Timid Choices and Bold Forecasts: A Cognitive Perspective on Risk Taking

Daniel Kahneman; Dan Lovallo

Management Science, Vol. 39, No. 1 (Jan., 1993), 17-31.

Stable URL:
http://links.jstor.org/sici?sici=0025-1909%28199301%2939%3A1%3C17%3ATCABFA%3E2.0.CO%3B2-I

Management Science is currently published by INFORMS.

Timid Choices and Bold Forecasts: A Cognitive Perspective on Risk Taking

Daniel Kahneman • Dan Lovallo
Department of Psychology, University of California, Berkeley, California 94720
Walter A. Haas School of Business Administration, University of California, Berkeley, California 94720

Decision makers have a strong tendency to consider problems as unique. They isolate the current choice from future opportunities and neglect the statistics of the past in evaluating current plans. Overly cautious attitudes to risk result from a failure to appreciate the effects of statistical aggregation in mitigating relative risk. Overly optimistic forecasts result from the adoption of an inside view of the problem, which anchors predictions on plans and scenarios. The conflicting biases are documented in psychological research. Possible implications for decision making in organizations are examined.
(*Decision Making; Risk; Forecasting; Managerial Cognition*)

The thesis of this essay is that decision makers are excessively prone to treat problems as unique, neglecting both the statistics of the past and the multiple opportunities of the future. In part as a result, they are susceptible to two biases, which we label isolation errors: their forecasts of future outcomes are often anchored on plans and scenarios of success rather than on past results, and are therefore overly optimistic; their evaluations of single risky prospects neglect the possibilities of pooling risks and are therefore overly timid. We argue that the balance of the two isolation errors affects the risk-taking propensities of individuals and organizations.

The cognitive analysis of risk taking that we sketch differs from the standard rational model of economics and also from managers' view of their own activities. The rational model describes business decisions as choices among gambles with financial outcomes, and assumes that managers' judgments of the odds are Bayesian, and that their choices maximize expected utility. In this model, uncontrollable risks are acknowledged and accepted because they are compensated by chances of gain. As March and Shapira (1987) reported in a well-known essay, managers reject this interpretation of their role, preferring to view risk as a challenge to be overcome by the exercise of skill and choice as a commitment to a goal. Although managers do not deny the possibility of failure, their idealized self-image is not a gambler but a prudent and determined agent, who is in control of both people and events.

The cognitive analysis accepts choice between gambles as a model of decision making, but does not adopt rationality as a maintained hypothesis. The gambling metaphor is apt because the consequences of most decisions are uncertain, and because each option could in principle be described as a probability distribution over outcomes. However, rather than suppose that decision makers are Bayesian forecasters and optimal gamblers, we shall describe them as subject to the conflicting biases of unjustified optimism and unreasonable risk aversion. It is the optimistic denial of uncontrollable uncertainty that accounts for managers' views of themselves as prudent risk takers, and for their rejection of gambling as a model of what they do.

Our essay develops this analysis of forecasting and choice and explores its implications for organizational decisions. The target domain for applications includes choices about potentially attractive options that decision makers consider significant and to which they are willing to devote forecasting and planning resources. Examples may be capital investment projects, new products, or acquisitions. For reasons that will become obvious, our

0025-1909/93/3901/0017$01.25

critique of excessive risk aversion is most likely to apply to decisions of intermediate size: large enough to matter for the organization, but not so large as to be truly unique, or potentially fatal. Of course, such decisions could be perceived as both unique and potentially fatal by the executive who makes them. Two other restrictions on the present treatment should be mentioned at the outset. First, we do not deal with decisions that the organization explicitly treats as routinely repeated. Opportunities for learning and for statistical aggregation exist when closely similar problems are frequently encountered, especially if the outcomes of decisions are quickly known and provide unequivocal feedback; competent management will ensure that these opportunities are exploited. Second, we do not deal with decisions made under severely adverse conditions, when all options are undesirable. These are situations in which high-risk gambles are often preferred to the acceptance of sure losses (Kahneman and Tversky 1979a), and in which commitments often escalate and sunk costs dominate decisions (Staw and Ross 1989). We restrict the treatment to choices among options that can be considered attractive, although risky. For this class of projects we predict that there will be a general tendency to underestimate actual risks, and a general reluctance to accept significant risks once they are acknowledged.

Timid Choices

We begin by reviewing three hypotheses about individual preferences for risky prospects.

Risk Aversion. The first hypothesis is a commonplace: most people are generally risk averse, normally preferring a sure thing to a gamble of equal expected value, and a gamble of low variance over a riskier prospect. There are two important exceptions to risk aversion. First, many people are willing to pay more for lottery tickets than their expected value. Second, studies of individual choice have shown that managers, like other people, are risk-seeking in the domain of losses (Bateman and Zeithaml 1989, Fishburn and Kochenberger 1979, Laughhunn et al. 1980).[1] Except for these cases, and for the behavior of addictive gamblers, risk aversion is prevalent in choices between favorable prospects with known probabilities. This result has been confirmed in numerous studies, including some in which the subjects were executives (MacCrimmon and Wehrung 1986, Swalm 1966).[2]

The standard interpretation of risk aversion is decreasing marginal utility of gains. Prospect theory (Kahneman and Tversky 1979a; Tversky and Kahneman 1986, 1992) introduced two other causes: the certainty effect and loss aversion. The certainty effect is a sharp discrepancy between the weights that are attached to sure gains and to highly probable gains in the evaluation of prospects. In a recent study of preferences for gambles the decision weight for a probability of 0.95 was approximately 0.80 (Tversky and Kahneman 1992). Loss aversion refers to the observation that losses and disadvantages are weighted more than gains and advantages. Loss aversion affects decision making in numerous ways, in riskless as well as in risky contexts. It favors inaction over action and the status quo over any alternatives, because the disadvantages of these alternatives are evaluated as losses and are therefore weighted more than their advantages (Kahneman et al. 1991, Samuelson and Zeckhauser 1988, Tversky and Kahneman 1991). Loss aversion strongly favors the avoidance of risks. The coefficient of loss aversion was estimated as about 2 in the Tversky-Kahneman experiment, and coefficients in the range of 2 to 2.5 have been observed in several studies, with both risky and riskless prospects (for reviews, see Kahneman, Knetsch and Thaler 1991; Tversky and Kahneman 1991).

Near-Proportionality. A second important generalization about risk attitudes is that, to a good first approximation, people are proportionately risk averse: cash equivalents for gambles of increasing size are (not quite) proportional to the stakes. Readers may find it instructive to work out their cash equivalent for a 0.50 chance to win \$100, then \$1,000, and up to \$100,000. Most readers will find that their cash equivalent increases by a factor of less than 1,000 over that range, but most will also find that the factor is more than 700. Exact

[1] Observed correlations between accounting variability and mean return have also been interpreted as evidence of risk-seeking by unsuccessful firms (Bowman 1982, Fiegenbaum 1990, Fiegenbaum and Thomas 1988), but this interpretation is controversial (Ruefli 1990).

[2] A possible exception is a study by Wehrung (1989), which reported risk-neutral preferences for favorable prospects in a sample of executives in oil companies.

proportionality for wholly positive prospects would imply that value is a power function, $u(x) = x^a$, where x is the amount of gain (Keeney and Raiffa 1976). In a recent study of preferences for gambles (Tversky and Kahneman 1992), a power function provided a good approximation to the data over almost two orders of magnitude, and the deviations were systematic: cash equivalents increased slightly more slowly than prizes.

Much earlier, Swalm (1966) had compared executives whose planning horizons, defined as twice the maximum amount they might recommend be spent in one year, ranged from $50,000 to $24,000,000. He measured their utility functions by testing the acceptability of mixed gambles, and observed that the functions of managers at different levels were quite similar when expressed relative to their planning horizons. The point on which we focus in this article is that there is almost as much risk aversion when stakes are small as when they are large. This is unreasonable on two grounds: (i) small gambles do not raise issues of survival or ruin, which provide a rationale for aversion to large risks; (ii) small gambles are usually more common, offering more opportunities for the risk-reducing effects of statistical aggregation.

Narrow Decision Frames. The third generalization is that people tend to consider decision problems one at a time, often isolating the current problem from other choices that may be pending, as well as from future opportunities to make similar decisions. The following example (from Tversky and Kahneman 1986) illustrates an extreme form of narrow framing:

> Imagine that you face the following pair of concurrent decisions. First examine both decisions, then indicate the options you prefer.
>
> Decision (i) Choose between:
> (A) a sure gain of $240 (84%)
> (B) 25% chance to gain $1000 and 75% chance to gain nothing (16%)
>
> Decision (ii) Choose between:
> (C) a sure loss of $750 (13%)
> (D) 75% chance to lose $1000 and 25% chance to lose nothing (87%)

The percentage of respondents choosing each option is shown in parentheses. As many readers may have discovered for themselves, the suggestion that the two problems should be considered concurrently has no effect on preferences, which exhibit the common pattern of risk aversion when options are favorable, and risk seeking when options are aversive. Most respondents prefer the conjunction of options A & D over other combinations of options. These preferences are intuitively compelling, and there is no obvious reason to suspect that they could lead to trouble. However, simple arithmetic shows that the conjunction of preferred options A & D is dominated by the conjunction of rejected options B & C. The combined options are as follows:

> A & D: 25% chance to win $240 and 75% chance to lose $760,
> B & C: 25% chance to win $250 and 75% chance to lose $750.

A decision maker who is risk averse in some situations and risk seeking in others ends up paying a premium to avoid some risks and a premium to obtain others. Because the outcomes are ultimately combined, these payments may be unsound. For a more realistic example, consider two divisions of a company that face separate decision problems.[3] One is in bad posture and faces a choice between a sure loss and a high probability of a larger loss; the other division faces a favorable choice. The natural bent of intuition will favor a risk-seeking solution for one and a risk-averse choice for the other, but the conjunction could be poor policy. The overall interests of the company are better served by aggregating the problems than by segregating them, and by a policy that is generally more risk-neutral than intuitive preferences.

People often express different preferences when considering a single play or multiple plays of the same gamble. In a well-known problem devised by Samuelson (1963), many respondents state that they would reject a single play of a gamble in which they have equal chances to win $200 or to lose $100, but would accept multiple plays of that gamble, especially when the compound distribution of outcomes is made explicit (Redelmeier and Tversky 1992). The question of whether this pattern of preferences is consistent with utility theory, and with particular utility functions for wealth has been discussed on several occasions (e.g., Lopes 1981, Tversky and Bar-Hillel 1983). The argument that emerges from these discussions can be summarized as "If you wish to obey the axioms of utility

[3] We are endebted to Amos Tversky for this example.

theory and would accept multiple plays, then it is logically inconsistent for you to turn down a single play". We focus on another observation: the near-certainty that the individual who is now offered a single play of the Samuelson gamble is not really facing her last opportunity to accept or reject a gamble of positive expected value. This suggests a slightly different argument: "If you would accept multiple plays, then you should accept the single one that is offered now, because it is very probable that other bets of the same kind will be offered to you later". A frame that includes future opportunities reduces the difference between the two versions of Samuelson's problem, because a rational individual who is offered a single gamble will adopt a policy for $m + 1$ such gambles, where m is the number of similar opportunities expected within the planning horizon. Will people spontaneously adopt such a broad frame? A plausible hypothesis, supported by the evidence for narrow framing in concurrent decisions and by the pattern of answers to Samuelson's problems, is that expectations about risky opportunities of the future are simply ignored when decisions are made.

It is generally recognized that a broad view of decision problems is an essential requirement of rational decision making. There are several ways of broadening the decision frame. Thus, decision analysts commonly prescribe that concurrent choices should be aggregated before a decision is made, and that outcomes should be evaluated in terms of final assets (wealth), rather than in terms of the gains and losses associated with each move. The recommended practice is to include estimates of future earnings in the assessment of wealth. Although this point has attracted little attention in the decision literature, the wealth of an agent or organization therefore includes future risky choices, and depends on the decisions that the decision maker anticipates making when these choices arise.[4] The decision frame should be broadened to include these uncertainties: neglect of future risky opportunities will lead to decisions that are not optimal, as evaluated by the agent's own utility function. As we show next, the costs of neglecting future opportunities are especially severe when options are evaluated in terms of gains and losses, which is what people usually do.

[4] Two agents that have the same current holdings and face the same series of risky choices do not have the same wealth if they have different attitudes to risk and expect to make different decisions. For formal discussions of choice in the presence of unresolved uncertainty, see Kreps (1988) and Spence and Zeckhauser (1972).

The Costs of Isolation

The present section explores some consequences of incorporating future choice opportunities into current decisions. We start from an idealized utility function which explains people's proportional risk preferences for single gambles. We then compute the preferences that this function implies when the horizon expands to include a portfolio of gambles.

Consider an individual who evaluates outcomes as gains and losses, and who maximizes expected utility in these terms. This decision maker is risk-averse in the domain of gains, risk-seeking in the domain of losses, loss-averse, and her risky choices exhibit perfect proportionality. She is indifferent between a 0.50 chance to win \$1,000 and a sure gain of \$300 (also between 0.50 chance to win \$10,000 and \$3,000 for sure) and she is also indifferent between the status quo and a gamble that offers equal chances to win \$250 or to lose \$100. The aversion to risk exhibited by this individual is above the median of respondents in laboratory studies, but well within the range of observed values. For the sake of simple exposition we ignore all probability distortions and attribute the risk preferences of the individual entirely to the shape of her utility function for gains and losses. The preferences we have assumed imply that the individual's utility for gains is described by a power function with an exponent of 0.575 and that the function in the domain of losses is the mirror image of the function for gains, after expansion of the X-axis by a factor of 2.5 (Tversky and Kahneman 1991). The illustrative function was chosen to highlight our main conclusion: with proportional risk attitudes, even the most extreme risk aversion on individual problems quickly vanishes when gambles are considered part of a portfolio.

The power utility function is decreasingly risk averse, and the decrease is quite rapid. Thus, a proportionately risk averse individual who values a 0.50 chance to win \$100 at \$30 will value a gamble that offers equal chances to win either \$1,000 or \$1,100 at \$1,049. This preference is intuitively acceptable, indicating again that the power function is a good description of the utility of outcomes

for single gambles considered in isolation. The power function fits the psychophysical relation of subjective magnitude to physical magnitude in many other contexts (Stevens 1975).

To appreciate the effects of even modest aggregation with this utility function, assume that the individual owns three independent gambles:

one gamble with a 0.50 chance to win \$500,
two gambles, each with a 0.50 chance to win \$250.

Simple arithmetic yields the compound gamble:

0.125 chance to win \$1,000, and 0.25 to win \$750, \$500, and \$250.

If this individual applies the correct probabilities to her utility function, this portfolio will be worth \$433 to her. This should be her minimum selling price if she owns the gamble, her cash equivalent if she has to choose between the portfolio of gambles and cash. In contrast, the sum of the cash equivalents of the gambles considered one at a time is only \$300. The certainty premium the individual would pay has dropped from 40% to 13% of expected value. By the individual's own utility function, the cost of considering these gambles in isolation is 27% of their expected value, surely more than any rational decision maker should be willing to pay for whatever mental economy this isolation achieves.

The power of aggregation to overcome loss aversion is equally impressive. As already noted, our decision maker is indifferent between accepting or rejecting a gamble that offers a 0.50 chance to win \$250 and a 0.50 chance to lose \$100. However, she would value the opportunity to play two of these gambles at \$45, and six gambles at \$304. Note that the average incremental value of adding the third to the sixth gamble is \$65, quite close to the EV of \$75, although each gamble is worth nothing on its own.

Finally, we note that decisions about single gambles will no longer appear risk-proportional when gambles are evaluated in the context of a portfolio, even if the utility function has that property. Suppose the individual now owns a set of eleven gambles:

one gamble with a 0.50 chance to win \$1,000,
ten gambles, each with a 0.50 chances to win \$100.

The expected value of the set is \$1,000. If the gambles were considered one at a time, the sum of their cash equivalents would be only \$600. With proper aggregation, however, the selling price for the package should be \$934. Now suppose the decision maker considers trading only one of the gambles. After selling a gamble for an amount X, she retains a reduced compound gamble in which the constant X is added to each outcome. The decision maker, of course, will only sell if the value of the new gamble is at least equal to the value of the original portfolio. The computed selling price for the larger gamble is \$440, and the selling price for one of the smaller gambles is \$49. Note that the premium given up to avoid the risk is 12% of expected value for the large gamble, but only 2% for the small one. A rational decision maker who applies a proportionately risk averse utility function to aggregate outcomes will set cash equivalents closer to risk neutrality for small gambles than for large ones.

As these elementary examples illustrate, the common attitude of strong (and proportional) aversion to risk and to losses entails a risk policy that quickly approaches neutrality as the portfolio is extended.[5] Because possibilities of aggregation over future decisions always exist for an ongoing concern, and because the chances for aggregation are likely to be inversely correlated with the size of the problem, the near-proportionality of risk attitudes for gambles of varying sizes is logically incoherent, and the extreme risk aversion observed for prospects that are small relative to assets is unreasonable. To rationalize observed preferences one must assume that the decision maker approaches each choice problem as if it were her last—there seems to be no relevant tomorrow. It is somewhat surprising that the debate on the rationality of risky decisions has focused almost exclusively on the curiosities of the Allais and Ellsberg paradoxes, instead of on simpler observations,

[5] The conclusions of the present section do not critically depend on the assumption of expected utility theory, that the decision maker weights outcomes by their probabilities. All the calculations reported above were repeated using cumulative prospect theory (Tversky and Kahneman 1992) with plausible parameters ($a = 0.73$; $b = c = 0.6$ and a loss aversion coefficient of 2.5). Because extreme outcomes are assigned greater weight in prospect theory than in the expected utility model, the mitigation of risk aversion as the portfolio expands is somewhat slower. Additionally, the risk seeking that prospect theory predicts for single low-probability positive gambles is replaced by risk aversion for repeated gambles.

such as the extraordinary myopia implied by extreme and nearly proportional risk aversion.

Risk Taking in Organizations: Implications and Speculations

The preceding sections discussed evidence that people, when faced with explicitly probabilistic prospects in experimental situations, tend to frame their decision problem narrowly, have near-proportional risk attitudes, and are as a consequence excessively risk averse in small decisions, where they ignore the effects of aggregation. Extending these ideas to business decisions is necessarily speculative, because the attitudes to risk that are implicit in such decisions are not easily measured. One way to approach this problem is by asking whether the organizational context in which many business decisions are made is more likely to enhance or to inhibit risk aversion, narrow framing and near-proportionality. We examine this question in the present section.

Risk Aversion. There is little reason to believe that the factors that produce risk aversion in the personal evaluation of explicit gambles are neutralized in the context of managerial decisions. For example, attempts to measure the utility that executives attach to gains and losses of their firm suggest that the principle of decreasing marginal values applies to these outcomes (MacCrimmon and Wehrung 1986, Swalm 1966). The underweighting of probable gains in comparisons with sure ones, known as the certainty effect, is also unlikely to vanish in managerial decisions. The experimental evidence indicates that the certainty effect is not eliminated when probabilities are vague or ambiguous, as they are in most real-life situations, and the effect may even be enhanced (Curley et al. 1986, Hogarth and Einhorn 1990). We suspect that the effect may become even stronger when a choice becomes a subject of debate, as is commonly the case in managerial decisions: the rhetoric of prudent decision making favors the certainty effect, because an argument that rests on mere probability is always open to doubt.

Perhaps the most important cause of risk aversion is loss aversion, the discrepancy between the weights that are attached to losses and to gains in evaluating prospects. Loss aversion is not mitigated when decisions are made in an organizational context. On the contrary, the asymmetry between credit and blame may enhance the asymmetry between gains and losses in the decision maker's utilities. The evidence indicates that the pressures of accountability and personal responsibility increase the status quo bias and other manifestations of loss aversion. Decision makers become more risk averse when they expect their choices to be reviewed by others (Tetlock and Boettger 1991) and they are extremely reluctant to accept responsibility for even a small increase in the probability of a disaster (Viscusi et al. 1987). Swalm (1966) noted that managers appear to have an excessive aversion to any outcome that could yield a net loss, citing the example of a manager in a firm described as "an industrial giant", who would decline to pursue a project that has a 50–50 chance of either making for his company a gain of $300,000 or losing $60,000. Swalm hypothesized that the steep slopes of utility functions in the domain of losses may be due to control procedures that bias managers against choices that might lead to losses. This interpretation seems appropriate since "several respondents stated quite clearly that they were aware that their choices were not in the best interests of the company, but that they felt them to be in their own best interests as aspiring executives."

We conclude that the forces that produce risk aversion in experimental studies of individual choice may be even stronger in the managerial context. Note, however, that we do not claim that an objective observer would describe managerial decisions as generally risk averse. The second part of this essay will argue that decisions are often based on optimistic assessments of the chances of success, and are therefore objectively riskier than the decision makers perceive them to be. Our hypotheses about risk in managerial decisions are: (i) in a generally favorable context, the threshold for accepting risk will be high, and acceptable options will be *subjectively* perceived as carrying low risk, (ii) for problems viewed in isolation the willingness to take risks is likely to be approximately constant for decisions that vary greatly in size, and (iii) decisions will be narrowly framed even when they could be viewed as instances of a category of similar decisions. As a consequence, we predict (iv) an imbalance in the risks that the organization accepts in large and in small problems, such that relative risk aversion is lower for the aggregate of small decisions than for the aggregate of large decisions. These hypotheses are restricted to essentially favorable situations,

which often yield risk aversion in laboratory studies. We specifically exclude situations in which risk seeking is common, such as choices between essentially negative options, or choices that involve small chances of large gain.

Narrow Framing. We have suggested that people tend to make decisions one at a time, and in particular that they are prone to neglect the relevance of future decision opportunities. For both individuals and organizations, the adoption of a broader frame and of a consistent risk policy depends on two conditions: (i) an ability to group together problems that are superficially different; (ii) an appropriate procedure for evaluating outcomes and the quality of performance.

A consistent risk policy can only be maintained if the recurrent problems to which the policy applies are recognized as such. This is sometimes easy: competent organizations will identify obvious recurring questions—for example, whether or not to purchase insurance for a company vehicle—and will adopt policies for such questions. The task is more complex when each decision problem has many unique features, as might be the case for acquisitions or new product development. The explicit adoption of a broad frame will then require the use of an abstract language that highlights the important common dimensions of diverse decision problems. Formal decision analysis provides such a language, in which outcomes are expressed in money and uncertainty is quantified as probability. Other abstract languages could be used for the same purpose. As practitioners of decision analysis well know, however, the use of an abstract language conflicts with a natural tendency to describe each problem in its own terms. Abstraction necessarily involves a loss of subtlety and specificity, and the summary descriptions that permit projects to be compared almost always appear superficial and inadequate.

From the point of the individual executive who faces a succession of decisions, the maintenance of a broad decision frame also depends on how her performance will be evaluated, and on the frequency of performance reviews. For a schematic illustration, assume that reviews occur at predictable points in the sequence of decisions and outcomes, and that the executive's outcomes are determined by the *value* of the firm's outcomes since the last review. Suppose the evaluation function is identical to the utility function introduced in the preceding numerical examples: the credit for gaining 2.5 units and the blame for losing 1 unit just cancel out. With this utility function, a single gamble that offers equal probabilities to win 2 units or to lose 1 unit will not be acceptable if performance is evaluated on that gamble by itself. The decision will not change even if the manager knows that there will be a second opportunity to play the same gamble. However, if the evaluation of outcomes and the assignment of credit and blame can be deferred until the gamble has been played twice, the probability that the review will be negative drops from 0.50 to 0.25 and the compound gamble will be accepted. As this example illustrates, reducing the frequency of evaluations can mitigate the inhibiting effects of loss aversion on risk taking, as well as other manifestations of myopic discounting.

The attitude that "you win a few and you lose a few" could be recommended as an antidote to narrow framing, because it suggests that the outcomes of a set of separable decisions should be aggregated before evaluation. However, the implied tolerance for "losing a few" may conflict with other managerial imperatives, including the setting of high standards and the maintenance of tight supervision. By the same token, of course, narrow framing and excessive risk aversion may be unintended consequences of excessive insistence on measurable short-term successes. A plausible hypothesis is that the adoption of a broad frame of evaluation is most natural when the expected rate of success is low for each attempt, as in drilling for oil or in pharmaceutical development.[6] The procedures of performance evaluation that have evolved in these industries could provide a useful model for other attempts to maintain consistent risk policies.

Near Proportionality of Risk Attitudes. Many executives in a hierarchical organization have two distinct decision tasks: they make risky choices on behalf of the organization, and they supervise several subordinates who also make decisions. For analytical purposes, the options chosen by subordinates can be treated as independent (or imperfectly correlated) gambles, which usually involve smaller stakes than the decisions made personally by the superior. A problem of risk aggre-

[6] We owe this hypothesis to Richard Thaler.

gation inevitably arises, and we conjecture that solving it efficiently may be quite difficult.

To begin, ignore the supervisory function and assume that all decisions are made independently, with narrow framing. If all decision makers apply the same nearly-proportional risk attitudes (as suggested by Swalm 1966), an unbalanced set of choices will be made: The aggregate of the subordinates' decisions will be more risk averse than the supervisor's own decisions on larger problems—which in turn are more risk averse than her global utility for the portfolio, rationally evaluated. As we saw in an earlier section, the costs of such inconsistencies in risk attitudes can be quite high.

Clearly, one of the goals of the executive should be to avoid the potential inefficiency, by applying a consistent policy to risky choices and to those she supervises—and the consistent policy is *not* one of proportional risk aversion. As was seen earlier, a rational executive who considers a portfolio consisting of one large gamble (which she chose herself) and ten smaller gambles (presumably chosen by subordinates) should be considerably more risk averse in valuing the large gamble than in valuing any one of the smaller gambles. The counter-intuitive implication of this analysis is that, in a generally favorable context, an executive should encourage subordinates to adopt a higher level of risk-acceptance than the level with which she feels comfortable. This is necessary to overcome the costly effects of the (probable) insensitivity of her intuitive preferences to recurrence and aggregation. We suspect that many executives will resist this recommendation, which contradicts the common belief that accepting risks is both the duty and the prerogative of higher management.

For several reasons, narrow framing and near-proportionality could be difficult to avoid in a hierarchical organization. First, many decisions are both unique and large at the level at which they are initially made. The usual aversion to risk is likely to prevail in such decisions, even if from the point of view of the firm they could be categorized as recurrent and moderately small. Second, it appears unfair for a supervisor to urge acceptance of a risk that a subordinate is inclined to reject—especially because the consequences of failure are likely to be more severe for the subordinate.

In summary, we have drawn on three psychological principles to derive the prediction that the risk attitudes that govern decisions of different sizes may not be coherent. The analysis suggests that there may be too much aversion to risk in problems of small or moderate size. However, the conclusion that greater risk taking should be encouraged could be premature at this point, because of the suspicion that agents' view of prospects may be systematically biased in an optimistic direction. The combination of a risk-neutral attitude and an optimistic bias could be worse than the combination of unreasonable risk aversion and unjustified optimism. As the next sections show, there is good reason to believe that such a dilemma indeed exists.

Bold Forecasts

Our review of research on individual risk attitudes suggests that the substantial degree of risk to which individuals and organizations willingly expose themselves is unlikely to reflect true acceptance of these risks. The alternative is that people and organizations often expose themselves to risk because they misjudge the odds. We next consider some of the mechanisms that produce the 'bold forecasts' that enable cautious decision makers to take large risks.

Inside and Outside Views

We introduce this discussion by a true story, which illustrates an important cognitive quirk that tends to produce extreme optimism in planning.

> In 1976 one of us (Daniel Kahneman) was involved in a project designed to develop a curriculum for the study of judgment and decision making under uncertainty for high schools in Israel. The project was conducted by a small team of academics and teachers. When the team had been in operation for about a year, with some significant achievements already to its credit, the discussion at one of the team meetings turned to the question of how long the project would take. To make the debate more useful, I asked everyone to indicate on a slip of paper their best estimate of the number of months that would be needed to bring the project to a well-defined stage of completion: a complete draft ready for submission to the Ministry of Education. The estimates, including my own, ranged from 18 to 30 months. At this point I had the idea of turning to one of our members, a distinguished expert in curriculum development, asking him a question phrased about as follows: "We are surely not the only team to have tried to develop a curriculum where none existed before. Please try to recall as many such cases as you can. Think of them as they were in a

stage comparable to ours at present. How long did it take them, from that point, to complete their projects?" After a long silence, something much like the following answer was given, with obvious signs of discomfort: "First, I should say that not all teams that I can think of in a comparable stage ever did complete their task. About 40% of them eventually gave up. Of the remaining, I cannot think of any that was completed in less than seven years, nor of any that took more than ten". In response to a further question, he answered: "No, I cannot think of any relevant factor that distinguishes us favorably from the teams I have been thinking about. Indeed, my impression is that we are slightly below average in terms of our resources and potential".

This story illustrates several of the themes that will be developed in this section.

Two distinct modes of forecasting were applied to the same problem in this incident. The *inside view* of the problem is the one that all participants in the meeting spontaneously adopted. An inside view forecast is generated by focusing on the case at hand, by considering the plan and the obstacles to its completion, by constructing scenarios of future progress, and by extrapolating current trends. The *outside view* is the one that the curriculum expert was encouraged to adopt. It essentially ignores the details of the case at hand, and involves no attempt at detailed forecasting of the future history of the project. Instead, it focuses on the statistics of a class of cases chosen to be similar in relevant respects to the present one. The case at hand is also compared to other members of the class, in an attempt to assess its position in the distribution of outcomes for the class (Kahneman and Tversky 1979b). The distinction between inside and outside views in forecasting is closely related to the distinction drawn earlier between narrow and broad framing of decision problems. The critical question in both contexts is whether a particular problem of forecast or decision is treated as unique, or as an instance of an ensemble of similar problems.

The application of the outside view was particularly simple in this example, because the relevant class for the problem was easy to find and to define. Other cases are more ambiguous. What class should be considered, for example, when a firm considers the probable costs of an investment in a new technology in an unfamiliar domain? Is it the class of ventures in new technologies in the recent history of this firm, or the class of developments most similar to the proposed one, carried out in other firms? Neither is perfect, and the recommendation would be to try both (Kahneman and Tversky 1979b). It may also be necessary to choose units of measurement that permit comparisons. The ratio of actual spending to planned expenditure is an example of a convenient unit that permits meaningful comparisons across diverse projects.

The inside and outside views draw on different sources of information, and apply different rules to its use. An inside view forecast draws on knowledge of the specifics of the case, the details of the plan that exists, some ideas about likely obstacles and how they might be overcome. In an extreme form, the inside view involves an attempt to sketch a representative scenario that captures the essential elements of the history of the future. In contrast, the outside view is essentially statistical and comparative, and involves no attempt to divine future history at any level of detail.

It should be obvious that when both methods are applied with equal intelligence and skill, the outside view is much more likely to yield a realistic estimate. In general, the future of a long and complex undertaking is simply not foreseeable in detail. The ensemble of possible future histories cannot be defined. Even if this could be done, the ensemble would in most cases be huge, and the probability of any particular scenario negligible.[7] Although some scenarios are more likely or plausible than others, it is a serious error to assume that the outcomes of the most likely scenarios are also the most likely, and that outcomes for which no plausible scenarios come to mind are impossible. In particular, the scenario of flawless execution of the current plan may be much more probable a priori than any scenario for a specific sequence of events that would cause the project to take four times longer than planned. Nevertheless, the less favorable outcome could be more likely overall, because there are so many different ways for things to go wrong. The main advantage of the outside approach to forecasting is that it avoids the snares of scenario thinking (Dawes 1988). The outside view provides some protection against forecasts that are not

[7] For the purposes of this exposition we assume that probabilities exist as a fact about the world. Readers who find this position shocking should transpose the formulation to a more complex one, according to their philosophical taste.

even in the ballpark of reasonable possibilities. It is a conservative approach, which will fail to predict extreme and exceptional events, but will do well with common ones. Furthermore, giving up the attempt to predict extraordinary events is not a great sacrifice when uncertainty is high, because the only way to score 'hits' on such events is to predict large numbers of other extraordinary events that do not materialize.

This discussion of the statistical merits of the outside view sets the stage for our main observation, which is psychological: the inside view is overwhelmingly preferred in intuitive forecasting. The natural way to think about a problem is to bring to bear all one knows about it, with special attention to its unique features. The intellectual detour into the statistics of related cases is seldom chosen spontaneously. Indeed, the relevance of the outside view is sometimes explicitly denied: physicians and lawyers often argue against the application of statistical reasoning to particular cases. In these instances, the preference for the inside view almost bears a moral character. The inside view is valued as a serious attempt to come to grips with the complexities of the unique case at hand, and the outside view is rejected for relying on crude analogy from superficially similar instances. This attitude can be costly in the coin of predictive accuracy.

Three other features of the curriculum story should be mentioned. First, the example illustrates the general rule that consensus on a forecast is not necessarily an indication of its validity: a shared deficiency of reasoning will also yield consensus. Second, we note that the initial intuitive assessment of our curriculum expert was similar to that of other members of the team. This illustrates a more general observation: statistical knowledge that is known to the forecaster will not necessarily be used, or indeed retrieved, when a forecast is made by the inside approach. The literature on the impact of the base rates of outcomes on intuitive predictions supports this conclusion. Many studies have dealt with the task of predicting the profession or the training of an individual on the basis of some personal information and relevant statistical knowledge. For example, most people have some knowledge of the relative sizes of different departments, and could use that knowledge in guessing the field of a student seen at a graduating ceremony. The experimental evidence indicates that base-rate information that is explicitly mentioned in the problem has some effect on predictions, though usually not as much as it should have (Griffin and Tversky 1992, Lynch and Ofir 1989: for an alternative view see Gigerenzer et al. 1988). When only personal information is explicitly offered, relevant statistical information that is known to the respondent is largely ignored (Kahneman and Tversky 1973, Tversky and Kahneman 1983).

The sequel to the story illustrates a third general observation: facing the facts can be intolerably demoralizing. The participants in the meeting had professional expertise in the logic of forecasting, and none even ventured to question the relevance of the forecast implied by our expert's statistics: an even chance of failure, and a completion time of seven to ten years in case of success. Neither of these outcomes was an acceptable basis for continuing the project, but no one was willing to draw the embarrassing conclusion that it should be scrapped. So, the forecast was quietly dropped from active debate, along with any pretense of long-term planning, and the project went on along its predictably unforeseeable path to eventual completion some eight years later.

The contrast between the inside and outside views has been confirmed in systematic research. One relevant set of studies was concerned with the phenomenon of overconfidence. There is massive evidence for the conclusion that people are generally overconfident in their assignments of probability to their beliefs. Overconfidence is measured by recording the proportion of cases in which statements to which an individual assigned a probability p were actually true. In many studies this proportion has been found to be far lower than p (see Lichtenstein et al. 1982; for a more recent discussion and some instructive exceptions see Griffin and Tversky 1992). Overconfidence is often assessed by presenting general information questions in a multiple-choice format, where the participant chooses the most likely answer and assigns a probability to it. A typical result is that respondents are only correct on about 80% of cases when they describe themselves as "99% sure." People are overconfident in evaluating the accuracy of their beliefs one at a time. It is interesting, however, that there is no evidence of overconfidence bias when respondents are asked after the session to estimate the number of questions for which they picked the correct

answer. These global estimates are accurate, or somewhat pessimistic (Gigerenzer et al. 1991, Griffin and Tversky 1992). It is evident that people's assessments of their overall accuracy does not control their confidence in particular beliefs. Academics are familiar with a related example: finishing our papers almost always takes us longer than we expected. We all know this and often say so. Why then do we continue to make the same error? Here again, the outside view does not inform judgments of particular cases.

In a compelling example of the contrast between inside and outside views, Cooper et al. (1988) interviewed new entrepreneurs about their chances of success, and also elicited from them estimates of the base rate of success for enterprises of the same kind. Self-assessed chances of success were uncorrelated to objective predictors of success such as college education, prior supervisory experience and initial capital. They were also wildly off the mark on average. Over 80% of entrepreneurs perceived their chances of success as 70% or better. Fully one-third of them described their success as certain. On the other hand, the mean chance of success that these entrepreneurs attributed to a business like theirs was 59%. Even this estimate is optimistic, though it is closer to the truth: the five-year survival rate for new firms is around 33% (Dun and Bradstreet 1967).

The inside view does not invariably yield optimistic forecasts. Many parents of rebellious teenagers cannot imagine how their offspring would ever become a reasonable adult, and are consequently more worried than they should be, since they also know that almost all teenagers do eventually grow up. The general point is that the inside view is susceptible to the fallacies of scenario thinking and to anchoring of estimates on present values or on extrapolations of current trends. The inside view burdens the worried parents with statistically unjustified premonitions of doom. To decision makers with a goal and a plan, the same way of thinking offers absurdly optimistic forecasts.

The cognitive mechanism we have discussed is not the only source of optimistic errors. Unrealistic optimism also has deep motivational roots (Tiger 1979). A recent literature review (Taylor and Brown 1988) listed three main forms of a pervasive optimistic bias: (i) unrealistically positive self-evaluations, (ii) unrealistic optimism about future events and plans, and (iii) an illusion of control. Thus, for almost every positive trait—including safe driving, a sense of humor, and managerial risk taking (MacCrimmon and Wehrung 1986)—there is a large majority of individuals who believe themselves to be above the median. People also exaggerate their control over events, and the importance of the skills and resources they possess in ensuring desirable outcomes. Most of us underestimate the likelihood of hazards affecting us personally, and entertain the unlikely belief that Taylor and Brown summarize as "The future will be great, especially for me."

Organizational Optimism

There is no reason to believe that entrepreneurs and executives are immune to optimistic bias. The prevalence of delusions of control among managers has been recognized by many authors (among others, Duhaime and Schwenk 1985, March and Shapira 1987, Salancik and Meindl 1984). As we noted earlier, managers commonly view risk as a challenge to be overcome, and believe that risk can be modified by "managerial wisdom and skill" (Donaldson and Lorsch 1983). The common refusal of managers to refuse risk estimates provided to them as "given" (Shapira 1986) is a clear illustration of illusion of control.

Do organizations provide effective controls against the optimistic bias of individual executives? Are organizational decisions founded on impartial and unbiased forecasts of consequences? In answering these questions, we must again distinguish problems that are treated as recurrent, such as forecasts of the sales of existing product lines, from others that are considered unique. We have no reason to doubt the ability of organizations to impose forecasting discipline and to reduce or eliminate obvious biases in recurrent problems. As in the case of risk, however, all significant forecasting problems have features that make them appear unique. It is in these unique problems that biases of judgment and choice are most likely to have their effects, for organizations as well as for individuals. We next discuss some likely causes of optimistic bias in organizational judgments, some observations of this bias, and the costs and benefits of unrealistic optimism.

Causes. Forecasts often develop as part of a case that is made by an individual or group that already has, or is developing a vested interest in the plan, in a context

of competition for the control of organizational resources. The debate is often adversarial. The only projects that have a good chance of surviving in this competition are those for which highly favorable outcomes are forecast, and this produces a powerful incentive for would-be promoters to present optimistic numbers. The statistical logic that produces the winner's curse in other contexts (Capen, Clapp and Campbell 1971; Bazerman and Samuelson 1983; Kagel and Levin 1986) applies here as well: the winning project is more likely than others to be associated with optimistic errors (Harrison and March 1984). This is an effect of regression to the mean. Thus, the student who did best in an initial test is also the one for whom the most regression is expected on a subsequent test. Similarly, the projects that are forecast to have the highest returns are the ones most likely to fall short of expectations.

Officially adopted forecasts are also likely to be biased by their secondary functions as demands, commands and commitments (Lowe and Shaw 1968, Lawler and Rhode 1976, Lawler 1986, Larkey and Smith 1984). A forecast readily becomes a target, which induces loss aversion for performance that does not match expectations, and can also induce satisficing indolence when the target is exceeded. The obvious advantages of setting high goals is an incentive for higher management to adopt and disseminate optimistic assessments of future accomplishments—and possibly to deceive themselves in the process.

In his analysis of "groupthink," Janis (1982) identified other factors that favor organizational optimism. Pessimism about what the organization can do is readily interpreted as disloyalty, and consistent bearers of bad news tend to be shunned. Bad news can be demoralizing. When pessimistic opinions are suppressed in this manner, exchanges of views will fail to perform a critical function. The optimistic biases of individual group members can become mutually reinforcing, as unrealistic views are validated by group approval.

The conclusion of this sketchy analysis is that there is little reason to believe organizations will avoid the optimistic bias—except perhaps when the problems are considered recurrent and subjected to statistical quality control. On the contrary, there are reasons to suspect that many significant decisions made in organizations are guided by unrealistic forecasts of their consequences.

Observations. The optimistic bias of capital investment projects is a familiar fact of life: the typical project finishes late, comes in over budget when it is finally completed, and fails to achieve its initial goals. Grossly optimistic errors appear to be especially likely if the project involves new technology or otherwise places the firm in unfamiliar territory. A Rand Corporation study on pioneer process plants in the energy field demonstrates the magnitude of the problem (Merrow et al. 1981). Almost all project construction costs exceeded initial estimates by over 20%. The norm was for actual construction costs to more than double first estimates. These conclusions are corroborated by PIMS data on start-up ventures in a wide range of industries (cited by Davis 1985). More than 80% of the projects studied fell short of planned market share.

In an interesting discussion of the causes of failure in capital investment projects, Arnold (1986) states:

> Most companies support large capital expenditure programs with a worst case analysis that examines the projects' loss potential. But the worst case forecast is almost always too optimistic. . . . When managers look at the downside they generally describe a mildly pessimistic future rather than the worst possible future.

As an antidote against rosy predictions Arnold recommends staying power analysis, a method used by lenders to determine if organizations under severe strain can make payments. In effect, the advice is for managers to adopt an outside view of their own problem.

Mergers and acquisitions provide another illustration of optimism and of illusions of control. On average, bidding firms do not make a significantly positive return. This striking observation raises the question of why so many takeovers and mergers are initiated. Roll (1986) offers a "hubris hypothesis" to explain why decision makers acquiring firms tend to pay too much for their targets. Roll cites optimistic estimates of "economies due to synergy and (any) assessments of weak management" as the primary causes of managerial hubris. The bidding firms are prone to overestimate the control they will have over the merged organization, and to underestimate the "weak" managers who are currently in charge.

Costs and Benefits. Optimism and the illusion of control increase risk taking in several ways. In a discussion of the Challenger disaster, Landau and Chis-

holm (1990) introduced a "law of increasing optimism" as a form of Russian roulette. Drawing on the same case, Starbuck and Milliken (1988) noted how quickly vigilance dissipates with repeated successes. Optimism in a competitive context may take the form of contempt for the capabilities of opponents (Roll 1986). In a bargaining situation, it will support a hard line that raises the risk of conflict. Neale and Bazerman (1983) observed a related effect in a final-offer arbitration setup, where the arbiter is constrained to choose between the final offers made by the contestants. The participants were asked to state their subjective probability that the final offer they presented would be preferred by the arbiter. The average of these probabilities was approximately 0.70; with a less sanguine view of the strength of their case the contestants would surely have made more concessions. In the context of capital investment decisions, optimism and the illusion of control manifest themselves in unrealistic forecasts and unrealizable plans (Arnold 1986).

Given the high cost of mistakes, it might appear obvious that a rational organization should want to base its decisions on unbiased odds, rather than on predictions painted in shades of rose. However, realism has its costs. In their review of the consequences of optimism and pessimism, Taylor and Brown (1988) reached the deeply disturbing conclusion that optimistic self-delusion is both a diagnostic indication of mental health and well-being, and a positive causal factor that contributes to successful coping with the challenges of life. The benefits of unrealistic optimism in increasing persistence in the face of difficulty have been documented by other investigators (Seligman 1991).

The observation that realism can be pathological and self-defeating raises troubling questions for the management of information and risk in organizations. Surely, no one would want to be governed entirely by wishful fantasies, but is there a point at which truth becomes destructive and doubt self-fulfilling? Should executives allow or even encourage unrealistic optimism among their subordinates? Should they willingly allow themselves to be caught up in productive enthusiasm, and to ignore discouraging portents? Should there be someone in the organization whose function it is to achieve forecasts free of optimistic bias, although such forecasts, if disseminated, would be demoralizing? Should the organization maintain two sets of forecasting books (as some do, see Bromiley 1986)? Some authors in the field of strategy have questioned the value of realism, at least implicitly. Weick's famous story of the lost platoon that finds its way in the Alps by consulting a map of the Pyrenees indicates more respect for confidence and morale than for realistic appraisal. On the other hand, Landau and Chisholm (1990) pour withering scorn on the "arrogance of optimism" in organizations, and recommend a pessimistic failure-avoiding management strategy to control risk. Before further progress can be made on this difficult issue, it is important to recognize the existence of a genuine dilemma that will not yield to any simple rule

Concluding Remarks

Our analysis has suggested that many failures originate in the highly optimistic judgments of risks and opportunities that we label bold forecasts. In the words of March and Shapira (1987), "managers accept risks, in part, because they do not expect that they will have to bear them." March and Shapira emphasized the role of illusions of control in this bias. We have focused on another mechanism—the adoption of an inside view of problems, which leads to anchoring on plans and on the most available scenarios. We suggest that errors of intuitive prediction can sometimes be reduced by adopting an outside view, which forecasts the outcome without attempting to forecast its history (Kahneman and Tversky 1979b). This analysis identifies the strong intuitive preference for the inside view as a source of difficulties that are both grave and avoidable.

On the issue of risk we presented evidence that decision makers tend to deal with choices one at a time, and that their attitudes to risk exhibit risk-aversion and near-proportionality. The reluctance to take explicit responsibility for possible losses is powerful, and can be very costly in the aggregate (for a discussion of its social costs see Wildavsky 1988). We claimed further that when the stakes are small or moderate relative to assets the aversion to risk is incoherent and substantively unjustified. Here again, the preference for treating decision problems as unique causes errors that could be avoided by a broader view.

Our analysis implies that the adoption of an outside view, in which the problem at hand is treated as an

instance of a broader category, will generally reduce the optimistic bias and may facilitate the application of a consistent risk policy. This happens as a matter of course in problems of forecasting or decision that the organization recognizes as obviously recurrent or repetitive. However, we have suggested that people are strongly biased in favor of the inside view, and that they will normally treat significant decision problems as unique even when information that could support an outside view is available. The adoption of an outside view in such cases violates strong intuitions about the relevance of information. Indeed, the deliberate neglect of the features that make the current problem unique can appear irresponsible. A deliberate effort will therefore be required to foster the optimal use of outside and inside views in forecasting, and the maintenance of globally consistent risk attitudes in distributed decision systems.

Bold forecasts and timid attitudes to risk tend to have opposite effects. It would be fortunate if they canceled out precisely to yield optimal behavior in every situation, but there is little reason to expect such a perfect outcome. The conjunction of biases is less disastrous than either one would have been on its own, but there ought to be a better way to control choice under risk than pitting two mistakes against each other. The prescriptive implications of the relation between the biases in forecast and in risk taking is that corrective attempts should deal with these biases simultaneously. Increasing risk taking could easily go too far in the presence of optimistic forecasts, and a successful effort to improve the realism of assessments could do more harm than good in an organization that relies on unfounded optimism to ward off paralysis.[8]

[8] An earlier version of this paper was presented at a conference on Fundamental Issues in Strategy, held at Silverado, CA, in November 1990. The preparation of this article was supported by the Center for Management Research at the University of California, Berkeley, by the Russell Sage Foundation, and by grants from the Sloan Foundation and from AFOSR, under grant number 88-0206. The ideas presented here developed over years of collaboration with Amos Tversky, but he should not be held responsible for our errors. We thank Philip Bromiley, Colin Camerer, George Loewenstein, Richard Thaler, and Amos Tversky for their many helpful comments.

References

Arnold, J. III, "Assessing Capital Risk: You Can't Be Too Conservative," *Harvard Bus. Rev.*, 64 (1986), 113–121.

Bateman, T. S. and C. T. Zeithaml, "The Psychological Context of Strategic Decisions: A Model and Convergent Experimental Findings," *Strategic Management J.*, 10 (1989), 59–74.

Bazerman, M. H. and W. F. Samuelson, "I Won the Auction but Don't Want the Price," *J. Financial Econ.*, 27 (1983), 618–634.

Bowman, E., "Risk Seeking by Troubled Firms," *Sloan Management Rev.*, 23 (1982), 33–42.

Bromiley, P., *Corporate Capital Investment: A Behavioral Approach*, Cambridge University Press, New York, 1986.

Capen, E. C., R. V. Clapp and W. M. Campbell, "Competitive Bidding in High-Risk Situations," *J. Petroleum Technology*, 23 (1971), 641–653.

Cooper, A., C. Woo and W. Dunkelberg, "Entrepreneurs' Perceived Chances for Success," *J. Business Venturing*, 3 (1988), 97–108.

Curley, S. P., F. J. Yates and R. A. Abrams, "Psychological Sources of Ambiguity Avoidance," *Org. Behavior and Human Decision Processes*, 38 (1986), 230–256.

Davis, D., "New Projects: Beware of False Economies," *Harvard Bus. Rev.*, 63 (1985), 95–101.

Dawes, R. M., *Rational Choice in an Uncertain World*, Harcourt Brace Jovanovich, Orlando, FL, 1988.

Donaldson, G. and J. Lorsch, *Decision Making at the Top*, Basic Books, New York, 1983.

Duhaime, I. and C. Schwenk, "Conjectures on Cognitive Simplification in Acquisition and Divestment Decision Making," *Academy of Management Rev.*, 10 (1985), 287–295.

Dun and Bradstreet, *Patterns of Success in Managing a Business*, Dun and Bradstreet, New York, 1967.

Fiegenbaum, A., "Prospect Theory and the Risk-Return Association," *J. Econ. Behavior and Organization*, 14 (1990), 187–203.

—— and H. Thomas, "Attitudes Toward Risk and the Risk Return Paradox: Prospect Theory Explanations," *Academy of Management J.*, 31 (1988), 85–106.

Fishburn, P. C. and G. A. Kochenberger, "Two-Piece von Neumann-Morgenstern Utility Functions, *Decision Sci.*, 10 (1979), 503–518.

Gigerenzer, G., U. Hoffrage and H. Kleinbölting, "Probabilistic Mental Models: A Brunswikian Theory of Confidence," *Psychological Rev.*, 98 (1991), 506–528.

——, W. Hell and H. Blank, "Presentation and Content," *J. Experimental Psychology: Human Perception and Performance*, 14 (1988), 513–525.

Griffin, D. and H. Tversky, "The Weighting of Evidence and the Determinants of Confidence," *Cognitive Psychology*, 24 (1992), 411–435.

Harrison, J. R. and J. G. March, "Decision Making and Post-Decision Surprises," *Admin. Sci. Quarterly*, 29 (1984), 26–42.

Hogarth, R. M. and H. J. Einhorn, "Venture Theory: A Model of Decision Weights," *Management Sci.*, 36 (1990), 780–803.

Janis, I. L., *Groupthink* (2nd Ed.), Houghton-Mifflin, Boston, MA, 1982.

Kagel, J. H. and D. Levin, "The Winner's Curse and Public Information in Common Value Auctions," *American Econ. Rev.*, 76 (1986), 894–920.

Kahneman, D., J. L. Knetsch and R. H. Thaler, "The Endowment Effect, Loss Aversion, and Status Quo Bias," *J. Econ. Perspectives*, 5 (1991), 193–206.

—— and A. Tversky, "On the Psychology of Prediction," *Psychological Rev.*, 80 (1973), 237–251.
—— and ——, "Prospect Theory: An Analysis of Decision Under Risk," *Econometrica*, 47 (1979a), 263–290.
—— and ——, "Intuitive Prediction: Biases and Corrective Procedures," *Management Sci.*, 12 (1979b), 313–327.
Keeney, R. and A. Raiffa, *Decisions with Multiple Objectives: Preference and Value Tradeoffs*, Wiley, New York, 1976.
Kreps, D. M., "Static Choice in the Presence of Unforseen Contingencies," Working Paper: Stanford Graduate School of Business, Stanford, CA, 1988.
Landau, M. and D. Chisholm, "Fault Analysis, Professional Football, and the Arrogance of Optimism: An Essay on the Methodology of Administration," Working Paper: Univ. of California, 1990.
Larkey, P. and R. Smith, Eds., "Misrepresentation in Government Budgeting," *Advances in Information Processing in Organizations*, JAI Press, Greenwich, CT, 1984, 68–92.
Laughhunn, D., J. Payne and R. Crum, "Managerial Risk Preferences for Below-Target Returns," *Management Sci.*, 26 (1980), 1238–1249.
Lawler, E., "Control Systems in Organizations," *Handbook of Industrial and Organizational Psychology*, Rand-McNally, Chicago, IL, 1986, 1247–1291.
—— and J. Rhode, *Information and Control in Organizations*, Goodyear, Pacific Palisades, CA, 1976.
Lichtenstein, S., B. Fischhoff and L. D. Phillips, "Calibration of Probabilities: The State of the Art to 1980," in D. Kahneman, T. Slovic and A. Tversky (Eds.), *Judgment under Uncertainty: Heuristics and Biases*, Cambridge Univ. Press, New York, 1982, 306–334.
Lopes, L., "Decision Making in the Short Run," *J. Experimental Psychology: Human Learning and Memory*, 7 (1981), 377–385.
Lowe, E. and R. Shaw, "An Analysis of Managerial Biasing: Evidence From a Company's Budgeting Process," *J. Management Studies*, 5 (1968), 304–315.
Lynch, J. G. and C. Ofir, "Effects of Cue Consistency and Value on Base-Rate Utilization," *J. Personality and Social Psychology*, 56 (1989), 170–181.
MacCrimmon, K. and D. Wehrung, *Taking Risks*, Free Press, New York, 1986.
March, J. and Z. Shapira, "Managerial Perspectives on Risk and Risk Taking," *Management Sci.*, 33 (1987), 1404–1418.
Merrow, E., K. Phillips and C. Myers, *Understanding Cost Growth and Performance Shortfalls in Pioneer Process Plants*, Rand Corporation, Santa Barbara, CA, 1981.
Neale, M. and M. Bazerman, "The Effects of Perspective-taking Ability under Alternate Forms of Arbitration on the Negotiation Process," *Industrial and Labor Relations Review*, 36 (1983), 378–388.
Redelmeier, D. A. and A. Tversky, "On the Framing of Multiple Prospects," *Psychological Sci.*, 3 (1992), 191–193.
Roll, L., "The Hubris Hypothesis of Corporate Takeovers," *J. Business*, 59 (1986), 197–218.
Ruefli, T. W., "Mean-Variance Approaches to Risk-Return Relationships in Strategy: Paradox Lost," *Management Sci.*, 36 (1990), 368–380.
Salancik, G. R. and J. R. Meindl, "Corporate Attributions as Strategic Illusions of Management Control," *Admin. Sci. Quarterly*, 29 (1984), 238–254.
Samuelson, P. A., "Risk and Uncertainty: A Fallacy of Large Numbers," *Scientia*, 98 (1963), 108–113.
Samuelson, W. and R. Zeckhauser, "Status Quo Bias in Decision Making," *J. Risk and Uncertainty*, 1 (1988), 7–59.
Seligman, M. E. P., *Learned Optimism*, Alfred A. Knopf, New York, 1991.
Shapira, Z., "Risk in Managerial Decision Making," Working Paper: Hebrew Univ. School of Business Administration, 1986.
Spence, M. and R. Zeckhauser, "The Effect of the Timing of Consumption Decisions and the Resolution of Lotteries on the Choice of Lotteries," *Econometrica*, 40 (1972), 401–403.
Starbuck, W. and F. Milliken, "Challenger: Fine-Tuning the Odds Until Something Breaks," *J. Management Studies*, 25 (1988), 319–340.
Staw, B. and J. Ross, "Understanding Behavior in Escalation Situations," *Science*, 246 (1989), 216–220.
Stevens, S. S., *Psychophysics*, John Wiley and Sons, New York, 1975.
Swalm, R. O., "Utility Theory: Insights into Risk Taking," *Harvard Bus. Rev.*, 44 (1966), 123–136.
Taylor, S. E. and J. D. Brown, "Illusion and Well-Being: A Social Psychological Perspective on Mental Health," *Psychological Bull.*, 103 (1988), 193–210.
Tetlock, P. E. and R. Boettger, "Accountability Amplifies the Status Quo Effect When Change Creates Victims," Working Paper: University of California at Berkeley, Berkeley, CA, 1992.
Tiger, L., *Optimism: The Biology of Hope*, Simon and Schuster, New York, 1979.
Tversky, A. and M. Bar-Hillel, "Risk: The Long and the Short," *J. Experimental Psychology: Learning, Memory, and Cognition*, 9 (1983), 713–717.
—— and D. Kahneman, "Extensional Verses Intuitive Reasoning: The Conjunction Fallacy in Probability Judgment, *Psychological Review*, 90 (1983), 293–315.
—— and ——, "Rational Choice and the Framing of Decisions," *J. Business*, 59 (1986), S251–S278.
—— and ——, "Reference Theory of Choice and Exchange," *Quart. J. Economics*, (1991), 1039–1061.
—— and ——, "Advances in Prospect Theory: Cumulative Representation of Uncertainty," *J. Risk and Uncertainty*, 5 (1992), 297–323.
Viscusi, K., W. Magat and J. Huber, "An Investigation of the Rationality of Consumer Valuations of Multiple Health Risks," *Rand J. Economics*, 18 (1987), 465–479.
Wehrung, D. A., "Risk Taking Over Gains and Losses: A Study of Oil Executives," *Ann. Oper. Res.*, 19 (1989), 115–139.
Wildavsky, A., *Searching for Safety*, Transaction Books, New Brunswick, 1988.

Accepted by Gregory W. Fischer; received April 3, 1991. *This paper has been with the authors three months for one revision.*