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BEHAVIORAL DECISION RESEARCH: A CONSTRUCTIVE PROCESSING PERSPECTIVE

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INTRODUCTION

Almost 40 years ago, Ward Edwards (1954) provided the first major review for psychologists of research on decision behavior done by economists, statisticians, and philosophers. He argued that work by economists and others on both normative and predictive decision models should be important to psychologists interested in judgment and choice. About the same time, Herbert Simon (1955) argued that if economists were interested in understanding actual decision behavior, then research would need to focus on the perceptual, cognitive, and learning factors that cause human decision behavior to deviate from that predicted by the normative "economic man" model. Simon emphasized that the limited computational capabilities of the decision-maker interact with the complexity of task environments to produce bounded rationality—i.e. decision behavior that reflects information processing bounds. As a consequence, Simon suggested that actual decision behavior might not even approximate the behavior predicted by normative models of decision tasks (Simon 1978).

Nearly four decades later, a clear and separate area of inquiry has emerged, which we refer to as Behavioral Decision Research (BDR). This area is intensely interdisciplinary, employing concepts and models from economics, social and cognitive psychology, statistics, and other fields. It is also nearly unique among subdisciplines in psychology, because it often proceeds by testing the descriptive adequacy of normative theories of judgment and choice; in doing so, it makes substantial use of psychological concepts in general, and cognitive mechanisms in particular.

This chapter reviews behavioral decision research for the period 1983–1991. We have noticed several trends in the course of our review. First, behavioral decision research concepts and methods are being widely adopted. A substantial amount of research in the area, for example, is conducted by scholars with primary interests in many applied areas, including accounting, environmental studies, finance, law, marketing, and medicine (Ashton et al 1989; Froot & Thaler 1990; Noll & Krier 1990; Schwartz & Griffin 1986; Simonson 1989). In addition, researchers are using behavioral decision concepts to gain insights into such complex, multiperson phenomena as negotiations and the behavior of experimental markets (Carroll et al 1988; Camerer

1992). Second, there is a growing focus on the problem structuring and learning elements of decision behavior, although the amount of such research is still small. Examples include research on alternative generation (Gettys et al 1987; Keller & Ho 1988) and studies of how cues for inference are learned from outcome feedback (Klayman 1988). Third, the richness of methods and problem descriptions used in decision research continues to increase. For example, process-tracing techniques, case methods, computer-game simulations, and even the presentation of data via radar screens are being used (Ford et al 1989; Eisenhardt 1989; Brehmer 1990; Lusk & Hammond 1991). These trends can be found in the thousand-plus articles and chapters that have been written on behavioral decision topics during the past eight years. However, given page constraints, our review is selective rather than exhaustive; we focus on a fourth major trend of much recent behavioral decision research: a theoretical concern with the constructive nature of judgment and choice. See Abelson & Levi 1985, Slovic et al 1988, and Stevenson et al 1990 for reviews of behavioral decision research that cover a longer time span and offer alternative perspectives.

THE CONSTRUCTIVE NATURE OF PREFERENCES AND BELIEFS

An underlying theme of much recent decision research is that preferences for and beliefs about objects or events of any complexity are often constructed—not merely revealed—in the generation of a response to a judgment or choice task (Slovic et al 1990). March (1978) attributes the constructiveness of preferences to the same limits on information processing capacity emphasized by Simon. In his words, "Human beings have unstable, inconsistent, incompletely evoked, and imprecise goals at least in part because human abilities limit preference orderliness" (March 1978:598). March's argument about preference applies to belief judgments as well, and the constructive view is a major organizing theme of this review.

The idea of constructive preferences goes beyond a mere denial that observed preferences result from reference to a master list in memory. The notion of constructive preferences means as well that preferences are not necessarily generated by some consistent and invariant algorithm such as expected value calculation (Tversky et al 1988). It appears that decision-makers have a repertoire of methods for identifying their preferences and developing their beliefs. These multiple methods or strategies result from both experience and training (Fong et al 1986; Kruglanski 1989; Larrick et al 1990).

Descriptive research on decision-making processes has shown that the information and strategies used to construct preferences or beliefs appear to be highly contingent upon and predictable from a variety of task, context, and individual-difference factors. Task factors are general characteristics of a decision problem, such as response mode (judgment or choice, for example), which do not depend upon the particular values of the alternatives. Context factors such as similarity of alternatives, on the other hand, are associated with the particular values of the alternatives. Task and context factors cause different aspects of the problem to be salient and evoke different processes for combining information. Thus, characteristics of the decision problem, such as the response mode or similarity, can evoke different strategies that at least partially determine the preferences and beliefs we observe. Further, the characteristics to which people are sensitive are from a normative perspective often, although certainly not always, irrelevant (Tversky & Kahneman 1986; Tversky et al 1988). Consequently, people sometimes ignore normatively relevant information such as base-rates, and sometimes use base-rate information in an appropriate fashion. Hence an important question in current decision research is the identification of the task conditions that determine when normatively important information like base-rates will and will not be used (Gigerenzer et al 1988; Ginossar & Trope 1987).

Also related to the constructive nature of decision behavior are the multiple and sometimes conflicting meta-goals adopted for the decision episode—e.g. maximize accuracy or justifiability; or minimize effort, regret, or conflict (Einhorn & Hogarth 1981; Tetlock 1985). Finally, how a solution to a decision problem is constructed will also, of course, be a function of individual-difference factors such as processing capacities (Bettman et al 1990) and prior knowledge or expertise (Shanteau 1988). Another important ongoing issue is the extent to which individual differences in values and beliefs are related across task and context changes (MacCrimmon & Wehrung 1990; Schoemaker 1990).

Thus many current issues in behavioral decision research can be related to the notion of the constructive nature of human preferences and beliefs and the contingent use of multiple approaches for solving decision problems. We use this theme in organizing our review. We first consider two central elements of decisions—preferences and beliefs about uncertain events—focusing on the use of multiple strategies in such judgments and the factors that influence which strategies are used. Then we consider decision-making under risk and uncertainty, again focusing on contingent strategy use. This prevalence of evidence for contingent strategy use leads us to consider possible frameworks explaining such contingencies. Finally, we consider how the research and concepts reviewed can be applied to improve assessments of preferences, beliefs, and decisions.

PREFERENCES

Common sense suggests that good decisions are consistent decisions and that small changes in how a question is asked or how options are presented should not change what we prefer. In more formal terms, we would expect our choices and judgments to possess procedural invariance: Normatively equivalent procedures for assessing preferences should result in the same preference order (Tversky et al 1988). Similarly, we would expect descriptive invariance to hold: Different representations of the same choice problem should yield the same preference (Tversky & Kahneman 1986). As discussed below, a great deal of research demonstrates that both procedural and descriptive invariance often fail to hold. In fact, Shafer (1986) has called the failure of decisions to be invariant across procedures and descriptions "the most fundamental result of three decades of empirical investigation" (p. 464) in behavioral decision-making.

Why does invariance fail? A constructive view of decision-making suggests at least three sources of such failures. First, decisions often involve conflicting values, where we must decide how much we value one attribute relative to another. In trying to deal with such conflicts, individuals often adopt different strategies in different situations, potentially leading to variance in preferences. Second, decisions are often complex, containing many attributes or alternatives. Since these problems are simplified by decision-makers in different ways, failures of invariance might be related to task complexity. Finally, although we may know what we get when we choose an option, we may not know how we feel about it. A prestigious Ivy League school may offer a competitive and high-pressure graduate program, but we might be uncertain about how we would like that environment. Hence, invariance may fail because of uncertainty in values, even when we know what we will receive.

Below, we consider the underlying theme of the constructive nature of judgment and choice. We review investigations of how individuals respond to decisions made difficult by conflicting values, decision complexity, and uncertainty in values. In addition, we consider how individuals may restructure problems or construct arguments in assessing their preferences.

Conflicting Values

Conflict among values arises because decisions generally involve a choice among options where no option best meets all of our objectives. Conflict has long been recognized as a major source of decision difficulty (Shepard 1964). The presence of conflict and the fact that a rule for resolving the conflict cannot readily be drawn from memory are also reasons why decision-making, even in the simplest laboratory tasks, is often characterized by tentativeness and the use of relatively weak methods (heuristics). The use of such heuristics is often associated with novice-like problem solving rather than the kind of recognize-and-calculate processes associated with expertise (Chi et al 1988; Langley et al 1987).

In cases where there is clearly a dominating option—i.e. option A is at least as good as option B on all valued attributes and strictly better on one or more attributes—there is no conflict, and the choice of the dominating option is easy. In fact, the idea that the dominant option should be chosen in such a case is the most widely accepted principle of rational decision-making. When the relation of dominance is highly transparent, people indeed choose the dominating option; however, the principle of dominance can be violated if the relation of dominance is masked by the way a decision is presented (Tversky & Kahneman 1986) or by erroneous beliefs such as the fixed-pie assumption in negotiations (Bazerman 1990).

How do people make decisions among multiattribute alternatives when no alternative dominates, and hence conflict exists? People use a variety of evaluation strategies, some of which can be thought of as conflict confronting and others as conflict avoiding (Hogarth 1987). The most common assumption is that such decisions are made by considering the extent to which one is willing to trade off more of one valued attribute (e.g. economy) against less of another valued attribute (e.g. safety). That is, conflict among values is confronted and resolved. A decision model often used to represent the trading-off process is the weighted additive value model, in which a measure of the relative importance (weight) of the attribute is multiplied by the attribute value for the particular alternative and the products are summed over all attributes. The alternative with the highest overall evaluation is chosen.

Exactly how people think of "weights" in such decisions is the subject of investigation. There is some evidence that weights are sometimes interpreted in a local sense: The relative weights reflect the ranges of attribute values across the alternatives in the choice set—i.e. the greater the range, the greater the importance of the attribute (Goldstein 1990). At other times, subjects interpret the weight given to an attribute more globally—e.g. safety might always be viewed as much more important than costs, without much consideration of local ranges of values (Beattie & Baron 1992).

To the extent that people make decisions consistent with an additive model, the key research problems are to measure the weights and values a person assigns to the attributes describing the decision alternatives. Unfortunately, the tradeoffs people exhibit among conflicting attributes are highly contingent on a host of task and context factors. Individuals also use strategies other than weighted adding in many situations, depending upon task and context factors. Many of the heuristics used are noncompensatory, meaning that a good value on one attribute cannot compensate for a bad value on another. Hence, tradeoffs may not be made explicitly in many cases.

PROCEDURAL VARIANCE One of the most important task variables demonstrating procedural variance in preference assessments is the method by which the decision-maker is asked to respond. Different response modes can lead to differential weighting of attributes and different preference assessments. Research on choice vs matching tasks and on preference reversals documents such response mode effects.

Choice vs Matching An excellent illustration of the contingent weighing of attributes as a function of response mode is provided by the so-called "prominence effect" investigated by Tversky et al (1988). They show that the predominant attribute (e.g. lives saved in comparison to the cost of a safety program) is given even more weight when preferences are assessed using a choice mode than when preferences are assessed using a matching task.

Let us illustrate the difference between a matching task and a choice task. Imagine that you are asked to consider two programs for dealing with traffic accidents. The programs are both described to you both in terms of yearly dollar costs and in terms of the number of casualties per year each will result in: Program A is expected to lead to 570 casualties and cost $12 million, while Program B is expected to lead to 500 casualties and cost $*X*. In a matching task you are asked to provide an estimate *X* for the cost for program B—presumably an amount greater than $12 million—that will make Program B equal in overall value to Program A.

In a choice task, on the other hand, values for the cost and casualties of both programs are given (e.g. you know all the values in the example above, and you know that Program B will cost $55 million). You are asked to choose the program you prefer. Most people choose B over A in this situation, implying that saving 70 lives is more important than saving $43 million. In a matching task, on the other hand, people estimate *X* at less than $55 million, implying that a cost difference of less than $43 million is equivalent to the difference in casualties of 70. Hence, the tradeoffs when performing matching tasks differ from those when performing choice tasks.

Tversky et al (1988) suggest that different heuristics or computational schemes are likely to be used in the two kinds of tasks. Of the two, choice is thought to involve more qualitative reasoning, such as that involved in the lexicographic choice strategy (i.e. select the option that is ordinally superior on the most important attribute). Lexicographic reasoning is viewed as both cognitively easier than explicit tradeoffs and easier to justify to oneself and others. A lexicographic strategy for choice also avoids rather than confronts conflict. Matching, on the other hand, requires a more quantitative assessment. In order to perform the matching task, one must consider the size of the intervals for both attributes and the relative weights of the attributes.

More generally, Tversky et al suggest a principle of strategy compatibility between the nature of the required response, ordinal or cardinal, and the types of reasoning employed by a decision-maker. Choice, for example, requires an ordinal response and is hypothesized to evoke arguments (processes) based on the ordering of the attribute values.

Preference reversals As discussed by Fischer & Hawkins (1989), an idea related to, but distinct from, the concept of strategy compatibility is that of "scale compatibility," which states that the weight of a stimulus attribute is enhanced by its compatibility with the response scale. The idea of scale compatibility has been in the literature for some time and has played a major role in elucidating the classic preference reversal phenomenon (Lichtenstein & Slovic 1971). In the standard preference-reversal paradigm, two bets of comparable expected values are evaluated. One of the bets offers a high probability of winning a small amount of money while the other bet offers a low probability of winning a much larger amount of money. When asked to choose between the two bets, most people prefer the bet with the higher probability of winning. When asked to bid on (assign a cash equivalent to) each bet separately, most people assign a higher value to the low-probability, high-payoff bet. Tversky et al (1990) show that overpricing of the low-probability, high-payoff bet, as suggested by the scale compatibility of payoff amount with the bid response mode, is a major cause of preference reversals (see also Bostic et al 1990). Schkade & Johnson (1989), using a computer-based method for monitoring information-acquisition behavior, also found support for the notion that scale compatibility is a factor underlying preference reversals.

Scale compatibility clearly plays a role in preference reversals; however, other mechanisms may also contribute to preference reversals. For example, Goldstein & Einhorn (1987) assume that the evaluation process is the same for all response modes. They locate the principal source of procedural variance in the expression of the underlying internal evaluation on different response scales.

Hershey & Schoemaker (1985) suggest that preference reversals also may be understood in terms of how individuals reframe decisions with certain response modes. Suppose that a person is given a sure-thing option and a gamble offering the possibility of either a specified greater-amount outcome or a specified lesser-amount outcome, and that the person is asked to set (match) a probability p of obtaining the greater amount in order to make the sure-thing option and the gamble equal in value. Hershey & Schoemaker suggest that the person uses the amount of the sure thing as a reference point, with the two outcomes of the gamble then coded as a gain and as a loss. With other response modes the framing of the problem is assumed to be different (see Bell 1985 for the suggestion that the expected value (EV) of a gamble serves as a natural reference point in a bidding mode). Casey (1991) emphasizes the related idea of an aspiration level in his explanation of a new form of preference reversal. Finally, Johnson & Schkade (1989), using process-tracing methods, show that the more an individual uses a reframing and an anchoring and adjustment strategy, the greater the extent to which value assessments differ across response modes. We have more to say about framing effects and anchoring and adjustment below.

As suggested by the strategy-compatibility hypothesis discussed above, preference reversals may also be due to changes in evaluation processes as a function of response mode (e.g. Johnson et al 1988; Mellers et al 1992; Schkade & Johnson 1989). People may use different strategies to generate each type of response, thus leading to reversals. In a series of experiments pitting strategy compatibility and scale compatibility against one another, Fischer & Hawkins (1989) found strategy compatibility effects to be stronger as explanations of procedural variance.

To summarize, various preference-reversal explanations locate the cause of the phenomenon at either the framing, strategy selection, weighting of information, or expression of preferences stage of decisions. However, as suggested by several authors (e.g. Goldstein & Einhorn 1987), the preference-reversal phenomenon may be so robust because there are multiple underlying causes, each of which may be operative in some situations but not others. In any event, it is now clear that the answer to how much you like a decision option can depend greatly on how you ask the question.

DESCRIPTIVE VARIANCE Research conducted in the past eight years confirms that the manner in which problems are presented affects preferences, even when the descriptions or presentations are normatively equivalent (Tversky & Kahneman 1986). Two major streams of research that demonstrate descriptive variance are investigations of framing effects and effects of information presentation.

Framing effects Framing involves the determination of the effective acts, contingencies, and outcomes of a decision. Framing is influenced by how the decision problem is presented and by the norms, habits, and expectations of the decision-maker (Tversky & Kahneman 1986). Tversky & Kahneman (1981) illustrated the impact of presentation on framing by showing that simple wording changes—e.g. from describing outcomes in terms of lives saved to describing them in terms of lives lost—can lead to different preferences. Numerous other researchers have demonstrated such wording effects (Fagley & Miller 1987; Huber et al 1987; Kramer 1989; Levin & Gaeth 1988; Puto 1987). These studies most often distinguish between (*a*) framing that leads one to code outcomes as gains and (*b*) frames that result in outcomes' being coded as losses. It is clear that people treat negative consequences and positive consequences differently. Tversky & Kahneman (1992) have emphasized the importance of this difference in the concept of loss aversion, which states that the impact of a difference on a dimension is greater when that difference is seen as a loss than when it is seen as a gain. We believe that this concept will prove important in understanding decision behavior.

More generally, however, a complete theory of framing has proven difficult to formalize, although progress has been made in identifying important elements of framing. For instance, Thaler (1985; Thaler & Johnson 1990) has suggested that framing may be an active process rather than simply a passive response to the decision problem as given. He examined the hypothesis that people prefer outcomes framed to make the options appear the most pleasant or the least unpleasant. Using the prospect theory value function (Kahneman & Tversky 1979) as a starting point, Thaler (1985) argued that people generally prefer to have gains kept separate (segregated) and to have all negative outcomes integrated (packaged together) into one total.

Thaler & Johnson (1990) term this view *hedonic editing* and asked whether people actively edit options to a more pleasant frame. Their study examined how prior gains and losses (e.g. sunk costs) influence subsequent choices (Arkes & Blumer 1985; Laughhunn & Payne 1984; Staw 1981). Their results suggest a more complex picture of hedonic editing; for example, people apparently prefer to have financial losses separated temporally. They also report a "break-even" effect, in which the impact of a prior loss on risk-taking is influenced by whether the choice of a new gamble will or will not offer the possibility of getting back to some original reference position or break-even point.

Linville & Fischer (1991) also provide evidence that the original hedonic-framing hypothesis does not account for peoples' preferences for temporally separating or combining good and bad news. They find that people prefer to segregate bad news but to combine a positive and negative event on the same day. They suggest that frames are driven by the need to conserve the limited, but renewable, physiological, cognitive, and social resources available to people for dealing with emotional events. Like Thaler, they see framing as at times a proactive process.

The concept of a reference point, target level, or aspiration level that contributes to framing effects, and perhaps to procedural variance, is a venerable one in theories of decision-making (Siegel 1957; Simon 1955).

Simon, for example, suggested that individuals can simplify choice problems by coding an outcome as being one of two types: satisfactory if the outcome is above the aspiration level or unsatisfactory if it is below. Substantial evidence indicates that choice depends on the reference level used in the coding of outcomes (Fischer et al 1986; Payne et al 1984; Tversky & Kahneman 1990). A particularly important form of reference-level effect is the status quo bias (Samuelson & Zeckhauser 1988; Kahneman et al 1990), in which the retention of the status quo option is favored over other options. Recently, Hogarth & Einhorn (1991) have emphasized the role of a reference point in the encoding of evidence for the purpose of updating beliefs.

Framing effects are dramatic examples of descriptive variance. Hence, understanding how frames are selected would be very important. Fischhoff (1983) found it hard to predict when certain frames would be used. However, Puto (1987) was able to relate the selection of reference points to expectations and objectives in an industrial buying context. Given the crucial nature of framing effects in decision behavior, much more research on this topic is needed.

Information presentation effects Differences in modes of information presentation also affect decision behavior. For example, Stone & Schkade (1991) found that representing attribute values with words led to less compensatory processing than representing the values numerically. Wallsten and his colleagues (Budescu et al 1988; Erev & Cohen 1990; Wallsten 1990) have carried out an important related series of experiments testing differences between numerical and verbal representations of probability information. In general, people prefer to receive information about probabilities of events in numerical form but prefer to express the probabilities of events to others in words (e.g. doubtful, likely).

The format or structure of information presentation also can influence how information is processed. Jarvenpaa (1989, 1990), extending an earlier result by Bettman & Kakkar (1977), found that how information was processed tended to be consistent with how graphic displays were organized—i.e. by alternative or by attribute. MacGregor & Slovic (1986) also show that people will use a less important cue in predictive judgments simply because it is more salient in the display. While the finding that information acquisition proceeds in a fashion consistent with display format is not surprising (see Slovic 1972, for an early statement of this idea), it does have important implications both for aiding decision behavior using relatively simple changes in information presentation and for the design of graphics for computer-based decision support systems.

Another series of experiments has dealt with a third aspect of information presentation, the completeness of information displays (Dube-Rioux & Russo

1988; Hirt & Castellan 1988; Weber et al 1988). Those studies show that the apparent completeness of a display can blind a decision-maker to the possibility that important information is missing from a problem description (a result earlier obtained by Fischhoff et al 1978). Individuals may respond differently to the problem if they do not realize that information is missing.

Finally, Fischer et al (1987) found that when a more fundamental attribute (e.g, health effects) is represented by a proxy attribute (e.g. levels of pollutants in the air) there was a strong bias toward overweighting the proxy attribute (relative to an expectation model of the value of the proxy). Fischer et al suggest that this bias is due to the inference processes people use to construct values when they do not have well-articulated preferences for tradeoffs among attributes.

Complexity of Decisions

Studies showing procedural and descriptive variance in how individuals deal with conflicting values provide clear examples of constructive decision behavior; however, other striking examples exist of multiple strategy use and contingent judgment and choice. Many of these examples concern how people adapt their decision processes to deal with decision complexity. The primary hypothesis underlying most of this research is that the more complex the decision problem, the more people will use simplifying decision heuristics. This hypothesis has been supported by a number of studies conducted during the past eight years. Decision complexity has been manipulated using the number of alternatives, number of attributes, and time pressure, among other factors.

Perhaps the most well-established task-complexity effect is the impact of changes in the number of alternatives available. When faced with two alternatives, people use compensatory decision strategies like the weighted additive model; these involve trading off a better value on one attribute against a poorer value on another. However, when faced with multi-alternative decision tasks, people prefer noncompensatory choice strategies (Biggs et al 1985; Billings & Marcus 1983; Johnson et al 1989; Klayman 1985; Onken et al 1985; Sundstrom 1987).

Varying the amount of attribute information is another way to manipulate decision complexity. A number of studies, though not all, indicate that decision quality can decrease with increases in the number of attributes after a certain level of complexity has been reached (Keller & Staelin 1987; Shields 1983; Sundstrom 1987). These studies of "information overload" effects have been criticized on a variety of methodological grounds (e.g. Meyer & Johnson 1989). Nonetheless, it is clear that people use selective attention to deal with increased task complexity. The crucial question is how people focus on the most important information and avoid getting distracted by irrelevant information. Grether & Wilde (Grether & Wilde 1983; Grether et al 1986) argue that in "real" tasks people are able to ignore the less-relevant information, and hence overload is not a serious issue. On the other hand, Gaeth & Shanteau (1984) found that judgments were adversely influenced by irrelevant factors, although that influence could be reduced with training. Research on the strategies people use for selectively attending to information would be valuable.

People also respond in several ways when faced with decision problems varying in time pressure. These coping mechanisms include the acceleration of processing, selectivity in processing, and shifts in decision strategies. As time constraints are made more severe, the amount of time spent processing an item of information decreases substantially (Ben Zur & Breznitz 1981). Under time stress, processing is focused on the more important and/or more negative information about alternatives (Ben Zur & Breznitz 1981; Svenson & Edland 1987; Wallsten & Barton 1982; Payne et al 1988). There is also evidence that decision strategies may shift as a function of increased time pressure (Zakay 1985; Payne et al 1988). Finally, there may be a hierarchy of responses to time pressure. Payne et al (1988) found that under moderate time pressure subjects accelerated processing and to a lesser extent became more selective in their processing. Under more severe time pressure, people accelerated processing, focused on a subset of information, and changed processing strategies.

Research on decision complexity, therefore, also documents the constructive nature of judgment and choice, since people respond to complex decisions using different strategies depending upon the nature of the task.

Uncertainty in Values

Rational choice involves two kinds of guesses: "guesses about future consequences of current actions and guesses about future preferences for those consequences" (March 1978:40). Decisions are difficult whenever either kind of uncertainty (need to guess) is present. Below, we review research on how people assess the probabilities of uncertain events that link future consequences to actions. In the current section we examine research considering the second kind of uncertainty. How well do people assess uncertainties about their own future preferences, and how do people make choices when their values are ambiguous?

Kahneman & Snell (1990), for instance, have explored how people predict future experiences of enjoyment or discomfort (i.e. future utility values). They conclude that people have difficulty evaluating the utilities of future consequences. People also have trouble estimating the utilities of consequences that will result after a series of repetitive experiences with the same outcome.

Choice among alternatives whose outcomes occur at different points in time is related to prediction of utilities for consequences over time. The standard approach to such choice problems is to assume a discount function that permits an individual to make value comparisons between immediate and delayed consumption. Stevenson (1986) and Benzion et al (1989) provide experimental studies of discounting.

Loewenstein (1988) extends the discounting analysis by including the concept of a reference point used by individuals in the evaluation of immediate and delayed consumption options. For example, Loewenstein argues that delay in consumption of a good assumed to have already been purchased will be framed as a loss, and a high level of compensation for that loss will be demanded. A speed-up in delivery of a consumption item, on the other hand, will not be valued as much: the "speed-up cost" will be lower than the delay premium demanded. Loewenstein shows that different methods of eliciting intertemporal preferences yield different estimates of subjects' relative preferences for immediate and delayed consumption in ways consistent with the concept of a reference-point effect and inconsistent with standard discounting models. While the focus of Loewenstein's paper is on framing and intertemporal preferences, his studies also provide an example of the more general phenomenon of procedural variance in the elicitation of preferences.

Norm Theory also deals with uncertainty in preferences and the context-dependent aspects of judgment. Kahneman & Miller (1986) suggest that the particular subjective value given to an attribute score—e.g. travel time to an apartment from campus—will be constructed ad hoc on the basis of the recall or generation in memory of a comparison class of objects or decision episodes that seem relevant to the task at hand. The value assigned to an attribute score of a particular stimulus will reflect the distribution of scores for that attribute within the set of exemplars of that object evoked in memory. Kahneman & Miller also suggest that the attributes that control judgments may often not be the most central attributes, given that the generated set of exemplars may not be seen as varying much on the most central attributes.

An obvious hypothesis is that the more uncertainty (ambiguity) in one's preferences, the more one's expressed preferences will be subject to procedural and descriptive effects. For example, preferences for events further and further in the future may be more susceptible to framing effects. As another example, Alba & Hutchinson (1987) contend that consumers less familiar or less expert in a product class are more likely than familiar buyers to select information based on non-task related cues, such as display form (see also Hoch & Ha 1986; Levin & Gaeth 1988). Conversely, people who have more experience in making decisions within a particular domain may be less susceptible to effects such as the prominence effect of choice vs matching. A key research issue is whether the major determinant of susceptibility to procedural and display variables is the number of facts, the knowledge possessed about a domain, or the number of tradeoff decisions made within a domain.

Restructuring Decision Problems

Researchers typically assume that a decision-maker takes the decision problem as initially presented and seeks to find the preferred alternative given that structure—what Slovic (1972) refers to as the concreteness principle. However, a decision-maker might restructure the problem. Restructuring might involve transformations of information (e.g. rounding off, standardizing, or performing calculations), rearranging information (e.g. the order of brands or attributes), or simplifying by eliminating information. The restructuring might serve to reduce either the amount of perceived conflict in the decision or the degree of complexity.

The restructuring phenomenon expresses our theme that preferences are often constructed. Montgomery (1983), for example, has proposed that people actively restructure decision problems until one alternative is seen to be dominant, which provides a (relatively) conflict-free way to make the decision. The restructuring may involve such operations as collapsing two or more attributes into a more comprehensive one, emphasizing an attribute, or adding new attributes to the problem representation that will bolster one alternative.

Coupey (1990) suggests that various restructuring activities might also ease the total cognitive effort of solving a given decision problem. She allowed some of her subjects to take notes while solving decision problems and then coded the restructuring operations evident in the notes. Individuals who received information sequentially, or information that was poorly structured, used notes to generate alternative × attribute matrixes. Individuals who restructured were more likely ultimately to utilize alternative-based strategies. Hence, one interpretation of these data is that individuals put effort into restructuring so that later they can use a more accurate heuristic with a reasonable amount of effort.

Other researchers have also stressed restructuring in their accounts of decision behavior (M. Johnson 1984, 1989; Ranyard 1989). Michael Johnson's work deserves special note for its innovative look at the problem of preferences among more noncomparable alternatives. Most decision research has examined choices among options easily defined on a common set of attributes—e.g. alternative brands of television. In contrast, Johnson explored how people choose among items from different product classes (e.g. a new television vs a vacation) that possess different attributes. He identified several processes used by people to deal with such noncomparable choice options, including the generation of more abstract attributes, a form of restructuring. Bettman & Sujan (1987) argue that the criteria individuals construct for such choices are a function of how the problem is framed.

Argument-Based Decisions

A final concept related to the notion of constructive preferences is that choice is based on arguments that are generated in support of one option over another (Shafer 1986; Slovic 1975; Tversky 1988). Simonson (1989), for example, has shown that choice phenomena that are difficult to explain with more traditional models can be explained in terms of a search for reasons (arguments) to prefer one option over another. Specifically, he showed that the size of the asymmetric dominance (attraction) effect, in which the addition of an asymmetrically dominated alternative to a choice set (i.e. dominated by one alternative but not another) increases the probability of choosing the dominating alternative (Huber et al 1982; Ratneshwar et al 1987), was increased by the need to justify one's decisions to others. Further, he showed that the choice of the dominating alternative was felt by subjects to be less likely to be criticized and to provide a better argument.

To summarize, there is ample evidence that preferences are often constructed in response to a judgment or choice task. Next we consider evidence that people use multiple strategies to construct assessments of uncertainty. Following that discussion, we consider choice involving both uncertainty and values in more detail.

BELIEFS ABOUT UNCERTAIN EVENTS

The question of how people judge the probabilities or likelihoods of uncertain events has been a major focus in behavioral decision research for a number of years, and interest continued during the period under review. Efforts to compare intuitive probability judgments to the rules of statistics continue to be a major focus, as detailed below. The fact that such intuitive judgments often deviate from the laws of probability is now widely accepted, although some investigators question both the meaning and the relevance of errors in intuitive judgments (von Winterfeldt & Edwards 1986).

Much of the recent work on how people assess the probability of an event has adopted many of the same concepts used to explain preferential choice. That is, people are seen as having available several ways of assessing beliefs about uncertain events, and individuals use different modes of probabilistic reasoning in a highly contingent fashion. In addition, probability judgment can be thought of as the construction of arguments (Shafer & Tversky 1985). In the following sections, we consider different strategies for probabilistic reasoning and then consider evidence for the contingent use of such strategies.

Strategies for Probabilistic Reasoning

Specific heuristics involved in probabilistic thinking (e.g. availability, representativeness, and anchoring and adjustment) continue to be investigated. The availability heuristic refers to the assessment of the probability of an event based on the ease with which instances of that event come to mind. The representativeness heuristic involves an assessment of the probability of an event by judging the degree to which that event corresponds to an appropriate mental model such as a sample and a population, an instance and a category, or an act and an actor. Anchoring and adjustment is a general judgment process in which an initially generated or given response serves as an anchor and other information is used to adjust that response. It is generally assumed that the adjustment is insufficient.

The availability heuristic has been investigated in relation to judgments of political events (Levi & Pryor 1987), perceptions of the risk of consumer products (Folkes 1988), the generation of hypotheses by accountants (Libby 1985), and judgments about others (Shedler & Manis 1986). More generally, the relationship between memory access and judgment has been examined by Lichtenstein & Srull (1985) and Hastie & Park (1986).

A detailed study of the representativeness heuristic is offered by Bar-Hillel (1984). In an innovative study, Camerer (1987) has shown that representativeness affects prices in experimental markets, although the effect is smaller for subjects with greater experience in that market.

Finally, the anchoring and adjustment heuristic has been investigated in a variety of domains, including accounting (Butler 1986), marketing (Davis et al 1986), the assessment of real estate values (Northcraft & Neale 1987), and as a general process by which belief-updating tasks are performed (Hogarth & Einhorn 1991).

Contingent Usage of Strategies for Assessing Uncertainty

One characteristic of the use of heuristics is the neglect of potentially relevant problem information. As discussed more fully below, the adaptive use of heuristics, even though neglecting some information, can save substantial cognitive effort and still produce good solutions to decision problems. However, in many situations people do make systematic errors in forming probability judgments. As illustrated below, the question is no longer whether biases exist, but under what conditions relevant information will or will not be used to construct a response to a probability judgment task. We examine this issue for usage of base-rate information, the conjunction fallacy, and the effects of expertise on uncertainty judgments.

THE USE/MISUSE OF BASE-RATE INFORMATION Almost 20 years ago, Kahneman & Tversky (1973) reported a series of studies that involved presenting subjects with a brief personality description of a person and a list of different categories to which the person might belong. The task for the subject was to indicate the category to which the person was most likely to belong. The striking finding was that subjects all but ignored the relative sizes of the different categories—i.e. the base rates; instead, judgments were based almost exclusively on the extent to which the given description matched the various category stereotypes (representativeness). Since then, many researchers have investigated when and how base-rate information is utilized in decision-making (see Bar-Hillel 1990 for an overview of base-rate studies). Base-rate information is often, but by no means always ignored. For example, Medin & Edelson (1988) report that in one series of studies "participants use base-rate information appropriately, ignore base-rate information, or use base-rate information inappropriately (predict that the rare disease is more likely to be present)" (p. 68).

Evidence that base-rate information is sometimes neglected and sometimes used appropriately in assessing the probability of an event has led to the view that probabilistic reasoning involves contingent processing. Two recent examples of contingent-processing approaches to base-rate use are provided by Gigerenzer et al (1988) and Ginossar & Trope (1987). Both studies show that the use of base-rate information is highly sensitive to a variety of task and context variables. For example, Gigerenzer et al found that a change of problem context from guessing the profession of a person to predicting the outcome of a soccer game influenced the use of base-rate information, with the use of base-rates greater in the soccer problem. They argued that "the content of the problem strongly influenced both subjects' performance and their *reported strategies*" (p. 523, emphasis added).

Ginossar & Trope (1987) propose that people have a variety of rules for making probabilistic judgments, including both statistical and nonstatistical inference principles. Which rule is used to solve a particular judgment task is contingent upon the recency and frequency of prior activation of the rules, the relation of the rules to task goals, and their applicability to the givens of the problem. More generally, Ginossar & Trope view strategies for thinking under uncertainty as sequences of production rules whose application depends on the same general cognitive factors that determine production rule application in other task domains (Anderson 1982). They conclude that instead of asking whether people are inherently good or bad statisticians, attention should be directed to understanding the cognitive factors that determine when different inferential rules, statistical or nonstatistical, will be applied. The Ginossar & Trope viewpoint is one we share completely and is consistent with much of the research on preferences reported above.

THE CONJUNCTION FALLACY The idea that the same person will use a variety of approaches to solving probabilistic reasoning tasks also arises in discussions of the conjunction fallacy. Tversky & Kahneman (1983) distinguish intuitive (holistic) reasoning about the probabilities of events from more extensional (decomposed) reasoning, where events are analyzed into exhaustive lists of possibilities or compound probabilities are evaluated by aggregating elementary ones. A fundamental law of probability derived from extensional logic is the conjunction rule: The probability of a conjunction of events, *P(A & B)*, cannot exceed the probability of any one of its constituents, *P(A)* and *P(B)*. Intuitive reasoning, on the other hand, is seen by Tversky & Kahneman as being based on "natural assessments" such as representativeness and availability, which "are often neither deliberate nor conscious" (p. 295). Consistent with the hypothesis that probabilistic reasoning is often intuitive, Tversky & Kahneman demonstrate numerous instances where people state that the probability of *A & B* is greater than the probability of *B*, violating the conjunction rule. Additional evidence of violations of the conjunction rule can be found in several studies (Crandall & Greenfield 1986; Thuring & Jungermann 1990; Wells 1985; Yates & Carlson 1986). Einhorn & Hogarth (1986b) relate causal reasoning to the conjunction fallacy and suggest that there is a link between the need for multiple causes of an event and the conjunction fallacy.

Tversky & Kahneman argue that violations of the conjunction rule are both systematic and sizable; however, they also note that "probability judgments are not always dominated by nonextensional heuristics . . .[and] judgments of probability vary in the degree to which they follow a decompositional or holistic approach" (p. 310). Thus, understanding when the decision-maker will use one approach or another in solving problems under uncertainty is of the same crucial importance as understanding the use of different strategies in the assessment of preferences. A related argument is offered by Beach et al (1986), who propose that a person has a repertoire of strategies for making forecasts that includes both strategies utilizing aleatory reasoning (extensional) and explicit reasoning (unique characteristics). They suggest that the selection of a forecasting strategy will depend on a variety of task factors. Beach et al also make a useful distinction between task factors that determine which strategy will be used and environmental factors that determine the vigor with which a strategy will be applied. They suggest that a variable like the extrinsic benefit of making an accurate forecast will be more likely to determine how rigorously a strategy is applied than to determine which strategy is applied.

EXPERTISE AND UNCERTAINTY JUDGMENTS The studies of base-rate use, violations of the conjunction rule, and, more generally, intuitive vs statistical reasoning in the solving of uncertainty problems illustrate constructive decision behavior. In discussing such contingent judgments and choices, we have emphasized elements of the task as determinants of behavior; however, it is clear that the processes used to construct a solution to a decision problem may differ as a function of individual differences as well.

One question of current interest is the extent to which the strategies for assessing uncertainties found in studies of novices doing laboratory tasks generalize to the judgments of experts dealing with tasks relevant to their areas of expertise. It is clear that experience does not necessarily improve judgment. Garb (1989), for example, provides a review of the effects of training and experience on the validity of clinical judgment in mental health fields. He concludes that "the results on validity generally fail to support the value of experience in mental health fields. However, the results do provide limited support for the value of training" (p. 391). Garb also argues that experienced judges do seem better at knowing which of their judgments are likely to be correct; that is, their judgments are better calibrated.

Other research demonstrates that expertise is not a panacea for making assessments of uncertain events. Experts, too, use heuristics such as representativeness and show such biases as the misuse of base-rate information. Cox & Summers (1987), for example, found that experienced retail buyers used the same heuristics when making sales forecasts (i.e. representativeness) and displayed biases similar to those found with novice subjects. The extent to which the heuristics and potential biases that have been observed in studies using college students will also be observed in "real-world" settings using experts continues to be a subject of much debate (see, for example Bunn & Wright 1991; Shanteau 1988).

Why might expertise not lead to better assessments in some cases? The prediction of future events often depends on learning from and understanding past events. One factor that may cause people to learn less from experience than they should is the hindsight bias (Fischhoff 1975) or the "I knew it all along" phenomenon. An excellent review of the research on hindsight is offered by Hawkins & Hastie (1990). They conclude that the hindsight phenomenon extends to the judgments of experts in nonlaboratory settings. For other reasons why expertise may not lead to better assessments, see Camerer & Johnson (1991).

Next we examine in more detail an area of research that draws upon and combines findings from studies both of preferences and of judgments about uncertain events, namely how people make decisions under risk and uncertainty.

DECISIONS UNDER RISK AND UNCERTAINTY

The study of how people make decisions that involve tradeoffs between the desirability of consequences and the likelihood of consequences—e.g. choice among gambles—continues to be one of the most active areas of decision research. Not only do responses to gambles provide insight into basic psychological processes of judgment and choice, but understanding decision-making under uncertainty and risk has direct relevance for improving decisions in business and public policy. Increasingly, as might be expected, decisions under risk are seen as being sensitive to the same types of context and task variables described above for preferences among multi-attribute alternatives and for the assessment of uncertainties. In the following sections, we consider research on generalizations of expected-utility models (how values depend upon the specific set of available options and interactions between payoffs and probabilities), on responses to repeated-play gambles, and on ambiguity and risky choice.

Generalizations of Expected-Utility Models

Expected-utility (EU) theory (von Neuman & Morgenstern 1947) has long been the standard model for decisions under risk, although the descriptive validity of the expected-utility model has also long been questioned. An economist, Mark Machina, recently summarized risky-decision research by noting that "choice under uncertainty is a field in flux" (Machina 1987:121). We agree; evidence of violations of the standard EU model has accumulated to the point that numerous theorists have offered alternatives to the standard EU model. The goal has been to model risky decisions in ways that will allow the tradeoffs between probabilities and values to reflect contextual factors. One approach has been to develop generalizations of the expected-utility model. Decision weights that may not be additive over outcomes, for example, are used in place of linear probabilities. Another type of generalization allows the value of an outcome of a gamble to differ depending on the specific gamble of which it is a part (Becker & Sarin 1987). A related idea is that the value placed on the outcome of one gamble depends on the outcome that would have been received if a second gamble had been chosen and the same random event had occurred—i.e. the notion of regret (Bell 1982; Loomes & Sugden 1987). Regret is a good example of a contextual factor that may effect decisions.

Many of the proposed generalizations of EU also reflect a weakening of the view that the disentanglement of belief and value is essential to rational decision-making (Shafer 1986). For example, one can weight the probabilities (decision weights) of outcomes by the rank order of the attractiveness of the outcomes. The lowest-ranked, least-attractive outcomes, for instance, might be given relatively greater weight (Quiggin 1982; Segal 1989). One could also allow decision weights to differ for gain outcomes and loss outcomes (Einhorn & Hogarth 1986a). Weber et al (1992) extend the idea of sign-dependent decision weights to judgments of the riskiness of gambles as well as to attractiveness judgments.

Another generalization of the expected-utility model allows the decision weights assigned to the outcomes to vary as a function of both the rank *and* the sign of the payoffs. Luce (1990; Luce & Fishburn 1991) and Tversky & Kahneman (1990) propose models with this property. In the Luce model, a framing or "plausible accounting" assumption is that gambles that have a mixture of gains and losses are decomposed into two subgambles, one consisting of gain outcomes and null consequences and another consisting of loss outcomes and null consequences. Within the gain and loss subgambles, respectively, the decision weights are rank dependent. The decision weights for the gain and loss consequences are allowed to differ.

Recently, Tversky & Kahneman (1990) have offered a generalization of prospect theory that also allows for different decision weights for gains and losses. The decision weights are also rank dependent based upon the marginal contributions of the events ordered by payoffs. The new theory, called Cumulative Prospect Theory, is extended to cover both probabilistic and uncertain (ambiguous probability) gambles. Cumulative Prospect Theory retains the major features of the original versions of prospect theory. In particular, the prediction of reflection of risk attitudes for gains and losses is preserved; risk aversion and risk seeking are predicted, respectively, for gains and losses of moderate or high probability—e.g. $p > .5$. However, for small probabilities—e.g. $p < .1$—the prediction is for risk seeking for gains and risk aversion for losses. These risk attitude predictions are derived from the principles of (*a*) diminishing sensitivity for both value functions (from a reference point) and weighting functions (from certainty and impossible events) and (*b*) loss aversion.

The predictive power of rank- and sign-dependent models is impressive; however, Tversky & Kahneman note that formal models of the valuation of risky options are at best approximate and incomplete, arguing that "choice is a constructive and contingent process. When faced with a complex decision problem, people employ a variety of heuristic procedures in order to simplify the representation and the evaluation of prospects. The heuristics of choice do not readily lend themselves to formal analysis, because their application is contingent on the method of elicitation, the formulation of the problem and the context of choice" (p. 36). While we agree with their assessment that judgment and choice are often constructive and characterized by contingent usage of heuristics, we believe that the contingent use of heuristics is more susceptible to formal analyses than implied above (e.g. see Payne et al 1988).

To what extent do generalizations of EU much beyond those already proposed represent the best direction for theory development in the attempt to understand risky decision behavior (Camerer 1989)? One suggestion, offered by Shafir et al (1989), is to combine the absolute approach of expectation models, in which the attractiveness of a gamble is assumed to be independent of other alternatives, with a comparative approach, in which the attractiveness of a gamble depends on the alternatives to which it is compared. Another suggestion, offered by Lopes (1987; Schneider & Lopes 1986), is to move away from expectation models of decisions to models that more directly reflect the multiple and conflicting goals that people may have in solving risky decision problems. Some suggested goals are maximizing security, maximizing potential gain, and maximizing the probability of coming out ahead . The Lopes concept of multiple goals is similar in spirit to the early idea of characterizing gambles by risk dimensions rather than moments (Slovic & Lichtenstein 1968; also see Aschenbrenner 1984 for a test of dimensional vs moment-based explanations of risky decisions).

Repeated-Play Gambles

Whether people respond differently to gambles involving a single play versus repeated-play gambles may be related to the notion that multiple goals can underlie risky choice. People may pay attention to different goals depending on how often a gamble will be played (Lopes 1981) or whether the decision involves a single individual or a group of comparable individuals (Redelmeir & Tversky 1990). Recent work provides substantial empirical support for the need to distinguish between risky-choice behavior for unique and repeated gambles (Keren & Wagenaar 1987; Joag et al 1990). Wedell & Bockenholt (1990), for example, show that the frequency of preference reversals is less under repeated-play conditions. They offer an interpretation of the effects of multiple plays that emphasizes the concept of an aspiration level in both choice and pricing. An interesting connection exists between the repeated play of gambles and the question of when people will reason statistically. As suggested by Kahneman & Lovallo (1992), framing an apparently unique risky decision as part of a much larger set of risky choices may lead to behavior more in line with a considered tradeoff of beliefs and values.

Ambiguity and Risky Choice

In most discussions of decision-making under risk, it is assumed that the probabilities representing the decision-maker's uncertainties about events are well specified. However, there is often ambiguity concerning the probabilities of events. That is, a decision-maker might tell you that his or her best guess is that the probability of an event is .4, but he or she may also tell you that the estimate is shaky. While the standard theory of subjective expected utility prescribes that an "expected probability" adequately represents the individual's uncertainty about an event, it is clear that people respond differently to decisions under uncertainty as a function of the uncertainty about uncertainties, even when the expectations of the probabilities are the same. Thus, the presence or absence of ambiguity about the probabilities may represent an important context variable affecting risky decisions. As illustrated by the classic Ellsberg paradox (Ellsberg 1961) and subsequent experimental results, individual choices often exhibit an aversion to ambiguity, at least when the probabilities of the events are moderate (e.g. .5) or larger. Frisch & Baron (1988) suggest a number of reasons why it may be reasonable for an individual to show ambiguity aversion. Ambiguity seeking, however, can occur for lower-probability events (Curley & Yates 1989), a result suggested by Ellsberg.

A number of researchers have investigated ambiguity and risky decisions during the period under review (Curley & Yates 1985, 1989; Curley et al 1986; Einhorn & Hogarth 1985; Frisch & Baron 1988; Gardenfors & Sahlin 1983; Hogarth & Einhorn 1990; Hogarth & Kunreuther 1985; Kahn & Sarin 1988). This interest reflects both a theoretical concern with the limits of the standard expected-utility model and a recognition that ambiguity is a prevalent feature of real-world decision problems. Ritov & Baron (1990), for example, suggest that ambiguity lowers the willingness to vaccinate a child against potentially deadly diseases.

Einhorn & Hogarth (1985) offer a model of how people adjust probabilities under ambiguity to reflect what might be imagined. Imagination is likened to a mental simulation process. The adjustment is from an anchor that corresponds to an initial estimate of the probability of an event. The size of the adjustment depends on the amount of ambiguity as well as on the value of the initial probability. Hogarth & Kunreuther (1985, 1989) use the ambiguity model as a basis for understanding when, and at what prices, insurance coverage for different uncertainties will be offered. Hogarth & Einhorn (1990) also propose a model of how people assess decision weights in evaluating risky options which is based upon their model for ambiguous probabilities. The adjustment of decision weights in the Hogarth & Einhorn model is affected by the size as well as the sign of the payoffs, as is the case for several of the generalizations of expected utility noted above.

Curley et al (1986) provide evidence that concern about the evaluation of one's decisions by others is at least a partial explanation for ambiguity avoidance. In the standard Ellsberg task, where there is one urn containing 50 red balls and 50 black balls and another urn containing 100 red and black balls in unknown proportions, the preference for a bet based on the known 50:50 urn is enhanced by the anticipation that the contents of the unknown urn will be shown to others.

Heath & Tversky (1991) have extended the study of ambiguity to domains where the judged probabilities are based on knowledge rather than chance. They argue that the willingness to bet on an uncertain event depends on one's feelings of knowledge or competence in a given context, as well as on the estimated likelihood of that event and the precision of that estimate. In support of their idea, they report that subjects who felt knowledgeable about a domain (e.g. politics) were more likely to prefer a bet based on a judged probability event than on a matched lottery (chance) bet. The chance bet was preferred over a matched judgmental bet in content domains in which one felt less competent. Heath & Tversky conclude that the effect of knowledge or competence far outweighs the contribution of ambiguity or vagueness in understanding how beliefs and preferences interact in determining risky decisions. In other words, factors beyond simple beliefs about the likelihoods of events and values (e.g. feelings of competence) may determine risk-taking behavior.

The research outlined above suggests a variety of methods individuals may use to construct probability assessments or make decisions when confronting ambiguity. How individuals use these methods in a contingent fashion has not been investigated; however, given the prevalence of contingent-strategy usage in the areas reviewed thus far, examining how individuals respond contingently to ambiguity would be a fertile area for future research.

FRAMEWORKS FOR CONTINGENT-DECISION BEHAVIOR

We have now reviewed research on preferences, judgments of beliefs about uncertain events, and risky decision-making. In all cases, we have seen substantial evidence for contingent use of multiple strategies for dealing with such decision tasks. Awareness of the highly contingent nature of decision behavior has led several researchers to propose frameworks within which constructive decision behavior could be understood. Some of these frameworks emphasize the cognitive costs and benefits of the various strategies people might use in constructing preferences and beliefs. In that regard, such frameworks are direct extensions of the bounded-rationality concept. Other frameworks emphasize more perceptual processes of problem representation, formulation, or framing that determine which strategies, values, and beliefs will be used to solve a particular problem.

Cost/Benefit Frameworks

The most frequently used approach to explaining contingent decision behavior assumes that people have available or can generate a repertoire of strategies or heuristics for solving decision problems. The available strategies or abilities may have been acquired through formal training (Larrick et al 1990) or natural experience (Kruglanski 1989), and their availability in any given situation will be a function of the frequency and recency of prior use (Ginossar & Trope 1987). It is also assumed that the strategies have differing expected advantages (benefits) and disadvantages (costs). The selection of a strategy then involves the consideration of the anticipated benefits and costs of each strategy given the specific task environment.

Beach & Mitchell and their colleagues offer one version of a cost/benefit framework (Beach & Mitchell 1978; Beach et al 1986; Waller & Mitchell 1984). Beach & Mitchell identify three broad categories of strategies: 1. "aided-analytic", 2. "unaided-analytic", and 3. "nonanalytic." Task factors assumed to influence strategy selection include complexity, ambiguity of goals (values), significance of outcomes, and accountability. Recently, Beach & Mitchell have argued that their original model is too limited and have proposed a new model called "Image Theory" that stresses the intuitive and automatic aspects of decision-making (Beach 1990; Mitchell & Beach 1990). The emphasis in Image Theory is on noncompensatory tests of the acceptability or compatibility of a single alternative (candidate option) with the decision-maker's values or goals (images). They stress that individuals make judgments about the compatibility of an option with one's image; this is seen as a rapid, smooth process that can be called "intuitive" decision-making. The more analytical processes specified in the original Beach & Mitchell model are assumed to be evoked only if there is more than one acceptable alternative.

A comparison between analytical and intuitive decision-making is also stressed by Hammond and his associates (Hammond et al 1987).They argue that the cognitive processes (modes of thought) available to a decision-maker can be seen as falling on a continuum from intuition (characterized by rapid data processing, low cognitive control, and low awareness of processing) to analysis (characterized by slow data processing, high cognitive control, and high awareness of processing). Hammond et al claim that properties of the decision task, such as whether information is presented pictorially or presented via bar graphs or numbers, lead to one mode of cognition versus another. An important feature of their framework is the distinction they make between the frequency and the size of judgmental errors assumed to result from intuitive and analytical modes of thought. Analysis is viewed as leading to fewer but larger errors than intuition. Hammond et al (1987) provide a good example of a computational error (execution of analysis) in decision-making involving an engineer who wrote down a weight of .8 for a cue instead of the .08 that he intended, thus reducing his judgmental accuracy to little better than chance.

The Beach & Mitchell and the Hammond frameworks deal with contingent decision processing at a fairly general level of analytic vs nonanalytic and analytic vs intuitive modes of thought. Explaining contingent strategy selection at a more detailed information processing level has been the focus of a series of studies by Payne et al (summarized in Payne et al 1990a). They investigate the costs and benefits of solving complex preferential choice problems using specific decision strategies such as satisficing (Simon 1955), lexicographic choice (Tversky 1969), elimination-by-aspects (Tversky 1972), equal weighting (Einhorn & Hogarth 1975), and more normative strategies like additive utility.While Payne et al acknowledge the importance of factors like decision accuracy, avoidance of conflict, and accountability in strategy selection, they focus on the role played in strategy choice by the cognitive effort (mental resources) required to execute a strategy in a specific task environment (Simon 1955; Russo & Dosher 1983). Payne et al note that different decision strategies require different amounts of computational effort and that a measure of such cognitive effort in decision-making can be obtained by decomposing strategies like elimination-by-aspects and weighted adding into sets of elementary information processes (EIPs) (see O. Huber 1989 for similar ideas). Examples of EIPs are reading an alternative's value on an attribute into working memory, comparing two alternatives on an attribute, and adding the values of two attributes in working memory. Bettman et al (1990) show that a weighted EIP model provides good predictions of the response times and subjective effort reports associated with the use of various decision strategies in different task environments.

By combining measures of strategy effort with measures of decision accuracy, Johnson & Payne (1985), Payne et al (1988), and Payne et al (1990b) use simulation to show that adaptive choice of decision heuristics can often provide reasonable effort/accuracy tradeoffs. Their studies of the adaptiveness of actual decision behavior to changes in decision tasks, contexts, and goals show that people often adapt their behavior in ways that seem reasonable given a concern for both decision effort and decision accuracy (Payne et al 1988; Creyer et al 1990). However, Klayman & Ha (1987) argue that people may not always be as adaptive to task demands as they should be. In the case of hypothesis testing, for instance, Klayman & Ha argue that people generally rely on a "positive test strategy" that often works very well, but can lead to systematic errors or inefficiencies. Overgeneralizing the applicability of reasonable heuristics is perhaps a typical failure of adaptivity (Baron 1988). Klayman & Ha (1987), like Tversky & Kahneman (1986), suggest that the use of more optimal strategies may require that the relationships between task variables and strategy performance be highly transparent.

Most current attempts to explain contingent or constructive decision behavior focus on goals and strategies that the decision-maker brings to the task, which are assumed to interact with task structure and context in determining strategy use. However, people can decide how to decide not only at the beginning of a decision episode but also as they learn more about a problem in the course of solving it. That is, people can be opportunistic (data driven) as well as top-down (goal driven) (Hayes-Roth and Hayes-Roth 1979). One argument for a more opportunistic view of strategy use is that people may store procedures for decision-making in terms of simple processing operations such as comparison processes rather than in the form of more complete strategies like elimination-by-aspects (Bettman & Park 1980; Biehal & Chakravarti 1986). It has been suggested that opportunistic or constructive processes will be more likely to be used as decision problems become more complex or stressful (Klein & Yadav 1989). Evidence that people scan alternatives in a more nonsystematic fashion under stress, and therefore may be more data driven, is provided by Keinan (1987). Information display factors may also impact the degree of bottom-up vs top-down processing (Jarvenpaa 1990).

Perceptual Frameworks

As reviewed above, some of the most dramatic demonstrations of the lack of invariance in human decision behavior have come from studies of framing effects (Tversky & Kahneman 1986). Tversky & Kahneman acknowledge that contingent processing in decision-making can sometimes be explained in terms of mental effort; however, they prefer to trace contingent decision behavior to more basic perceptual principles governing the formulation or representation of decision problems. Examples of such principles include the diminishing sensitivity of values and decision weights and the coding of outcomes from a reference point discussed earlier. Tversky & Kahneman stress that "in the persistence of their appeal, framing effects resemble visual illusion more than computational errors" (Tversky & Kahneman 1986:S260).

Another approach to the issue of multiple decision strategy use which blends cost/benefit and perceptual approaches has been offered by Montgomery and his associates (Lindberg et al 1989; Montgomery 1983; Montgomery & Svenson 1983). As noted earlier, Montgomery sees decision-making as series of structuring and restructuring activities. The various compensatory and noncompensatory decision rules like elimination-by-aspects are seen as operators used in the restructuring of the decision problem. Thus, like Tversky & Kahneman, Montgomery emphasizes problem formulation or representation activities in his account of the constructive nature of decision behavior. Montgomery also emphasizes the justifiability of the decision process as a goal of the decision-maker.

A key distinction between the perceptual perspective and that offered by the cost/benefit approach concerns the role of incentives in determining decision behavior. If the only factors influencing decision behavior were a concern with accuracy and a concern for decision effort, then one would expect that violations of rational decision principles could be eliminated by proper incentives. For example, many economists continue to argue that the lack of incentives may cause individuals to perform suboptimally (e.g. Harrison

1989). Further, as was found by Creyer et al (1990), the processes used in decision-making should become more consistent with normative models as incentives are increased. However, errors in preferential choice and probabilistic reasoning persist even in the presence of monetary payoffs (Grether & Plott 1979; Tversky & Kahneman 1983). Even a casual view of decision-making in the real world suggests that reasoning errors sometimes occur in important decisions. Consequently, much recent research has examined the effects of incentives on decision behavior, leading to a view that incentives can both help and hinder decision performance (Ashton 1992; Berg & Dickhaut 1990; Hogarth et al 1991).

As noted by Tversky & Kahneman (1986), incentives do not work by magic. Generally, what incentives do is prolong deliberation or attention to a problem; people generally work harder on more important problems. More effort is generally believed to lead to better performance. However, as reported in Paese & Sniezek (1991), increased effort may lead to increased confidence in judgment without accompanying increases in accuracy. Devoting more effort to using a flawed decision strategy can lead to poorer performance (Arkes et al 1986).

For incentives to change decision strategies and increase performance, several conditions seem necessary. First, one must believe that one's current decision strategy is insufficient in terms of desired accuracy (i.e. if you don't think it's broken, you won't fix it). Failure to adapt may result from overconfidence in assessing the likelihood that a current strategy will lead to a successful outcome. In many decision environments feedback is often not sufficient to sway such assessments (Einhorn 1980). A related factor that may cause people to overestimate the quality of their current judgments is the hindsight bias. A failure to adapt can also result from difficulty in properly assessing the task environment and the relationship between the environment and the strategy. For example, the degree of intercorrelation among cues or attributes affects the accuracy of heuristics, yet correlations are difficult to estimate (Alloy & Tabachnik 1984).

Second, for incentives to lead to a strategy shift, a better strategy must be available. If one doesn't know what else to do, a belief that one is stuck with a flawed strategy may lead to a panic response under high incentives (Janis 1989). There is evidence that better strategies are sometimes unavailable. For example, several effective memory strategies for encoding and retrieval are not possessed by young children (John & Cole 1986). Deficits in strategy knowledge for solving certain classes of problems have recently been examined by Kaplan & Simon (1990). Brehmer (1990) makes the related point that knowledge of suboptimality in the process of solving a complex and dynamic decision problem is not a primary perceptual datum. Instead, "it is an inference based on a normative model of the task, and, if the decision-maker does not have a well-developed model of the task, the possibility of doing better will not be detected" (Brehmer 1990:267). Thus, it is certainly possible that better decision strategies for some situation are not known by most decision-makers. On a more positive note, however, recent work by Nisbett & Fong and their colleagues has shown that the teaching of statistical and decision principles increases the likelihood of using statistical and decision theoretic reasoning processes (Fong et al 1986; Larrick et al 1990).

Third, one must believe that one is capable of executing the new, hopefully more optimal strategy. For complex problems there may be a constraint on which strategies are believed to be feasible. In the words of Simon (1981), "what a person cannot do he will not do, no matter how much he wants to do it" (p. 36). More generally, incentive effects can be seen as one more question concerning the conflicting goals (i.e. accuracy, effort minimization, conflict avoidance, and justifiability) that a decision-maker might have in constructing a solution to a decision problem.

Integrating the Cost/Benefit and Perceptual Frameworks

The perceptual framework clearly complements the cost/benefit framework, because it is difficult to see how simple wording changes alone (e.g. as seen in "lives saved" versus "lives lost" in Tversky & Kahneman 1981) change either cognitive effort or the desire for accuracy. On the other hand, it is not clear how the perceptual framework would handle contingent behavior due to the number of alternatives, for example, yet that phenomenon fits nicely into a cost/benefit framework. There are opportunities to integrate cost/benefit and perceptual frameworks. For example, Tversky & Kahneman (1990) suggest that the framing process is governed by such rules of mental economy (effort saving) as the general tendency to accept the problem as given and the segregation of the decision problem at hand from its broader context. In addition, during the course of constructing a heuristic, decision-makers may cycle between noticing aspects or characteristics of the choice set (e.g. extreme values across alternatives) and deciding how to exploit those aspects. Perceptual frameworks may be most relevant for the noticing process, whereas cost/benefit notions may be more relevant for determining what to do to take advantage of what has been noticed. A third opportunity for integrating the two frameworks would be to consider that individuals' assessments of costs and benefits for any heuristic may be greatly influenced by perceptual concerns such as how information is presented or how the problem is framed.

The concepts of multiple strategies and constructive decision-making also provide a point of integration between decision research and other areas of psychology. For example, Weber et al (1991) suggest that research on memory processes can shed light on the possible decay, distortion, or confusion of intermediate computations in the execution (implementation) of a decision strategy. They also suggest that the idea of parallel processing in memory may require a rethinking of our measures of decision effort. Another area of integration is between the concept of decision strategies and mood or affect (Isen 1987; Mano 1992). Mano, for instance, shows that people employ simpler strategies when under distress.

APPLICATIONS

Behavioral decision research is often motivated by the desire to improve the decision-making process. Several approaches to improving decisions are identifiable in the literature. Some stress changes in the task environment facing the decision-maker. For example, the fact that decision behavior is often descriptively variant (i.e. information presentation matters) suggests that decisions might be improved through rather straightforward, inexpensive changes to the information environments in which individuals make judgments and choices.

Other approaches, such as decision analysis, stress changes in the capacity of the decision-maker for dealing with decision tasks. The concept of information-processing limits on decision behavior, for instance, suggests that tasks might be restructured (decomposed) to make required judgments and choices easier for the decision-maker and hopefully more accurate. Decision analysts also often try to improve directly the capacity of a decision-maker to cope with complex decisions through the provision of decision aids such as computer-based decision support systems and through training in statistical and decision-theoretic reasoning. Of course, combinations of improvements in information provision, decomposition of tasks, decision aids, and training are possible.

The approaches to aiding decision mentioned above can be thought of as methods for improving the match between task and person. An alternative approach is to replace the computations or processing done in the head with an automated decision procedure (a formula or model). Finally, when societal decisions (e.g. whether to improve some aspect of the environment at some cost to the public) affect, or depend upon, the preferences of others, providing decision-makers with better information on the values and beliefs of other people should also improve the decision process (see Lichtenstein et al 1990, for a discussion of some of the dilemmas facing a societal decision-maker).

Changing Information Environments to Aid Decisions.

The great adaptability of human decision behavior makes it possible to improve decisions by improving the information environments in which decisions are made. For example, the processing of current information can be made cognitively easier—without making more information available.

That is, the *processability* of currently available information can be improved (Russo 1977).

In a now classic study, Russo (1977) showed that providing a rank-ordered list of unit-price information at the point of purchase resulted in shifts in purchasing patterns and increased cost savings for consumers. In a recent extension of that study, Russo et al (1986) found that using an organized display to provide nutritional information on proteins, minerals, and vitamins had little impact on consumer behavior; but when the nutritional information concerned negative attributes such as sodium, sugar, and calories, the organized information display had an impact. Russo et al offer a cost/benefit explanation of this difference in results: Most consumers were not concerned about deficiencies in vitamins, but they were concerned about getting too much sodium, sugar, and calories. The importance of improved formats is also borne out in studies of hazard-warning labels on household products (Viscusi et al 1986) and the provision of information on radon in homes (Smith et al 1988).

The processability of information depends on the congruence between (*a*) the format and organization of information and (*b*) the type of processing (judgment) to be done (Bettman et al 1986). There are two basic approaches to congruence. The first, a reactive approach, is to attempt to determine how decision-makers are currently processing information and to make that processing easier. Typical displays of information in *Consumer Reports* illustrate this approach. Consumers would generally like to compare information on several attributes across several alternatives. By providing matrix displays of such information and by using comparative rating scales, *Consumer Reports* makes any comparison process easier. A second and more proactive approach is to determine the types of processing one wishes to encourage and then design formats that facilitate such processing. The Russo unit-price study is an example of this approach if one wanted to encourage comparisons based upon unit price, since the rank-ordered list contained only that information for the various brands. This latter approach may be particularly relevant for public policy decision-makers, although obvious issues arise concerning the degree to which processing should be guided.

Decision Analysis

Decision analysis is a set of methods and procedures designed to help people structure and simplify the task of making complex, confusing, and stressful decisions. Decision analysis depends heavily on human assessments of beliefs and/or preferences as inputs. Increasingly, decision analysis as a field of research and practice is sensitive to the contingent nature of decision behavior. Behavioral research is causing decision theorists to revise both models and procedures (Watson & Buede 1987; von Winterfeldt & Edwards 1986).

Bell (1985), for example, suggests that psychological factors such as the possibility of disappointment or regret might well be included in formal decision analyses. Instead of the alternative-focused thinking that is used in most decision problems, Keeney (1988) suggests that people would be better served by a more value-focused approach, in which one asks whether one could do better in achieving one's values than is suggested by the most readily apparent alternatives. Keller & Ho (1988) offer suggestions for how new alternatives might be constructed.

As noted above, a key feature of decision analysis is the incorporation of human beliefs and preferences into the analysis. The essential idea is to provide a structure by means of which a complex decision problem may be decomposed into a series of cognitively simpler judgments. Research continues on how decomposition of judgments might improve decisions (Henrion et al 1992; MacGregor et al 1988; Ravinder et al 1988); however, the constructive nature of even the simplest tradeoff and belief judgments raises questions regarding the validity of the subjective inputs into decision analyses. Consequently, a variety of new methods have been proposed for eliciting the beliefs and values necessary to operationalize decision models. These new methods are designed to avoid some of the context factors influencing probability and preference assessments. For instance, the most common procedures for assessing von Neumann-Morgenstern utility functions involve the matching of a sure-thing option with a gamble. This procedure is subject to the so-called certainty effect, in which outcomes that occur with certainty are given more weight. McCord & de Neufville (1986) have suggested a utility-assessment method designed to reduce this effect that involves the comparison of one gamble against a second gamble. Another approach commonly suggested for dealing with contingent judgments is sensitivity analysis, in which utility is measured in several ways and any discrepancies are explicitly reconciled by the decision-maker (von Winterfeldt & Edwards 1986). One of the major advantages of the new computer-based packages for decision analysis is the ease with which such sensitivity analysis can be conducted. Finally, Slovic et al (1988) discuss how a deeper understanding of task and context effects could help us deliberately to manage our own preferences more effectively, a proactive approach to contingent decision behavior.

Formulas or Models Versus Heads

The focus of our review so far has been on understanding how a decision-maker combines or processes information mentally. Alternatively, a decision-maker could use a mathematical, statistical, or mechanical procedure to combine the information when asked to make a judgment or choice. The process of combining information in the head is often called clinical judgment. The use of a formula or model to combine information may involve the automation of a human judge's decision rules, or it may reflect empirically established relations between data and the outcomes of interest—i.e. an actuarial approach (Dawes et al 1989). Numerous studies have shown that judgments are generally better if made using a formula (Dawes et al 1989; Kleinmuntz 1990), and organizations do use formulas instead of clinical judgment for some decision problems. The use of statistical judgment in place of clinical is more the exception than the rule, however. Consequently, recent research has emphasized two questions. First, what factors influence the use of an automated decision procedure? Second, how can models and humans complement rather than compete with one another as decision systems?

Dawes et al (1989) suggest several reasons why we still use our heads instead of formulas: lack of familiarity with the evidence showing the benefits of formulas, a belief that the evidence does not apply to case-by-case decisions, and an inflated belief in the accuracy of clinical judgment. Kleinmuntz (1990) offers several other reasons why formulas are not often used, including the error possibilities in the execution of a formula (Hammond et al 1987). Arkes et al (1986) show empirically that a simple decision formula was used less in solving a probabilistic judgment task when incentives for performance existed, when outcome feedback was available, and when people felt themselves to have more domain expertise. Under the conditions of incentives, feedback, and felt expertise, people frequently shift strategies, apparently in the hope that they will be able to beat the odds inherent in the probabilistic nature of the judgment task.

Einhorn (1986) suggests that people generally find it difficult to accept some level of explicit error associated with the use of a decision rule, even though the use of the statistical rule would lead to fewer overall errors in prediction. Einhorn (1986) also suggests that the degree to which one decides to use a statistical formula depends on whether one believes the phenomenon being predicted is inherently random (a formula is more likely) or systematic in nature; and as Einhorn notes, people tend to believe even random events are systematic (see also Gilovich et al 1985; Lopes & Oden 1987). Similarly, Kahneman & Tversky (1982) hypothesize that the laws of probability are more likely to be accepted (and used) when uncertainty is attributed to the external world and a distributional mode of reasoning is adopted. Given the contingent nature of probabilistic reasoning, one might be able to frame problems as being more external and distributional and thus increase the acceptability of formal statistical and decision models.

An old idea that has received much recent emphasis is to combine the use of formulas and judgment in the head. One approach is to use experts to measure the inputs to a model but to combine the subjective inputs mechanically (e.g. Libby & Libby 1989). At a more aggregated level, a judgment from a model and an intuitive judgment might be integrated in several ways. The model might be used as one input to be combined with other information known to the decision-maker (Peterson & Pitz 1986). The model could also be used as a baseline judgment, which should only be modified by the judge in special cases. Finally, the judgment by formula and the judgment in the head might be aggregated using another formula—e.g. 50% human judgment and 50% model (Blattberg & Hoch 1990).

The Measurement of Values

The measurement of human values (preferences) has practical significance in a number of different domains. Marketing, for example, has long been concerned with understanding and predicting the preferences of consumers in the hope that such understanding will lead to better managerial decisions (Green & Srinivasan 1990). Sophisticated methods of measuring preferences are also being used to guide decisions in a variety of nontraditional areas, such as medicine, law, and public policy (Keeney et al 1990). For example, the method of contingent valuation (CVM) is being used to assess the value of environmental goods (Cummings et al 1986; Fischhoff & Furby 1988; Mitchell & Carson 1989) both to guide policy decisions about protection of the environment and to establish liability in the case of damages to the environment. A contingent valuation (CV) study typically involves the assessment of tradeoffs by a large sample of respondents. Essentially, CV studies assess preferences by asking a respondent to match an option defined by an environmental good (level of air quality) at a clearly specified level (1) and a wealth level (1) against a second option defined by an environmental good at a specified second (more preferred) level (2) and an alternative (less preferred) wealth level (2). In the typical willingness-to-pay (WTP) task, the respondent is asked to specify an amount by which he/she would be willing to reduce his/her current wealth level—i.e. move down from level 1 to level 2—in order to gain an environmental improvement—a move up from level 1 to level 2. A subject of much practical import is the extent to which the assessed value of a public good (e.g. clean air) is contingent on a host of procedural variables (such as the order in which questions are asked; whether one matches by considering a potential gain or a potential loss in the level of a public good; or whether the event to be assessed—environmental damage—may occur or has already occurred) (Kahneman & Knetsch 1992; Schulze & McClelland 1990).

The constructive nature of human preferences, particularly in domains where people do not commonly make tradeoff decisions, raises the question of the extent to which any technique such as CV creates values as much as it reveals them. Fischhoff & Furby (1988) offer one response to the labile (constructive) nature of values that emphasizes a careful provision of information to the respondent. Gregory & McDaniels (1987) suggest another approach that involves the explicit construction of values using multi-attribute decision analysis. On the other hand, in the spirit of decision theory, one should also ask whether there is an alternative to the measurement, however flawed, of individual values as input to policy decisions. Using an unstructured intuitive approach to judge the value of some environmental good may be even more biased. Ignoring the value of an environmental good because it is difficult to measure is a questionable response. We hope that increased understanding of the details of procedural and descriptive variance can lead to the development of better value assessment tools.

CONCLUSION

Behavioral decision research has made much progress between 1983 and 1991. We now better understand and appreciate the constructive nature of decision behavior. Behavioral decision research is also being used increasingly to inform a variety of applied areas of study, including health, business, and public policy.

The highly contingent nature of decision behavior both poses problems (costs) and creates opportunities (benefits) for decision researchers. At the theoretical level, the fact that decision processes are not invariant across task environments complicates the search for a small set of underlying principles (models) that can describe behavior. In addition, as noted by Hogarth & Einhorn (1991), the importance and pervasiveness of task and context effects may create a view of decision research as a fragmented and chaotic field. Nonetheless, as researchers ask questions about the conditions under which different types of information and different decision processes are likely to be used, generalizations about decision behavior seem to be emerging. Well established, for example, are the effects of task complexity on decision strategy use, the importance of the gain-vs-loss distinction in both risky and riskless preference, and the prevalence of the anchoring and adjustment process in judgment. In addition, phenomena like loss aversion suggest that general principles of value can be discovered. Thus, the constructivist view does not imply that there is no reflection of underlying beliefs and values in generating a decision.

Also on the theoretical level, the need to predict and explain the constructive aspects of decision behavior should contribute to a greater integration of decision research with other areas of psychology. For example, Norm Theory, which emphasizes context as a factor in making decisions (Kahneman & Miller 1986), clearly depends on cognitive psychology and an understanding of how memory is structured and operates. Similarly, Ginossar & Trope (1987) stress that the strategies used for assessing beliefs will depend on the same cognitive factors that influence use of procedural knowledge in other task domains. Finally, the importance of accountability, justifiability, and argument-based reasoning in decision-making helps reinforce the long-standing connections between decision research and social/organizational psychology.

The constructive and contingent nature of decision behavior has important implications at the level of application as well. We have summarized some of those implications for the design of information environments, the practice of decision analysis, the design of combined judgment/formula decision systems, and the measurement of values. Behavioral decision research continues to reflect a rich interplay between basic and applied disciplines and between descriptive and prescriptive concerns.

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