision problems based on knowledge factors related to the manner by which the decision maker structures the decision problems.

The organization of ideas afforded by a taxonomic system should be useful towards efforts of integrating knowledge in any domain of inquiry, including decision-making research. If the proposed taxonomy of decision problems is valid, that is, it makes genuine and meaningful distinctions among various decision situations, it should provide researchers with the primary structure needed for studying decision making. To provide an example from another field, one could look at biology. It would be difficult to overemphasize how the organization implied by Darwin's theory or the taxonomy developed by Lyell proved to be critical to the development of the biological sciences. A valid taxonomy of decision problems will, therefore, prove to be at least useful, if not necessary to the study of decision making.

We believe that this taxonomy will be of particular use for psychological decision-making research in the Philippines. Most published research on decision making in this country focus on the end-product of the decision process (i.e., the decision itself) and social psychological factors that influence these final decisions. Often the primary evidence for the operation of such factors are verbal reports of the decision makers themselves (see, e.g., Torres, 1983). Nisbett and Wilson (1977), however, have already found that people have little or no introspective access to higher order cognitive processes like decision making. Hence, the reliance on verbal reports might not reveal the true processes and factors that are operating in the decision making situation. The proposed taxonomy could be used to provide or to select an appropriate framework for specific local decision-making research. This framework could then be used to rationalize and better understand the data on decisions and the factors that affect them.

Other psychological decision-making research in the Philippines use rather well-developed decision-making models and approaches (e.g., the value-expectancy model used in SyCip & Fawcett, 1988, and a decision-tree approach used in Gonzales-Intal & Valera, 1990) in describing decision-making processes of specific Filipino groups. The use of these well-developed decision models makes certain assumptions about the decision task, the decision maker, and the decision maker's knowledge and strategies. The proposed taxonomy could be used to ascertain whether the critical assumptions of the model are tenable for the specific decision-making situations that are being studied, and also therefore, to rationalize the use of such models when found appropriate.

Another way that a taxonomy of decision problems will be useful is that it will put the findings of any particular research work in its proper perspective with respect to the general phenomenon. Tversky (1980) raised the possibility that the different theories of decision making that have been derived from different approaches to studying the phenomenon could be only describing different "sub-routines" in a "general" decision making routine. It could very well be that the specific type of decision problem determines which sub-routines will be accessed.

The taxonomy should also be useful for various types of planners. The taxonomy organizes scientific information about decision making according to the various characteristics of decision problems and situations. This organization should make it easier to

relate what social scientists know about different decision situations to the actual decision situations in the "real" world. For example, if medical educators and practicioners know the characteristic features of the decision making situation involved in medical diagnosis, they can refer to the closest decision problem type described in the taxonomy and draw from the scientific knowledge that has been determined about decision problems of that type.

Our goal in this paper, therefore, is to describe a taxonomy of decision problems based on assessments of the decision maker's knowledge set with respect to the critical aspects of the decision making process. In the process, we will also integrate the important research findings as they relate to different components of the taxonomy. Most of the research findings will be drawn from the subareas of psychology: cognitive psychology, social psychology, and mathematical psychology. However, we shall also bring in some findings and ideas from studies in economics, political science, organizational research, and the administrative sciences.

Before we discuss the taxonomy, we shall first delimit the phenomenon of decision making. Then, we shall describe the factors upon which the proposed taxonomic scheme is based. We shall then proceed to a description of the different components of the taxonomy and a discussion of the various scientific findings relevant to each component.

Decision Making: What it Is and What it Is Not

Any behavior can involve decision making. Decisions can range from choosing which aspects of a perceptual stimulus to which one will attend, to committing oneself to a particular lifestyle after retirement. The simple imperative "Do something!" suggests the gamut of possible decision problems. However, conceiving of decision making in this manner renders the phenomenon intractable, and therefore, scientifically meaningless.

For our definition of decision making, we use as a reference point the more general cognitive function of problem solving. Reitman (1964) provides us with a very useful general framework for describing different problems. All problems, it is proposed, consist of an initial state, a different terminal state, and the operations undertaken to reach the terminal state. MacCrimmon and Taylor (1976), use the terms decision making and problem solving almost synonymously. They do not make a distinction, in terms of a set-subset relationship, for instance, pointing to the fact that different literatures used the terms in many ways.

In this paper, we propose that the decision-making function is a subset of the problem-solving function. Decision situations are problem situations, but they are distinct from other problem types in regard to one important aspect. Decision problems always involve a choice or selection in the operation component, referring to Reitman's framework. Making the same point, MacCrimmon (1973) defines decision making as processes that culminate in choice behavior. A pure decision problem would then be described as follows: (1) the initial state is characterized by the presence of more than one option, and (2) the terminal state is characterized by the selection of just one option. In most decision problems, however, the options in the initial state are either symptomatic of a more "real" problem (e.g., one is single/unmarried, but no longer wants to be one, and the options are the prospective partners that have been lined up). Likewise, the single option in the terminal state indicates either that having one option is the ideal state, or that the single option is the particular course of action that will lead one to a larger goal or a solution of the more "real" problem.

By referring to "real" problems, we are implying that making decisions is, more often than not, imbedded in bigger problem situations, with more important goals than just being able to make a choice or to express a

preference. The choices and preferences are almost always made with some more basic goal in mind. However, as with some classes of problems described by Reitman, these goals or the nature of the terminal state may or may not be clear to the decision maker/problem solver at the onset. (Early research in decision making suggested that this larger goal was that of maximizing utilities; more recent research, however, indicate that this claim seems to be unwarranted).

Basis for a Taxonomy of Decision Problems

In various earlier works (Abelson, 1976; Beach and Mitchell, 1978; Hogarth and Kunreuther, 1989; MacCrimmon and Taylor, 1976; also to a lesser degree, Einhorn and Hogarth, 1978, 1985) it was suggested that a useful way of approaching different decision problems is by referring to the knowledge set of the decision maker in terms of the different aspects of the decision process. Abelson (1976, Abelson and Levi, 1985), Gilovich (1981), and Phillips (1984) assert that the manner in which the decision maker structures or represents the decision problem at the onset of the decision process, to a great extent, determines the decision strategies actually undertaken. The importance of the initial representation of the decision problem, therefore, cannot be underestimated.

How the decision maker structures the decision problem is, of course, dependent on her knowledge about the problem. Based on this notion, we developed the taxonomy of decision problems by referring to the different components of the decision maker's knowledge about the decision problem. These knowledge components lead the decision maker to structure the decision problem in specific ways that predictably lead to the use of particular decision-making strategies (see Anderson, 1986, for a specific example of a cognitive model of processing information in decision situations).

We propose that the decision maker's knowledge about three aspects of the decision process are most critical in determining the decision strategy she will use: (1) knowledge about available alternatives; (2) knowledge about the goals of the decision, or the nature of the ideal alternatives; and (3) knowledge about information on the alternatives.

Knowledge about the available alternatives. Having defined decision making as necessarily involving choice, it is reasonable to propose that the way the decision maker structures a problem should be based in part on the identification of decision alternatives. The availability of decision alternatives to the decision maker indicates the prior knowledge or experience of the decision maker about the decision problem. We propose that the availability of decision alternatives to the decision maker can be classified into two general types of situations: (1) the alternatives are easily identifiable by or are specified for the decision maker, and (2) the alternatives have to be generated by the decision maker.

Regarding the first type of situation, Abelson (1976) and Gilovich (1981) asserted that decision makers tend to structure the decision problem by matching them to more familiar or schematic decision situations. This is especially true when the decision maker has had extensive experience in the domain of the decision problem and has substantial prior knowledge about the problem itself. Decision alternatives are, therefore, readily available, in the sense that they can be accessed by some quick, or sometimes not, memory search. As one example, political scientist, Axelrod (1976) described how "the political elite" use highly entrenched cognitive maps of typical decision alternatives for what could be extremely complex political decision problems.

Another form of the first type of situation is when the decision alternatives are explicitly specified for the decision maker. In most voting situations, for example, the decision maker's alternatives are determined by external sources. Either the candidates for an office are determined by nomination, or the voter will simply decide whether a particular propo-

sition should be approved or vetoed. It should be noted that in these situations, in contrast with the situation in the preceding paragraph, it is not necessary that the decision maker has had a lot of prior knowledge about the decision problem when decision alternatives are specified for him at the onset. (The quality of the decision might be affected by prior knowledge, but this point will be subsumed in later discussions.)

The common feature underlying the two situations described is that the decision alternatives are set, either by the decision maker's prior experience with similar or analogous decision problems or by external forces that prescribe the possible decision alternatives. The fact that decision alternatives can be set in some way suggests that the decision problem must be a relatively well-structured one and that it should be easy to make sense of the alternatives within the problem domain.

On the other hand, some decision problems are extremely novel, that is, the decision maker lacks knowledge of the domain. Therefore, decision alternatives are not and cannot be readily available and will have to be generated by the decision maker, either by designing new alternatives, or searching for existing ones that are not readily available (i.e., possible decision alternatives used in other domains of decision problems). For such decision situations, Gettys and Fisher (1979) proposed a hypothesis-generation model of how people consider new decision alternatives as they are being generated. They propose that decision makers determine whether an alternative exceeds a "plausibility threshold" before accepting this alternative. The important implication of this proposal is that the evaluation of decision alternatives is done concurrently with the generation of the alternatives themselves.

It is with this point in mind that we proposed to distinguish between problems with available options and those where the options have to be generated. When there are available decision alternatives, the decision maker can evaluate the alternatives following a serial procedure in which the qualities of the different alternatives can be compared and contrasted. On the other hand, when the decision alternatives need to be generated, the decision maker would have to follow a recursive or iterative procedure in which an alternative is evaluated as it is being generated. As will be evident in the later discussions, this difference will have implications for the type of information-gathering strategy that the decision maker will undertake.

We would like to emphasize, however, that we do not believe that the two types of situations regarding the availability of decision alternatives are mutually exclusive. In fact, in some decision situations, the generation of alternatives can be undertaken after the available alternatives are evaluated to be inadequate (Gettys & Fisher, 1979). This observation suggests that there is no dichotomy between the two levels being discussed. Kelly (1979) described an interesting example of decision making in close relationships. He observed that in close relationships, a person perceives a set of decision alternatives for himself or herself. However, the person often has to revise these alternative or create new ones based on what he or she perceives to be the decision alternatives available to his or her partner in the close relationship. Therefore, it seems very likely, as Mintzberg, Raisinghani, and Theoret (1976) and Alexander (1979) have suggested, that in most decision situations, decision makers use a combination of searching for known alternatives and generating new ones. It seems best to view the two types of situations as two poles in a continuum.

Knowledge about the ideal alternative. As Soelberg (1967) suggested, in some decision situations the decision maker might not be able to specify the nature of the ideal solution to the decision problem. The same possibility is presented in Reitman's (1964) taxonomy of problems. In these situations, it would be difficult to specify some a priori

criteria which could be used to evaluate the decision alternatives. Mintzberg et al. (1976) and Soelberg (1967) mention that in these decision situations these criteria are developed and modified as the alternatives are generated. Tversky and Shafir (1992a) showed how expanding the range of alternatives makes salient new dimensions that can be added to the decision criteria (see also Svenson, 1979), and therefore, creates conflict among the alternatives. This conflict can be so much so that the decision maker would choose to defer making a decision and seek more information about the alternatives. Consider, for example, having to decide among a set of candidates for a political office. With two candidates, particular issues become salient for differentiating the two. As other candidates enter the field, each new candidate may bring to the fore new issues, and therefore, new dimensions by which the candidates may be evaluated.

On the other hand there are some decision situations which are fairly well-structured. In these cases the nature of the ideal solution is very specific. We can expect that the evaluation of the decision alternatives will be relatively straightforward. Consider for example, a small retail company has to decide on which three radio stations to advertise. This company could specify two criteria—the stations' ratings share and target audience. The company will then simply evaluate the pertinent information about the different radio stations, and pick the three radio stations that best satisfy the criteria.

We, therefore, propose that decision problems can be classified into (1) problems where the nature of the ideal decision is specified, and (2) problems where the same is vague. Again we can conceive of the two as points in a continuum. The critical difference is that in the first class, the decision alternatives can be evaluated using stable decision criteria, whereas, for the other class, the decision alternatives are evaluated using preference functions that are unstable, dynamic and may not even be represented cognitively. March (1978) and Dyckman (1981) have made similar proposals. Note that while it is possible that the nature of the ideal decision alternative may be specific or vague, it is inconceivable for the goal of the decision situation to be completely unknown. The decision maker must, in the very least, have a very vague notion of what she is aiming for; otherwise, nothing is preventing her from making a random choice.

Knowledge of information about alternatives. Assuming that some criteria exist for evaluating decision alternatives, information regarding the relative worth or inappropriateness of the alternatives is necessary in order to make judgments about these alternatives. Montgomery and Svenson (1976, Svenson, 1979) suggest that information about the different alternatives may be represented in terms of values on a set of "attributes" defined by the decision criteria. They argue that the decision makers characterization of the information on the alternatives determine the types of decision rules and information processing strategies that the decision maker will follow.

Hogarth and Kunreuther (1989), using knowledge of payoffs and probabilities as critical parameters, identify three levels of knowledge lying in a continuum; knowledge about these parameters are either (1) precise, (2) vague, or (3) unknown. We shall borrow this scale for this taxonomy. However, this scale shall be used to describe the information, in general, required for a particular decision situation. For example, when deciding on buying a house, this information could include the cost of the house, the location and accessibility, the value of property in that area, the quality of the construction, the space available for different purposes, availability of financing, and so on. When betting on a racehorse, other types of information like age of the horse, previous track record, type of racing surface, the booker's odds, and so on, would be considered. By information we also mean to include the "classical" concepts of

information: "value" of the outcomes of the alternatives and the uncertainties or probabilities associated with the occurence of the outcomes. Whether the nature of the ideal alternative is vague or specified will determine the number and stability of the parameters for which this scale will be used.

Still borrowing from Hogarth and Kunreuther, we shall use "precise" to mean, that a person has very specific knowledge about the parameters of interest. For example, if the decision maker is interested in probabilities associated with different decision outcomes, these are specified. Or if a physician is considering information about the hit and false positive rates of different types of medication, these are likewise available. The level "unknown" means the decision maker is ignorant about the values of these parameters. One can think of an election situation were the candidates avoid any discussion of the issues as one decision situation wherein the decision maker becomes practically ignorant about the information which she needs for making the appropriate evaluation of her alternatives. "Vague" refers to the knowledge state between "Precise" and "Unknown", (this is similar to Einhorn and Hogarth's, 1985, notion of "ambiguity"). Information may be vague for several reasons. It is possible that the source of information is not verifiable, the information is unreliable, or possibly incomplete, conflicting, or contradictory, or constantly changing during the decision process, and so on. There may even be ambiguity when the decision maker suspects that she is deliberately being given incorrect or misleading information.

Einhorn and Kunreuther (1989) proposed that different knowledge sets on payoffs and probabilities create very different decision contexts. For example, a problem can be described as being decision under "risk," decision under "ambiguity," or decision under "ignorance." They expected that decision behavior will vary across these different contexts. For instance, under "ignorance," decision behavior might take the form of "justifying" a decision. On the other hand, with decisions under "risk," the decision maker might take a more analytic or rule-determined approach. It is, therefore, important to consider the dimension of the decision makers knowledge about the information about the alternatives in characterizing decision problems.

A TAXONOMY OF DECISION PROBLEMS

We have so far proposed categorizing decision problems by referring to three different types of knowledge a decision maker may have about the decision situation: according to the subjects knowledge (1) about available alternatives, (2) about the ideal alternative, and (3) about the information on the alternatives. The decision maker's knowledge about the first two factors are described as being of two levels, while the last factor is described as being of three levels. However, all three factors are conceived of as being continuous variables, with the different levels being convenient points in the continuum. We propose that the three factors can be completely crossed and we shall come up with a 2 x 2 x 3 matrix, the units of which are represented in Table 1. This matrix provides the basis for our proposed taxonomy of decision problems and strategies.

Each of the 12 cells in the figure represents a different knowledge set for the decision maker, and therefore, a different decision type. Even before discussing each decision type in detail, we can compare the decision types in the matrix with classification schemes that have been used by other researchers. Using the distinction used by Abelson and Levi (1985), for example Decision Types 1 to 6 represent decision making with well-structured or well-defined problems, while Decision Types 7 to 12 represent decision making with unstructured or ill-defined problems. We have strong doubts, though, whether there are problems that would actu-

Table 1. A 2 x 2 x 3 Matrix Summarizing the Different Categories of the Proposed Taxonomy of Decision Problems

	Decision of ideal alternative is SPECIFIED/IDENTIFIABLE		Decision alternatives have to be GENERATED	
	Nature of ideal alternative is SPECIFIC	Nature of ideal alternative is VAGUE	Nature of ideal alternative is SPECIFIC	Nature of ideal alternative is VAGUE
Information on alternatives is PRECISE	Decision Type 1	Decision Type 4	Decision Type 7	Decision Type 10
Information on alternatives is VAGUE	Decision Type 2	Decision Type 5	Decision Type 8	Decision Type 11
Information on alternatives is UNKNOWN	Decision Type 3	Decision Type 6	Decision Type 9	Decision Type 12

ally fall under Decision Types 7 and 10. On the other hand, Decision Types 2, 5, 8, and 11 would be decision making under "ambiguity" as defined by Einhorn and Hogarth (1985). If the only relevant information needed is regarding probabilities and/or payoffs, the same decision types would be decision making under "uncertainty" as it is commonly used. Using Hogarth and Kunreuther's (1989) definition, Decision Types 3, 6, 9, and 12 represent decision making under different degrees of ignorance; 6 and 12 under almost complete ignorance (Hogarth and Kunreuther argue that there are no situations in which the decision maker is completely ignorant about the decision situation).

In the following sections, we shall describe each decision type in the matrix, that is, each element in the proposed taxonomy of decision problems. In the discussion for each decision type, we shall also attempt to recount the different research findings that are relevant to the particular decision problem type.

Decision Type 1 represents decision making with a completely structured decision problem—the alternatives are set, the nature of the ideal alternative is specified, and the information pertinent to this ideal is available. An example of this would be a person deciding which among three cars has the highest mileage, given the mileage of each of the three cars. The decision problem is more like an arithmetic problem that would be given in school, where the operations are very straightforward yet analytic, and the only thing the decision maker will have to avoid is making careless errors. If there are more dimensions by which the alternatives can be evaluated, an additive or compensatory strategy is used—still straightforward.

Though it might seem to some that decision problems are never this clearly cut out, some decision problems are indeed approached with this efficacy. Mintzberg, et al. (1976), in their case studies of decision processes in different business organizations, described a set of actual cases which they called "basic design search process." In these cases, the organizations were able to set relatively clear guidelines for a solution to the decision problem at the outset. The organizations arrived at their decisions by simply finding the best available ready-made solution.

Decision Type 2 comes closest to "decision making under uncertainty" as the term has been used in studies on the Expected Utility Theory (Raiffa, 1968; von Neumann and Morgenstern, 1944), Prospect theory (Kahneman & Tversky, 1979, 1983; Tversky & Kahneman, 1981), or Regret theory (Bell,

1982; Loomes & Sugden, 1982). In the decision problems used in such studies, the decision alternatives are specified for the subject. It is also assumed that the nature of ideal decision is clear (e.g., maximum gain and minimal loss according to Prospect theory, or minimal regret according to Regret theory, and so on). However, there are uncertainties associated with the different decision outcomes. The uncertainty is one form of ambiguous information. The decision maker deals with this type of ambiguity by modeling the uncertainty in the decision situation (MacCrimmon & Taylor, 1976). For example, as expected utility theorists would assert, the decision maker models the uncertainty by assigning probabilities. Works of psychologists like Simon (1955), and Kahneman and Tversky (1973) would suggest that there are cognitive constraints in modeling of uncertainty using probabilistic models. As a result decision makers lose acuity in the decision process and, therefore, the manner in which the ambiguity or uncertainty of the information is modeled follows more simplified rules or heuristics. Sometimes, the loss of decision acuity even causes decision makers to seek information about the alternatives that actually has no impact on the decision (Tversky & Shafir, 1992b).

The area of medical diagnosis and treatment is one domain in which researchers have demonstrated the use of heuristics instead of systematic procedures for modeling uncertainty or ambiguity. In this domain the nature of ideal alternative is very clear depending on the particular case at hand (e.g., saving the life of the patient, curing a disease, etc.) and the different decision alternatives (medical treatments or diagnoses) are known by the physician and are defined by her resources. The information associated with the outcomes of the different alternatives, however, is not completely precise. For example, test for a particular disease like cancer, can diagnose the disease correctly (correct hits) most of the time, but it can diagnose the disease incorrectly (false positives) some of the time. Several studies of medical doctors showed that doctors tend to neglect base rate information on false positives, and therefore, often overestimate the validity of their diagnoses (Balla, Iansek, & Elstein, 1985; Berwick, Fineberg, & Weinstein, 1981; Casscells, Schoenberg, & Graboys, 1978; Schwartz, Gorry, Kassirer, & Eddig, 1973).

In choice of medical treatment, McNeil, Pauker, Sox, and Tversky (1982) demonstrated the effects of framing decision outcomes, a factor that according to Prospect theory (Kahneman & Tversky, 1979) is important in modeling uncertainty. McNeil, et al. asked patients and physicians about alternative treatments for lung cancer. The choice of treatment was influenced by whether the outcomes were framed in terms of losses (probability of death) or in terms of gains (probability of survival). The decision makers were also found to respond more strongly to losses than to gains.

Another effect of ambiguity and uncertainty in choice of treatment was demonstrated by Baron, Beattie, and Hershey (1988). They showed the tendency of experimental subjects in a hypothetical medical setting to choose to conduct tests that were not going to change the choice of a treatment. The subjects already made a choice and were seeking information that would have no impact on their decisions; that is, new information could not have possibly altered their original choice. This effect is not simply an experimental artifact, however; Kassirer (1989) noted the same problem of excessive testing among actual doctors.

Decision problems in Decision Type 3 differ from those in Decision Type 2 only in terms of the unavailability of information on the decision alternatives. However, because of the highly structured nature of the problem, the total lack of information in Decision Type 3 might be a tentative constraint. The structure of the problem, merely requires the decision maker to search for the relevant information

that he needs. This information acquisition strategy (MacCrimmon and Taylor, 1976) could yield precise or vague information which could then be acted upon accordingly. For example, a voter might be faced with a choice of totally unknown candidates for an election. Or more plausibly, the candidates may be known for things other than their positions on political matters (e.g., a candidate who is a show business personality, who has not ever made any statement on any political issue). The decision maker would then try her best to get information on the issues that are important to her. It is possible, though, that information acquisition still will not yield any useful information. In this case, as suggested by Curley, Yates, and Abrams (1986) and Hogarth and Kunreuther (1989), individuals would focus instead on justifying decisions they make, instead of evaluating alternatives. To follow up on our example, the voter will probably vote for one candidate anyway and then try to "rationalize" the choice which was probably simply based on possibly vague impressions or information about the candidates that may not be as important in the decision criteria. Consistent with previous research and the predictions of cognitive dissonance theory (Baumeister & Tice, 1984; Festinger, 1957; Linder, Cooper & Jones, 1967), rationalization is engaged in as a means of avoiding the cognitive dissonance that may ensue after having made a personal choice and, particularly, if the choice behavior will be known to people other than the decision maker.

The decision problems in Decision Type 4 are similar to those in Decision Type 1 except for the problem that the decision maker has no clear notion about the nature of the ideal decision alternative. The studies done by Payne and his colleagues (Payne, 1976; Payne, Braunstein, & Carroll, 1978) using "information boards" in choosing among a set of one-bedroom apartments are good examples of Decision Type 4 decision problems. The decision alternatives are specified and the relevant information on each is provided in the "information board." There is no single rule, though, for determining which among the apartments is the best choice. They found out that with a small number of alternatives and dimensions for evaluating the alternatives, the subjects combine all components in an additive manner, consistent with the so-called compensatory decision strategies. Up to this point Decision Type 4 requires similar strategies as Decision Type 1. However, with multi-alternative, multi-dimensional problems, the subjects use strategies geared towards eliminating some alternatives immediately, even with incomplete information (see also Svenson, 1979). This finding is similar to the information seeking strategies used by decision makers for evaluating several job offers found by Englander and Tyszka (1980), and is also consistent with conjunctive models of decision making proposed by Einhorn (1970; see also Coombs, 1964; Dawes, 1964). Montgomery and Svenson (1976) suggest that this tendency to narrow down the alternatives quickly is guided by a tendency to minimize cognitive effort during the decision making process.

Decision problems in Decision Type 5 are similar to those in Decision Type 4 except that the information on the decision alternative is more ambiguous. Jury decision making (as used in the American judicial system) is an example of such a problem. The alternatives are defined by the opposing counsels, the evidence is for most of the time vague or conflicting, and the ideal alternative (i.e., the "true" occurence of events) instead of being specified, is constructed by the decision maker as the different evidences come. Ebbesen and Konecni (1980) studied such behavior and their finding reflect those found by Payne and his colleagues which we referred to for Decision Type 4, in particular, the use of the compensatory strategy and the rejection of some alternatives with incomplete information. Pennington and Hastie (1986) also studied jury decision making but focused on how

the subjects represented the different evidences presented. In accounting for their results they invoke heuristic-like strategies, for example, judging likelihood of scenarios by testing for possible causal links (c.f., Tversky & Kahneman, 1980), which suggest similar strategies to those in Decision Type 2; that is the use of short-cut rules or heuristics instead of more systematic but complex procedures. This is consistent with Fiske and Taylor's (1984) characterization of a "cognitive miser" who, if she could get away with it, would rather resort to quick strategies and rules of thumb than effortfully process all the needed information.

It is reasonable to assume that similar strategies will be used by decision makers in Decision Type 6 and Decision Type 3, since the alternatives have been specified or limited for the decision maker in both cases. However, since the nature of the ideal alternative is not specified in Decision Type 6, we propose that there will be a stronger tendency to justify a preference for one alternative, than to seek out the relevant information, following a least effort principle. We can use the same example we used in Decision Type 3, but this time, the voter may not be as sophisticated, and therefore, not as clear about what she seeks from the ideal candidate (i.e., she may not know what the position entails, or is unclear about what makes a person effective in the position, etc.). She will probably simply pick out a candidates that she "likes" based on personal impressions, and not worry about whether her choice was in fact the best. If we ask this voter, why she voted for her candidate, she would then try to justify her decision by posing simple arguments. Often these arguments will reveal that there has been no systematic attempt to compare the candidates (e.g., "He is a good and hard-working man" or "She will work for the good of the people"; c f., Conaco & Samonte, 1993).

Another illustration would be in the area of the effects of persuasion on decision making. Consider the case of a rural housewife who is the target of an information/education campaign on malaria. The communicator, a young doctor who works with the Department of Health, drops by her house when she is busy preparing meals. The doctor then proceeds to lecture her on the potentially fatal disease of malaria, its root cause and the various options she has for protecting her family from the disease. To the uneducated, busy housewife, the doctor's scientific discussion is vague and hard to follow, the causal factor and the goal of all the specified options incomprehensible. She is not even clear as to how exactly the specified choices may work (e.g., what does destroying the breeding places of mosquitoes have to do with malaria?). All these things considered, the distracted or uncaring housewife would probably resort to salient, but insignificant, factors like communicator credibility, attractiveness or similarity to self as the basis for choice (Petty & Caccioppo, 1985; Eagly & Chaiken, 1984). That is, because she has not time to consider what the doctor has said, she could very well opt to just not do anything and reject all the doctor's alternatives. Or she could also strongly believe that the doctor must know what he is talking about and on this basis then decide to accept his recommendations without further scrutiny.

As mentioned earlier, it seems very unlikely that there can be precise information available for decision problems without readily available decision alternatives. Thus, in this paper, we will not discuss decision strategies for Decision Types 7 and 10.

There are important similarities among decision problems in Decision Types 8, 9, 11, and 12, due to the constraint that alternatives have to generated. First, there would be no clear separation between the generation of alternatives and the evaluation of the same. Studies indicate that generation and evaluation of alternatives is an iterative process which become more and more particular in terms of the factors considered for evaluating the alternatives (Mintzberg, et al., 1976; Al-

exander, 1979; Abelson & Levi, 1985). Furthermore, in this cyclical processes, as some preferences are established, acquisition and evaluation of information becomes directed towards strengthening and resolving problems about the established preferences (Soelberg, 1967; Englander & Tyzka, 1980). This observation is highly consistent with the dominance model proposed by Montgomery (1984, Dahlstrand & Montgomery, 1984) in which the decision maker seeks to represent the decision situation such that one alternative is seen as being dominant over all other alternatives. Busemeyer (1983) and Schmalhofer and Gertzen (1986) suggest that such a strategy, particularly when the alternatives are considered sequentially, also serve to reduce the cognitive load during the decision making process.

There will be important differences, though, depending on how specific the nature of the ideal decision alternative is. If there are very clear guidelines for the ideal solution at the outset, as in Decision Types 8 and 9, the tendency would be for the decision maker to undertake an efficient search for the alternative that best fits the guideline. An example could be when the President of the country has to nominate a new justice for the Supreme Court. It is possible that the President and his advisers have some idea of what qualities are required and desirable for a Supreme Court Justice. With these ideas in mind, they undertake a systematic search for potential nominees that fit the qualities they have prescribed (by no means are we implying that this is the actual process used by our current President or any recent one).

On a related point, Abelson and Levi (1985) suggest a generalization that an increase in the decision maker's desire to obtain an optimal outcome will increase the tendency to generate alternatives by designing new ones, rather than merely searching for them. This is consistent with the contingency model proposed by Beach and Mitchell (1978).

On the other hand, for Decision Types 11 and 12, where the ideal decision alternative is not specified, there would be a greater tendency for preferences to change (March, 1978; Dyckman, 1981). As Soelberg (1967) observed in his study of career choices of MIT students, except for the most critical dimensions for evaluation, the importance of the different information on the alternatives is determined during the iterative generation and evaluation of alternatives. Fischhoff, Slovic, and Lichtenstein (1980) point out the possibility that people might even be ignorant about their goals and preferences regarding certain issues.

Regarding Decision Type 11, we could also consider Steinbruner's (1974) cybernetic model for decision making as mapping on to this decision situation. A cybernetic model, operates by simplifying ambiguous problems, that is, decreasing the variability in the information involved. For instance, if the dimensions for evaluating decision alternatives are not specified, a cybernetic mechanism would monitor only a small set of critical variables, and make decisions based on whether the alternatives move outside "tolerable ranges." Steinbruner, incidentally, asserts that this type of cybernetic operations applies to all types of decision situations.

We have made no distinctions, so far, between the cells where information about the alternatives are vague and unknown. This is because, we think that similar iterative processes of generation and evaluation will be used. According to the dominance model (Montgomery, 1984), alternatives without the necessary information relative to the dominant alternative will be ignored. If information is not enough even to arrive at one dominant alternative, decision making will be delayed or terminated (Montgomery, 1984; see also Corbin, 1981). Bystander apathy in an emergency situation is an example of such a situation (Darley & Latane, 1968; Latane & Darley, 1970). In such situations, the individual is faced with the decision of intervening

in some way or not to do anything. However, for the bystander, there is a great deal of ambiguity regarding what is going on, what should be done, what is the ideal course of action, and what information there is on the alternatives that she might be able to generate on the spot. In particular, the bystander does not clearly know what "safe" help (i.e., useful to the victim and at no cost or danger to the helper) she can offer, if help is needed at all, if help will be appreciated by the victim, if getting involved will have any untoward consequences, and so on. It may, therefore, be a sounder decision to opt not to do anything.

If, however, somehow, a preference for an alternative is attained, it seems reasonable to predict that the decision maker would tend to justify this preference rather than seek the necessary information for establishing dominance. This tendency would be greater for Decision Type 12 than for Decision Type 9, where the specification for an ideal alternative should limit the range of dimensions for justifying any decision. An appropriate example might be found in the current social/political/economic malaise in the country today which begs for some action from government decision makers. But where does the decision process start and how does it proceed given the ambiguity of the total situation? The problem seems so colossal and poorly defined that the goals are never clear defined or agreed upon, alternatives are too sketchy and lacking in specifics, and the information on the outcomes of the different alternatives is highly uncertain, unclear or, worse, unknown. We know something is terribly wrong somewhere, we know we ought to do something, but no one is really sure what the possible choices are, what they entail, or if they have a fighting chance of working at all. The result is piece meal decision making and heavy post facto rationalization by the decision maker.

CONCLUSION

We described ten decision contexts based on different knowledge sets of the decision maker with respect to three aspects of the decision process: available alternatives, the nature of the ideal alternative, and information on the alternatives. We proposed that different decision strategies will be used in each decision context due to the constraints imposed by the knowledge set. Note that this position is different from that of Beach and Mitchell (1978) where the different factors influence the decision makers choice of a decision strategy in dealing with different decision problems.

The taxonomy of decision problems proposed is clearly very sketchy. The characteristics of the decision problems in each of the decision contexts have to be better clarified. It would be a significant improvement if more researches in the area are accounted for in the taxonomy. This would be very useful in telling us if the taxonomy is useful in making distinctions about the diverse research findings. The predictions regarding the decision strategies that will be used in each context should be made more precise. This could be done by a more efficient accounting of the researches already done.

However, from the preliminary discussion of the various components of the taxonomy, we can already see how different theories and findings about specific aspects of decision behavior can map on to various types of decision making situations we find in our society—medical decisions, legal decisions, policy decisions, common everyday household decisions, to name a few.

For what seem to be the most significant decision problems, we can see that the decision situation can be extremely complex and problematic, particularly in terms of the informational requirements. Consider the current confusion over the family planning issue. For the couple trying to arrive at a decision regarding family size and, as a corollary, type of family-planning method to use, the situation is fraught with uncertainty regarding ideal alternative or the goal of the decision (i.e., birth control or child spacing), uncertainty

regarding alternatives or options (i.e., natural methods or artificial contraception), and ambiguity or lack of information on the various alternatives (i.e., the IUD is an abortifacient; the condom does not protect from AIDS; withdrawal is a natural method and is allowed by the church; when exactly can one have sex when using the calendar method). Various groups with their own vested interests in the couple's decision sow both information as well as disinformation contributing further to the confusion. In addition, although the couple is the unit making the decision, the husband and the wife may each have their own knowledge sets and preferences (i.e., number and gender of children to have, etc.) which have to be communicated and negotiated with each other if a satisfactory decision is to be arrived at. The decision situation seems to be rendered such that it is almost impossible for the couple to undertake a systematic decision-making process.

The "social dilemma" is another area which reflects well the problematic, and often dynamic, nature of typical decision making. In a social dilemma, the conflict and, therefore, the decision point is between the short term interests of the individual and long term group interests (Messick and Brewer, 1983). For example, to the logging concessionaire whose goal is profit, the obvious decision might be to cut as many trees as possible in as short a time as possible. Yet if this person had only taken the time to reflect on his options and considered all the information, he might have seen that the "obvious" decision is not the optimal one. The quick profit strategy could only lead to faster depletion of a slowly replenishing resource and the shortening of the period when logging could be a viable means of livelihood. In addition, it could trigger an onrush of environmental problems like erosion, floods in the rainy season, the drying up of natural water sources, the extinction of rare forest flora and fauna, and pollution. The dilemma of the decision required in this situation lies in the very real difficulty of discounting for the long-term and more far-reaching consequences of one's decisions. It would seem inevitable, therefore, that people would keep making decisions that are for their individual, short-term advantage.

Fortunately, this scenario does not have to be an inevitable one. Messick and Brewer (1983) make a suggestion for solving social dilemmas by using influence on individual choice. Through communication among group members, information about the various alternatives and information about individual preferences are brought out in the open thus making it more likely that the individual's ultimate choice is more informed and takes into consideration all the possible repercussions. In addition, group discussions activate certain normative pressures that make less likely the individual selfish and short-sighted decision.

The two examples discussed above probably depict the typical decision making context for most people, ambiguous and uncertain, with too many unknowns. We have also demonstrated how making available certain critical knowledge elements can improve decision quality in the social dilemma situation. Yet if the decision maker does not even know what these critical knowledge elements are, where does the person begin the whole process? The utility of a taxonomy of decision problems thus cannot be overemphasized. If for nothing else, it can provide the decision maker valuable information on what critical knowledge is needed, available, or missing in her particular context and how this critical knowledge can affect the quality of her decision. This knowledge can be valuable in at least two ways. First, it can show the decision maker the limitations of any decision she may have made, thus providing the decision as well as its consequences a more appropriate perspective. Second, and more importantly, the decision maker can choose to use this knowledge as a guide for the actual decision making process being undertaken. Doing so would ensure that any decision she arrives at

would be derived using information about the best possible strategies that can be used in similar highly constrained circumstances.

NOTES

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