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What is decision making?

Psychological research is often organized around particular tasks, such as problem solving and categorization. Decision making work has also historically taken this

approach. Decision situations are generally defined as those in which the decision maker has some unsatisfied goal and a set of options that might satisfy the goal. The decision maker must then evaluate the options in some way and select one. For example, a business executive may fly to Chicago and have to get from the airport to a downtown hotel. There are many ways to get there, including limousine, taxi, shuttle, and train. These options differ in their comfort, convenience and price. Typically these attributes trade off, so that higher priced options provide greater comfort and convenience. The executive might be on an expense account, in which case comfort and convenience may be factored into the decision more heavily than price. The executive may choose to ride downtown by taxi and then implement this decision by standing on line and taking a taxi to the hotel.

To bring these sorts of decision situations into the laboratory, researchers commonly focused on the goal of obtaining money, which they assume is shared across people. In the prototypical task, subjects are given choice options that differ in probability and amount. The use of gambles enabled researchers to explore decision making under risk. Often, a number of different choices are made in a single experimental session, and the pattern of choices across sets is analyzed. For example, people might be asked whether they prefer a 45% chance to win \$200 or a 50% chance to win \$150. Later in the same session, they might be asked whether they prefer a 90% chance to win \$200 or a 100% chance to win \$150. At issue in studies like these is the consistency of people's choices. The analyses would involve an examination of whether the people who preferred the 45% chance to win \$200 also preferred the 90% chance to win \$200.

These sorts of betting situations can be powerful diagnostic tools. For example, standard economic models (e.g. subjective expected utility models) are constrained to predict that people's choices are consistent across transformations of choices. Thus, if people opt for the 45% chance for \$200 instead of the 50% chance to win \$150, then they should also prefer the 90% chance for \$200 over the 100% chance to win \$150. In point of fact, however, people often prefer the 45% chance for \$200 but the 100% chance for \$150, in violation of this prediction. It is not surprising, therefore, that some have referred to choices varying in amount and probability as the “fruit flies” of decision research.

If this review of decision making research were written in the 1970's or 1980's, then it would tell a simple and coherent story with a clear moral. The drama would be organized around the question of whether human choice behavior is rational and optimal, with economists arguing that it is (at least as a first approximation) and psychologists arguing that it is not. The upshot of this tale would be that the psychologists won the debate. Human decision making behavior violates the fundamental axioms of economic models of choice in predictable ways. These violations reflect people's reliance on heuristics, biases and strategies that perform reasonably well in most cases but can lead to systematic errors (e.g. Kahneman, Slovic, and Tversky, 1982; Dawes, 1988). {Things got a bit more complicated in the later 1980's and 1990's but not enough to overturn the essential message that people are far from optimal decision makers.}

In short, writing the review would have been relatively easy; we would take the definition of choice behavior in the first paragraph as a starting point, and then describe economic approaches to choice that define the normative practice of decision making. Next, we would present research that examined the degree to which human decision

makers approach this normative ideal. This would large consist of a catalog of heuristics and biases, along with a discussion of why they might be adaptive much of the time (e.g. Hogarth, 1990) and what is known about overcoming these biases (e.g. Fischhoff, Lichtenstein, Slovic, Derby, and Keeney, 1981, Fischhoff ,1988). We would likely have ended with a description of mechanisms that people use to make choices in this prototypical context, and some discussion about the effectiveness of these strategies in normal situations.

Starting in the 1990's, however, the sharp focus on the target (or foil) of rationality/optimality gave way to series of new developments that are still unfolding.¹ First of all, decision research began to question the adequacy of the simple definition of the standard decision situation. A brief examination of these sorts of bets suggests that many elements involved in choice are missing. For example, the set of available options often is not be specified in advance. In addition, many choices (such as deciding whether to have children or even what flavor of ice cream to buy) do not involve money but rather have a strong emotional component. In principle, models of choice should work as well here; one simply has to determine what value or utility the child or ice cream has and combine this with some measure of (psychological) probability to determine the expected utility or value. The key question is how well this straightforward approach works, or even whether it can be applied to these new situations at all.

A related issue concerns how goals might influence choice. If John goes to Las Vegas and loses all of his money, and needs \$80 to rent a room for the night, he may prefer a 50% chance to gain \$80 to a 100% chance of gaining \$60 (Lopes, 1983; Lopes, 1987). This situation doesn't seem too complicated. But what about situations where

multiple goals might be active? Suppose Joan is trying to quit smoking and her friends (who smoke) invite her to a bar for a drink. How does she reach a decision when she is confronted with balancing her goal of maintaining friendships with the potential cost of resuming smoking? Joan's assessment of the attractiveness of these options will change dynamically with the strength of goals and desires (as anyone who has tried to quit smoking will readily attest).

Furthermore, in many cases where a decision is possible, a person does not appear to actually make a choice. When traveling to Chicago, for example, an executive may simply take a taxi without considering any other alternative methods for getting from the airport to a hotel. Thus, it is not clear what circumstances require the evaluation of multiple options. Does taking the cab count as a decision? Certainly people may experience regret when they find themselves stuck in traffic and realize that they could have saved an hour by taking the train into the city. See Svenson (1996, in press) for an analysis of types and levels of decisions.

These and related developments have placed decision research in a state of flux. In this chapter, we want to provide an overview of the ways that researchers have begun to explore decision making. To place the new research in perspective, we begin with a brief summary of the standard approach to decision making in the '70s and '80s. Then, we explore the underlying assumptions of this approach and discuss what is missing. Next, we summarize some of these new areas of research and show how they bear on the earlier framework. It is not feasible to provide a comprehensive presentation of current research in decision making (see Schneider and Shanteau, in press, for a book-length effort to do so) but rather we focus on a cross-section of research in order to give a sense

of the scope of current research trends. We conclude by noting how these trends have transformed the focus of decision research from the structure of options to the dynamic structure of decision makers themselves.

The standard story

In order to place the discussion of decision making in context, we provide a brief description of economic models of choice and the psychological research that was motivated by them. At the end of each of the following sections, we provide some suggested readings for those who want a more detailed treatment of these issues.

Economic approaches to choice

In the standard decision setting a person selects one of a set of options in order to satisfy some goal. Much research on the psychology of choice was motivated by economic theories that suggest how choices ought to be made. These economic theories assume that people are rational and that they want to make the optimal choice in a given setting. In this case, optimal is defined as the choice that best reflects a person's preferences. It might not actually be the choice that is best for that person in the kind of objective third-party sense that parents use when suggesting to their children that they should do what is "best" for themselves.

Rationality requires that people make consistent choices across settings. To capture this desirable property, economic models typically assume that options are evaluated relative to some global preference scale. In modern economic theory, this global preference is called utility (e.g. von Neumann & Morgenstein, 1944; Edwards, 1954; Savage, 1954; Luce and Raiffa, 1957). The notion of utility implicitly assumes that

a person's goals are important for determining their preferences. For example, what is the psychological value of \$10? That depends in part on what the \$10 can be used for. For people with very little money, \$10 might allow them to eat a healthy meal or to buy a new shirt. For wealthy people, there may be few things that this additional \$10 will allow them to accomplish. Thus, the utility of \$10 will be greater for the poor person than for the wealthy one. In our earlier example of John needing \$80 to get a room, the utility of \$80 might be more than twice the utility of \$60. Of course, there are some constraints on subjective utility; for example it is assumed that the utility of money is monotonically increasing. Thus, more money is always better than less.

In order to calculate the overall utility of an option, most models assume that the attributes (or features) of an option can be treated independently. Thus, each attribute has a utility that indicates the degree to which that property helps to achieve the decision maker's goals. Each attribute also has an importance or weight. Attributes are weighted by multiplying the utility of the attribute by its importance weight. The overall utility of an option is then the sum of the weighted utilities of the attributes. Once the utility of each option has been determined, making a choice is just a straightforward process of selecting the item with the highest utility. In the case of probabilistic outcomes, subjective utility theory assumes that the utility of an outcome is multiplied by the probability that it will occur.

Utility models have a number of nice properties. First, they take all available information about the choice options into account. Each attribute is weighted by its importance, and thus, there are no attributes of options that are ignored. Second, because preference is translated onto a single utility scale, any pair of options can be compared.

Third, once the utility of each option is selected, a consistent preference structure is established (that is options are ordered by their utility). In short, subjective utility provides a clear bottom line. Thus, by using the overall utility of options, decision makers are guaranteed that if they prefer option A to option B in one setting, that they will prefer option A to option B in another setting as well (except, of course, in the case where new attribute information becomes available that changes the evaluation of the options).

Economic models make a number of predictions about people's choice behavior. One involves the effect of equivalent transformations. If option A is preferred to option B, then if the same information is added to both options, preference for the options should not change. A second important prediction is *consistency* across measures of preference. There are many ways to assess people's preference. For example, people can be given a set of options and asked to choose one. They can be given a set of options and asked how much they would be willing to pay for each one. Consistency suggests that if a person selects option A over option B, that person should also be willing to pay more for option A than for option B. Related to consistency is *independence*. Utility models assume that options are evaluated independently, and so adding a new option to a choice set should not change the relative preferences of the other options (Luce, 1959).

In the next section, we present some tests of these predictions. This description of economic models has been brief and cursory. Readers interested in more detail about economic models are encouraged to consult Edwards (1992), Birnbaum and Chavez, (1997), Quiggin (1993) and Luce **& Marley??** (In press).

Testing economic models

Economic models of choice behavior inspired considerable psychological research. This work was based on the general assumption that human behavior is rational. Thus, if economic models define the rational standard for choice behavior, people's choices should conform to the predictions of rational models (within limitations of human processing ability; Simon, 1956). While a complete catalog of tests of the predictions of economic models is beyond the scope of this chapter, we will discuss evidence that bears on the four predictions described in the previous section.

One prediction we described above was the influence of equivalent transformations. An early observation in the study of decision making was that choice behavior violated this prediction. One demonstration of this violation is the *Allais paradox* (Allais, 1953) involving pairs of decision problems like the one that follows. If people are asked to select either option A or option B, many people prefer option A to option B.

Option A: \$1,000 with probability 1.00

Option B: \$1,000 with probability .89

\$5,000 with probability .10

\$0 with probability .01

If they are asked to select from options C and D, however, they often select option D.

Option C: \$1,000 with probability .11

\$0 with probability .89

Option D: \$5,000 with probability .10

\$0 with probability .90

The second pair of options in this set are generated by removing a .89 probability of winning \$1,000 from each option. Thus, the same amount has been taken away from each option and, like weights on a balance scale, if A has more utility than B then C must have more utility than D. In short, normative economic models must predict that these two pairs of options will be treated equivalently so that people who prefer option A should also prefer option C, and those who prefer option B should also prefer option D. In this case, however, people tend to exhibit a certainty bias, where they prefer option A over option B, because there is a small possibility of winning nothing in B (perhaps they imagine how much regret they might feel if they pick B and receive nothing; see Loomes and Sugden, 1982) whereas A is a certain gain. In contrast, in the choice between C and D, both options have a high probability of winning nothing, and so the disparity in payoffs is salient. These results suggest that people are *risk averse* when there is a possible gain. That is, they would prefer not to take a risk to win a larger amount of money in the presence of an option that involves a certain gain.

Another violation of the equivalence across transformations has been found in research on framing effects (e.g., Tversky & Kahneman, 1974, 1981; see Levin, Schenider, and Gaeth, 1998 for a recent review). In the classic "disease" problem, people are told to imagine the impending outbreak of a rare disease. People given a *gain* frame are told that the disease is expected to kill 600 people. They are asked to choose between one prevention program that will save 200 people, and a second program that will save all 600 people with a one-third probability and save no people with a two-thirds probability. People given these options often choose to save 200 people. A second group is given the same scenario, but the options are described differently. They are told that if the first

prevention program is adopted, 400 people will die, but if the second is adopted, then there is a one-third probability that no people will die and a two-thirds probability that 600 people will die. People given these options often choose the program with the small chance to save all 600 people.

The two pairs of options are equivalent in the number of people who will be saved and will die. What differs is whether the framing of the options focuses on lives saved or lives lost. As discussed above, people tend to be risk averse for gains. Thus, when the options are framed in terms of lives saved, people tend to select the least risky option. In contrast, people tend to be *risk seeking* for losses. That is, they prefer a chance to lose nothing (or a small amount) over a certain large loss. When the options are framed in terms of lives lost, people tend to select the risky option. This framing effect violates the prediction that equivalent transformations will not influence relative preference. Simply changing how the options are described changes people's preference for them.

Other research has demonstrated violations of the prediction that preferences will be stable across different measures of preference. As one example, a number of *preference reversals* have been demonstrated in which two different measures of preference lead to different options being preferred (Slovic, 1995; Tversky, Sattath, & Slovic, 1988; see Hsee, Loewenstein, Blount, and Bazerman, 1999; Hsee, 2001 for recent reviews). In a classic study, Slovic and Lichtenstein (1983) gave people a pair of gambles like the following

Bet E: 11/12 chance to win 12 gambling chips

1/12 chance to lose 24 chips

Bet F: 2/12 chance to win 79 chips

10/12 chance to lose 5 chips

People were asked both to choose which bet they would prefer to play, and to say how much they would be willing to sell each gamble for. If different measures of preference yield consistent results, then the gamble chosen by the most people should also be the one they would want the most money to sell. In contrast to this prediction, participants selected bets E and F equally often, but they set a higher selling price for F than for E 88% of the time.

This result has often been explained as a type of *compatibility effect*. When asked to choose between gambles, people give weight both to the probability of winning and the magnitude of the payoffs. In contrast, when setting a selling price, people focus on the monetary outcomes. Because the potential gain in Bet F is much higher than the gain in Bet E, people set a higher selling price for F than for E.

Compatibility effects have also been observed for acceptance and rejection of options. Shafir (1993, 1995) asked participants to consider a pair of vacations. One of the vacations was rather bland (e.g., average weather and average nightlife). The other vacation had both very good features (e.g., lots of sunshine) and very bad features (e.g., no nightlife). One group in this study was asked to select one of the vacations. The other group was told that they had reserved both vacations and they should cancel the one they did not want. Shafir suggested that the selection task should focus people on positive features of the vacations. In contrast, the cancellation task should focus people on negative features of the vacations. Because one of the options had both many good features and many bad features, Shafir predicted that this option would often be selected by one group and canceled by the other group. If canceling is just the converse of

selection, then percent cancellations plus selections should sum to 100 percent.

However, the results showed that cancellations plus rejections of the choice with good and bad features summed to reliably more than 100 percent, as Shafir predicted. In short, this framing produced a reliable preference reversal, suggesting that people's preferences may change as a function of the task used to measure preference.

The third prediction of economic models that we discuss is that options should be evaluated independently, so that the addition of a new option to a set should not affect the relative preference of the other options. Two interesting violations of this prediction are found in the *attraction effect* and the *compromise effect* (Huber, Payne, & Puto, 1982; Huber & Puto, 1983; Simonson, 1989).

In the attraction effect, options are presented as shown in the left-hand side of Figure 1 (Huber et al., 1982; Simonson, 1989). For each of these two dimensions, higher values are preferred to lower values. In this graph, option A is better than option B along dimension 1, but worse than option B along dimension 2. Assume that the particular values possessed by A and B along these dimensions have been selected so that the two options are equally preferable. What should happen if a new option is added to this set? According to economic models, options are evaluated independently. Thus, a new option (in this case, option C) should steal some choices from A and some from B. The only outcome that cannot occur (according to these models) is that the addition of option C should not *increase* the proportion of choices of option A or B (the original options).

-----Insert Figure 1 about here-----

In the left-hand part of Figure 1, option C is included in the choice set. This option is *asymmetrically dominated*. That is, C is worse than A along both dimensions.

There is still a tradeoff between C and B, however, as option C is better along dimension 1 and worse along dimension 2 than is option B. When participants are given a choice set like this one that has an asymmetrically dominated alternative, they are typically *more* likely to select option A than they were when just choosing between A and B. This outcome is called the *attraction effect*, because the new option attracts choices to the dominating alternative.

A similar context effect can occur when options like those in the right-hand side of Figure 1 are presented (Simonson, 1989). Imagine that options D and E are created so that they are equally preferable. What happens if option F is added to this set? Option F is much better than the other options along one dimension, but much worse along the other. In this choice set, option D is selected more often than it was when options D and E were presented alone, in violation of economic models. In this case, option D becomes a compromise option between E and F. Compared to each of these options, it has reasonable values along both dimensions. If instead of adding option F some option G is added that makes E the compromise choice, then choices of E increase.

The examples in this section are demonstrations of violations of three basic predictions of economic models of choice. Starting in the 1950s, psychologists cataloged many such violations. These findings are typically quite robust. Furthermore, it can prove difficult to "de-bias" people and make them obey the dictates of rational economic models. This presentation of violations of the predictions of economic models has been brief. More complete discussions of these violations and their theoretical implications can be found in (Tversky and Fox, 1995; Bazerman, 1998, Luce, in press; and the edited book by Kahneman and Tversky, 2000)

Heuristics and biases

Demonstrations that people's choices do not follow the predictions of normative models of choice led to research on the processes that people do use to make choices. Much of this research, particularly that carried out from the late 1960s through the 1990s came to be known as the Heuristics and Biases approach (Kahneman, Knetsch, & Thaler, 1991; Kahneman, Slovic, and Tversky, 1982; Kahneman & Tversky, 1984; Tversky & Kahneman, 1974, 1986). A heuristic is a (fairly simple) rule that can be used to perform some cognitive task. In general, heuristics are efficient to use and they lead to accurate choices (see Polya, 1945 for an extensive discussion of heuristics). In this section, we will discuss a few of the heuristics that have been explored.

First, however, it is important to discuss some of the philosophical underpinnings of the heuristics and biases approach. Economic models of choice are computationally expensive to carry out. They require that the decision maker consider all available information and weight it appropriately. In many decision situations, it may not be possible to find out every relevant piece of information. Even if it were possible, most options have so many possible features that it would take too long to consider every relevant piece of information.

The use of heuristics falls within Simon's (1957) notion of *bounded rationality*. On this view, people seek to evaluate information as completely as possible subject to the limitations of human cognitive processing (e.g., limitations on working memory and attentional processes). In many situations, according to Simon, people may stop their information search when they find an option that will meet their goals. That is they *satisfice*. The idea was that the heuristics used by the cognitive system are accurate

enough, often enough, to be useful, even though they may sometimes lead to sub-optimal decisions.

Simon's notion of satisficing creates a fuzzy border between rationality/optimality on the one hand, and biases and heuristics on the other. In order to demonstrate that people were using a particular heuristic, researchers typically have identified situations in which using that rule would lead to a violation of the predictions of normative models. Thus, decision making studies tended to focus on cases where people made sub-optimal decisions. Rarely was there corresponding work that would allow researchers to see how effective or ineffective a strategy might be across a representative sample of situations where the strategy might be applied. More recent work has actually explored some of the most popular heuristics and has demonstrated that they are indeed quite accurate in many real-world situations (Gigerenzer & Goldstein, 1996). From one perspective the debate might be whether the glass is one quarter empty or three-quarters full. At the same time, however, we think there is compelling evidence that human decision making is not limited solely by computational resources (Kahneman and Tversky, 1996) and that it can be improved (e.g. Nisbett, Fong, Lehman, and Cheng, 1987; Larrick, Nisbett and Morgan 1993).

We begin our discussion of heuristics with a presentation of some choice heuristics. These are methods for carrying out choices that are often accurate, but do not take into account all of the available information about a set of options. Then, we will discuss some evaluation heuristics. These heuristics focus on sources of information that can be used to evaluate particular choice options.

Choice Heuristics. Decision making researchers have studied a variety of processes that people use to make decisions. These heuristics all have in common that they are methods for making reasonably good choices without having to evaluate all of the available information about an option. As we noted earlier, one of the earliest choice heuristic is satisficing whereby, the decision maker searches for the first option that will satisfy the goal of the decision, and then selects that option. For example, if you are trying to hire someone to mow your lawn, you might interview a succession of candidates until a satisfactory one is found. It is very unlikely that you would interview *everyone* who might have some interest in the job and only then decide who to hire. Selecting the first option that satisfies the goal may be appropriate, because the degree of accuracy (i.e., the closeness of the decision to optimal) does not justify additional expenditure of effort (Payne, Bettman, & Johnson, 1988, 1993).

More elaborate decision heuristics have also been described. For example, Tversky (1972) presented *elimination by aspects*. According to this heuristic, people take the set of choice options and start by considering the most important attribute. Then, they eliminate all options that have unsatisfactory values of this attribute. Next, they consider the second most important attribute, and eliminate the options that have unsatisfactory values of this attribute. This process continues, considering attributes in order of their importance. The process ends when there is only a single option left. For example, when buying a car, safety might be the most important attribute, and so all models that are not sufficiently safe might be rejected. Then, the next most important attribute (e.g., engine power) might be considered.

This strategy uses more information about options than does simple satisficing, though it need not take into account all of the information about a set of options. Despite its efficiency, elimination by aspects is often quite accurate. Gigerenzer and Goldstein (1996) examined the elimination by aspects heuristic in the context of making judgments. They applied elimination by aspects to a variety of naturalistic judgment problems (such as judging the relative populations of cities) and found that it often gave results that were as good as an optimal model for that domain, suggesting that this heuristic is well worth using in many natural situations.

To summarize, both satisficing and elimination by aspects provide ways of making reasonably good decisions without expending significant effort. Elimination by aspects uses more information than does satisficing, and it tends to provide somewhat more accurate choices. Thus, a decision maker can select from among decision strategies in order to use one that provides an acceptable level of choice accuracy and also a reasonable degree of choice effort. For a more detailed discussion of choice heuristics and the tradeoff between effort and accuracy, see Payne, Bettman, and Johnson (1993). They make the point that the theoretically optimal decision rule may be far from optimal if the time to decide is limited and they also show that people are capable of adjusting their decision procedure as the decision deadline varies.

Evaluation heuristics. According to economic models, evaluating options involves weighting each attribute value by its importance, and then adding up these weighted evaluations. This view suggests that there must be some way of evaluating the relative goodness of attributes as well as the importance (or probability) associated with these attributes. Some research on heuristics has focused on strategies that can be used to

evaluate the goodness and importance of options and their attributes (Tversky & Kahneman, 1974). In this section, we discuss two prominent heuristics: *availability* and *representativeness*.

The availability heuristic is used to assess the likelihood of an occurrence. This heuristic assumes that ease with which an option comes to mind is related to the frequency that it has been encountered in the past, and presumably the likelihood that it will be encountered again in the future. For example, it is easier for us to think of times that we, or someone we know, has had a cold than to think of times when we or someone we know has had shingles. Thus, we might judge (correctly) that colds are more common than shingles.

As with all heuristics, of course, there are cases where this heuristic fails to give an accurate assessment of relative likelihood. For the availability heuristic, these cases tend to be of two kinds. First, retrieving something from memory is a function of both the presence of that item in memory and the match between the cue and the item in memory. Thus, more specific cues may make information in memory more accessible, thereby skewing judgments of likelihood (Tversky and Kahneman 1974). It is readily demonstrated that people estimate that there are more words in English that end in *__ing* than *__n_* (where the penultimate letter is an n). Of course, the set of words ending in "ing" is a proper subset of the words whose penultimate letter is "n." However, "*__ing*" is a more specific retrieval cue than "*__n_*," (and it is also a meaningful unit in English). Thus, it forms a better retrieval cue. Because people are using availability to assess likelihood, they are mistaken in their estimates of word frequency.

A second heuristic that people use when making evaluations is *representativeness*. Representativeness refers to the degree to which an item is similar to an ideal. When evaluating some new item, if it is very similar to the ideal object for satisfying some goal, then it also is probably going to be useful for satisfying the goal. The operation of this heuristic can be seen in elections when candidates are evaluated for the degree to which they appear to be "presidential." Although having a commanding presence need not be a sign that a person will be a good leader, the fact that many prior presidents have had this quality seems to play a role in our evaluations.

Availability and representativeness are just two evaluation heuristics that have been described in the judgment literature. A number of good papers and books have summarized the evaluation heuristics that people use (Bazerman, 1998; Dawes, 1988; Kahneman & Tversky, 1984). In general, the research strategy for presenting these heuristics has been to describe the type of information used by subjects and then to demonstrate how the heuristic can sometimes lead to sub-optimal evaluations. To reiterate the point raised earlier, however, the observation that these heuristics sometimes lead to sub-optimal judgments should not be taken as a sign that they are not usually a good basis for people's judgments. Kahneman and Tversky have suggested that some heuristics and biases are analogous to perceptual illusions and resistant to change. Of course, the fact that we are susceptible to perceptual illusions does not mean that our perceptual system does not function quite well much of the time. To extend the analogy, perception researchers have identified situations, such as airplane takeoffs and landings, where limitations of human perception can have literally disastrous consequences and it

is necessary to take steps to compensate for these limitations. The same likely holds for decision making.

Prospect Theory

One way that decision making researchers responded to findings like those that emerged from the heuristics and biases research was to develop new models that could account for these findings. The models often had the same general structure as normative economic models, but differed in the way that options were evaluated (Kahneman & Tversky, 1979; Shafir, Osherson, & Smith, 1993b). Although there were a large number of demonstrations of limitations of human decision making, the publication of *Prospect Theory* (Kahneman & Tversky 1979) marks an inflection point for increasing interest and influence of psychological models of decision making.

In prospect theory, as in the economic models described above, the evaluation of an option is the sum of the goodness of each of its attributes weighted by the importance of that attribute. Where Prospect Theory differs from economic models is that it uses psychologically motivated functions for evaluating the goodness and importance of attributes and for the weighting of probabilities.

In economic models, the goodness of an attribute is measured on an absolute rather than a relative scale. That is why people should treat saving 200/600 lives in the same way as losing 400/600 lives in the well-known Asian disease scenario. In Prospect Theory, attributes are evaluated relative to a reference point. Furthermore, consistent with observations about differences between gains and losses, the evaluation function changes more steeply for losses (relative to the reference point) than for gains. A sample function of this type is shown in Figure 2a. In this Figure, the reference point is the X

axis. The reference point is typically the status quo in a problem. For example, in the disease problem, the status quo in the lives saved frame is 0 lives saved (and thus each life saved is a gain), but the status quo in the lives lost frame is 0 lives lost (and thus each life lost is a loss relative to the reference point). Finally, as shown, a positive change of a particular magnitude has a lower evaluation than does a negative evaluation of the same magnitude. (Often the curve is actually negatively accelerated rather than a line to capture the fact that the perceived magnitude of a constant change is smaller as the distance from the reference point gets larger. We drew this figure with straight lines to highlight the difference in value between gains and losses.)

-----Insert Figure 2 about here-----

Prospect theory also places importance or probability weights on a psychological scale. In many of the examples considered earlier, the choices have involved monetary gambles. In these items, the importance weights are subjective probabilities. Figure 2b shows a typical psychological scaling for probabilities. There are two key aspects of this curve. First, the area of the curve near 0 is relatively flat. That is, people are relatively insensitive to changes in small probabilities, but the change from a zero to a nonzero probability is a qualitative shift. Furthermore, the weighting of small probabilities is above the diagonal (shown as a dashed line), suggesting that people are giving small probabilities a higher weight than they would get if people treated probabilities veridically. Conversely, there is a sharp, qualitative change as one goes from certainty to probabilities less than one, reflecting that people give a high weight to certain outcomes. In general, for high probabilities, people are hypersensitive to changes and any probability less than certainty is subjectively much smaller than certainty. This

weighting reflects the certainty bias that is evident in the Allais paradox and in the risk seeking behavior for losses in the examples above.

Clearly, both the subjective evaluation of gains and losses and subjective probability evaluation in Prospect Theory are based on previous experimental findings. Thus, it should not be surprising that Prospect Theory can be used to account for patterns of data that violate the assumptions of normative models. The power of Prospect Theory is that it is formulated in terms that are similar to those used in normative economic models (See Kahneman and Tversky, 1992 for recent developments in Prospect Theory and Camerer, 2000 for a summary of relevant applications and observations). Thus, it is a psychological model that was accessible to economists. As such, it led many economists to begin to think about the psychology of choice behavior. Indeed, behavioral economics has become a thriving area of research that explores the way people make decisions (see Hertwig & Ortmann, in press, for a discussion of the relative merits of methods in behavioral economics and psychology for the study of decision making).

Summary so far

So far, we have given a brief version of the state of decision making research up to about 1990. Normative economic models provided an initial set of hypotheses about human behavior that could be tested. Because these assumptions were likely too strong (as people do not have the unlimited processing capacity necessary to make optimal decisions in all situations), there was good reason to expect violations of the predictions of normative models. Psychologists were not disappointed, as the central predictions of rational models often were violated at least in some circumstances.

The news was not all bad, of course. The strategies that people use to make decisions are often quite good. They give reasonably accurate results using very little effort (Tversky and Kahneman, 1974, 1981; Gigerenzer & Todd, 2000). Thus, although the heuristics that people use can be shown to lead to sub-optimal choices under some conditions, people's decisions based on heuristics are pretty good, pretty often.

The initial response to data like those reviewed so far was to generate new models that resemble the economic models in many respects, but that incorporate more psychologically realistic assumptions about the way attributes and probability (or importance) are evaluated. As we will see, however, there has been a second and more radical reaction to the research program outlined so far.

Researchers in psychology and related more applied disciplines like management and consumer behavior have begun to examine what is missing from the standard story about decision making. Economic models start with a particular definition of a choice: there is a set of options and the chooser must decide from among them. However, there are many decision situations that do not resemble this archetypal case at all. For example, studies of naturalistic decision making suggest that experts often consider only a single option under time pressure, and yet they typically make good decisions (Klein, 2000). Consumers at the store often purchase the same products in every trip, suggesting they are making these choices automatically without considering many options (Guidagni & Little, 1983). As a final example, there has been a growing recognition that the set of choice options may not be known at the start of a decision situation, but rather must be constructed (Kardes, Kalyanaram, Chandrashekar, & Dornoff, 1993; Shapiro, Macinnis, & Heckler, 1997).

Perhaps more important, there is a growing recognition that topics central to cognitive and social psychology such as problem solving, goals and motivations, emotions, expertise, categorization, and memory must be incorporated into decision making research. If decision making is an important psychological process, then *process models* of decision making are needed (e.g. Busemeyer, Hastie, and Medin, 1995). The rest of this chapter will explore the emerging research that ties decision making to more basic psychological processes. As with many emerging fields, there is no consensus on the right way to conduct research. Nonetheless, we feel that it is important to impose some structure on current research in order to avoid a simple laundry list of studies. Thus, in the next section, we will suggest three general themes that have guided current research. Our review of the current literature is selective; nonetheless, we feel this presentation provides a balanced view of research on choice.

Recasting Decision Making

In order to go beyond the research program that is framed by the goal of undermining economic models of choice, it is important to understand the biases that the rationality/optimal approach introduces into decision making research. Once these biases have been identified and called into question, it is possible to extend work in new directions that were not explored previously. In this section, we begin by discussing four biases of the economic approach to choice. Then, we discuss some important extensions that need to be made to choice research. The remainder of the paper will then summarize more recent research that has begun to address these issues.

Biases of the economic approach

It is common in psychology for explanatory models to influence the kind of data that are collected. In particular, the studies that test a particular model must yield data that are compatible with the explanatory constructs and knowledge representations assumed by the model (see Chapter X of this volume; Dougherty, Gronlund, Ogden, and Gettys, in press). As a result, a subtle confirmation bias may be introduced into research, as experiments may be designed to collect data in the image of the model being tested.

In decision research based on economic models of choice there have been three important aspects that have strongly influenced paradigms and procedures. First, these models assume that options are evaluated relative to some common scale such as utility. Second, the models assume that there is a fixed set of options that are being evaluated relative to this common scale. Third, the evaluation of options assumes that people assess the goodness of each attribute and weight it by the attribute's importance. These assumptions have led to the use of options like gambles for which the goodness and importance of the attributes can be defined objectively. Finally, using economic models as the standard of evaluation for psychological models leads to a focus on the importance of rational or optimal behavior, which may overestimate the importance of optimality in human performance.

The idea that preference can be measured along a common scale is important for normative models, because it enables the models to ensure that preferences will be consistent. If one cannot achieve a common scale it is not easy to see how a coherent decision can even be made or priorities weighed (Baron and Spranca, 1997; Weber, Baron, and Lewis, 2001). The assumption of a common currency often leads researchers

to use measures that assess outcomes on a common scale (Indeed, it's hard to see any alternative to this practice).

Nonetheless, people's judgments may not show a corresponding coherence. For example, Chapman (1996) explored people's preferences for health and money. She points out that these two types of outcomes are very different, but that utility approaches allow them to be placed on a single scale. However, in order to make these domains comparable, the monetary questions in her study involved amounts of money to be won, while the health questions involved assessing the value of a medical procedure by asking for the number of years of full health it would have to produce.

Thus, because a utility model was assumed as the basis of this research, the dependent measures obtained focused on numerical outcomes. Furthermore, this same theoretical framework implies that people should discount the future at the same rate for health as they do for money or else their judgments will be incoherent and subject to "Dutch book" ploys.² Nonetheless Chapman finds that people do not discount health and money at the same rates.

Another influence of the common currency approach to choice is that it tends to focus research on choice *outcomes* rather than on choice *processes*. That is, if all options can be evaluated against some common metric, then focusing on the consistency of people's selections is a good research strategy. The specific psychological processes that people use to make choices can be inferred from the pattern of selections, because normative models and economically inspired evaluation models (like Prospect Theory) all assume that options are evaluated relative to a common metric.

This focus on outcomes parallels the development of research on similarity (Medin, Goldstone, & Markman, 1995). In early research on similarity, people tended to focus on similarity ratings (and other assessments of the similarity of pairs of items) under the assumption that there was some common similarity scale against which pairs could be judged (e.g., Shepard, 1962; Tversky, 1977). Later work assumed that the feeling of similarity is a reflection of the way concepts are compared, and that variability in similarity ratings that suggested malleability of similarity masked stability in performance at the level of underlying processes (Gentner & Markman, 1997; Medin, Goldstone, & Gentner, 1993). Thus, more recent research in similarity has focused on the processes underlying similarity comparisons rather than on people's similarity judgments. As we will see below, moving beyond the economic framework in choice research has also led to greater attention to the processes underlying decision making.

The second bias introduced by economic models is that people are deciding from among a set of options. There are two aspects of this bias that creep into research. First, these models assume that there is some set of options that people consider. Thus, studies often present people with a fixed set of options and ask them to pick one. Many of the examples presented in the previous section involved selections of one of a set of items. Some research explores variations of this theme. For example, some studies have explored how people make choices when options are presented sequentially rather than simultaneously (e.g., Read, Antonides, van den Ouden, & Trienekens, 2001), or from memory rather than with the options present (Hastie & Park, 1986). In addition, some researchers have allowed decision makers the option to defer a choice until some later time rather than selecting one of the available options (e.g., Tversky & Shafir, 1992a).

All of this research is done against a background assumption that a choice is based on a set of options.

There are two aspects of this assumption that are potentially problematic. First, a substantial part of the choice process may involve developing the *consideration set*, which is the set of options that are actually being considered (Kardes et al., 1993; Shapiro et al., 1997). Second, there may be many cases in which a decision maker only considers a single option. In these cases, experts may be retrieving potential options sequentially and accepting or rejecting them immediately rather than explicitly comparing a set of options. This process of generation and evaluation may differ substantially from comparative choice processes (Klein, 2000). We will discuss these issues in more detail below.

The third assumption of economic models is that options are evaluated by assessing the goodness and importance of the attributes of options. In order to carry out this research, it is useful to have options that have obvious attributes whose goodness and importance can be assessed in some way. In this way, good experimental control can be established in studies of choice. In many naturalistic setting, the attributes of the options are not obvious. For example, if a person goes to a pet store to buy a dog, it is not clear what attributes of dogs will be relevant to the choice. That does not mean that attributes are not used to make choices, only that it is difficult for decision makers to know which attributes are being used.

Thus, it is not surprising that decision researchers have often turned to monetary gambles as stimuli. Gambles have nice properties for assessing normative models of choice. They have an explicit set of outcomes, each of which can be treated as an

attribute of the gamble. These outcomes have a monetary value. The monetary value can be varied as a way of changing the goodness of the attributes. Finally, each outcome has a probability, which can serve as a stand-in for the importance of that outcome. Thus, the structure of gambles maps closely to the structure of normative models. (Indeed, an early economic model, the *expected value* model, assessed the value of gambles by simply multiplying the monetary value of the outcome by its probability of occurrence.)

Goldstein and Weber (1995) argued that decision making research must go beyond the use of gambles as materials. They drew an analogy between the use of gambles in decision making studies and the use of nonsense syllables in memory research. In memory research, nonsense syllables were meant to provide a way to assess the underlying principles of memory without having to worry about the effects of the content of what is being remembered. For example, if people are given a list of words like "dog, cat, cup" they might imagine dogs and cats sitting in cups to help them recall the list. In contrast, if they are given the list "fep, dax, vod," they cannot use the meanings of these syllables to help them recall the list later. Presumably, more elementary memory processes would be involved in memory for this list. As many theorists have pointed out, however, the purpose of memory is to remember the content of previous situations, and so excising the content from the experimental materials leads people to use strategies that do not reflect what occurs in more naturalistic situations (e.g., Bransford & Johnson, 1973; Glenberg, 1997).

Similarly, people's decisions involving gambles may lead them to use strategies that do not reflect more general processes in choice. In particular, it focuses people selectively on the evaluation of attributes and the importance of those attributes.

Research that focuses selectively on gambles will systematically underestimate the contribution of other processes that go beyond evaluation and importance.

Finally, economic models suggest that process models of choice behavior should be rooted in optimal behavior. Thus, the normative economic models had two influences on theories of decision making behavior. First, they tended to dampen interest in psychological processes. Second, to the extent that these theories were considered as process models, they provided an oversimplified and misleading view of what people are doing. Consider the following example from Frisch and Clemen (1994):

“..Imagine that a person has a \$1000 balance on his or her VISA card and pays 17% annual interest. Imagine that this person also has \$2000 in a savings account earning 4% interest. From the perspective of utility theory one would conclude that the utility to this person from having money in a savings account (e.g. feeling of security) outweighed the cost of paying the high interest on the VISA bill.”

As Frisch and Clemen point out, however, whether this choice reflects the results of an explicit assessment of value or utility should be an empirical question, not a given. They suggest that it may reflect a habit of keeping the money in savings and it is easy to think of other possibilities (as Medin and Bazerman, 1999, note). For example, 1) the person may not have remembered that they had money in a savings account during times when they paid their bill, 2) the savings may have been a gift from a relative and may be linked to a moral prohibition from using it to pay current expense bills (Zelizer, 1994) or 3) the credit card bill may have been produced by impulsive purchases and the person in question may be protecting themselves from future impulse buying by leaving a balance

near their credit limit (Shefrin & Thaler, 1992). The point is that, when treated as a process model, utility theory prejudices the basis for decisions and forecloses on the exploration of other kinds of motivations. As we shall see, researchers have recently begun to explore the possibilities that people may have “multiple selves” which have to negotiate before decisions are reached (Bazerman, Tenbrunsel, & Wade-Benzoni, 1998) or that cognition and emotion may play differing roles in determining decisions without necessarily even being integrated into an overall evaluation (Loewenstein, 1996).

In summary, the use of economic models of choice and the focus on human rationality has led to systematic biases in the way research is carried out. Studies of choice tend to focus on measures that allow options to be evaluated against some common metric. These studies also focus on choice outcomes rather than on choice processes and the underlying goals and motivations that underlie choice. This work typically presents participants with a fixed set of options to be evaluated. The use of gambles (and other choices that fall outside the range of participants' general experience) may have led to a focus on specialized procedures for evaluating gambles that may not be applicable to more naturalistic situations. Finally, the use of economic models has led to an assumption that choice behavior should be evaluated with respect to a normative ideal.

Moving forward

Because, historically, decision research has focused on comparisons of human performance to normative models, this area of research has not been closely connected to other research in cognitive and social psychology. While articles on decision making do appear in general psychology journals like the branches of the *Journal of Experimental Psychology*, and the *Journal of Personality and Social Psychology*, there are many

specialized journals that focus on decision making research such as *Organizational Behavior and Human Decision Processes*, and the *Journal of Behavioral Decision Making*. There is also a professional society, the Society for Judgment and Decision Making that promotes research on decision making and holds an annual conference.

As decision making researchers have gone beyond economic models as a theoretical basis for research, there has been a growing recognition that decisions involve a variety of cognitive and motivational processes that are also important in other areas of psychological research (see also, Goldstein & Weber, 1995). This work has focused on broadening the constraints placed on research by economic models. To set the stage for our discussion of other areas of research, we begin by examining how more recent research has gone beyond the boundaries established by economic models of choice.

In recognition of the limitations of the common currency assumption in economic models, research has begun to focus on factors that influence evaluation of choices. Some of this research has explored the influence of motivational processes on choice. Other work has examined how goals and goal activation influence choice. Related to this research is the study of emotion and its affect on evaluation. The distinction between "hot" emotional processing and "cool" reason-based choices has been a target of current work. Finally, there has been a stream of research that has explored how the evaluation of options is affected by the ease of comparison of options in a choice set and the ease of evaluation of individual attributes.

Research attempting to elucidate decision processes has looked at the influence of a variety of component choice processes. For example, one important line of research has examined parallels between problem solving and choice. Other work has looked at

the role of causal reasoning processes on decision making. Research has also been directed at the assumption that decisions are made by choosing from among a fixed set of options. One stream of research has focused on the way that the consideration set (i.e., the set of options being evaluated) is determined. A second stream of research has explored situations in which only a single option is considered. This work often looks at expert decision making, particularly in cases where the choices must be made under time pressure. One theme that emerges from this research is that there is no single process that will suffice to explain all kinds of decisions. Instead, people have a variety of strategies that they bring to bear on choices. Some are used when choices are being made in novel situations. Others are specific to particular conditions.

Finally, decision making research has broadened out from its traditional focus on gambles. The domain of consumer choice has looked at the way people make decisions about consumer goods ranging from items purchased at supermarkets to more significant purchases like buying a house.³ Other research has explored the moral content of decision making, looking at how issues of fairness and values influence choice. In addition, a variety of different kinds of expert decision making have been explored such as military decisions and medical diagnostic choices. Finally, as with many other areas of psychology, there has been a growing recognition of the importance of culture on the way people make choices. This research has demonstrated important variations in choice behavior across cultures.

In the following sections, we will briefly take up each of these research topics. While reading the descriptions of this research, it is worth considering how this work goes beyond the assumptions associated with economic models. Because there are many

types of decisions as well as cultural and expertise differences in decision processing, there may be no single framework for studying choice. Instead, the main lesson of this work is that decision making integrates across topics that have traditionally been studied by cognitive and social psychology.

Choice evaluation: Goals, motivation, and emotion

Moving beyond economic models of choice opens up a number of avenues for exploring the way choice options are evaluated. Economic models focused on evaluations in which attribute goodness was weighted by importance. Evaluation of information in the environment has been a topic of study in a number of areas of psychology. In this section, we first discuss the role of goals in evaluation and present some research that bears on the activation and use of goals. Then, we turn to the more general issue of motivational systems. Motivation and emotion are tightly intertwined, and there is growing evidence that emotional states are important for generating evaluations. This work involves both behavioral and neurophysiological evidence.

Goals and choice

Theories of behavior often assume that agents control their behavior by pursuing some desired state of the world using some kind of feedback loop to compare the state of the world to the desired state (e.g., Miller, Galanter, & Pribram, 1960). These desired states of the world are called *goals*. When the end state of the goal is something desirable, then the goal is called an *approach goal*. For example, if an agent wants to eat, then food is the end state of an approach goal. When the end state is something undesirable, then the goal is called an *avoidance goal*. When an organism is trying to

protect itself from predators, then being eaten is the end state of an avoidance goal. Intelligent systems are typically designed to decrease their psychological distance to the end states of approach goals and to increase their psychological distance to the end state of avoidance goals. Approach and avoidance goals must work in concert. There are many ways to avoid something (e.g., there are many directions one may run away from a dangerous object). Having approach goals in addition to avoidance goals will direct people away from one state and toward another (e.g., Carver & Scheier, 1990, 1998).

The cognitive system decides between goals by allowing them to wax and wane in their strength or activation (e.g., Lewin, 1935). While the details of goal activation are still being studied, there are a few general principles that can be stated. First, goal activation drives behavior. Thus, agents attend to goal-relevant stimuli in the environment, and they prefer items that will enable them to satisfy goals to those that will not. Second, some goals have a physiological basis. These goals (such as hunger or thirst) are often called *drives* or *needs*, but like more cognitive goals (such as buying a toaster), they guide behavior. Third, active goals that have not yet been satisfied tend to remain active and will draw attention to information in the environment that will enable the goals to be satisfied (Patalano & Seifert, 1997; Zeigarnik, 1927). Finally, all else being equal, the strength of avoidance goals increases faster than the strength of approach goals as the end state of the avoidance goal draws nearer (Miller, 1959; see Busemeyer and Townsend, 1993 for a more recent treatment). This aspect of goals enables agents to explore potentially noxious options without doing something too dangerous.

To the extent that an intelligent agent uses goals to guide action, goals become a standard against which options can be evaluated. Using goals as a basis for action

permits cognitive agents to solve a key problem that common currency models of choice were developed to avoid. In particular, if all options are evaluated on a single scale (such as utility), then when the evaluation of all options is complete, one option will have the highest value on the scale, and it can be chosen. Thus, the common currency models of choice guarantee that a selection will be made.

One danger in moving away from common currency models is that the evaluations of different options will be incommensurable. Such an outcome would lead to indecision. For example, a person deciding whether to buy a smoke alarm or a toaster might determine that a particular smoke alarm is good, because it has long battery life and a loud buzzer. The toaster might be deemed good, because it has ten heat settings and an optional broiler attachment. How should the decision maker determine which of these options should be selected? These evaluations still require more global tradeoffs.

Because agents have goals to guide actions, using goals as the basis of evaluations in decision situations means that options are being evaluated in service of action. One way to conceptualize this change is that normative economic models posited a global common currency against which all options could be compared. An approach based on goals assumes that options are evaluated against the agent's current goals. For example, if a person needs to be able to make breakfast each morning, then the toaster in the example above may be selected rather than the smoke alarm, because it satisfies the person's active goals.

Thus, the dynamics of goal activation typically ensures that an agent will continue pursuing actions rather than getting lost in decision processes. Certain goals (like the physiological needs described above) will continue to increase in activation if not

satisfied, and thus will eventually exceed the activation of other goals and drive behavior. In many other situations, the activation of one goal tends to inhibit competing goals. However, there are some cases in which there is a conflict among goals that does not go away just through the mechanisms of goal activation. This situation typically occurs for cognitive goals of great importance. For example, in the classic approach-approach conflict, two options may seem important (though perhaps for different reasons). Focusing on one option makes it seem like the best, but switching focus to the other makes it also seem attractive (Houston, Sherman, & Baker, 1989).

Often people develop strategies for carrying out difficult choices that involve goal conflicts. One such strategy is the omission bias (Spranca, Minsk, & Baron, 1991). People generally judge a decision maker to be more culpable when they carry out an act than when they fail to carry out an act that leads to the same consequence. For example, a doctor who vaccinates a child leading to that child's death is felt to be more of a "cause" of the child's death than is a doctor who fails to vaccinate a child leading to the child's death. This omission bias is observed in choice situations as well. For example, younger people (i.e., college students) tend to avoid performing actions they feel they will regret later. Interestingly, older people tend to regret actions they did not take rather than their sins of commission (Gilovich & Medvec, 1995). While the regret associated with omissions is often just a general wistfulness, there are times when it is a more powerful despair (Gilovich, Medvec, & Kahneman, 1998). These policies are used in those situations where simple goal activation is not sufficient to allow a choice to be made.

Goals allow actions to be carried out through their interaction with motivational systems. The activation of a goal engages motivations to approach or avoid situations.

Thus, in order to understand the influence of the dynamics of goal activation on behavior, it is also important to have some understanding of motivational systems. Furthermore, goal satisfaction (or failure) will also lead to emotions (see e.g., Carver & Scheier, 1998). We discuss the connections between goals, motivations, and emotions after discussing research related to goals and evaluation.

To start things off, we explore research that bears on two important predictions of this view of goals. First, because the activation of goals changes over time, factors that influence the activation of a goal will also influence the evaluation of goal relevant objects. Thus, if some factor increases the activation of a goal, then evaluations of goal related items should get more positive to the degree that they facilitate goal satisfaction. Second, to the extent that evaluation depends on goal activation in a context, people should be quite poor at predicting their future preferences. This difficulty should arise because the effects of future goal activation cannot be simulated in the present.

Goal Activation and Evaluation

In general, goals are assumed to increase in activation as they become more important. There are many factors that govern goal activation (see e.g., Gollwitzer & Moskowitz, 1996 for a discussion of goal activation). Physiological needs increase in their activation as a function of both underlying physical states as well as social factors. For example, a smoker's need to smoke will increase both through nicotine withdrawal and because of environmental cues associated with smoking. For goals with a physiological basis, satisfaction of the goal (e.g., smoking a cigarette) decreases the activation of the goal almost immediately upon satisfaction.

More cognitively-based goals (those without a clear physiological basis) are strongly influenced by both environmental factors and internal cognitive states. Cues from the environment may increase activation of a goal and may provide opportunities for goal fulfillment (Gollwitzer, 1999; Heckhausen & Beckmann, 1990). For example, an advertisement for a stereo might activate the goal to purchase a new CD player. Passing by a stereo store may serve as a cue that the goal can be satisfied by entering the store. In addition, cognitive structures can support goal activation. For example, thinking about home improvements might lead to setting a goal to purchase a new CD player.

Gollwitzer (1999) discusses the importance of the environment in satisfaction of these cognitive goals. He points out that many intentions to satisfy a goal are thwarted, but that people are much more likely to satisfy a goal when they also envision specific circumstances in which they will fulfill that goal. Gollwitzer suggests that people will be reminded of these specific circumstances at times when goal satisfaction is possible.

The idea that goal activation waxes and wanes over time suggests that people's momentary evaluations of options should be influenced by the activation of goals relevant to those options. There is certainly a lot of anecdotal evidence consistent with this claim. For example, food seems to taste better when we are hungry than when we are not. Nisbett and Kanouse (1969) confirmed the intuition that people tend to purchase more at the supermarket when they are hungry than when they are not (though interestingly this effect does not occur for obese people whose food consumption tends to be driven by external factors like time of day rather than internal cues like hunger).

Presumably hungry people purchase more at the store than do sated people because the food at the store is more attractive for them.

Markman and Brendl (2000) describe another study that suggests that current goal activation influences evaluation. In this study, German college students who were habitual smokers were approached after a large lecture class finished. They were offered the opportunity to purchase raffle tickets (for about a quarter apiece) for one of two lotteries--one with a cash prize and one with a cigarette prize. Participants were offered only one of the two lotteries, and were not aware of the other lottery. The raffle would be held two weeks from the date of the study, so the prize could not be used to satisfy any current goal. Half of the smokers were approached before smoking a post-class cigarette (and hence they had a strong goal to smoke a cigarette). The other half were approached just after smoking their post-class cigarette (and hence the strength of the goal to smoke a cigarette was diminished). Consistent with the idea that active goals influence value, those who had not smoked yet purchased more raffle tickets to win cigarettes than did those who had already smoked. In contrast, those who had not smoked yet purchased fewer raffle tickets for the cash prize than did those who already smoked.

One implication of the view that evaluations are based on active goals is that people should have difficulty predicting their preferences in the future in those cases where goals that are not currently active will become active. A number of researchers have provided evidence for this claim. For example, Kahneman and Snell (1992; see also Loewenstein and Adler, 1995) found that people's judgments about what flavor of ice cream they would prefer in the future were only moderately correlated with their actual choices.

Loewenstein and his colleagues have explored varieties of what they call an *empathy gap* (Loewenstein, 1996; Van Boven, Dunning, & Loewenstein, 2000). Essentially, people have difficulty understanding the emotional (or what Loewenstein calls *visceral*) influences on evaluation. Thus, people exhibit an egocentric bias, assuming that other people will feel as they do now, and that they will feel in the future the way they do now. The hypothesized empathy gaps (between self and others and between self at different times) can explain a number of preference anomalies. For example, people's inability to predict their own future preferences (as in the Kahneman and Snell finding above) falls out naturally from this view.

Another finding that arises from an empathy gap is that people systematically mispredict other people's preferences. For example, there is a well-known choice anomaly called the *endowment effect* (Kahneman, Knetsch, & Thaler, 1991). In a typical experimental demonstration of the endowment effect, half of the people in a room are given an object like a mug. After being given the mug, they are asked how much they would be willing to sell it for. The rest of the people in the room (who were not given mugs) are asked how much they would be willing to pay for the mug. In general, the selling prices set by people with mugs are significantly higher than the buying prices set by people without mugs. This phenomenon is called the endowment effect, because it has been suggested that the people given the mugs endow them with additional value because they own the mug. As a control condition, a group of people are asked to set a selling price, but are not given a mug. This group sets a price similar to that given by the buyers. Thus, the difference between the buyers and sellers above is not simply due to a schema in which buyers and sellers are both trying to get a good deal (i.e., buy low, sell high).

Van Boven et al. (2000) suggest that this effect occurs because buyers are unable to simulate the endowment effect. That is, they cannot simulate the increase in value that comes from not owning an object. Similarly, the sellers are unable to recognize that they are adding value to the mug simply because they own it. Thus, they cannot factor in the added value they place on the mug when setting a selling price.

Taken together, the research described in this section suggests that people use their active goals to evaluate objects. Using active goals allows people to make evaluations in service of carrying out actions. A potential danger with using active goals as a source of activation is that goals wax and wane in their strength. Thus, people's evaluations are labile. This variability can be a particular problem when people must make determinations about future preferences. In this case, if people's current goals differ from their future goals, they will systematically misestimate their future preferences.

Mental Accounting

Active goals can also influence how people perceive the relationship among events in a choice situation. We start with an example. Kahneman and Tversky (1984) described a situation in which people went to a store and selected a calculator that cost \$25 and a jacket that cost \$120. Some people were told that if they drove across town to a new store they could save \$15 on the calculator. Others were told that they could save \$15 on the jacket. People who could save money on the calculator were more likely to say they would go across town than were people who could save money on the jacket. This finding suggests that people are segregating the costs associated with the calculator and the jacket.

What factors govern whether people will integrate the costs of two events or segregate them? One suggestion is that people create mental accounts that are analogous to the sorts of accounts used by businesses to segregate expenses (Heath, 1995; Heath & Fennema, 1996; Thaler, 1985, 1999). On this view, people do not treat all monetary gains and losses as the same, despite the fact that money is fungible, and thus could be treated in a single account. Instead, people have a set of topical accounts that enable them to combine those gains and losses that come from particular events. Often, these mental accounts are organized around the satisfaction of a particular goal.

For example, Kahneman and Tversky (1984) presented a scenario in which people went to a theater to see a play. When they arrived at the theater, half of the people were told they discovered they had lost the ticket they purchased earlier. The other half were told that they had not yet purchased a ticket, but they discovered they had lost an amount of money equal to the purchase price of the ticket. People who were told they had lost cash were much more likely than were people who were told they lost a ticket to purchase (another) ticket to see the show. This finding suggests that people who had lost a ticket were combining the price of the initial ticket with the potential purchase price of a second ticket. In contrast, the people who were told they had lost cash were treating this lost cash as if it came from a separate account. In this case, the account was organized around the goal of seeing a show.

A final example of mental accounting is the "house money effect (Thaler & Johnson, 1990)." When people gamble, if they win money early in the gambling session, they often pursue riskier gambles later compared to situations where they lose money early. This observation suggests that people are treating the early gambling winnings as

if they are playing with someone else's money (in this case, the gambling establishment's money). The only case where Thaler and Johnson (1990) found that people tended to be risk seeking was when they were losing money was toward the end of a gambling session. At this point, they would risk money in order to make a bet that would eliminate their losses for the day. This finding suggests that people do not like to "close" a mental account that has a negative balance (see Thaler, 1999 for more discussion of this issue).

Examples like these make mental accounting seem as though it is primarily a source of poor decisions. However, mental accounting can play an important self-regulatory role. In particular, mental accounts can protect long-term goals from competing (and potentially attractive) short-term goals (Shefrin & Thaler, 1992). For example, it is often important for people to save money for the future in order to be able to make large purchases like buying a house or sending a child to college. It may be difficult to save money, because a long-term goal whose outcome is many years off may seem remote compared to an attractive option that can be obtained in the near future.

One way people handle this situation is by creating different types of money. For example, retirement accounts are treated separately from the rest of people's money, and people are quite reluctant to spend it. Money in long-term investments like stocks, bonds, and home equity are treated as wealth, and people are reluctant to spend it as well (though less reluctant than they are to spend retirement income). In contrast, many people are quite willing to spend money in savings accounts. Thus, by physically segregating money into different types of accounts, people are able to protect long-term goals (see Zelizer, 1994, for an extensive sociological discussion of this issue). Thus, mental accounts can serve as a source of policies for resolving goal competition.

To summarize, in the previous section we discussed the role of goals in evaluating specific options. The research on mental accounting extends the role of goals to multiple outcomes. A set of outcomes are treated as part of the same event when they are related to a common goal (e.g., entertainment or retirement). Outcomes are treated as part of different events when they are related to different goals. The creation of mental accounts can lead to sub-optimal choices in situations where it would be advantageous to integrate outcomes that are placed in different accounts. However, in general, mental accounts permit people to protect long-term goals from potentially enticing short-term goals.

Motivation and emotion

Goals enable actions to be taken by engaging motivational systems, which enable people to approach desired situations and avoid noxious ones. Satisfaction (or failure to satisfy) goals can lead to the experience of emotions. These emotions serve both as a holistic evaluation of options and choice settings and also as a force that may influence choice processing. In this section, we begin by discussing the role of approach (or *promotion*) and avoidance (or *prevention*) motivation on motivation and choice. Then, we discuss the relationship between emotion and risk. Finally, we discuss some research on the role of emotion on choice processing.

Motivation and self-regulation

There are many proposals for mechanisms that allow people to achieve their goals (e.g., Ajzen, 1991; Anderson, 1983; Carver & Scheier, 1998; Gollwitzer, 1999; Vallacher & Wegner, 1985). In this section, we briefly discuss *regulatory-focus theory* (Higgins, 1987; Higgins, 1997). This theory explores the relationship between motivation and

cognition and also the relationship between motivation and emotion. Finally, the theory has been extended to choice and evaluation. Thus, it provides a nice example of the way motivational issues can be explored in decision making.

According to regulatory-focus theory, active goals engage motivational systems. Following the distinction between approach goals and avoidance goals, there are two motivational systems: the promotion system and the prevention system. The promotion system is engaged to achieve desired states of the world (i.e., gains). The prevention system is engaged to protect against undesired states of the world (i.e., losses). This distinction between motivational systems is also compatible with research from neuroscience suggesting that avoidance related motivation (such as fear conditioning) involving different brain regions than do approach related motivations (such as appetitive conditioning, e.g. Fanselow, 1995, and see Caccioppo and Gardner, 1999 for a corresponding analysis of the human emotional system).

Regulatory-focus theory can also be applied to emotions. Basic theories of emotion distinguish between positively and negatively valenced emotions (Mellers, 2000). On this view, goal satisfaction leads to positive emotions (e.g., joy) and goal failure leads to negative emotions (e.g., sadness). Regulatory-focus theory posits distinct emotions associated with each motivational system. Satisfaction of an approach goal (e.g., winning a game) leads to joy. In contrast, satisfaction of an avoidance goal (e.g., finding out you passed a difficult exam) leads to relief. Failure to satisfy an approach goal (e.g., losing a game) leads to dejection. In contrast, failure to satisfy an avoidance goal (e.g., failing a difficult exam) leads to anxiety. Thus, the particular emotions experienced in a situation depend on what kind of motivational system was engaged.

The motivational system engaged also influences how tasks are performed. In promotion situations, people attempt to achieve correct performance. In prevention situations, people attempt to avoid making mistakes. For tasks that involve solving multiple problems (like anagrams), people will often stay on task longer in promotion than in prevention situations, because that will enable them to maximize the number of correct trials (Crowe & Higgins, 1997).

The motivational system engaged during choice may also influence the way decisions are processed. Luce, Bettman, and Payne (1997) examined the way people process information when making choices with negative emotional content. These decisions were ones that would engage prevention motivation (e.g., selecting a child to receive financial support, where the negative emotion arose from the knowledge that the children not chosen would be unlikely to receive support). Relative to a control group (e.g., where the children chosen would also be likely to receive support), people in the negative emotion condition tended spend more time on the decisions, but they engaged in less complex processing. Less complex processing in this case meant more attribute-based comparisons and less holistic processing of individual options relative to the control group. If people are trying to avoid errors, then we would expect them to examine a lot of information. It is not clear exactly why the prevention situation led to increased use of comparison-based processing, but it is possible that the attributes were difficult to evaluate in isolation and comparison-based strategies provided the best method for evaluating options (Hsee, 1996).

Regulatory focus theory has been extended to explore aspects of decision making (Shah & Higgins, 1997; Idson, Liberman and Higgins, 2000). In one study, college

students were put in a promotion focus (by framing a decision in terms of likelihood of getting into an honors society) or in a prevention focus (by framing a decision in terms of likelihood of being rejected by an honors society). Students were then asked whether they would take a particular difficult course in their major. Consistent with regulatory focus theory, students were much more likely to say they would take the class in the promotion case than in the prevention case.

The benefits of using the promotion system for goal attainment suggest that people may adopt strategies that allow them to frame new situations in terms of approach goals (Schneider, in press). Most real world situations are inherently ambiguous, and thus, they can be framed in terms of either approach or avoidance goals. For example, a student applying to college can either view the experience as an attempt to get into the best possible academic school (an approach goal) or to avoid being rejected by colleges (an avoidance goal). By framing this decision in terms of approach goals, promotion motivation will be engaged, which will lead to risk-taking (such as applying to "reach" schools that carry a high probability of rejection combined with an opportunity for admission to a high-caliber school). Often, in order to keep this promotion focus, it is necessary for people to view the world optimistically, which requires interpreting potentially ambiguous information (e.g., mediocre SAT scores) in the best possible light.

In summary, regulatory focus theory assumes that approach goals engage promotion motivation and avoidance goals engage avoidance motivation. Promotion motivation (which is associated with emotions of joy and dejection) leads people to focus on achieving positive or correct outcomes. Prevention motivation (which is associated with emotions of relief and anxiety) leads people to focus on avoiding negative or

incorrect outcomes. This distinction has been shown to influence cognitive strategies as well as the way people form preferences.

Emotions and decision making.

A large body of empirical and theoretical work suggests that emotions interfere with rational decision-making by affecting both the cognitive and motivational forces that shape decisions. First, emotions are said to produce impulsive choices at the expense of options that provide larger long-term gains (e.g. Metcalfe and Mischel, 1999, De Sousa, 1987). Second, emotions adversely affect decision-making by interfering systematically with proper belief-formation (Lazar, 1999). The consensus has been that emotions stand in the way of rationality (De Sousa, 1987).

Recently, however, a number of philosophers and psychologists have suggested that emotions play a positive role in decision-making (e.g. Frank, 1985; Wollheim 1999). Specifically, it has been suggested that anticipatory feelings such as guilt (Baumeister and Heatherton, 1996) or regret (Loomes and Sugden, 1982) may guide decisions. For example, people given a lottery ticket are often reluctant to exchange that ticket with a friend's ticket for the same lottery even though each has an equal chance to win. One explanation for this phenomenon is that if the ticket they gave away were the winner, they would regret giving up the ticket, and hence they are unwilling to trade.

Other theories posit a more central role for emotions, arguing that emotional reactions provide information about aspects of decisions that are not accessible to consciousness and deliberation (e.g. Wilson and Schooler, 1991). In this vein, Damasio (1994) conjectures that anticipatory somatic feedback (skin conductance response) from the emotional system is necessary for proper decision-making.

Damasio and his associates have reported a series of striking observations about the effects of damage to the ventro-medial prefrontal cortex. This type of damage is correlated with impairments in emotional regulation and decision-making (Damasio, 1994; Bechara, Damasio, Damasio, and Anderson, 1994). Importantly, poor decision-making and emotional regulation characterize patients who have both normal working memory and normal IQ (Bechara, Damasio, Tranel, and Anderson, 1997). These deficits are well-known in the personal lives of patients with prefrontal damage but Bechara et al (1994) have succeeded in showing these deficits in laboratory tasks. First, patients with prefrontal damage show deficits in emotional conditioning: unlike normal control patients, they never develop anticipatory skin conductance responses when evaluating risky choices (Bechara, Damasio, Tranel, and Damasio, 1997; Bechara, Damasio, Damasio, and Lee, 1999).

The performance of prefrontal patients on some gambling tasks is even more striking. Damasio and his associates (Bechara et al, 1994) constructed a risky decision task that they thought would capture many important properties of real world decision-making. Patients were allowed to choose cards from any of four decks A, B, C, or D. Decks A and B offered a sure gain of 100 points (patients were given play money and points translated directly into money) whereas decks C and D offered a sure gain of 50 points. However, all decks were associated with occasional, unpredictable punishments or losses. These losses were larger for decks A and B than for decks C and D such that overall, the expected value for decks C and D was greater than the expected value for decks A and B. Deck A and deck B differed only in that one had larger but more infrequent punishments than the other, balance such that their expected value was equal.

Decks C and D had an analogous difference in probability and amount of punishments and did not differ from each other in expected value. Normal patients tended to be attracted to the larger gains offered by decks A and B initially, but after experiencing the larger punishments, learned to rely on decks C and D which offer better long-term prospects. In contrast, patients with prefrontal damage did not learn to choose the better decks within the 100 trial limit associated with the study. In fact, they tended to choose from decks A and B more than from decks C and D.

These results could be explained by the hypothesis that patients with prefrontal damage are either hyper-sensitive to rewards or insensitive to punishments. To evaluate this possibility, Bechara, Tranel, and Damasio (2000) ran a version of the four deck task where the pattern of rewards was reversed. That is, two decks had high immediate punishment but much higher occasional rewards and the other decks has small, consistent punishments but much lower occasional rewards such that the former two decks had the better long-term consequences. Patients with prefrontal damage tended to choose the disadvantageous decks and failed to learn to choose the decks offering the better payoffs over the long run. Bechara et al argue that their findings are consistent with the generalization that prefrontal patients are relatively insensitive to future consequences and, instead, are guided by immediate consequences. Damasio and his associates conclude that anticipatory emotional responses in the form of somatic arousal are necessary intermediaries for performance on risky decision-making tasks. They call this view *the somatic marker hypothesis*.

The fact that patients with normal IQ but prefrontal damage show deficits on the laboratory gambling task is striking from a number of perspectives. If normal IQ implies

that the patients have sufficient computational resources to calculate expected values, then why are these deficits seen? Bechara et al. do report anecdotal evidence that prefrontal patients may know which decks are “better” but still fail to choose them. Although Damasio, Bechara, and their associates describe the deficits in terms of immediate versus delayed outcomes, it would be more precise to say that the contrast is between certain and probabilistic outcomes. Thus, one could conclude that the prefrontal patients approach higher certain gains and avoid higher certain losses, giving much less weight to uncertain events.

This research puts a new spin on the role of emotion in decision making. While emotions may sometimes stand in the way of rational choice, emotions are also important for proper evaluation of options. Future research must establish more precisely the deficits in decision making that follow prefrontal damage and explore the positive role of emotion in choice.

Emotions and risk

Emotions also influence choices that involve risk. One of the earliest influences is the loss aversion described above. As discussed above, Prospect Theory assumes that losses have a larger negative (emotional) impact than equivalent gains have positive (emotional) impact. Of course, Prospect Theory still shares the utility assumption with earlier normative models of choice. More recent work has explored Prospect Theory's assumption that the impact of a given probability is a function of the magnitude of the probability without regard to the outcome to which it is attached. In contrast to this supposition, Loewenstein, Weber, Hsee, and Welch (in press) proposed a framework on the role of emotions in decision making that questions this independence. Specifically,

emotionally-vivid options involving fear or hope may yield a subjective probability function different from that associated with less emotionally-salient events (see also Finucane, Peters, and Slovic, in press).

Rottenstreich and Hsee (in press) provide a nice demonstration of the interaction between affect and subjective probability. The general idea is that the probability weighting function used by Prospect Theory (shown in Figure 2b) will be more extreme for emotionally-vivid events than for more bland options. For positive events the implication is that for a positive outcome, going from a zero probability to a nonzero probability triggers hope, whereas going from certainty to less than certainty triggers fear. The greater the vividness, the greater the jump in subjective probability as one moves from a zero probability and the greater the drop as one moves from certainty to uncertainty.

In the first experiment by Rottenstreich and Hsee, participants were told that they could receive either \$50 in cash or “the opportunity to meet and kiss your favorite movie star.” Half the participants chose between those two options and half chose between lotteries offering 1% chance for these options. In the certainty condition 70% of the participants chose the cash over the kiss but in the lottery condition 65% preferred the chance for a kiss to the chance for the money. This finding is consistent with the prediction based on the idea that vivid outcomes (like a kiss) show less sensitivity to differences at the low end of the probability scale. In a followup study participants valued a 1% chance for a \$500 coupon for a trip to Europe (a vivid event) four times as much as a 1% chance for a \$500 coupon for tuition reduction (a less vivid event). When the probabilities were shifted to 99% the valuations reversed, again as predicted. In other

studies Rottenstreich and Hsee showed that this same pattern held for aversive events (electric shock, a vivid event, versus loss of money, less vivid).

These results support the idea that the probability weighting function is not independent of the outcome under consideration. Specifically, the probability weighting function (shown in Figure 2b) appears to be flatter for emotionally-rich than for less engaging outcomes. Rottenstreich and Hsee conclude that probability-outcome independence may hold for different monetary outcomes but not for different affective values.

Summary

In this section, we have explored the role of goals, motivation, and emotions in evaluation. The normative economic models described at the beginning of this chapter are "cool" reasoning models in that they assume each attribute can be evaluated and weighted without considering the role of emotion and motivation directly. Indeed, emotions are typically assumed to be factors that decrease the rationality of decisions.

We suggested that options are evaluated relative to a decision maker's active goals. The more strongly activated a goal, the more that an option is valued. Furthermore, the two kinds of goals--approach and avoidance goals--are associated with different kinds of motivational systems that support goal satisfaction. The promotion system is concerned with satisfying approach goals. The prevention system is associated with satisfying avoidance goals.

Finally, goal satisfaction or failure are associated with emotions. These emotions are not only a result of goal satisfaction, but are also used as a source of evaluative information about the goodness of options and the degree of risk. Current evidence

suggests that patients with damage to emotional processing systems are actually worse at making decisions than are people who experience emotions normally.

Choice Processes: Categorization, memory, and problem solving

One result of the move away from economic models of choice behavior is a growing recognition that decision making involves a variety of cognitive (and social-cognitive) processes that are shared with other common tasks like problem-solving, causal reasoning, analogical reasoning and similarity comparison. In this section, we review some of the work that has explored parallels between decision making and cognitive processing more generally.

Knowledge, explanation, and problem solving

One important theme in current decision making research is that making choices involves constructive processes that make extensive use of a decision maker's background knowledge (Goldstein & Weber, 1995). In this section, we review two types of constructive processes. First, decision makers may use analogies to previous scenarios to generate a consideration set and to evaluate options. Second, they may develop causal stories that connect available information in order to evaluate options. Both analogy and causal reasoning are more general cognitive processes used for many tasks in addition to decision making.

The prototypical decision making experiment presents the subject with a set of options and asks them to choose one (or to provide some other measure of preference). This situation is similar to what happens when people shop in settings where there are a range of options available in a single store. In many naturalistic decision contexts,

however, the set of options must be generated. In these more ill-defined cases, people often rely on their previous experience to determine the consideration set.

Analogy can play a prominent role in consideration set formation (Gregan-Paxton & Roedder John, 1997; Markman & Moreau, in press). A decision maker may see a new situation as analogous to a prior episode, which may suggest potential options. The role of analogy in generating options has been explored extensively in the domain of political decision making (Holyoak & Thagard, 1995; Khong, 1992; May, 1973; Shimko, 1994). In particular, historians have examined the analogies that have influenced important political decisions.

For example, prior to the Vietnam War, politicians in the United States were trying to decide whether and how to intervene in the growing tension in Vietnam (Khong, 1992; May, 1973). Three interesting points emerge from an analysis of the analogies used. First, many of the analogies tended to come from similar situations. When generating military options for Vietnam, decision makers used other similar political situations (such as the experience of the United States in the Korean conflict in the 1950s) rather than drawing parallels from far-flung domains such as domestic disputes (see also Dunbar, 1997). Similar domains were used so that specific aspects of prior situations could be carried over from prior conflicts rather than just abstract principles. That is, by drawing analogies from Vietnam to previous conflicts like World War II and Korea, specific diplomatic and military options could be drawn from these base domains. If Vietnam had been compared to a marital dispute, then only general principles (such as strategies for negotiating with an adversary) could be drawn (assuming military action is not a key aspect of most marital disputes).

Second, the analogy selected placed strong constraints on the options that were considered. In the end, the dominant analogy used in the Vietnam conflict drew a parallel between Vietnam and the Korean conflict. One of the major difficulties faced by United States military forces during Korea was that the Chinese entered the conflict on the side of North Korea. Because Vietnam was being compared to the Korean conflict, military leaders spent considerable time developing options that would avoid having the Chinese commit military forces. There is some speculation that this constraint imposed by the analogy kept the United States from using sufficient force early in the conflict and thus contributed to the protracted hostilities.

The third interesting aspect of this use of analogy is that political leaders tended to consider only a small number of analogies (often only one or two, May, 1973). One important reason why a small number of analogies were used is that analogies tend to provide a causal structure for thinking about a domain (Gentner, 1983). Once an analogy has been used to suggest how the events in a political situation are related, new analogies no longer seem apt. Thus, people are strongly influenced by the first analogy they consider.

The importance of the first analogy presented has also been demonstrated in consumer choice (Moreau, Markman, & Lehman, in press-b). In this work, people were shown advertisements about digital cameras that compared them either to scanners or to film-based cameras. In general, people who were unfamiliar with digital cameras got a better impression of them when they were compared to film-based cameras than when they were compared to scanners. Of interest, if people were shown both the scanner and film-based camera ads sequentially, their impression of the camera was based primarily

on the first ad. This finding suggests that once the new product is conceptualized in one way (on the basis of the first analogy), subsequent potential analogies no longer provide a good base domain for reasoning about the new product.

The importance of structuring a domain in order to make decisions about it also emerges from research on explanation-based choice (Pennington & Hastie, 1988, 1992). This research suggests that in some cases, people make choices on the basis of which option provides the most coherent account of the available information. For example, when people serve on a jury, their verdict may depend on whether assuming the guilt or innocence of the defendant provides the most coherent story that fits the evidence. Furthermore, given the standards of evidence in the United States, if the prosecution in a case is unable to provide a coherent story that connects the evidence, then a juror is likely to decide that the defendant is not guilty, even if the defense has not provided a coherent story for the defendant's innocence.

These results suggest that the ease of creating an explanation may influence people's evaluation of an option. Other research extends this view by suggesting that people may select a particular option because of the reason they can give for their choice (Shafir, Simonson, & Tversky, 1993a). As one example, Tversky and Shafir (1992b) told students to imagine they had just taken a difficult final exam and that they did not yet know whether they passed. They were told about a vacation trip to Hawaii that was available at a travel agent for a reduced price. They could elect to purchase the trip, decline the trip or pay \$5 to reserve a seat and make a final decision the following day (at which point they would know the outcome of the exam). Given this scenario, 61% of people elected to pay the \$5 to reserve a seat and thus to defer the final choice.

Interestingly, two other groups of participants were run--one told that they had taken a difficult exam and passed and the other told that they had failed. In both of these groups, over 50% of the participants elected to go on the trip. This finding suggests that at least some of the participants in the first group paid \$5 to obtain a piece of information that would not influence their choice (as they would elect to go on the trip whether they passed or failed).

One explanation for why people might have been willing to pay for this "irrelevant" information is that it may have provided a reason for going on the trip. If the student passed the exam, then the trip was a celebration. If the student failed the exam, then the trip was consolation. Without knowing the outcome of the exam, the reason for making the decision was not known, and thus the decision could not be made.

In other cases, a choice may be made because it is easy to justify (Simonson, 1989). People may believe that their choices will be evaluated by others, and hence they select an option in order to facilitate the process of justifying the choice. For example, Simonson (1989) explored the attraction effect described above (see also Aacker, 1991). Recall that in the attraction effect people are more likely to select one of a pair of options in the presence of a third option that it dominates (see Figure 1a). Simonson found that the attraction effect was stronger when people were told their decisions would be scrutinized by others than when they were told their decisions would be kept confidential.

With choice settings like the attraction effect, it is not clear how to interpret the way choice is influenced by having to give a reason. After all, self-presentation goals are important, and so it would make sense that options that a person feels would make them appear more positive would get good evaluations. Nonetheless, there is some evidence

that having to give reasons may cause a person to make worse decisions in some cases (Wilson et al., 1993; Wilson & Schooler, 1991). In one study, Wilson and Schooler (1991) found that people who had to consider reasons for their preferences for brands of jam were less well correlated with the preferences of experts than were people who did not consider reasons. Wilson and Schooler speculate that thinking about reasons may lead people to consider easily accessible verbal information, while some preferences (like taste preferences) may involve attributes that are not easy to state. Furthermore, Wilson et al. (1993) found that choices made immediately after considering reasons led to lower satisfaction with the choice a few weeks later than did choices made without considering reasons. These results suggest that thinking about reasons led to a focus on information about the domain that was not important to people in the long run.

The importance of analogy, causal explanation, and reasons in choices suggests that choice processing bears many similarities to problem solving. In particular, when solving problems, people must take find some kind of causal structure that connects the elements in a problem domain in order to the obstacles that prevent the satisfaction of some goal. Similarly, in many ill-defined decision situations, the options that permit a goal to be satisfied must be generated and evaluated.

Similarity, comparison and choice

Often, when faced with a consideration set, people compare options to each other in order to make a choice (though see the discussion of expert decision making below). The process of comparison has also been the focus of study in research on similarity. Thus, it might make sense to search for parallel phenomena in similarity and choice (Medin et al., 1995). As discussed above, research on similarity started by focusing on

the output of similarity judgments. Later work focused more on the processes underlying similarity comparisons. To illustrate why this shift was made, we will discuss a finding suggesting that similarity judgments and preference judgments differ. Then, we will present other research that focuses on processing which suggests both similarity comparisons and choices involve common processes.

Earlier, we examined research on the compromise effect illustrated in Figure 1b (Simonson, 1989; Simonson & Tversky, 1992). In compromise, people tend to select an option that provides a moderate value along the dimensions along which a choice is described rather than an option that is extremely good along one dimension and poor along another. This finding is actually the opposite of what is found in many similarity situations. Tversky and Gati (1982) provided evidence for a *coincidence* (pronounced coincide-ence) effect. They collected similarity judgments for a variety of pairs of objects that could be described by two feature dimensions (analogous to the items pictured in Figure 1b). They found that pairs that had an exact match along one dimension and a dissimilar value along a second dimension were generally perceived as more similar than were pairs that had moderate dissimilarities along both dimensions. Thus, coincidence and compromise appear to be distinct phenomena involving a similar task structure. Indeed, Kaplan and Medin (1997) used the same stimulus sets in studies of similarity comparison and preference construction and found a tendency toward coincidence in similarity judgments and a tendency toward compromise in preference.

This finding would seem to suggest that similarity and choice are distinct. However, it is also possible that these two tasks involve some common processes (such as comparison) and some unique processes (such as weighting of common and distinctive

properties). Much research now suggests that similarity and decision making involve the same process of comparison.

Research on similarity suggests that mental representations contain information about objects, the features of those objects, and also structural information about relations among features and objects (see the chapter on Knowledge Representation, this volume). Comparisons of these structured representations (using a process called *structural alignment*) permit people to see the commonalities and differences of the items (Gentner & Markman, 1997; Medin et al., 1993). In particular, because there are relationships among items, some differences between items are connected to commonalities. For example, cars and motorcycles both have wheels. That is a commonality of this pair. Cars have four wheels and motorcycles have two. This difference can only be found because of the commonality that both have wheels. Thus, this difference is called an *alignable difference* (Gentner & Markman, 1997; Markman & Gentner, 1993). In contrast, some properties of one item have no correspondence at all in the other. For example, cars have seatbelts, and motorcycles do not. These differences, which are not related to the commonalities, are called *nonalignable differences*. Considerable research on similarity suggests that alignable differences are a more focal output of comparisons than are nonalignable differences (Gentner & Markman, 1997).

There is mounting evidence that alignable differences of options are also more important to decisions than are nonalignable differences. In an early study of judgment, Slovic and MacPhillamy (1974) asked people to make judgments about the Freshman GPA of two students each of whom was described by two test scores. One score was from a test taken by both students (i.e., it was an alignable difference). The other score

was from a test taken by one student but not the other (i.e., it was a nonalignable difference). Participants in this study tended to focus primarily on the score from the shared test rather than the score from the unique test, suggesting that alignable differences were important for these judgments. Other studies also demonstrated that dimensions with missing information tended to be discounted during choice (e.g., Levin, Johnson, & Faraone, 1984).

Other studies have manipulated the presence of alignable and nonalignable differences more directly. Markman and Medin (1995) had people decide which of a pair of video games would sell best and to justify their decisions. The descriptions were set up so that they had some alignable differences and some nonalignable differences. The justifications mentioned significantly more alignable differences than alignable differences. Finally, Zhang and Markman (1998) have demonstrated that when people are learning about new options, they tend to focus on alignable differences first, and those alignable differences influence their preferences for the new items.

People are also quite good at finding a level of abstraction for comparing sets of items that enables them to be compared along alignable attributes. Johnson (1984, 1988) found that when people are given sets of options that are easily comparable (e.g., a pair of toasters) they focus on specific properties of the items (e.g., the number of slots or the number of heat settings). In contrast, when they are given sets of options that are hard to compare (e.g., a toaster and a smoke alarm) they focus on more abstract properties like the degree to which they need a toaster or a smoke alarm. Thus, the evaluation of options takes place at a level of abstraction that permits the representations of the options to be aligned.

There are two reasons why alignable differences play a central role in judgments. First, studies of similarity suggest that alignable differences often signal information that is likely to be important. Thus, attending to alignable differences permits the cognitive system to focus on information about a new situation that is likely to be useful. Second, alignable differences are easier to evaluate than are nonalignable differences (Hsee, 1996). In order to evaluate an alignable difference, it is only necessary to know which value is better. In contrast, in order to evaluate a nonalignable difference, it is necessary to know the value of an attribute on an absolute scale. Both of these factors are likely to contribute to the observed advantage of alignable differences over nonalignable differences in choice.

Summary

The research summarized in this section are examples of work suggesting that decision making involves general cognitive processes that are involved in many other tasks. Thus, general processes of evaluation and causal explanation that occur across higher cognitive processes like problem solving are also important in decision making. Furthermore, analogical reasoning and comparison processes more generally, which have been shown to be part of a variety of fundamental cognitive processes like categorization are also central to the way people make choices.

With the growing recognition that cognitive processing involves many of the same mechanisms involved in other tasks comes the sense that decision making research can be used to illuminate these other cognitive processes. For example, Hutchinson and Alba (1991) used a context in which people were exposed to consumer products as a way to explore the role of analytic and holistic processing in category acquisition. As the

links between decision making and other areas of cognition become clearer, research of this type will become more commonplace.

Types of Decisions I: Fairness, Values, and Tradeoffs

In the next two sections, we concentrate on how choice processing varies in different settings. This section focuses on how decision making may change as a function of context. In some contexts, people may take the fairness of a decision into account when evaluating options, while in other contexts fairness is not an issue. As another example, what people do when they make choices about consumer products differs from what they do when they make choices about moral situations. Furthermore, people must have strategies for dealing with conflicts in values that they hold. For example, there are often tradeoffs between the speed of a car and its goodness for the environment. After we discuss the influence of context on choice processing, we will examine how person variables such as personality, expertise, and culture influence choice processing.

Commensurability, tradeoffs and protected values.

Values, meaning, and morality may all affect the way people make choices. Departures from normative or prescriptive descriptions of choice behavior go well beyond cognitive heuristics and biases. In this section we review research on the moral side of decision making. Not only do people depart from rational choice but also there are circumstances where people's performance is "better than rational." Research on values and meaning also shows limited commensurability and a reluctance to make certain types of tradeoffs (often to the consternation of policy makers).

Fairness

Consider the following ultimatum game (Guth, Schmittberger, and Schwarze, 1982; Roth, 1991). Participants are paired off (call the players A and B) where one person (A) is allowed to propose an allocation of some resource and the other (B) must either accept or reject it. If the offer is accepted both, players receive their allocation; however, if B rejects the offer, neither player receives anything. For example, the resource may be \$10 and A may propose to take \$9 and give B \$1. From one point of view the B's decision is quite simple--B should accept any nonnegative outcome because it is better than nothing.

To the contrary, B's typically reject such an unequal distribution on grounds that it is not fair. Furthermore, the modal offer by A's is a 50-50 split, even when the participants do not know each other and are unlikely to interact again in the future. These basic ultimatum results have been replicated time after time (Bazerman, et al. 1998). At least for modest amounts of money, Player B's are quite willing to punish greedy Player A's. Thaler (1985) suggested that transactions involve two kinds of utility, acquisition utility and transaction utility. The former depends on the value of the good in itself and the latter refers to the perceived merits of the deal. For the above example, the acquisition utility is positive but the transactional utility may be negative. Kahneman, Knetsch and Thaler (1991) provide numerous other examples where judgments of fairness fail to correspond to standard economic models. Interestingly, notions of fairness, trust, and reciprocity which have no role in rational analyses of social dilemmas appear to allow groups to achieve levels of outcomes that are "better than rational" in that they exceed what is predicted by rational choice analysis (see Ostrum, 1998, for a review and

Axelrod, 1997, for a set of formal models for cooperation). These standards of fairness are another policy that people use to help them out of a situation in which goals might potentially conflict.

Attributional Aspects of Decision Making

Judgments of fairness convey one attributional aspect of decision making. The point is that people make attributions about the behaviors of others and that decisions may constitute particularly meaningful behaviors. That is, decisions often have the property of conveying information to both the decision maker and to others. This attributional or meaning component of decisions gives rise to complexities that undermine attempts to use monetary value or straightforward notions of a “homogeneous currency” (e.g. subjective utility) as a close proxy or descriptive framework for judgments.

Sometimes decisions are often made with the explicit goal in mind of conveying information. For example, a person completely unhappy with his or her dining experience in a restaurant may choose to leave a one cent tip rather than no tip at all. The goal of leaving a one cent tip is to make sure that the message of dissatisfaction is conveyed, since leaving no tip could possibly be attributed by the waiter as forgetfulness or stinginess on the part of the customer. To verify this intuition, Medin, Schwartz, Blok, and Birnbaum (1999) asked undergraduates to imagine they had a job waiting on tables in a restaurant and then queried them as to whether they would rather receive no tip or a one cent tip. The overwhelming majority indicated that they would prefer no tip. Their comments indicated that a one cent tip would be perceived as an unkind act. Note that

these judgments imply a non-monotone relation between monetary value and utility, where no tip and a large tip are preferred to a very small tip.

Meaning may depend on inferences about goals even within a narrow domain. For example, (Medin et al, 1999) found that within the sphere of donations attributions are not some straightforward function of monetary values. They asked undergraduates to rate their liking for a person who donated \$500 to Princeton University. The person was described as being either a billionaire CEO or a shoe salesman. The shoe-salesman received positive ratings 92% of the time compared with only 20% for the CEO (the CEO was also described by participants in very negative terms in an open-ended descriptive adjective task). Of course, these judgments could be revealing a general dislike for CEOs. However, when the CEO was described as donating a first edition of poems valued at \$500 to Princeton rather than cash, positive ratings for the CEO increased from 20% to 75%.

In a follow-up study, the multi-billionaire scenario was described in two stories where the final use of the donation was the same. Undergraduates rated the multi-billionaire after reading one of two scenarios. In the first vignette the donation is \$500 to the Princeton University Library and is used to purchase books. In the second story, the multi-billionaire finds the first edition of poems in an antique desk he has purchased at auction, is told that it is worth \$500 and then donates it to the Princeton University Library. The story continues that the library already has several first editions and the head librarian sells the gift for \$400 and uses the proceeds to purchase books. Note that the latter scenario undermines the idea that the book had strong sentimental value for the multi-billionaire or that the gift met a special need for the library. Note also that the final

value for the library was less in the second vignette than the first. Nonetheless, the multi-billionaire was rated reliably more favorably after the second story than after the first. Apparently, the book donation suggests a different kind of intention than the money donation and the latter evokes the multi-billionaire's wealth as the context for evaluating the gift. In brief, it is the perceived intention that serves to determine attributions, not the value of the gift by itself.

Kinds of Decisions

Decisions may be divisible into *kinds* based on the values, meaning or evaluation procedure associated with them (e.g. Beattie and Baron, 1995, Chapman, 1996, 1998; Goldstein and Weber, 1995; Irwin & Baron, in press-b). Furthermore, there are both across- and within-kind obstacles to notions of common currency or simple exchangeability.

A focus on meaning is also consistent with the idea that there may be kinds of decisions with different principles and strategies associated with a given kind. These sorts of influences are most readily seen in studies where (more or less) the same context is involved but cues are present that bias the interpretation of the context in one way or another. For example, Larrick and Blount (1997) presented participants with game that could be seen either as a social dilemma or as involving fairness (an ultimatum game). They varied whether the situation was described in terms of "claiming" versus "accepting or rejecting" offers. Larrick and Blount reasoned that the accept or reject framing is more compatible with an ultimatum game than with a social dilemma. They found that the description affected both the offers made and their likelihood of being accepted---when

the situation was framed terms of accepting versus rejecting participants were less willing to accept small shares than they were when the situation was framed in terms of claiming.

Tenbrunsel and Messick (1999) presented research participants with resource dilemmas in which individual self-interest conflicted with a cooperative solution that would protect the resource. In one study participants played the role of managers of manufacturing plants that were faced with the problem of toxic gas emissions. Their plants had smokestacks equipped with scrubbers that could eliminate the toxicity. Operating the scrubbers cost money and participants had to decide what percentage of the time their scrubbers would run. As in the usual dilemma, accepting the expense of running scrubbers would produce clean air only if managers cooperated. In one condition mild sanctions for failure to run scrubbers were introduced and in the other, there were no penalties. Tenbrunsel and Messick found that mild sanctions for non-cooperation actually *increased* non-cooperation compared with no sanctions. Other measures suggested that, without sanctions, people viewed the dilemma as involving a personal or ethical decision; with mild sanctions, people tended to see the dilemma as a business decision. (See also Bazerman, Tenbrunsel, and Wade-Benzoni, 1998 for related evidence). Thus, when the dilemma was viewed as an ethical choice, participants playing the role of managers were more likely to operate the scrubbers than when the choice was viewed solely as a business decision.

Social relation theory

One specific theory about kinds of decisions is the Fiske and Tetlock (1997) social relation theory. On their analysis there are four types of social relationships: communal sharing, authority ranking, equality matching, and market pricing. Communal

sharing is categorical in character--members do not “keep track” of favors nor is direct reciprocity involved. For example, a father who helps his daughter move into a new apartment would not expect to be compensated (monetarily or otherwise). Friendships typically correspond to equality matching where there is something of a loose reciprocity and problems may arise if exchanges get too far out of balance. In contrast, business exchanges embody a “market pricing” relationship where exchanges are precisely monitored and money is the prototypical medium. The fourth type of relation, “authority for example, the relation between a queen and her subjects. In dominance relations exchange may be asymmetrical (e.g. subordinates paying tribute). In short, according to Fiske and Tetlock, there is a semantics of exchange that varies as a function of type of relation.

Although some forms of exchange may involve culture-specific conventions, the general rules of exchange for a given type of relation are held to be universal. Fiske and Tetlock’s main argument is that exchanges between entities in different domains are often painful, condemned as unethical, or just plain taboo. Parents selling their children into slavery is an extreme example of the forbidden mixture between community sharing and market pricing. Other cross-domain tradeoffs are less offensive and may only be perceived as tactless. For example, offering money to a neighbor who helped you with a spare tire is not immoral, but may be seen as a display of bad taste. Money is an appropriate exchange only for the right relationships and only for certain kinds of exchanges (see Medin et al, 1999 for empirical evidence supporting the Fiske and Tetlock theory). Conversely, non-monetary goods and services are inappropriate in certain contexts where only money will do.

Commensurability, tradeoffs and protected values

Decision-making involves judgment about values. Some values may be easy to compare, and lend themselves to a common measure. For example, if two business projects are considered, then the one that generates more cash flow may be accepted as more valuable and worth investing in. However, not all values can be converted to a common currency. For the same two projects, if the one that generates more cash flow does so using manufacturing techniques that endanger the lives of workers, then one might reject it as an investment. It is commonly said that one cannot put a price on a human life, suggesting that people are unwilling to make tradeoffs between money and lives (at least when they are asked to do so explicitly). Many people think of such values (e.g. protecting the natural environment, human life, sacred objects, etc.) as absolute, not to be traded off for anything else, particularly economic values. Such values are known as “protected values” (Baron and Ritov, 1994; Baron and Spranca, 1997; Ritov and Baron, 1999; Fiske and Tetlock, 1997).

An interesting phenomenon associated with protected values is that people who indicate some value as protected appear to show a larger than average omission bias. Consider an example from Ritov and Baron (1999): “An epidemic will cause 1000 children to die, and a vaccine is available that would prevent these deaths but would also cause 100 children to die. Would you use the vaccine?” Ritov and Baron (1999, see also Ritov and Baron, 1990) report that many subjects oppose such a vaccine both for their own child and as a matter of policy. When asked for a threshold amount of harm from action, a few participants said zero. That is, they would not vaccinate a group of children if the vaccine had caused a single death. Of course, many more participants give some

number between zero and 1000. Importantly, people who were found to hold protected values (by an independent measure) showed a larger omission bias than people who did not indicate a protected value. Thus, despite the fact that a vaccine is also likely to save some children, these participants prefer to avoid taking an action that might harm some children.

In brief, researchers (Baron and Spanca, 1997; Ritov and Baron, 1999) have found that protected values are associated with a particularly large bias against harmful acts that undermine the value in question, as opposed to harmful omissions. Apparently, it is much worse to cause something bad to happen by one's actions than to allow something bad to happen through one's inaction. That is, protected values represent prohibitions against actions (Baron and Spranca, 1997).

In most of the situations studied concerning omission bias, a decision is made between two alternatives: one is omission (status quo), the other is active commission that may incur loss as well as gain. The losses or gains are about human or animal lives, the natural environment or other potentially protected values. Even though the act of commission involves tradeoffs that might generate a net gain, many participants do not readily accept them.

One explanation for omission bias is that the status quo is taken as a reference point and that alternatives are evaluated relative to it. Furthermore, losses loom larger than gains (Baron and Ritov, 1994). In the vaccine example, a loss of 80 children caused by a vaccine may be weighted more heavily than the gain of 100 lives that would have been saved from the disease. This observation suggests that the size of the omission bias may vary with how readily the gain and loss alternatives can be integrated. When the gain

and loss items involved in the trade-off (human lives, for example) are from the same samples, omission bias appears to be significantly smaller. For the vaccine example, Ritov and Baron (1990) found that omission bias was reduced when people were told that the vaccine did not actually cause deaths but rather that the deaths occurred when the vaccine was ineffective against the disease. Perhaps more relevant, omission bias was also reduced when subjects were told that the children who would die from the vaccine were the same ones who would have died anyway from the disease (Ritov and Baron, 1994). This is consistent with the idea that gains and losses are more easily integrated or made commensurable when the deaths from vaccination are a proper subset of the potential deaths from the disease.

The most straightforward account of why people with protected values show a larger omission bias is the idea suggested by Baron and Spranca (1997) that protected values represented prohibitions against actions which are harmful. In this sense, they may simply represent an exaggerated form of normal behavior that results in omission bias. As Baron and Spranca (1997) point out, the defining characteristic of a protected value is an unwillingness to consider tradeoffs. Recall from our discussion above that one reason why people may be unwilling to consider tradeoffs is that it eases choices in situations where there are competing goals.

One potential problem with this view of protected values is that it risks circularity. People indicate protected values by their attitude towards tradeoffs so it is perhaps not surprising that they are often found to be unwilling to make tradeoffs in the scenarios. Thus, what are being called protected values might just be prominent examples of

situations in which people show an omission bias. They are notable because they occur in emotionally charged contexts.

Contingent valuation.

In general it has proven difficult to get people to place monetary value on certain sorts of goods. For example, policy makers have been interested in the importance or value that people place things such as a national park or clean air in order to determine priorities in expenditures or penalties to be imposed on polluters. Two common measures employed are people's willingness to pay (WTP) to ensure some good or outcome and people's willingness to accept (WTA) money to give up some good or outcome. These attempts consistently have been met with frustration. Not only do the WTA and WTP measures not agree but also people's judgments show insensitivity to quantity. For example (Kahneman and Knetsch, 1992) found that WTP to clean up all the lakes in Ontario was barely higher than WTP to clean up the lakes in specific regions of Ontario (see also Baron and Greene, 1996). Kahneman and Knetsch suggested that, if anything, WTP might correspond to the "purchase of moral satisfaction," in other words, a symbolic act to mark that fact that the person has the appropriate values. In general, respondents seem to treat such goods as things that cannot be traded off for money (see also Ritov and Kahneman, 1997, Beattie and Barlas, 2001, Baron, 2001). Indeed, in a series of studies Irwin and Baron (in press-a) find that alternatives to pricing responses (such as a rating of a person's willingness to purchase some item) are more sensitive to moral values than are pricing responses.

Summary.

The straightforward framework where values are assigned to entities and the resulting values provide the basis for a common currency to mediate exchanges is severely limited when morality and meaning are at stake. A further important qualification is that value and exchange are relation-dependent. This means that findings from the prototypical market pricing context may not generalize beyond that context. Instead, it appears that a lack of commensurability is the norm when moral values are engaged. Yet to be systematically explored are the inter-relationships between values and emotions, though Baron and Spranca (1997) note that the mere offer of an exchange involving protected values may trigger moral outrage. We now turn to the role of expertise and cultural differences in choice.

Types of Decisions II: Expertise and Cultural Differences

So far, we have discussed decision making as if all people make choices in approximately the same way, even if their choice of strategy may be influenced by the domain in which the choice is being made. Recently, there has been significant interest in the way people may differ in their choice strategies, even within a given domain. In this section, we review research that explores how experts decision making may differ from novice decision making. In addition, we examine other kinds of individual differences, particularly those that result from cultural differences. This work illustrates current thinking about how people vary in the way they approach choice situations.

Individual differences

An important theme in decision research is concern with ecological validity. Do people respond to real bets the same way they do to hypothetical ones? In general, results from laboratory studies have held up surprisingly well when tested, for example, on the floor of a casino or at the race track (See Camerer, 2000, for a review). Of course, generality is multi-faceted and can include task variable, context, and participant characteristics. In keeping with our theme of a shift between a focus on the structure of decisions to a concern with the structure of the decision maker, in this section we consider individual difference variables and their role in decision making.

One place where people differ is in their degree of risk aversion. The prospect theory weighting function (shown in Figure 2) is aimed at describing aggregate data and it is an open question how well individuals conform to it. Lola Lopes (1987, 1995, Lopes and Oden, 1999) has argued that an important individual difference variable is the degree to which individuals are risk-seeking versus risk-averse (corresponding more or less prevention versus promotion motivation). She suggests that people who are risk averse pay more attention to the worst outcomes associated with an option whereas risk-seeking individuals attend more to the best outcomes.

Another variable in her theory is a person's aspiration level. The idea is that a person sets some criterion or goal and gives extra weight to options that meet or exceed this aspiration level. For example, if person's goal is to "break even" at the race track and they find themselves behind by \$30 going into the last race, then the person might prefer to bet on a horse with long odds and a small chance to win over betting on the favorite going off at very short odds. According to her SP/A theory (SP stands for

Security bias versus Potential bias, A for aspiration level) choices are a function of the security-potential weighting functions and the aspiration level. Although the SP/A theory shares some characteristics with cumulative prospect theory (Tversky and Kahneman, 1992), there are some differences that center around the contrast between reference points and aspiration levels (see Lopes and Oden, 1999 for details).

Another approach to individual differences is to wonder if results from undergraduate and business students hold for other populations. For example, Nisbett and his colleagues (Lehman & Nisbett, 1993; Lehman, Nisbett, & Lempert, 1993) find that social science graduate students and majors are less susceptible to some cognitive biases than humanities or natural science majors. They attribute this difference not to self-selection but rather specific learning experience involving, for example, probabilistic reasoning. Nisbett, Fong, Lehman, and Cheng (1987) provided clear evidence that training students on probabilistic reasoning (e.g. concepts such regression to the mean) has enduring effects outside the classroom (see also Larrick, Morgan, and Nisbett, 1990). Larrick, Nisbett, and Morgan (1993) report that the uses of cost-benefit decision rules among University of Michigan faculty (avoiding sunk costs, attending to opportunity costs, etc) correlates significantly with economics training and salary.

Tentori, Osherson, Hasher, and May (in press) observed that older adults were far less susceptible to biases such as framing effects than younger adults (see Wang, 1996, for another age-related difference in risk-sensitive choices involving family members). All of the above results suggest that there are clear individual differences in decision making. Furthermore they may be tied to learning and experience. We now turn to a more direct look at expertise effects.

Expertise

An important way that people differ from each other is in the knowledge they acquire. Acquisition of expertise can have a number of important effects on decision making (Alba & Hutchinson, 1987). First, expertise may influence the way decision makers perceive a domain. Second, experts can bring domain knowledge to bear on choice, and thus may be able to retrieve a possible solution rather than having to compare a set of options. Third, expertise may allow decision makers to go beyond the information given. Finally, there may be situations in which expertise may hinder decision processing. Often, these negative effects of expertise arise when a new option (such as an innovative product) is developed that goes beyond the expert's knowledge. In this section, we present examples of each of these phenomena.

Expertise influences the way people encode information about options. Increasing expertise can actually change people's perception of visual stimuli. For example, Lesgold and his colleagues found that expert radiologists (doctors with many years of experience) making diagnostic decisions focused on much smaller aspects of x-ray films than did residents who had much less experience interpreting x-ray films (Lesgold et al., 1988). Thus, the basic input to diagnostic decisions changes based on expertise.

The perceptual changes are not just a matter of some kind of "hard wiring" of the perceptual system that changes with experience. Conceptual information may interact with available perceptual information in the environment to determine what is seen in a stimulus. For example, physicians use conceptual information to influence their perception during diagnosis. Brooks, LeBlanc and Norman (2000) showed doctors

different case histories along with textbook pictures of dermatological disorders. When the case history was consistent with the disorder, the doctors saw the proper symptoms in the pictures nearly all the time. In contrast, when the case did not suggest a particular disorder, doctors were much less likely to perceive the same features in the pictures. Thus, the perceptual information that an expert seeks will depend in part on conceptual information that is active during decision making.

One thing suggested by the role of conceptual information in diagnostic decision making is that doctors are constructing choices rather than selecting from among a set of possible options. This view of choice is consistent with Klein's (2000) observations of expert decision makers in practical situations. His work with firefighters and military decision makers suggests that it is rare for experts to consider multiple options and to compare them. Instead, decision makers appear to use their background knowledge to remind them of prior situations in which particular solution strategies were carried out. For example, an expert firefighter who approaches the scene of a fire will be able to decide how to configure the trucks and deploy firefighters by carrying out variations of plans used while fighting previous fires.

Nearly all of the potential decisions studied by Klein and his colleagues involved this kind of constructive processing rather than choices among options. Indeed, most of the cases in which people compared a set of options occurred when a novice was forced to make a decision or when an expert decision maker had to act in a situation that went beyond their domain of expertise.

Even when experts did not have a specific case in memory to handle a new situation, they tended to consider one option at a time. The experts would generate a

potential course of action and mentally simulate the outcome attempting to find flaws in their plan. If the mental simulation revealed a fatal flaw in the plan, then another option was generated. Thus, even when multiple options were considered, they were examined serially. Klein (2000) refers to this type of decision making as *recognition primed decision* and suggests that it characterizes most of expert behavior.

Why then do most studies of decision making suggest that people are making comparisons among options? One reason is that decision researchers (and indeed most decision theorists) assume that decision making involves explicit choices from among a set of options. Thus, most studies are designed to force people to choose from among a set of options. Second, while Klein found recognition-primed decision making among the experts in his studies, he observed that novices tended compare a set of options to each other (as did the experts working outside of their domain of expertise). Many psychological studies of expertise tend to use weak manipulations of expertise, having graduate students or people with self-professed familiarity serve as experts (see Shanteau, 1988 for an insightful discussion of this issue). For this reason, changes in decision processing that occur with "real" experts may go unnoticed.

Another benefit of expertise is that experts can bring their knowledge structures to bear in cases where insufficient information has been presented. Earlier, we discussed that people tend to discount dimensions with missing information, leading to greater use of alignable differences rather than nonalignable differences in choice. In many cases, a nonalignable difference is a property that people know about for one option and they simply do not know the corresponding attribute for the other option. While it might be advantageous to find out the missing value, people often ignore that dimension instead.

However, experts are able to recognize when important information is missing and to use their background knowledge to make plausible guesses about the values of the missing properties. For example, Sanbonmatsu, Kardes, and Herr (1992) found that bicycle experts were more likely than novices to recognize that the weight of some models of bicycles in a consideration set were missing and to make reasonable guesses about the weight of those bicycles on the basis of the other values provided. One reason why experts may be better at processing information about missing information is also that they have a better sense of the criteria against which a set of options should be evaluated than do novices (Bettman & Sujan, 1987).

Finally, expertise can have negative consequences when people must learn about new products. When people become experts, part of what they are doing is acquiring information about relationships among properties of objects. For example, camera experts know how the parts of cameras are connected. They also know the conceptual relationships among parts so that they can predict the influence of changing the film speed, the shutter speed or the size of the aperture. Novices may know about some of these parts, but they knew fewer relations among them.

Sloman, Love, and Ahn (1998) suggest that it is more difficult for people to incorporate a change in a property into their knowledge when that property has many relational connections than when it has few. Thus, a camera expert will have more difficulty learning about products that change critical features of cameras than will novices. Support for this conjecture comes from research demonstrating that camera experts have more difficulty processing information about digital cameras than do novices (Moreau, Lehman, & Markman, in press-a). This research suggests that camera

experts find more potential risks of a new product, because they have many goals that can be satisfied by film-based cameras, and they do not know how those goals will be satisfied by the new product. This processing difficulty actually makes camera experts feel less inclined to purchase a digital camera than novices.

Culture

No one doubts that there are cultural differences in decision making. For example, one might expect cultural differences as well as individual differences in prevention versus promotion goals (e.g., Lee, Aaker, & Gardner, 2000). Although cultural differences may have practical implications for international commerce, a critical question is whether cultural and individual differences can be captured in terms of variations in the parameters of a single model or whether a different type of theory is needed to describe decision makers in different culture. It is premature to try to answer this question, if only because the field of decision making is so broad and there is no single unifying theory that covers all or even most of the major facets. Current progress takes the form of addressing two less ambitious questions: 1) How well do the generalizations concerning judgment and decision making developed so far carry over into other cultures? and 2) Can one use cultural differences in values, goals, and orientations to develop and test predictions of current theories. We will briefly consider examples of each of these questions.

Generality.

Nisbett, Peng, Choi, and Norenzayan (in press) argue that holistic versus analytic processing styles characterize a critical differences between East Asian and Western

thought. East Asians are said to be more dialectical and focused on relations whereas Westerners are more comfortable with formal logic and focused on relations. Nisbett et al. document a series of cultural differences in judgment that they argue follow from these differences. For example, East Asians are less likely to make the “fundamental attribution error” (Ross, 1977) but more likely to show hindsight bias. Nisbett et al. argue that East Asians also may tend to seek the “middle way” in reconciling conflicts or contradictions. In a more or less literal test of this idea Briley, Morris, and Simonson (2000) examined the compromise effect in East Asians and European American and found that asking for justifications for choices increased compromise choices for East Asians but decreased them for European Americans.

These examples suggest that cultural differences do influence patterns of judgment and choice. These findings suggest that what we have considered to be cognitive universals in decision making may sometimes be more specific to particular cultures. The cut between eastern and western cultures made in this section is quite broad and there are likely to be important differences within these categories. For example, Yates, Lee, Shinotsuka, Patalano, and Sieck, (1998, see also Yates, Lee, and Shinotsuka, 1996) find that Chinese students show a much larger overconfidence effect than American students and that Japanese students show the least overconfidence. Much additional research is required to further elucidate these issues.

Comparisons as theory tests

An exciting use of cultural differences is to use cross-cultural comparisons as a way of testing broader theories of choice. One important distinction among cultures that has been the basis of current research is the difference between individualist and

collectivist cultures. An individualist culture (such as the United States) tends to place emphasis on the individual and on independence. A collectivist culture (such as many Asian cultures) tend to value relationships among people. See Hofstede, 1980, 1983; Triandis, 1989, for a general review of individualist versus collectivist cultures and their cognitive implications.

Gelfand and Christakopolou (1999) suggested that members of a collectivist culture (Greece in their study) should differ from members of an individualistic culture (USA) in negotiation processes . Specifically, they predicted participants from the individualistic cultures would have more difficulty than members of a collectivist culture negotiating a settlement that was mutually advantageous. Instead, members of the individualistic culture tended to treat negotiations as a zero-sum game where gains by one side should be matched by losses on the other.

A more typical pattern of cross-cultural research starts with a puzzle (e.g., why do the cultures differ?) and then is followed by some detective work to try to pin down the basis for differences. A nice example of this approach is provided by the work of Weber and Hsee . The initial observation was that although American and Chinese students did not differ in their attitude toward risk, Chinese students saw financial risk situations as significantly less risky than did Americans (Incidentally, this is the opposite of the intuitions of both groups about cultural differences, Hsee and Weber, 1999).

Why did this difference in risk perception occur? Based on some ethnographic observations, Hsee and Weber (1999) suggested what they call the *cushion hypothesis*. The basic idea is that in a collectivist culture where the extended family is important, people are more likely to receive financial help if they need it than in a more

individualistic culture (like that of the United States) where the nuclear family tends to be more important than the extended family. An analysis of American and Chinese proverbs (Weber, Hsee, and Sokolowska, 1998), indicates that American proverbs are less applicable to the social domain than Chinese proverbs. Furthermore, Chinese students perceived proverbs to advocate more risk seeking than American students, but only for financial risks and not for social risks.

If this analysis is correct, then Chinese students may be more risk-seeking only in the financial domain. In support of this hypothesis, Hsee and Weber (1999) looked at risk preferences in the domains of finance, academics, and medicine. They replicated the cultural difference for financial decisions but found no difference in the academic or health domains. In a review of this and related research on cultural differences in risk perception Weber and Hsee (1999) argue that, where possible, cross-cultural research should be guided by and relevant to a theory or model (as opposed to a simple catalog of cultural differences).

As another example of cross-cultural research focused on model testing, Aaker and Lee (in press) predicted that people with a highly accessible independent self-concept would tend to have a promotion focus when evaluating consumer products, while people with a highly accessible interdependent self-concept would tend to have a prevention focus. To explore this issue, one study examined American and Chinese participants. As members of an individualistic culture, the American participants were expected to have a relatively independent self-concept. In contrast, as members of a collectivist culture, Chinese participants were expected to have a relatively interdependent self-concept. Consistent with their hypothesis, American participants showed relatively better recall of

promotion than prevention related information and Chinese participants showed better recall of prevention than promotion related information. It is important to note, however, that a manipulation of regulatory focus (which focused people winning or not losing a prize) had a larger effect on people's recall than did their dominant culture. Thus, while cultural differences can provide a chronic source of motivational focus, situational effects are likely to be stronger.

Cultural differences in choice behavior may also be used as a way of assessing underlying mental models of the choice domain. As an example, Atran, Medin, Ross, Lynch, Coley, Ucan Ek', and Vapnarsky (1999) began with the observation that three cultural groups living in the lowland rainforest of Guatemala had distinct differences in the sustainability of their agro-forestry practices. The indigenous group, the Itza' Maya, appears to operate sustainably. Two other groups that immigrated to the area--Ladinos and Q'eqchi' Maya--are more destructive than the Itza' with the Q'eqchi' being much more destructive than the Ladinos.

In order to explore why the Ladinos and Q'eqchi' choose to be more environmentally destructive than the Itza' Atran et al. collected observations on social and expert networks, folk ecological models of the forest (i.e. how plants and animals affect each other), and human impact (both self-report and direct measurements on farmers land). They found dramatic differences in mental models. Only the Itza' Maya see animals as helping plants. Itza' and Ladinos have a common model for how plants affect animals and this model is much richer than the Q'eqchi' model. Furthermore, there is evidence that the Ladinos are learning from the Itza' ----Ladino network distance from the most expert Itza' correlates reliably with the number of plant-animal relations known

by the Ladino participants. Regression analyses on human impact indicate that the cash value predicts what Ladinos say they protect, whereas total uses and ecological centrality predict Itza' impact.⁴ Interestingly, Q'eqchi' see themselves as having less impact, though they do report (correctly) that they tend to destroy rather than protect species. These observations are correlational and it is possible that the folk ecological models are consequences rather than the causes of sustainable agro-forestry practice, as Atran et al, note. What is unequivocal is that surface differences in environmental decision can be accompanied by striking differences in cognitive models of resources.

The studies described in this section use cultural differences as a lever for studying cognitive processing. Research has begun to use the distinction between individualist and collectivist cultures as a way to explore hypotheses about risk aversion and motivational focus. This work also permits an examination of the differences between chronic motivational focus (imbued by culture) and situational motivational focus (determined by the current context). Finally, cultural differences permit the exploration of more complex topics like the influence of mental models on choice behavior. This work is particularly interesting, because there is not enough time in laboratory settings to provide participants with the kinds of detailed mental models that would be necessary to influence decisions.

Summary

Research on individual differences, especially that on cultural differences, is in its infancy (see Chen, 1995, Hui, Triandis and Yee, 1991, Leung, Bond and Schwartz, 1995, and the edited volume by Earley and Miriam, 1997, for data and review on culture and decision making). The safest prediction of our review is that this topic is going to receive

dramatically greater attention in the 21st century. The globalization of economies as well as the recognition of multiculturalism within nations demands consideration, if only to demonstrate the generality of current theories. We believe that comparative studies will provide a rich source of observations that will lead the field toward better theories.

Conclusions

It is difficult to provide a single summary of a chapter as long as this. We have covered a lot of ground. In particular, we have suggested that research on decision making is organized in a different way than it was in the '70s and '80s. The field has moved from one dominated by normative models borrowed from economics to one based on psychological models that inform (and in turn are informed by) the study of choice.

One key change is the shift in focus from an analysis of performance with particular sets of options to an exploration of psychological processes within decision makers. Research motivated by normative economic models created sets of decision situations designed to highlight anomalies in choice. There was concern for the way decision makers would process these decisions, but the interest was clearly centered on the particular choice settings. One way to see this focus is to note that many of the key decision settings were given names such as the "jacket scenario" (used to refer to the mental accounting demonstration involving the jacket and the calculator) the "disease problem" (used to refer to the problem that illustrates framing effects) and the "theater ticket scenario" (used to refer to an example of mental accounting involving a lost ticket).

Current research is focused less on these particular choice scenarios and more on characteristics of decision makers. Researchers are now more interested in the

psychological processes underlying choice behavior than in cataloging violations of normative models of choice.

Unlike many areas of psychology, the study of decision making cuts across traditional areas. The study of goals and motivations often appears in social psychology journals. The exploration of reasoning, problem solving, and similarity is generally presented in cognitive psychology. Explorations of fairness and values appears in management and public policy journals. The study of emotion and its links to decision making appears in law, philosophy and psychology journals. Yet, in order to understand decision making behavior all of these areas are relevant and must be integrated. Thus, decision making has moved from a peripheral area of psychology to one that is centrally located.

Footnotes

¹ This is not to say that all decision making research before 1990 focused on gambles and on rationality. Indeed, many of the papers cited here that go beyond gambles were published before 1990. It is just that there was more consensus about the main issues in decision making research before 1990 than after.

² A Dutch book is a set of gambles in which each successive pair is close in probability and value. When people choose among these similar gambles, they typically focus on the differences in amount to be won and select the gamble with the higher potential winnings. If they are then given the first and last gamble in the series (which differ both in probability and payoff), they often switch their choice to the item with the higher probability of winning. A judiciously selected set of gambles like this can lead to a case where people consistently favor gambles that favor the "house." Thus, a Dutch book can become a money pump.

³ There is even a burgeoning field of behavioral accounting that focuses on how financial statements are interpreted and used to make decisions (e.g., Hunton, 1998).

⁴ An interesting followup observation is that the Itza' believe that the forest spirits or "arux" not only value forest plants in accordance with their ecological centrality but also that they play an active role in protecting the forest. For example, Itza' attributed a man's falling out of a tree to the arux punishing him for cutting down a tree that should have been preserved. Note that this shift from a resource as passive to one that is responsive changes the very conception of the resource dilemma. Although both of the other two groups vouch for the presence of the arux, in neither group do the arux play any such role.

Author Identification Notes

This work was supported by NSF grant SBR-9905013 given to the first author and NSF grant SES-9910156 and a grant from the Russell Sage Foundation for the second author. The authors thank Jennifer Aaker, Julie Irwin, Daniel Kahneman, and Richard Thaler for encouragement and copies of papers as we were preparing this chapter. We thank Scott Atran, Kristine Ehrich, Julie Irwin, Carmen Tanner, and Dan Bartels for reading the paper and providing constructive comments and suggestions. This joint effort was prompted by the indecisiveness of an eminent decision making researcher. Writing the review was enjoyable enough for us to acknowledge that person here, but we assume that the person in question would prefer anonymity. Thanks also to Stephen King for giving us faith that a paper this long could be written in 3 weeks.

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Figure Captions

Figure 1. Examples of the attraction and compromise effects. In each example, the options are described along two dimensions. Goodness of each attribute increases with distance from the origin. In the attraction effect, options A and B are selected so that people are indifferent between them. Option C is then added. In the compromise effect, options D and E are selected so that people are indifferent between them. Option F or G is then added.

Figure 2. Psychological functions for evaluation of attributes and probabilities in Prospect Theory. (a) A hypothetical function for evaluating attribute values relative to a reference point. The function for losses is steeper than the function for gains. (b) A hypothetical function for the psychological perception of probability. According to this curve, people are relatively insensitive to changes in small probabilities and relatively sensitive to small changes in large probabilities.

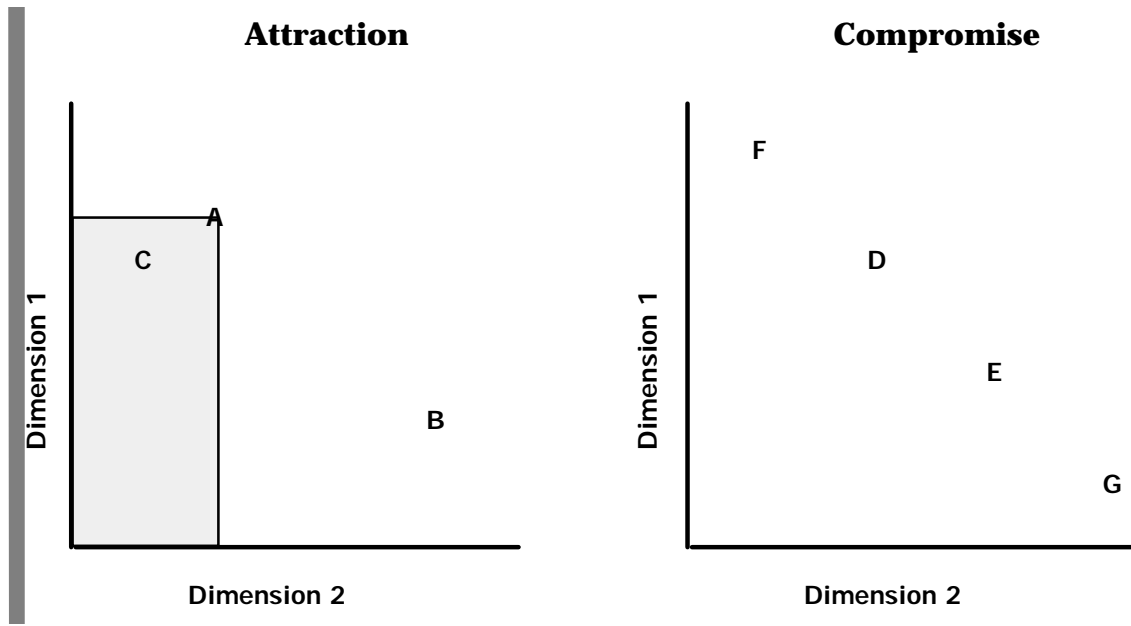


Figure 1.

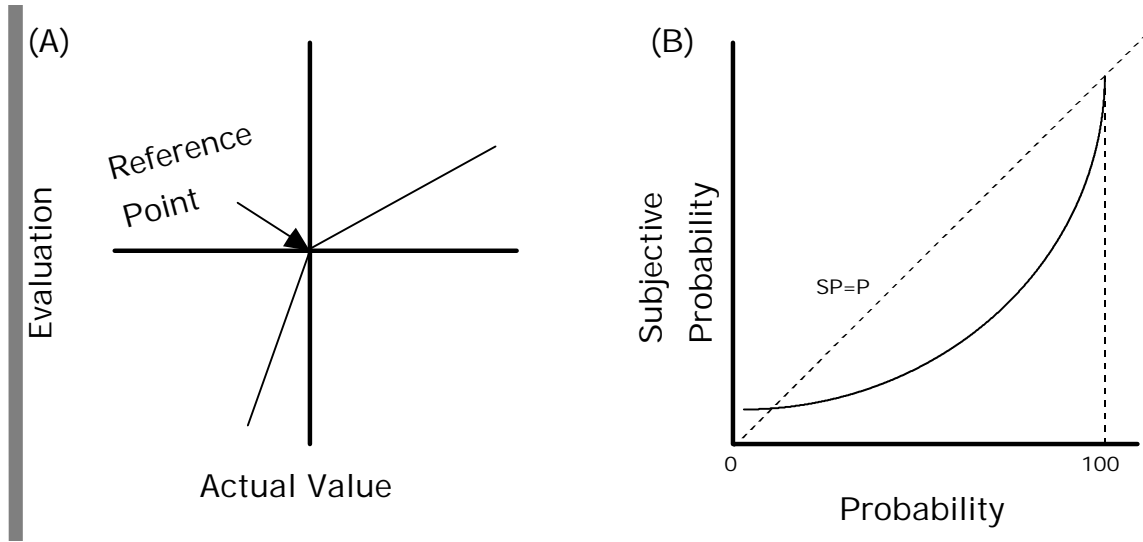


Figure 2.