Individual Decision-making

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WHAT IS A DECISION?

A decision is the identification of and commitment to a course of action. It may be as simple as choosing one from a fixed set of available options, such as picking a secretary from the three applicants sent by personnel. However, a decision may also be much more complex. Choosing a Director of Market Research may include, inter alia, crafting a job description, assembling a set of candidates, a sequence of decisions that reduce that set, and accountability to others for the chosen individual's performance.

How are the identification and commitment made? We view the commitment as the termination of a process whose overarching goal is the distinguishing of one option as superior in overall value. Thus, first and foremost, decision-making is a process, which means a series of cognitive (and emotional) activities that occur over time. This is not to deny that some decisions result from sudden insight. However, most of the important decisions that people make require a sequence of efforts to understand the situation, identify options, gather information, and draw the needed inferences. Further, that process is aimed at distinguishing one alternative from all others (Svenson, 1992, 1996, 2002). That is, the inferences that are drawn from the information acquired are aimed at identifying the one option that is superior in overall value.

What should be the basis of overall value? We dismiss economics' strong assumption that, for all options, decision-makers have known stable tastes or preferences that correspond to numerical 'utilities.' Even if such preferences existed, humans are not capable of recalling them fully and consistently. Alternatively, it has been argued that decision-makers have core values (Keeney, 1996) or principles (Beech, 1998) that underlie the overall worth of the available alternatives. In this view, consistent preferences require knowing oneself fully and fundamentally. Though more reasonable than the economists' fixed exogenous preferences, basing overall value on a set of primitive principles or values also entails cognitive ability and effort that seem to overtax human resources.

What then can be used as the primitive antecedent of overall value? This is a deep question that we do not claim to answer satisfactorily. However, as a working complement to our view of the decision process, we propose that the driver of overall value is the achievement of goals. We do not mean the simple maximizing of utility, with its attendant tautology of utility as what is being maximized and a choice revealing the alternative with the maximum utility. Instead, we base value on a psychologically deeper use of goals.

PLAN OF THE CHAPTER

The body of the chapter is organized by two distinctions. First, decision-making is a process whose time progression we partition into discrete phases. Although the decision process has occasionally been viewed as a continuum (e.g., Busenmeyer & Townsend, 1993), the great majority of the literature considering the entire process is organized into a sequence of distinct phases or stages. Second, within each phase the documented decision behaviors are partitioned into two groups. The first, called errors of untutored performance, can be corrected or
improved. The second, challenges to skilled performance, capture the factors that make decisions difficult even for skilled decision-makers. These two categories, errors and challenges, correspond roughly to the controllable (or internal) and uncontrollable (or external) obstacles to a satisfactory decision. The distinction between them is not unlike that between what coaching can and cannot do for an athlete’s performance. A coach can detect, communicate, and correct the common errors of naïve performance in sports like swimming and basketball (e.g., making contact with the opponent while boxing out for a rebound). However, even after all the physical and strategic inefficiencies have been ‘coached out’ of individuals, their performance is still limited by personal and environmental factors (e.g., the relative height and strength of the player and opponent). In summary, novice decision-makers must deal with both errors and challenges. Skilled decision-makers, no matter how great their expertise (we avoid calling them ‘experts’), must still confront the uncontrollable obstacles to a successful decision.

We also make one disclaimer. The content of this chapter is individual decision-making. It is not the decision-making of organizations, or even of individual decision-making in the organizational context. For an entry to the literature on organizational decision-making, as well as to the debate over whether organizational and individual decision-making are fundamentally different, see the edited volume by Shapira (1997). Within the domain of individual decision-making, our primary focus is managers and the decisions that confront them. However, both the theories and the empirical findings of the field typically extend to consumers and other individual decision-makers.

THE PROCESS OF MAKING A DECISION

This chapter is based on the view of decision-making as a process that is driven by goals. We first discuss goals as fundamental to the process, then overview the phases of the process itself.

Goals

Goals in Psychology

Dating back to James (1890) and Ach (1905), goals have been seen as directing human behavior. Reviewing ‘goal-like constructs’ in the last half century, Austin & Vancouver (1996: 339) list more than 25 social and cognitive goal-based theories. Unfortunately, there is less agreement on what goals are than on their importance. To Lewin (1935, 1943) goals were cognitions over desirable end states. This definition, or one very similar to it, remains popular (e.g., Huffman et al., 2001; Karmil & Ross, 1996; Kleinlorfer et al., 1993; Slade 1994). To others, goals serve as a bridge between motivation and cognition. Though some use the terms ‘motivation’ and ‘goal’ interchangeably (e.g., Kunda, 1990), others contend that goals should be viewed as a transaction point between motivation and cognition. For example, Schutz (1994: 137) contends that ‘thoughts [cognitions] are about something and are directed [motivated] toward some purpose or end.’ We adopt this latter view and apply it to decision-making. Thus, goals represent the end state the decision-maker attempts to attain, while cognitions and motivations capture, respectively, what the decision-maker is thinking and where that thought is being directed during the decision process.

Sources of Goals. Goals can be activated from within the decision-maker or from the environment (see Showers & Cantor, 1985 for a review). Numerous sources of goal activation have been proffered, including emotional states (Raghunathan & Pham, 1999), personal values (Beach, 1998), personality traits (Saunders & Stanton, 1976), the presence of others (Ariely & Levav, 2000; Earley & Kanfer, 1985), subtle environmental cues (Bargh, 1990), task requirements (Tubbs & Dahl, 1991) and so-called ‘chronic pursuits’ or those goals that tend to be generally active (Moskowitz et al., 2000).

Conflict Among Goals. Multiple goals may be activated and pursued simultaneously, and their activation levels may change over time. The acceptance of multiple active goals requires the resolution of the competition among those goals. How this resolution occurs is an open question, with several distinct answers. Each may be valid depending on the situation. Thus, goal conflicts may be reconciled in a deliberate and sensitive tradeoff, through a priority based on their relative levels of activation, or by such arbitrary means as letting certain goals always override others. Alternatively, like Simon’s (1991: 367) ‘committee of goals,’ they may not be resolved with any finality, but may coexist (Medin & Bazerman, 1999).

Goals in Decision-Making

The achievement of goals as the driving force of a decision process is a familiar assumption in theories of decision-making (Bagozzi, 1993; Bagossi & Dholakia, 1999; Beach, 1998; Beach & Mitchell, 1987; Bettman, 1979; Bettman et al., 1998; Huffman et al., 2001; Payne et al., 1992; Slade, 1994). Further, the empirical evidence of the role
of goals in decision-making is substantial. Decision-makers faced with different goals exhibit different decision processes (Tubbs & Ekeberg, 1991) – and even post-decisional processes (Svenson, 1996; Vroom, 1966; Vroom & Deci, 1971). Goals have also been used to explain such anomalous decision behaviors as the asymmetric dominance effect (Ariely & Wallsten, 1995; Simonson, 1989), exaggerated preference for variety (Ariely & Levav, 2000), maladaptive use of strategies (Payne et al., 1996), resistance to disconfirming information (Meloy, 2000), and risk preference reversals (Raghubir & Pham, 1999). There are many decision-relevant goals that can be activated, and they may be active at various intensities or levels. Goals like effort conservation are so general that they are likely to be active under almost all representations. Others may be elicited more selectively, like seeking a dominating alternative (Montgomery, 1983) or avoiding the choice of a poor alternative.

**Goals in Managerial Decision-making**

Decision-makers are assumed to be free to choose their own goals. Thus, the rationality of a decision does not depend on decision-makers’ personal goals. Instead, rationality is confined to the method or ‘means’ for achieving the chosen goals or ‘ends.’ ‘Reason … signifies the choice of the right means to an end that you wish to achieve. It has nothing whatever to do with the choice of ends’ (Russell, 1954: 8). This assumption is broadly accepted by economists and psychologists, e.g., ‘rational … denote[s] that the behavior is appropriate to the goal’ (Newell & Simon, 1972: 53).

The decision-maker’s full autonomy in the choice of goals does not apply to many managerial decisions. Managers must often strive to achieve not only their own internally activated goals, but also goals suggested or imposed by others (sometimes called objectives). A marketing manager responsible for a series of decisions regarding a new product launch is likely to be held accountable for objectives like market share and revenue. Thus, the freedom to choose goals on a purely subjective basis is, for managers, constrained to include their also achieving externally imposed objectives.

**Phases of the Decision Process**

The phases of the decision process have been extended both forward and back to complete a framework for decision-making. This framework is composed of the five sequential phases shown in Figure 15.1. It is only one in a long line of phase-based structures for decision-making (e.g., Bagozzi & Dholakia, 1999; Bettman, 1979; Payne et al., 1999). These range in detail from only two stages (e.g., Lussier & Oslavsky, 1974; Sheridan et al., 1975) to three stages (e.g., Pennington & Hastie, 1993; Russo & Leclerc, 1994) to as many as 19 distinct operations (Edwards & Fasolo, 2001).

**Phase 1. Mental Representation of the Decision Task**

The decision-maker’s mental representation of the decision task is a stable, coherent, cognitive structure that resides in memory, can be invoked automatically, and focuses the decision-maker’s attention on certain aspects of the problem while occluding others (McNamara, 1994; Ranyard, 1997). By helping decision-makers organize and simplify the task, the representation enables them to perceive, interpret, judge, choose, and act (Schoemaker & Russo, 2001).

The decision task is recognized and accepted in Phase 1. The created mental representation of the task (and context) combines with individual
tendencies to activate multiple goals. These, in turn, lead to an anticipated process and drive all further action. Note, however, that as the decision process unfolds, the activation levels of the goals may change and entirely new ones be elicited.

Returning to the decision about whom to hire as the Director of Market Research, when the Vice-President of Marketing learns that the existing position will be vacated, she recognizes the need to fill it. Various aspects of the task are acknowledged, such as time and budget constraints, and some desired characteristics of a new research director. The representation may be elaborated to include such contextual elements as corporate policy (maybe giving preference to internal candidates or to minorities and women), political considerations (acceptance by other groups may be greater if the new director has an information technology background or a doctoral degree), and interpersonal fit with the department’s employees (especially the new department leader’s four direct reports). The result is a plan for the remainder of the process, maybe starting by announcing the position internally, recruiting colleagues outside Market Research to interview applicants, organizing a timetable, and considering a contingency plan if no internal candidate proves satisfactory. Finally, and as important as anything else, certain goals are activated. Foremost among these is the overarching goal of distinguishing one candidate as superior, but others may include respecting the constraints, re-evaluating the job requirements, or even something as personal as hosting interview dinners at favored restaurants.

**Metadecisions.** Sometimes the first action that follows recognition and acceptance of a decision is deciding how to decide. This activity, sometimes called a metadecision, is an initial structuring of the approach to be taken to the current decision by considering how decisions like this one should be made. From the particulars, it abstracts the fundamental elements of the decision and uses an appreciation of them to guide the specific process to be followed. If the position of Director of Market Research must be filled, the Vice-President of Marketing might consider the best way to identify, recruit, evaluate, and attract highly qualified candidates for a generic upper management position. Such consideration may include a review of lessons learned from past senior hiring decisions, a recognition of the constraints of time and money, and an analysis of which part of the process is likely to cause the most difficulty (e.g., finding applicants versus determining which one can best do the job).

Based on our unstructured observations, the metadecision is rarely performed. One can move through all the other phases, and do so successfully, without making a metadecision. Little has been written on the metadecision (for an exception, see Russo & Schoemaker, 2002, Chapter 1). However, there is a small literature on ‘deciding how to decide’ (e.g., Johnson & Payne, 1985) that is more tightly focused than our meaning as an initial strategic structuring of the entire decision process. Because making a metadecision is optional and little treated either theoretically or empirically, we do not discuss it further.

**Phase 2. Generation of Alternatives**

The quality of the alternative finally chosen depends directly on having a sufficiently rich pool of options. Sometimes the possible alternatives are obvious – as when a consumer buys one brand of toothpaste on a supermarket shelf. At other times, however, creativity, effort, time, and money are needed to generate better options. With luck, the internal candidates for Director of Market Research are fully satisfactory. If not, however, an executive search firm may be hired, personal networks explored, and the vacant position advertised externally. If no adequate candidates can be found, the Vice-President may have to return to Phase 1 and restructure the position.

**Phase 3. Acquisition and Evaluation of Information**

Productive decision processes require pertinent information. The search for information is guided by a combination of the mental representation from Phase 1, the possible courses of action from Phase 2, and general guidelines of information gathering. Also, to the extent that the needed information is stored in memory, effective retrieval strategies are needed. Finally, whether the information is acquired or retrieved, it automatically receives an initial evaluation that cannot be suppressed. Evaluation, ‘defined as the assessment of the positive and/or negative qualities of an object, is assumed to be among the most pervasive and dominant human responses’ (Jarvis & Petty, 1996: 172).

Note, however, that Phase 3 contains only the evaluation of the individual units of information, not the combined evaluation of multiple units, which is reserved to Phase 4.

**Phase 4. Resolution of Multiple Units of Information to Distinguish One Alternative as Superior**

Much of the hard thinking occurs in Phase 4, where the evaluated units of information must be reconciled. Because it is rare that all the information points to one alternative as best, the decision-maker is confronted with opposing evaluations. One candidate for Directorship may have more experience, while another has the desired technology skills, while a third seems like the superior manager...
of people. The tradeoff among opposing units of information is the work of Phase 4.

Phase 5. Post-commitment Distinction, Implementation, and Learning

Even after a commitment has been made to one course of action, decision-makers tend to reflect on the chosen option, on the rejected ones, and on the information that supported or opposed them. This process is often oriented toward justification, even if only to oneself. The commitment is also followed by a process of implementing the selected course of action, during which parts of it may be fine-tuned or, if necessary, substantially altered. The new Director of Market Research may need coaching or, as one executive said to us about a new hire, ‘a kick in the pants.’ Finally, there is learning. Increasingly, important decisions are followed by a formal ‘lessons learned’ analysis that captures and preserves the conclusions to be usefully carried forward to similar future decisions.

Flow of the Decision Process

Transitions

The sequence of phases in Figure 15.1 is augmented by the four transitions between them. Note that each of these involves its own decision about the progress of the process: are the representation and goals appropriate to the task? Has a sufficient number of options been generated? Is the current information adequate? Has one alternative been sufficiently distinguished from the others so that the process can be terminated?

The value of explicitly recognizing these transitions may be clearest for the last one. Whenever Phase 4 is terminated, how could any alternative other than the one leading in overall value be chosen (with the exception of no option being good enough, in which case postponement is considered the best course of action). In other words, is a decision, in the commonly accepted sense of choosing the best option, any more than the obvious action at the time of termination? Thus, although the observable act of decision-making is selecting one alternative, the real decision may be when to terminate the distinction process and commit to the leading alternative.

Flexibility

The left-to-right linearity of this multi-phase process should not create the impression of a unidirectional path. The decision process is more adaptively flexible. For instance, if the previous Director of Market Research identified and groomed a nearly ideal replacement, the generation of alternatives (Phase 2) is unnecessary. More generally, there should be an efficient flow back and forth through the phases that is guided by the four transition decisions. The capacity for any of these transition decisions to send the process back to an earlier stage is indicated by the downward arrows to the backward directed line at the bottom of Figure 15.1. Continuing our example, if none of the internal candidates meets the job requirements (as determined in the termination decision), Phase 2 needs to be re-entered, possibly by hiring an executive search firm. What is not done, however, is to scour the universe of candidates so that Phase 2 is completed with finality before Phases 3 and 4 are begun. Alternatively, if no internal candidate proves acceptable but organization policies (or politics) require that the Directorship be filled internally, the job may have to be restructured and the process returned to Phase 1. Whatever the particulars, the essential point is that the transition decisions enable a flexible process that is not constrained to a one-pass sequence through each phase (see also Mintzberg & Westley, 2001).

Phase 1: Representation and Goals

Phase 1 begins the main overview of research in decision-making. Each phase is covered in sequence, and the content of each is partitioned into the errors of untutored behavior and the challenges to skilled performance. Most of the published literature falls into the category of errors, and does so uniformly across all five phases. Although we proceed through the phases in sequence, it is worth remembering that the actual process of decision-making usually exhibits a back-and-forth efficient flexibility.

Representation and Goals: Errors of Untutored Behavior

The representation adopted for a particular decision task is influenced by task requirements (Best & Ladd, 1985), situational context, and individual tendencies. Task requirements obligate the decision-maker to engage in particular procedures during the decision process, such as instructions to choose one alternative versus rank order all of them. They also activate certain goals, such as to select a restaurant as part of a romantic evening versus one suitable for a business dinner. They can be thought of as directives that require the decision-maker to focus on particular aspects of the problem and, in some cases, to implement specific decision routines.
Context

The representation will also be guided by the situational context, which includes both the options themselves and peripheral factors from the decision's environment (Goldstein & Weber, 1995; Markman & Gentner, 2001). The impact of the decision domain on the task representation, while holding the logical structure of the alternatives constant, was shown by Rettinger & Hastie (2001).

The same choice between a sure loss and a two-stage gamble was represented differently in the context of a casino gamble (a straightforward numerical calculation) versus a traffic ticket (where moral principles were elicited).

In the task of selecting a new Director of Market Research, salient characteristics of the internal candidates, such as relevant experience and technical knowledge, will almost certainly find their way into the representation of 'an acceptable candidate.' However, what might be overlooked in the construction of the representation are characteristics possessed by none of these candidates, such as the ability to recruit from outside the company. Similarly, how might the attitudes or anxieties of the market research department's personnel affect the representation of 'an acceptable candidate'? Note that situational context, and possibly the individual tendencies discussed below, may guide the formation of the representation so subtly that decision-makers are unaware of their effect.

Individual Tendencies

Individual tendencies are personal characteristics of the decision-maker, such as her needs, style, experience, etc., that influence the representation. These tendencies include, inter alia, expertise (Hollenbeck & Brief, 1987), mood (Mekoy, 2000), need for uniqueness (Simonson & Nowlis, 2000), processing capacity (Bettman et al., 1990), and regulatory focus orientation (Higgins, 1997). The representation of the decision can also be influenced by subtle prior experience, such as priming (Chartrand & Bargh, 1996). Finally, it is also affected by such conscious experiences as having been endowed with an option (Thaler & Johnson, 1990), having chosen an option once before (Muthukrishnan & Kardes, 2001), or having incurred sunk costs (Arkes & Blumer, 1985; Zeelenberg & van Dijk, 1997). Note that these last factors may also influence later phases of the decision process.

Framing

The bulk of the published research on decision representations alters the description of the alternatives in order to generate different representations or frames (e.g., Kahneman & Tversky, 1979; Meyrowitz & Chaiken, 1987; Roney et al., 1995; Tversky & Kahneman, 1981, 1988). As visible as these demonstrations have been, it is important to appreciate the range of factors, beyond the specific alternatives, that have been shown to influence framing. These include accountability (Huber & Seiser, 2001; Lerner & Tetlock, 1999), analogies (Klein, 1998), boundaries and constraints, both stated and presumed (Bazerman et al., 2001; Knoblich et al., 1999), decision importance (Billings & Scherer, 1985; Tyszka, 1998), points of comparison (Hinsz et al., 1997), a requisite sequence of subordinate choices (Dawes, 1998), and whether the decision requires that one option be selected or multiple options be rejected (Chernev, 2001; Dhar & Wertenbroch, 2000).

Framing effects have been demonstrated to arise from broad paradigms or worldviews (e.g., Beach, 1998; Johnson & Russo, 1994; Maddi, 1998; Nisbett et al., 2001; Slovic, 1997; Tetlock, 1991). Tetlock (2000) shows that managers with a conservative political ideology are more likely to prefer simple philosophies of corporate governance (the shareholder view over the broader notion of stakeholders), and simple structures of accountability. These same effects on task representation may derive from still broader, but more specific knowledge structures, like those of job or functional area within a company (see Dearborn & Simon, 1958 for an early illustration). Included in this work is an extensive literature on mental accounting (Thaler, 1980, 1999). Maybe the two specific phenomena most deeply studied are sunk costs (e.g., Bazerman & Neale, 1992; Boulding et al., 1997; Camerer & Weber, 1999; Heath, 1995; Soman & Gourville, 2001; Staw & Haang, 1995; Staw & Ross, 1989) and the endowment effect (Thaler & Johnson, 1990; see also the review and analysis by Camerer, 1995).

The most detailed or 'micro' framing effects may be the impact of different yardsticks (or metrics) and reference points of a single attribute. Consider shifting a reference point to frame the same outcomes as losses versus gains (Bazerman, 1984; Kahneman & Tversky, 1979, 1984; and see reviews in Dawes, 1998, and Camerer, 1995). In their well-known 'Asian disease' problem, Kahneman & Tversky (1979) presented individuals with a choice between two treatment options. When the alternative treatments highlighted the number of deaths, decision-makers were more likely to select the risky (all or nothing) treatment. In contrast, when the alternatives highlighted the number of lives to be saved, decision-makers were more likely to select the safe option (see also Highhouse & Yuen, 1996, and McNeil et al., 1982). Thus, a point of reference, as a detail of the framing of the options, can elicit valuations that are based not only on merit but also on whether the options are perceived as gains or losses relative to that reference point.

The framing of decisions has been one of the most active areas of decision research in the last two
with no errors of untutored behavior, a valid representation of the logical essence of a decision is often difficult, especially for new or complex decisions. Furthermore, should ecological validity be achieved, the mental representation must also trade off fullness and simplicity. This means capturing the important elements of the decision while discarding, or at least de-emphasizing, the unimportant ones so that the decision-maker's cognitive (and emotional) resources are focused where they can produce the most value.

The empirical work on the construction of decision representations is still very sparse, as are techniques for aiding such construction. At the same time, a valid and usable mental representation is crucial to most important managerial (and other) decisions. It would seem to be a challenge that deserves more scholarly attention.

**Transition: Are the Representation and Goals of the Decision Task Appropriate?**

Decision-makers typically do not recognize the need for a deliberate, careful construction of a mental representation of the decision task. This implies, in turn, that the related transition decision is largely non-strategic. Certainly, decision-makers' cessation of representation-building and movement to a new phase is unstudied. We know little or nothing about how decision-makers decide that a representation is adequate or that appropriate goals have been activated. Maybe in the future more will be known, but at present there is little to report.

**Phase 2. Generation of Alternatives**

Most frameworks for decision-making do not include a phase devoted solely to option generation. Rather, the options are presumed to be known and the task is only to select the best one. In most complex decisions, however, generating good options can play a great role in success as recognizing when one is superior (Kleindorfer et al., 1993).

**Generation of Alternatives: Errors of Untutored Behavior**

The uncoached errors of option generation are few but general. The mental representation from Phase 1 can limit the options considered. Companies that frame themselves as a family of employees may insist that they develop and promote only from within. We know of one such internally focused firm decades (Levin et al., 1998, 2002). As a natural consequence, its results have been challenged rigorously. Unsurprisingly, some of the reported results are narrower, or generalize less well, than originally claimed (Frisch, 1993; Schneider, 1992; van Schie & van der Pligt, 1995; see especially the critique in Mellers et al., 1998: 456). Nonetheless, the research on the framing of decisions has produced findings that are generally robust and have expanded the traditional focus of the field (i.e., Phases 3 and 4) to include the mental representation of the task. The topic of framing is likely to remain central to decision research.

Almost all of the above errors of untutored behavior deal with the representation of the decision rather than its goals. The latter both guide the construction of the representation and, in turn, are activated by it so that they then guide the processes that occur in subsequent phases. However, because there is so little empirical literature that measures and reports the activation of goals, there is little written above about them. As will become clear, this situation characterizes all five phases of the decision process. Indeed, the paucity of empirical studies of goals is explicitly addressed in the conclusion.

**Summary of Errors of Untutored Behavior**

Errors occur in all of the above categories of phenomena. With respect to framing, most of the published work demonstrates the susceptibility of the representation to superficial or irrelevant aspects of the task. With regard to the decision context, many contextual elements improperly influence the task representation. Individual tendencies should also, for the most part, not be allowed to influence the task representation, yet they do. This is true, notably, for mood, regulatory focus orientation, and various 'needs' like those for cognition and for uniqueness. The exception to individual tendencies as a source of errors is the decision-maker's expertise, which should legitimately affect the fullness or complexity of the representation. Although there has been nothing approaching an ecologically valid evaluation of the quality of decision-makers' mental representations, there is ample evidence of the intrusive influence of irrelevant elements of the task, and irrelevant characteristics of the individual.

**Representation and Goals: Challenges to Skilled Performance**

The mental representation of a decision task should, first of all, be ecologically valid. This is the focus of the errors described above: namely, an invalid representation of the task (and its context). Yet even
that, when it was absolutely forced to go outside for its Director of Market Research, hired the individual from one of its main research suppliers who had been for many years that supplier's chief contact with the hiring firm. It was as if, when they couldn't put a family member in the job, they accepted a neighbor of long and close standing. What is needed to avoid such errors is an awareness of the boundaries or blindspots of the task representation or, better yet, the consideration of alternative representations to expand those boundaries or expose those blindspots. Related to, but distinct from, the above, Fiedler (1988) showed that negative mood can narrow the focus of attention and cause a failure to search for new alternatives. Similarly, a feeling of ownership of the current set of alternatives can inhibit the expansion to incorporate new ones, especially if that ownership resulted from a process of elimination.

Another representation-driven error derives from a sense of completeness that obviates the need to search for more alternatives. If the Director's position is represented today just as it was when the last Director was hired (rather than re-evaluated to reflect changed conditions or to prepare for future ones), the set of candidates may be inappropriately limited. Some of the excluded candidates, if asked to describe how they 'see the job,' might well have stimulated the needed updating of Phase 1's representation.

The generation of alternatives is often considered to be in the domain of problem-solving or creativity, rather than decision-making. The research literature on problem-solving has been dominated by insight problems where the challenge is to generate the single correct option (e.g., Dunker, 1945; Wason, 1960). Implicit is the ease of recognizing the solution once it has been generated. Thus, there is a natural complementarity between the field of decision-making's dominant focus on evaluating options and that of problem-solving's on generating them. For reviews of the latter, see Klahr & Simon (1999) and Nickerson (1996). For an entrance to the diverse literature on creativity, see Sternberg (1988); and for the link between creativity and option generation, see MacCrimmon & Wagner (1994).

**Generation of Alternatives: Challenges to Skilled Performance**

The challenges of option generation are substantial. We have already noted that the decision representation can limit the generation of new options. To these can be added time pressure and mood. Shanteau and Dino (1993) show that greater time pressure undermines the creative process of option generation.

Finally, we note that the options themselves can sometimes be modified, especially if they are designed to be flexible in the first place (Russo & Schoemaker, 2002, Interlude A). The so-called 'real options' approach argues for flexible options in the face of uncertainty (Hamilton, 2000). We know one CEO who, when faced with no acceptable candidates for COO, considered hiring two applicants in a job-sharing arrangement. This would have postponed an all-or-none commitment to one of them, and bought time both to observe them on the job and determine whether one of them could develop into a COO.

**Transition: Is the Set of Alternatives Sufficient?**

Because we know of no empirical work on this transition decision, we can offer no deeper comment than a cost-benefit analysis that translates the work in information search into the task of option generation. One empirical result, however, suggests caution in the presumption that it is always better to have more alternatives than fewer. Several studies have found that, at the store level, the reduction of low-selling stockkeeping units (SKUs) can lead to an increase in total category sales when the perceived assortment of important category attributes is not reduced (e.g., Boeckmann & Nanes, 2001). At the individual level, Iyengar & Lepper (2000) found that consumers were more satisfied with their choices from six than when there were 24 alternatives (e.g., flavors of jam). They experienced choosing one from the larger set as more difficult and frustrating, producing what the authors termed choice overload. Thus, estimating the benefits of generating (or searching for) additional alternatives may need to be modified by the additional costs of processing them.

**Phase 3: Acquisition and Evaluation of Relevant Information**

Phase 3 is entered, or re-entered, because more information is required. It consists of two activities. The first is determining the kind of information that is needed, along with its source, either in memory or the external environment. The second is the interpretation and evaluation of the acquired information.

**Information Acquisition: Errors of Untutored Performance**

When more information is needed, the first step is to determine what that information should be. The prescriptive answer to this question is whatever information permits the decision-maker to distinguish
the options most effectively and efficiently. Unfortunately, this is guidance more easily stated than implemented.

The errors of an untutored search for information fall into three categories. The first is an all-too-natural tendency to create rather than discover separation among the alternatives. This tendency can lead decision-makers to be overly confident in their decisions, specifically, to believe that their decision is strongly supported when, in reality, it is not. Second, there is a variety of memory-based errors. Finally, we discuss mood and user control. All three classes of factors play an important role in the determination of what information to acquire.

The Problem of Manufactured Distinctions

The desire to distinguish one alternative as superior can lead to the creation, as opposed to the recognition, of a distinction (Svenson, 1996; Tyszka, 1998). Distinction-creation often leads decision-makers to seek information that supports (rather than informs) the currently observed distinctions or currently favored hypotheses (Einhorn & Hogarth, 1978; Lord et al., 1979). This biased testing of current hypotheses, preferences, or other beliefs can lead to a confirmation bias (for general conditions, see Klayman, 1995; Klayman & Ha, 1987; Rabin & Schrag, 1999). The tendency to seek more confirming than disconfirming evidence is particularly broad, though by no means universal (Klayman & Ha, 1987). This bias may be driven by the motivation to bolster one’s feeling of competence by finding information that supports the decision-maker’s leading option, currently preferred hypothesis, or other ‘owned’ belief. Alternatively, seeking confirming evidence may be driven by the goal of effort conservation, because such information increases the separation of the leading alternative and thereby brings the process closer to termination. Finally, a bias toward more confirmatory searches may follow from unintended attentional factors, such as a biased focus on the reasons for supporting the leading alternative (versus supporting the trailing alternatives).

Illusion of Control. A comforting presumption that highly uncertain, even random, events can be controlled by the decision-maker’s skill is known as the illusion of control (Langer, 1975; Permuter & Monty, 1977). Two mundane examples are the numerous heuristics for gambling like throwing the dice harder to produce a higher number, and the robust demand for commercial advice on picking lottery numbers (Thompson et al., 1998). In management, senior executives tend to overestimate the amount of control they have over their organization’s performance. They underappreciate the impact of global, national, and industry-wide factors in favor of the intra-company actions that they control. When dealing with risky alternatives, the illusion of control enables decision-makers to distinguish as superior the alternative over which they can exercise the most control.

Memory-based Errors

A second class of errors in information search derives from memory retrieval. Among the seven sins of memory identified by Schacter (1999, 2001), four may influence what information individuals believe should be acquired. Two of these—bias and suggestibility—lead to errors of untutored performance. The remaining two, transience and misattribution, are challenges to skilled performance.

Bias is the tendency for one’s current beliefs, knowledge, or feelings to influence memory for prior experience. It has been repeatedly demonstrated that in order to cohere with currently held beliefs and feelings, people distort their memories of past ones (Levine, 1997; Marcus, 1986). Ego enhancement may also bias memory. College students recalled correctly about nine of ten high school grades that were A’s, but only three of ten that were a D (Bahrick et al., 1996).

Suggestibility refers to the recall of experiences that did not occur (see Loftus et al., 1995 for a review). Representative examples are the leading question (Loftus et al., 1978) and eyewitnesses’ identification of a transgressor. For instance, Wells & Bradfield (1998) showed to eyewitnesses a photo-spread that did not include the picture of the actual bank robber. However, confirmation of an incorrect identification caused eyewitnesses to express greater confidence in and provide more detailed descriptions of the identified robber (compared to those who were given no feedback).

Mood

Although atmospheric and often irrelevant, in some situations mood can impact the information acquisition phase of the choice process. Each of the three most common explanations of this generalized positive affect account for some of its effects. According to the mood maintenance view, people wish to avoid information that would disrupt a positive mood (Isen, 1987; Wegener et al., 1995). In a two-alternative choice, Meloy (2000) showed that individuals in a good mood were more likely to ignore disconfirming information, presumably to preserve their progress in the distinction process and, thereby, maintain their good mood. In the second view, the decision-maker’s affective state primes mood-consonant information in memory (Isen, 1987; Mackie & Worth, 1989). As a result, decision-makers exhibit a tendency to acquire information that is consistent with their mood, whether good or bad (Adaval, 2001). The final view suggests that the overall affective state signals how
well things are going and, as such, provides useful information to the decision process (Bless et al., 1996; Loewenstein et al., 2001). For the present purpose, it is unnecessary to resolve the competing explanations for mood’s effects. We note only that all three agree on the potential role of mood in determining what information decision-makers seek.

User Control

We address one last topic under information seeking: the ability of the decision-maker to actively control how, when, and what information is acquired (as opposed to having to use a presented body of evidence). Unsurprisingly, allowing decision-makers to fit the information to their needs or goals increases efficiency (Alba & Hutchinson, 1987; Payne et al., 1993). Moreover, control has also been found to positively impact learning (Klayman, 1988), creativity (Kuhn & Ho, 1980), and the enjoyment of the decision task (Klein, 1999). However, along with its positive impact on the decision process, control can entail processing costs. Ariely (2000) showed that any expected benefits of user control are constrained to situations where managing that control did not place too heavy a burden on the decision-maker’s cognitive resources.

Information Acquisition: Challenges to Skilled Performance

Estimating Likelihoods

A constant challenge for decision-makers is the estimation of likelihoods. These may be for repeated events, like achieving monthly sales quotas, or unique ones, like the success of any specific candidate for Director of Market Research. Likelihoods also occur for internal events, such as whether a decision-maker’s recollection of an event is correct.

Missing Information

The challenge of missing information offers three options: inferring what is missing, discounting information when only part of it is missing (e.g., Slovic & MacPhilamy, 1974) or ignoring what is simply unavailable. Which action is chosen depends upon the particular task and context (Kivetz & Simonson, 2000). A frequent situation is the presence of some attributes or elements of an object while others are unknown and must be inferred. The estimates of the missing values are conditioned on the interdependencies among the attributes. For instance, in the determination of a superior brand, the inference about the relative

value of the competing products on a missing attribute depends on whether the attributes are positively or negatively correlated (Chernev & Carpenter, 2001).

Memory Challenges

Transience refers to the tendency to forget over time. For example, past situations may be temporarily inaccessible to recall because of interference from related situations (Postman & Underwood, 1973). Such a failure can impede the decision-maker’s ability to acquire the best information for the problem by undermining the ability to match the current problem to relevant situations from the past.

Misattribution refers to decision-makers’ failure to recall the source of some information. They may mistakenly attribute the information to their own insight or imagination, which may grant this information an undue status (Schacter, 1999). Consider how such a tendency might cause problems in the task of finding a new Director of Market Research. To the extent that members of the search committee forget where valuable information about potential prospects was obtained, they may be inclined to believe they simply ‘knew it all along’ or that their intuition is better than it actually is. This could lead the committee to rely too heavily on internal sources.

Summary

The natural challenges of uncertainty, missing information, and imperfect memory illustrate a general problem. Even if all the correctable error of unskilled information acquisition could be removed, there remain substantial difficulties to executing this part of the decision process.

Interpreting and Evaluating Acquired Information: Errors of Untutored Performance

The errors of untutored approaches are partitioned into those of focus and of generation. We then consider the task of dealing equitably with different formats of information.

Errors of Focus

One cause of errors might be broadly characterized as an overfocus on one part of the information so that its overall value is mis-estimated. Consider the underadjustment from an anchor (Slovic & Lichtenstein, 1971; Tversky & Kahneman, 1974). An estimate of next year’s sales is commonly reached by starting with this year’s sales and adjusting appropriately. This year’s sales offer a conveniently
precise and known starting point, called the anchor. Adjusting appropriately means moving up or down from the anchor, depending on what is known about the differences between this year and next, and doing so to the correct degree. Unfortunately, the anchor offers a clearer focus than does the adjustment. The result is a tendency to underadjust or to fail to move far enough from the anchor. Anchoring with insufficient adjustment has been invoked to explain a broad class of behaviors, including egocentric biases (Gilovich et al., 2000), overconfidence (Griffin & Tversky, 1992), effects of product promotion (Wansink et al., 1998), and the influence of others' opinions on product evaluation (Wooten & Reed, 1998). For recent discussions of anchoring and adjustment, see Chapman & Johnson (1999, 2001), Epley & Gilovich (2001), Hastie & Dawes (2001), and Mussweiler & Strack (2001).

Another focusing phenomenon is the relative attention paid to positive versus negative aspects of a product or service experience. Oif & Simonson (2001) show that informing people in advance that they will be asked to evaluate a product or service leads to lower evaluations and purchase intentions. They trace the cause of this ‘negativity effect’ to a focus during consumption on the negative elements of the product or service.

False Consensus. A very different focus is one's own beliefs or circumstances. The false consensus effect is a biased belief that others behave or believe more like us than they really do (Marks & Miller, 1987; Mullen, 1983; Ross & Sico, 1979; Ross et al., 1977; Snell & Gaelick, 1983). In estimating a national sample's agreement with various statements such as ‘Our family is too heavily in debt today,’ people tend to bias those estimates toward their own position (Hoch, 1987). Here the information about oneself, acting somewhat like the anchor discussed above, is better known than the information about others. The result is too great an influence of one's own beliefs on the estimate of others'. It must be noted that the false consensus effect is not universally observed (Hoch, 1987), and that the reverse presumption of dissimilarity between oneself and others may occur. Nonetheless, the effect is robust and, as Nickerson (1999, 2001) has argued, is part of the more general phenomenon of projecting what we know onto others, or ‘over-imitation of our own knowledge’ (2001: 170).

Confirming Beliefs. An entire subcategory of focus errors are those where the evaluation of the information is biased to confirm a currently held or otherwise preferred belief. The desirability bias, known variously as optimism (e.g., Darvill & Johnson, 1991; Messick & Bazerman, 1996), outcome bias (e.g., Cohen & Wallsten, 1992), value bias (e.g., Slovic, 1966; Yates, 1990), and wishful thinking (e.g., McGuire & McGuire, 1991; Slovic, 1966), is the distortion of information to make preferred outcomes seem more likely. For instance, voters tend to believe that their preferred candidate is likely to win an election (Fischer & Bodescu, 1995). This phenomenon is quite robust (but see Bar-Hillel & Bodescu, 1995, for one limitation), and has been found with professionals in finance (Olsen, 1997) and in medicine (Poses & Anthony, 1991).

Lord et al. (1979) showed that, after reviewing the same information, people who are opposed to capital punishment become more opposed, while those in favor of capital punishment become more favorable. They contend that such polarization occurs because people "accept confirming evidence at face value while subjecting disconfirming evidence to critical evaluation and as a result . . . draw undue support for their initial positions from mixed or random empirical findings" (1979: 2098; also see Kuhn & Lao, 1996 for a critique). Another demonstration of the impact of a prior belief on the evaluation of new information is the 'agreement effect' of Koehler (1993). Using practicing scientists, he showed that judgments of the quality of scientific evidence are biased to favor prior beliefs. There is a large empirical literature on the prior belief effect (e.g., Edwards & Smith, 1996), and accessible reviews are provided in the books by Gilovich (1991, see especially Chapter 5) and by Nybrett & Ross (1980, especially Chapters 4 and 8).

Temporal Perspective. A focus on the past versus the future can alter the evaluation of information. Maybe the most well-known exhibition of the effect of temporal perspective is the hindsight bias, which we postpone discussion of until the post-decisional phase. The differences in temporal perspective have been explained in several ways, each probably valid in particular situations (Jungermann & Thuring, 1987; Weick, 1979). Einhorn and Hogarth categorized retrospective analysis as diagnostic and 'largely intuitive and suggestive,' while for the more predictive prospective thinking 'the decisionmaker must assemble and weigh a number of variables' (1987: 66). Jung (2001) claims that retrospective searches for causal explanations of outcomes focus mainly on the actor or agent, while prospective ones include a balance between the agent and situational factors. Mitchell, Russo & Pennington (1980) showed that a retrospective view of a future event, so-called prospective hindsight, generated more detailed causal explanations. They further showed that the advantage of moving forward in time and looking back was not due to temporal perspective per se, but to the increased certainty associated with hindsight.

Explanation Bias. A biasing focus can be caused by the very process of information evaluation itself. One example is the explanation bias. For instance, individuals who explained how one particular outcome, of a hypothetical football game might occur increased their estimated likelihood of that outcome (Hirt & Sherman, 1985). Similarly, individuals who explained why two
variables might be related were more likely to judge the variables as related (Anderson & Seehler, 1986). Sengupta & Fitzsimmons (2000) found that analyzing the reasons for preferring a brand increased the likelihood of choosing that brand. However, the reverse happened when a delay of several days was inserted between the reasons analysis and product choice. This result echoes the finding of the disruptive effect of reason generation on attitude-behavior consistency (Wilson et al., 1989, 1993).

Similar to the explanation bias is the effect of elaboration. The evaluation of a positive option, like an ideal vacation, increases under more extensive elaboration (e.g., Shiv & Huber, 2000). Several studies have demonstrated that a judgment task, in comparison to a choice task, leads to the increased elaboration that can drive the above effect (e.g., Schkade & Johnson, 1989).

Relation to a Standard. Information is often evaluated relative to some standard or reference point. A high reference point versus a low one can lead to negative versus positive evaluations of the same information. When these standards of comparison emerge during Phase 3 (in contrast to their being embedded in the representation of the task from Phase 1), the error in evaluation is assigned to this later phase. For instance, if the previous Director of Market Research was a Ph.D., the educational credentials of all candidates may be compared to this standard.

Another source of standards is past experience, especially recent experience that tends to shift standards of evaluation. Wedell (1998) used two initial decisions, such as two choices between pairs of airline tickets, to widen the range of values on one dimension, either layover time or price. He then observed in a third choice that the values on the widened dimension shifted in accord with the range principle of Parducci’s range-frequency theory (Parducci, 1974; see also Mellers & Cooke, 1994).

Errors of Generation

The previous errors of focus encompass problems that occur after enough information has been acquired but needs to be explained, to be viewed in a temporal perspective, or to be judged relative to a standard. In contrast, the second category of evaluation errors results from decision-makers’ failure to generate a complete set of instances, evidence or obstacles. Errors of insufficient generation include the biases resulting from the use of the availability heuristic and planning fallacy.

Availability. Due to the resource constraints of time, money, and cognitive capacity, decision-makers are usually forced to assemble only a subset of instances from all those available and to base their decisions on this incomplete information. If the sampling procedure is flawed, then a biased set of instances may result and the quality of the decision may be compromised. When decision-makers draw instances from memory, those instances recalled are often the most vivid or self-relevant. Basing judgments on such a biased sampling of salient instances from memory is called the availability heuristic (see Dawes, 1998 for a thorough discussion). Use of this heuristic typically results in biases of incompleteness due to inadequate retrieval of non-events or self-irrelevant events. For example, when asked whether strokes or motor vehicle accidents cause more deaths in the US each year, more people respond accidents. In fact, strokes, though less well-publicized, cause more deaths each year in the US (Fischhoff et al., 1981; see also Koepsell et al., 1983).

In another illustration of memory-based availability, Dube-Rieux & Russo (1988) asked professionals from the hospitality industry to estimate the likelihood that a restaurant failure was primarily due to each of several possible categories of causes, including a category for ‘all other’ events. If these professionals were generating a complete set of possible causes for the outcome, then pruning one cause from the fault tree of all possible causes would lead to a compensatory increase in the likelihood of the ‘all other’ category. However, if the availability of causes from memory was incomplete, then this pruned cause might not be generated and the likelihood of the ‘all other’ category would not be augmented sufficiently. Consistent with imperfect availability, the likelihood of the pruned cause was mostly assigned to the remaining named categories rather than to the ‘all other’ category as it should have been (see also Fischhoff et al., 1978; Hirt & Castellan, 1988; Russo & Kolzow, 1994).

Planning Fallacy. Individuals repeatedly underestimate how long it will take to complete a task (Buehler et al., 1994). One explanation for this error is the failure to predict the obstacles that will thwart the plan’s progress. This planning fallacy is sometimes exacerbated by the dismissal of obstacles to implementation that have occurred in the past because they are considered unique, non-repeating events. Because it is difficult to generate the specific future events that will disrupt execution of the plan (Atance & O’Neill, 2001), there is a tendency to adopt a ‘no fault’ scenario that systematically underestimates the completion time (Morrow et al., 1979, 1981).

Information Format

A general set of evaluation biases derives from the task of dealing equally with different information formats, such as pictorial, verbal, or numerical. Decision analysts argue for the superior clarity of numerical information. Their case is bolstered by the sometimes alarming variance in the perceived numerical equivalent of a verbal description. In
their summary of this literature, Budea, Weinberg & Wallsten note that "[t]he overwhelming result is great variability in the values assigned to words and large overlap among the ranges assigned to the various [verbal] expressions' of likelihood (1988: 281). Outside the laboratory, this kind of variance has been observed in audit managers of a Big Five public accounting firm (Amer et al., 1994) and physicians (Bryant & Norman, 1980; Kenney, 1981). In early 1961, the general responsible for the military evaluation of the CIA's plan to invade Cuba at the Bay of Pigs gave it a 'fair' chance of success. He meant 30%. The invasion's planners thought higher. The result was a military failure (Behn & Vaupel, 1982).

Sometimes verbal descriptions are not only variable, and therefore subject to preferred slants, they are also indiscriminate. Jurors in a mock civil trial were asked to find for the plaintiff or defendant based on three increasingly strict criteria of strength of evidence: 'preponderance,' 'clear and convincing,' or 'beyond a doubt' (Kagehiro, 1990). The proportions of guilty verdicts (i.e., favorable to the plaintiff) were .44, .41, and .45, respectively. Thus, these verbal characterizations of the different requirements for culpability had no differential impact on people's verdicts. A second group judged the same cases under the same three criteria, but with numerical specifics added: 'preponderance' meant at least a 50% likelihood of culpability; 'clear and convincing' meant at least a 70% likelihood; and 'beyond a doubt' meant at least a 90% likelihood. The respective verdict proportions changed, in order, to .62, .45, and .30 -- a very systematic difference across the three criteria for culpability. Thus, the numbers and not the words conveyed the differences in the required strength of evidence.

Yet, a downside to precise numerical communication of information can occur when the numbers are only estimates but are taken as precise fact (Wallsten, 1990). That is, when the uncertainty of numerical estimates is conveniently ignored because it is unpleasant or complicating, those numbers may command an unjustified impact on decisions (Singer, 1971). More than a few senior managers have railed at their marketing's sales estimates as too fuzzy, as if intelligence or effort could yield perfect predictions of the future. In spite of numerical descriptions' susceptibility to overly precise interpretations, and verbal descriptions' defense as more flexibly suited to imprecise beliefs like likelihoods, on balance the evidence supports numbers when making decisions. In a typical finding, Budea et al. (1988) contrasted numbers versus words (and graphical displays) in a bidding task. They found performance worst with verbal expressions of probability. Possibly reflecting this, decision-makers tend to prefer numeric information to verbal information, particularly when they are receiving as opposed to providing the information (Olson & Budea, 1997).

Interpreting and Evaluating Acquired Information: Challenges to Skilled Performance

Evaluating information properly faces a standard range of potential challenges. How credible is the information? For instance, suppose that the Vice-President of Marketing speaks with a former boss of one of the candidates for the Directorship. How truthful will that person be, given the risk of a lawsuit if something negative is said? Unfortunately, the credibility of information seems not to be as well estimated as its strength, as demonstrated by Griffin & Tversky (1992) who use this imbalance to illuminate the overconfidence phenomenon (discussed shortly). Credibility is only one source of uncertainty, which typically complicates the evaluation of information. Closely related to uncertainty is ambiguity. Unsurprisingly, ambiguity aversion has been consistently found, from Ellsberg's (1961) ambiguity-driven paradox (Becker & Brownson, 1964) to the series of papers by Curley & Yates (1985, 1988; Curley, Yates & Abrams, 1986).

Excluding uncertainty, there remains what might be called the general challenge of evaluation. Briefly, all the information must be interpreted and compiled to provide the appropriate value on one attribute or aspect of an alternative. Thus, the observations of all the people who interviewed a candidate for Director of Market Research must be combined, possibly with other information (e.g., the opinions of a prior boss or someone else listed as a reference), to yield a value on, say, oral communication skills. Fischhoff et al. (1980: 399) contend that valuation is clearest when the attribute is 'familiar, simple, and directly experienced.' Thus, this challenge is so specific to each decision, that we can do little more than acknowledge it.

Finally, we note a few empirical regularities of how information that is time-dependent is evaluated. The two main findings are that values that are delayed are discounted, and that a time trend matters. The discounting of the value of a delayed outcome is a long-recognized phenomenon (e.g., Loewenstein & Elster, 1992). As consistent as time-based discounting is, there are wide differences in the slope of discounting depending on the nature of those outcomes, for instance a gain versus a loss (Shelley, 1994), risky versus riskless (Stevenson, 1993), and health versus money (Chapman, 1996). One of the most intriguing applications of the negative evaluation of a downward time trend is Hsee et al.'s (1991) demonstration of a preference for Job A paying, in consecutive years, $12,000, $13,000, $14,000, and $15,000, over Job B, paying in those
same years $18,000, $17,000, $16,000 and $15,000. Note that Job B dominates Job A, yet was less preferred by Hsee et al.’s subjects solely because of its downward trend in salary.

Similarly, research by Kahneman and colleagues (Fredrickson & Kahneman, 1993; Redelmeier & Kahneman, 1996; Varey & Kahneman, 1992) has examined remembered pain experienced during a prior procedure. One astounding result of this work is that duration of the experience fails to predict remembered discomfort during the procedure. However, Ariely & Loewenstein (2000) present evidence that duration does matter, when conversational norms and scale effects are accounted for. In related work, Kahneman et al. (1993) demonstrated that overall evaluations of a painful experience were reduced by adding a sequence of diminishing pain to the very end of the procedure. This finding, that the latter portion of the sequence plays a major role in the evaluation of the whole sequence, has found support elsewhere (Ariely, 1998; Baumgartner et al., 1997).

**Transition: Is the Information Adequate?**

The acquisition and evaluation of information (Phase 3) and the reconciliation of opposing information to distinguish one option as superior (Phase 4) are proximal activities that often cycle back and forth. A respect for efficiency means that the conclusion of enough information to usefully move to Phase 4 only means enough for the moment, not enough forever. It is simply expected that, at the present time, more progress toward the ultimate goal can be achieved by carrying the currently available information forward into the reconciliation and distinction process.

The one error of untutored decision-making that seems to recur and affect the judgment of information sufficiency is overconfidence (Ayton & McClelland, 1997; Klayman et al., 1999). If decision-makers believe that they are, say, 95% certain that next quarter’s sales will fall in a specified interval, they may well conclude that no more market research can justify its cost, and enter Phase 4 with this range as a key fact. If, however, they are overconfident, the true probability might be only 80%. Thus, in reality they should collect more evidence (i.e., remain in Phase 3) before basing any decision on the current estimated range of sales.

Although overconfidence is pervasive (Russo & Schoemaker, 1992), much can be done about it. For repetitive judgments, feedback is effective when combined with accountability (see, for example, Murphy & Winkler, 1984 on weather forecasters). For unique decisions, listing pro and con reasons can reduce this error (Koriat et al., 1980), with the con reasons doing most of the work. This last result points to the inadequate generation of negative or disconfirming evidence (discussed above) as one cause of overconfidence.

Once the tendency toward too much confidence in our own estimates and judgments is overcome, decision-makers still face the general challenge of judging when they have sufficient information. A precise computation of information sufficiency is exceedingly difficult. Indeed, with much of decision-making, such guidelines exist only for situations so constrained by simplifying assumptions as to be nearly useless to managerial decisions. The best approach may be one of successive refinement in which decision-makers use the current information in Phase 4, see where the remaining important gaps in information lie, and cycle back to Phase 3 to acquire as much of that needed evidence as can be done at reasonable cost. A repeated cycle of this nature means that decision-makers’ best judgments of information sufficiency need only be approximate – which may be all that can be realistically achieved.

**Phase 4: Distinguishing One Alternative as Superior**

The core task of what has traditionally been thought of as decision-making occurs in Phase 4. It is reconciling the multiple units of information that support the competing alternatives in order to identify the superior option. Initially, this task was accomplished with formal models like expected utility (see Schoemaker, 1982 for a review) and the weighted additive rule (e.g., Anderson, 1982; Dawes, 1979; Hammond & Adelman, 1976; Meehl, 1954). Although some psychologists participated in model building and testing, others directly addressed the phenomenon of the conflict among opposing units of information (e.g., Shepard, 1964; for a review, see Payne et al., 1992, and for recent work, see Weber et al., 2001).

The present discussion of conflict reconciliation is organized around three approaches – intuition, rule-following, and compensatory processes. Intuition means that a substantial portion of the reconciliation process is automatic, unable to be described, and based on ‘gut feel.’ Rules are effort-conserving rules of thumb; often termed heuristics, that are approximations to accurate tradeoffs. Compensatory processes attempt to use all the information by trading off sensitively the evidence for one alternative against that for the other alternative(s). From intuition to rule-following to compensatory processes, these three approaches tend to increase in the accuracy with which they identify
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the superior alternative, in the effort required, and in the clarity or transparency of the process itself (Schoemaker & Russo, 1993). The best approach depends on the parameters of the decision, such as the costs of errors and effort, time pressure, and the demand for a justification of the reasoning process. Yet whichever approach is selected, each has its errors of untutored performance, and each its unavoidable challenges.

**Intuition**

We all rely on intuition to some degree. Indeed, some people see themselves as very good intuitive decision-makers. They acquire evidence, often including the overall recommendations of others, then let it all nonconsciously percolate in their minds until, somehow, the best option emerges. How or why is never clear. It just happens. Of course, thoughtful managers are sometimes troubled by the absence of any reasoning process that can be examined for weaknesses. However, there is no conscious process available to inspection. Then, because nothing can be done, many uncomfortably assume that their intuition is sound. Excellent reviews of intuition are provided by Hayashi (2001) and Hogarth (2001), and Lieberman (2000) takes the analysis of intuition down to the neural level.

Although the process of intuitive reasoning is opaque to the decision-maker, scholars have made progress in understanding it. To a large degree, intuition is nonconscious pattern matching. Salient characteristics of the current decision, like the alternatives, information, and constraints, are automatically connected to related past decisions. If there is a good match, ‘intuition’ dictates choosing the identified alternative (Massaro, 1994). Sometimes the process is extended over time, but is still based on matched connections that remain opaque to the decision-maker. Finally, the match is sometimes transparent to others or, rarely, even to decision-makers themselves (e.g., when the VP of Marketing realizes that she favors one candidate because he most closely resembles the successful Director of Market Research who just resigned).

When is intuition useful, even necessary, as opposed to when does it lead decision-makers in the wrong direction? Sometimes intuition is based on ‘automated expertise’ (Simon & Prietula, 1989). This means that the match is (a) accurate, because it is based on valid knowledge in the decision domain, and (b) automatic or opaque, because all that knowledge has become, over time, inaccesible to conscious awareness. Though novice automobile drivers must, at first, think about the operation of the machine, the rules of the road, and the surrounding traffic, over years of experience they learn to drive with most of those thoughts automated.

Similarly, great experience can leave sound reasoning automatic and unavailable to inspection.

The problem comes when the automatic matching of the new situation to an old one is based on apparent characteristics of the new situation that do not accurately reflect the underlying causal drivers of a good choice. Maybe the intuitively indicated candidate for Director of Market Research resembles the former one in physical appearance, educational credentials, or social style, but not in some crucial areas of competence. The real problem is that because intuitive reasoning is opaque, there is no way for decision-makers to tell whether an intuitive choice is valid (i.e., based on genuine, if automated, expertise) or when the match is a false one in terms of the true drivers of overall value. For an illustration of the danger of intuition in medicine, see Redelmeier et al. (1993a, 1993b).

Any implication that revealing the (associative) process underlying an intuitive choice would enable better decision-making needs to be qualified. The attempt to introspect rapid or automated processes can backfire, either by inhibiting insight or yielding a biased evaluation (Schooler et al., 1993, 2002). This problem is very closely related to the explanation bias discussed in Phase 2’s errors of focus. As one illustration of this danger, Wilson et al. (1993) let people observe, rate, choose, and keep art posters. Those who rated the posters (compared to a control group that did not) reported two weeks later both lower satisfaction with the poster they had chosen and a lower likelihood of having hung the poster in their homes. Wilson et al. argue that the act of evaluation distorted the true attractiveness of the posters.

When should decision-makers use their intuition? The most obvious situation is when time is very short. Gary Klein and his associates have studied emergency decisions in several natural environments, like fire-fighting, military combat, neonatal nursing, and nuclear power plant operation (Klein, 1998; Klein & Weick, 2000). Klein’s recognition-primed view of ‘naturalistic decision-making’ describes the matching of the current situation to those familiar ones stored in the memory of experienced professionals.

**Intuition’s Errors and Challenges**

Because intuition is an automated approach to Phase 4’s task of combining all the available information to distinguish one option as superior, decision-makers’ challenge is always to recognize when to trust that the current situation is one where they have ‘automated expertise.’ To the extent that this matching task is performed poorly, possibly because of time pressure, decision-makers risk a superficial match that is fundamentally flawed, with all the context-specific costs that such an error entails.
Rule-following

A decision rule is a mental shortcut that is usually a good guide to the right course of action and which saves time and effort. Marketing managers adopt shortcut rules, or heuristics, like the following.

- If our main competitor lowers prices, follow.
- Avoid being the first client of a start-up service provider. Wait until the company has established a record of success.
- Never publicly acknowledge anything negative about our products.
- Set the price by adding X% to the cost of the labor and materials.

In the search for a new Director of Market Research, the VP of Marketing might simplify her reconciliation of opposing information by adopting the dictionary rule. 'Pick the candidate on the final list that is rated highest by my colleagues. If two or more candidates are tied (or nearly so) on the interviewers' ratings, pick the one with the most relevant experience. If there's still a tie (or nearly so), go with the direct reports' preference.' Note how this heuristic (like ordering words in a dictionary by the first letter, second letter, etc.) avoids making the hard tradeoffs on differences in ratings, experience, and staff preferences. The main danger is not matching the current case to those where the rule is a good fit. If decision-makers are unaware that they are using a heuristic, or unaware of what it requires to fit a situation, they are exposing themselves to the risk of choosing an inferior alternative.

Consider the following true story (Russo & Schoemaker, 2002: 139-40). A food manufacturer used the dictionary rule to guide product reformulation. The most important criterion was consumers' rating of different products in standard taste tests. The second consideration, used only to break ties on taste, was production cost. The company's rule was 'Substitute a new product formulation (e.g., use a cheaper cooking oil) only when cost is lower but taste is not.' The rule was backed by valid consumer taste tests and standard statistical criteria. The result: steadily declining market share in several unrelated product categories that defied all attempts at explanation. The reason: small annual decrements in taste were not statistically significant, but over several annual product reformulations those decrements accumulated to yield a noticeably inferior product (for an experimental example of this same accumulation, see Tversky, 1969). When the brand manager was told of the flawed use of the dictionary rule, he rejected the explanation — as did his boss. They had insufficient understanding of the dictionary rule in particular, and of heuristics in general.

Heuristics for Likelihood

Combining observations or other information to estimate likelihoods relies on its own set of simplifying rules that substitute for the more complex probability calculus. Consider the representativeness heuristic and the following clever demonstration devised by Tversky & Kahneman (1983). If a regular six-sided die has four Red (R) faces and two Green (G) faces and is tossed 20 times, which of the following sub-sequences is most likely?

1. RGRRR
2. GRGRRR
3. GRRRRR

Many of the experimental subjects who received this problem chose Sequence 2, though the correct answer is Sequence 1. Indeed, the latter is exactly Sequence 2 with the first Green deleted. Because this Green occurs only in Sequence 2, it must be less likely than Sequence 1. Tversky & Kahneman explain the majority choice of Sequence 2 as the use of the representativeness heuristic. The combination of four Reds and two Greens is more representative of the die than is the four to one sample of Sequence 1.

We list below several of the more prominent violations of the laws of probability. At the same time, we caution that their applicability to decision-making is sometimes narrow. Their generalizability is limited because highly structured situations are needed for the demonstrations of error, whereas most managerial tasks are far less structured.

- **Conjunction Fallacy.** The example of the red-green die illustrates a larger problem. The conjunction of two events, in this case the sub-sequences G and RGRRR, must always have a lower probability than either component event. Tversky & Kahneman (1983) have shown several systematic violations, including the well-known Linda problem. For a review, see Payne et al. (1992) and the arguments about probabilistic reasoning by Beach et al. (1986) and by Giossas & Trope (1987).

- **Gambler's Fallacy.** An event, say five Tails in successive tosses of a fair coin, lowers the estimated likelihood of its recurrence, though it should not. This is another illustration of the representativeness heuristic, in which five Tails followed by a Head is more representative of a fair coin than the same five Tails followed by yet another Tail. For an illustration of the gambler's fallacy in the choice of numbers that are chosen in a state lottery, see Clofelter & Cook (1993).

- **Hot Hand Fallacy.** This is the opposite of the gambler's fallacy, because it is based on skill rather than pure chance. People tend to believe too much in streaks, like players making numerous
successive shots in a basketball game because they have a ‘hot hand’ (Gilovich et al., 1985). Indeed, Gilovich et al. analyze NBA statistics to show that, contrary to popular belief and frequent anecdotes, the hot hand phenomenon does not exist in professional basketball.

- Baserate Neglect. Dull baserates are sometimes underweighted compared with more vivid case-specific information (Kahneman & Tversky, 1972). Contrary to the laws of (Bayesian) probability (Dawes, 1998), a single highly vivid event – like one person’s story of the mechanical problems of their Ford Windstar – may outweigh the frequency-of-repair data from years of J.D. Power surveys.

- Law of Small Numbers. People sometimes overestimate the resemblance of a small sample of events to the population from which it was drawn (Rabin, 2002; Tversky & Kahneman, 1974).

For other violations of the laws of probability, see Camerer (1995) and Dawes (1998). We also acknowledge problems with likelihood that are not strictly violations of laws. For instance, the illusion of control presumes too small a role for randomness or for factors outside the decision-maker’s control (e.g., Thompson et al., 1998).

In contrast to the numerous published examples of violations of the laws of probability is the assertion of Gigerenzer and his associates (many of) these errors of reasoning about likelihoods disappear when relative frequencies are used instead of probabilities (Gigerenzer & Hoffrage, 1995; Sedlmeier & Gigerenzer, 2001). The debate over probabilities versus relative frequencies remains active (Gigerenzer & Hoffrage, 1999; Kahneman & Tversky, 1996; Lewis & Keren, 1999; Mellers & McGraw, 1999). In spite of Gigerenzer’s argument, it does seem fair to conclude that people’s untutored treatment of likelihood deviates from the probability calculus or from other desirable criteria sufficiently often to be worrisome.

There are many general decision rules for simplifying the reconciliation process. Other examples are the threshold rule, in which the winning option must exceed a threshold value (or hurdle) on every criterion, and the majority of confirming dimensions, in which alternatives are compared in pairs and the winner is the one with the most criteria favoring it (Ruso & Dosher, 1983). Some heuristics are quite complex, like the policy making process described by Janis (1989). However, all such decision rules, even Janis’ policy process, are substantially simpler than a full analysis.

Rule-Following: Errors and Challenges

The errors of rule-following all derive from using a heuristic when it is not a good approximation to a full and sensitive use of the available information. This type of error may occur because decision-makers are unaware of the heuristic they are actually employing (e.g., Dhami & Ayton, 2001), are unaware of its dangers, use it mainly as a way of coping with emotion (Luce et al., 2000, 2001), or miscalculate the tradeoff among accuracy, effort, and transparency. Assuming that the first three are mastered, the continuing challenge lies in the final error, namely to make that tradeoff well. That is, the challenge is always knowing when to use a particular decision rule and when its expected costs exceed its benefits. A review of heuristics and rule-following can be found in Mellers et al. (1998).

Trading Off Multiple Pieces of Information: Errors of Untutored Behavior

There are many phenomena that result from decision-makers’ inequitable treatment of pieces of information when they are combined with the ultimate goal of identifying the single best course of action. In what follows, we organize these phenomena into three groups according to their origin: contrasting whole alternatives, contrasting their components (i.e., attributes or features), or the nature of the information being traded off.

Contrasting of the Alternatives

Fundamental to the contrast among alternatives is their position relative to each other, the status they attain during the choice process, and how they have been represented or framed at the outset of that process. We consider each, in turn.

Effects Due to Positioning of the Alternatives. In the direction-of-comparison effect, assessing the difference between two attractive alternatives enhances the preference for the ‘focal’ option, or the one to which the other was compared (Dhar et al., 1999). In contrast, when the two options are unattractive, the focal option is relatively less preferred. Thus, the positioning of an alternative as the benchmark or standard of comparison can significantly affect its perceived value. Mantel & Kardes (1999) qualify this finding to situations where the comparison is based on the individual attributes (rather than holistic judgments of the competing alternatives), and where low involvement leads to attribute processing that is less thorough or systematic.

A second kind of positioning effect derives from the alternatives’ relative status that emerges during the decision process. This is the pre-decisional distortion of information, or the tendency to see new information about a pair of alternatives as overly supportive of whichever one is currently leading
(Russo et al., 1996, 1998). Russo, Meloy, & Wilks (2000) showed that when sales representatives of a major pharmaceutical firm decided which of two physicians to call on, the evaluation of new information was distorted to favor whichever physician they were already leaning toward visiting. This error of evaluation is quite robust (for auditors, see Russo et al., 2000; for prospective jurors in a mock trial, see Carlson & Russo, 2001; and for a Bayesian interpretation see Boulding et al., 1999). It is also substantial—about twice the magnitude of post-decisional distortion due to cognitive dissonance reduction (Russo et al., 1996, 1998). Finally, because people are largely unaware that they are distorting new information to conform to old information, their choices can be manipulated. In consumer choice, Russo, Carlson & Meloy (2002) targeted one alternative by putting a single attribute that slightly but clearly favored the targeted alternative in the first position (and equivalent information favoring the nontargeted alternative later). The targeted alternative was selected 69% of the time, regardless of which alternative was targeted. The effect was traced to the first attribute’s being made the leading alternative, combined with decision-makers’ tendency to distort all subsequent information to favor that alternative/brand.

The pre-decisional distortion of information is closely related to the halo effect, in which an overall opinion biases the evaluation of a new piece of information (Baggozi, 1996). The halo effect is usually confined to information that reflects a component of the alternative (as opposed to a cue; see Connolly & Srivastava, 1995). An example would be how an overall judgment of how much a person is liked influences the separate evaluations of that person’s intelligence, social skills, physical attractiveness, and so on. There is no consensus on the causal nature of the halo effect (Balzer & Sulsky, 1992; Murphy et al., 1993).

Effects Due to an Alternative’s Inherited Character. Inequitable treatment of pieces of information can follow from an inherited character of one or more of the options. For example, assuming the absence of political incentives for project completion, unrecoverable costs that have already been incurred on a project should play no role in the current decision-making process. Instead, the decision-maker should value alternatives in terms of their benefits and costs from this point forward. If the expected future benefits outweigh the expected future costs, then support for the project should continue; otherwise, the project should be killed. However, as discussed earlier, decision-makers frequently take sunk costs into account and remain committed to projects that continue to lose money, largely because of the commitment built by sunk costs (Heath, 1995; Moon, 2001; Simonson & Nye, 1992; Thaler, 1991). That is, the alternative to continue the project for which resources have already been spent has a special status over the alternatives of killing the project or launching a new one.

Endowment also confers a special status. If one of the alternatives is the default or endowed option, decision-makers tend to over-value it (Chapman, 1998; Thaler, 1991; Van Boven et al., 2000; van Dijk & van Knippenberg, 1998). For example, Madrian & Shea (2001) showed that automatic enrollment in a 401(k) plan led to significantly increased participation in the plan, suggesting that decision-makers often find the default option sufficiently superior to the alternative options, regardless of what alternative is made the default option. Another naturally occurring example is Johnson et al.’s (1993) finding that 20% of New Jersey drivers purchased the right to sue when their default insurance plan omitted this provision, whereas 75% of Pennsylvania drivers purchased the right to sue (by not opting to drop it for a savings) when it was included as a default in their insurance plan.

Contrasting the Attributes

Errors in the valuation stage of the decision process can also derive from how the individual attributes or other units of information are contrasted. We focus on errors associated with inequitable attention to certain aspects of the alternatives.

Attribute Comparability. By comparability we mean the degree to which the attributes are measured on the same units (i.e., metrics or yardsticks). When alternatives have common (versus unique) features, Gentner & Gunn (2001) showed that the act of comparing two alternatives (as opposed to merely coprocessing them) leads to greater noticing of both commonalities and differences between the alternatives. This recognition of differences is critical to the distinction process of Phase 4. Dhar & Sherman (1996) showed that the likelihood that decision-makers select an alternative (versus postponing the choice) increases when the alternatives share bad attributes and possess unique good attributes (relative to when the two alternatives share good attributes and have unique bad ones). Chernov (1997, 2001) extended this work on the impact of common versus unique features to include the role of attribute importance. In related work on comparable (or ‘alignable’) attribute differences, Zhang & Markman (2001) show that differences on alignable attributes have a larger impact on the decision for low-motivation (relative to high-motivation) participants. This suggests that under conditions of high motivation, decision-makers exert the effort necessary to process nonalignable attribute differences.

Ritov (2000) has proposed an expectation-based explanation for both the relatively greater impact of unique or distinctive features and of alignable attribute differences. A distinctive feature may
receive greater weight because it is unexpected, where expectation derives either from the cohesiveness of the attributes that comprise the alternatives or from the environmental frequencies of these same components. Rotov discusses the general importance of expected structure, both for individual alternatives (the cohesiveness among the attributes) and for comparisons between alternatives (the likelihood that a feature is included in both alternatives).

**Joint versus Separate Evaluation.** There are several phenomena that arise from the contrast between evaluating alternatives in isolation versus choosing between those same alternatives. Maybe the most well known is Lichtenstein & Slovic’s (1971, 1973) observation that individuals who choose between a low probability of winning a large amount and a high probability of winning a small amount tend to select the latter, but when asked to price each of the same gambles, they often set a lower price on the gamble they selected. There is some controversy over what is the exact source of this effect (Dawes, 1998; Fischer & Hawkins, 1993; Mellers et al., 1998; Tversky et al., 1988). However, most explanations contend that the decision-maker gives different weight to the attributes (payoff and probability) in choice versus pricing because of compatibility between the attribute’s units and those of the required response (e.g., Slovic et al., 1990). Hsee (1996) suggests that joint evaluation provides information that makes certain attributes easier to value. These attributes gain impact under choice because they are inherently easier to evaluate in choice than they are in a single-alternative judgment. Though Hsee’s explanation fits well for the choice settings he explores (e.g., choices between dishes of ice cream), it seems less capable of accounting for the gambling scenarios above.

Nowlis & Simonson (1997) found that participants who chose between alternatives gave more weight to comparable attributes than participants who provided purchase likelihood ratings (single-alternative valuations). This is consistent with the above, if we assume that comparable attributes are easier to process and, thus, have more impact. An implication of this conjecture, based on Zhang & Markman’s (2001) evidence, is that we might anticipate Nowlis & Simonson’s pattern of data to be less pronounced when decision-makers are highly motivated.

**Attribute Character**

In addition to inequitable treatment of information arising from how decision-makers contrast alternatives and attributes, errors can arise from the character of the attributes. Attribute character captures a broad class of factors, such as whether the attribute is numeric or verbal, ambiguous or unambiguous, dull or vivid, relevant or irrelevant, etc.

**Numeric versus Verbal Information.** The discussion of Phase 3 considered the impact of different formats for representing individual units of information, especially numeric (e.g., 28 mpg) versus verbal (e.g., above-average fuel efficiency). Now, in Phase 4, we take up the errors made when the individual units of information are combined to distinguish the alternatives on overall value. Briefly, numeric information is associated with more compensatory processing (Stone & Schkade, 1991), more accurate preference predictions (Lindberg et al., 1991), and less variable probability forecasts that an event will occur (Budescu & Wallsten, 1990). Finally, numeric information tends to carry more weight in preferential prediction tasks (Lindberg et al., 1991; Svenson & Karlsson, 1986). Thus, and without surprise, the numeric format facilitates the ease and accuracy of combining individual information units.

**Ambiguous Information.** A characteristic of the numerical–verbal difference is information ambiguity. Indeed, researchers often study the impact of ambiguity on the decision process by contrasting verbal and numerical information (Teigen & Wibecke, 2000; Wallsten, 1990). As with the preference for numeric information, research on ambiguity has found that decision-makers prefer information that is less ambiguous (Keren & Gerritzen, 1999) and tend to overweight certain (relative to uncertain) outcomes (Kahneman & Tversky, 1979). However, this finding is not universal. Smithson (1999) found that individuals were willing to embrace ambiguous information when the alternative – unambiguous information – led to conflict. In fact, individuals preferred ambiguous information to unambiguous, conflicting information when the outcome was positive. In related work, Hsee (1995, 1996) showed that decision-makers relied more on appealing dimensions (e.g., enjoying one’s self) that were not pertinent to the primary task when uncertainty in the justifiable dimension existed. This finding, which Hsee refers to as “elastic justification,” can be treated as a variant of ambiguity aversion, where the ambiguity in a particular dimension motivates the individual to use factors that are attractive but not justifiable under normal circumstances.

**Dull versus Vivid Information.** The character of information includes its vividness. How vivid or striking the available information is has been shown to influence mock jurors’ judgments (Wilson, Northcraft & Neale, 1989), consumer preferences (Keller & Block, 1997), and estimates of probabilities (Shedler & Manis, 1986). The general result is that vivid information has more impact than non-vivid information. As an example of vividness, consider the case of shark attacks during the summer of 2001. Even though the number of shark attacks and consequent fatalities from them were not extreme by historical standards, there existed a perception
that shark attacks were becoming more common. One possible reason is a particularly vivid shark attack in early July that drew the world’s attention to the topic. Part of a CNN report from Pensacola, Florida, read as follows.

The boy was wading in knee-deep water at the Gulf Islands National Seashore on July 6 when he was mauled by a 7-foot bull shark, which tore off his arm and bit a large portion of his thigh. Jessie’s uncle, Vance Flosenizer, wrestled the shark to shore and pulled the arm from its mouth. The boy’s arm was reattached in an 11-hour operation later that night at Baptist Hospital in Pensacola.

The vividness here comes from several remarkable events, including that a seven-foot bull shark bit off a boy’s arm in knee-deep water, the uncle wrestled the shark to the shore, and the arm was recovered from the shark’s mouth and reattached.

Irrelevant Information. Decision-makers sometimes rely on irrelevant information when making predictions and choices. The dilution effect is the tendency for irrelevant information to reduce the use or impact of relevant information in prediction tasks (Nisbett et al., 1981; Tetlock et al., 1996). Tetlock & Boettger (1989) found that accountability caused individuals to use a wider range of information, but it did not universally eliminate the dilution effect.

In addition to irrelevant information, decision-makers are sometimes influenced by irrelevant alternatives. Huber, Payne & Puto (1982) showed that consideration of an alternative that was dominated by one of two other alternatives in the choice set led decision-makers to select the dominating option more often than when the dominated option was not present. This violation of the normative principle of regularity is striking because it means that adding irrelevant options to the consideration set can change the choice proportions of the viable options. This phenomenon, known as asymmetric dominance, has been extensively replicated and discussed (Azely & Wallsten, 1995; Simonson & Tversky, 1992; Wedell, 1991).

Order of Information and Illusory Correlation

The order in which information appears can greatly influence its impact on the decision process. Primacy refers to greater weight given to information that appears early in the information sequence. Similarly, information that appears late in the information sequence tends to have greater impact, termed a recency effect. The literature on order effects is large and varied. It includes effects not only of the order of information (Asare, 1992; Pennington & Hastie, 1988), but the order in which the alternatives are considered (Dean, 1980), and of a sequence of tasks (Davis et al., 1984).

Illusory correlation refers to the tendency for decision-makers to perceive a positive correlation among units of information when little or no correlation exists. This false perception of correlation among the different attributes of the options or units of information has several possible sources. It may arise from the goal to achieve coherence among the multiple pieces of information (Holyoak & Simon, 1999) or consistency between the expected and observed amounts of separation (or distinction) in the overall value of the alternatives (Carlson, 2000). The goal of separating the alternatives may yield an illusory correlation when new information is perceived as overly consistent with prior information in order to increase separation (Russo et al., 1998; Svennson, 1996, 1998). Even a desire to minimize effort may drive illusory correlation. If the evaluation of new information is distorted toward that of prior information, decision-makers can achieve more rapidly the distinction between alternatives that is deemed sufficient to terminate the process of Phase 4.

Trading Off Multiple Units of Information: Challenges to Skilled Performance

The task of combining the individual pieces of information always poses the challenge of comparing different attributes or features. The difficulty of this challenge is influenced by the expertise of the decision-maker and by the comparability of the attributes themselves (Fischer et al., 2000; Johnson, 1984, 1988). Further, the task is easier when the separation between the best and all other alternatives is large.

In addition, it must be acknowledged that some attributes are very difficult to trade off because the decision-maker has granted them protected status (Baron & Spranca, 1997; Luce et al., 2000; Ritov & Baron, 1999). For many people, human life is one of these dimensions. For example, every automobile manufacturer faces the difficult determination of how safe to make a car, knowing that extra safety means higher cost. The idea that engineers would determine how safe the car should be, and thus how many lives will be lost in car crashes involving the car, is unpalatable because human lives are a protected attribute or "value" (Lukes, 1996). Nevertheless, the determination must be made because the extremes (the car is either a deathtrap, or is entirely safe and probably useless as a vehicle) are unacceptable. Indeed, there is evidence that people can make tradeoffs between opposing protected values when they must (Baron & Leshner, 2000).

Finally, we also want to acknowledge the complicating effect of time pressure (which is a challenge to every part of the decision process) and of
cognitive limitations. The cognitive computational burden is often heaviest in the tradeoffs of Phase 4. Decision analysts might say that this occurs because most decision-makers choose not to quantify value and, therefore, deny to themselves the arithmetic concatenation operations. Managers might respond that the effort to generate valid numerical estimates, whether the momentary demand on cognitive resources or the total work over time, is not worth the benefit. Thus, most decision-makers face the challenge of 'keeping it all straight in their heads' as they deal with the inevitable tradeoffs among different attributes.

**TRANSLATION: IS DISTINCTION SUFFICIENT FOR TERMINATION AND COMMITMENT TO THE LEADING OPTION?**

This important transition decision is little studied. Only a few errors of untutored performance are known to affect the termination decision. As with most of these phase transitions, there is little theory and less empirical work. Some errors derive from mistakes made earlier in the process, such as false confidence in the completeness of the set of options (Phase 2), or of the information used to evaluate them (Phase 3).

Tversky & Shafir (1992) show that postponement, which is neither terminating nor returning to an earlier phase, is sensitive to the conflict felt among the competing alternatives. When this conflict was increased by adding more options, an act that should only make the best available option at least as attractive, postponement increased as well. Even if these errors are eliminated, the decision to terminate may be complicated by time pressure or the kind of perceived overload that underlies the postponement result of Tversky & Shafir. An important question is whether termination is based on a sensitive cost-benefit analysis or on rule-following. Several studies have shown an increased use of heuristics or other rule-like strategies under time pressure (e.g., Mano, 1988; Payne et al., 1988; Wright & Weitz, 1977).

Whether the termination analysis is sensitive or approximate, how does it incorporate external factors like incentives, as they influence effort? And how does it incorporate individual preferences, like risk-seeking (Weber, 1999; Weber & Milliman, 1997), that might lead to an earlier termination based on a less resolved conflict among opposing units of information? Some evidence is provided by Mano (1990), who found that time pressure and error penalties shifted the goal of completely processing the information. A related issue is the assessment of the decision-maker's perceived value of accuracy or of effort. For instance, Mellers et al. (1998) have argued that experimenters may fail to take into account the other uses that subjects have for the time they are spending in an experiment. This omission can lead to a discrepancy between what the observer (experimenter) and the decision-maker (subject) believe is rational behavior.

**PHASE 5. POST-COMMITMENT DISTINCTION, IMPLEMENTATION, AND LEARNING**

**Post-commitment Errors of Untutored Behavior**

Decision-makers are prone to error even after they have made a decision and begun to implement it. In this section, we consider two post-decisional errors, bolstering and hindsight, that can exact substantial costs on subsequent decision processes.

**Post-decisional Bolstering**

Decision-makers tend to bolster their judgment of the selected alternative (Geller & Pitz, 1968; Peterson & DuCharme, 1967). The conventional explanation for the bias toward bolstering is that the act of deciding requires knowledge that one must forgo the positive features of the rejected alternatives and accept the negative features of the chosen one. This knowledge can lead to dissonance (Festinger, 1964) or regret (Loovens & Sugden, 1982), which the decision-maker attempts to quell by avoiding disconfirming information and/or distorting encountered information to bolster the chosen alternative. Evidence that decision-makers are, in fact, more critical of disconfirming information than of supporting information is provided by Dito & Lopez (1992) and by Edwards & Smith (1996).

There are at least three mechanisms for this differential criticality of opposing (versus supportive) information. First, decision-makers can prefer and seek out information that is supporting of their choice (Frey, 1986; Janis & Mann, 1977; Jonas et al., 2001). Second, decision-makers can distort the evaluation of new information to support the selected alternative (Russo et al., 1998; Svenson, 1996). Third, decision-makers can mistakenly remember the original information as more supportive of the selected alternative than it actually was (Mather et al., 2000).

The cost of post-decisional bolstering is undervaluing the new information. That is, decision-makers who bolster the chosen alternative may remain too committed to it when new information suggests they should abandon it (and the environment allows them to do so freely). Note that this is closely related to the sunk cost phenomenon that we have addressed above.
Hindsight Bias

The second post-decisional error commonly exhibited by decision-makers is hindsight bias - when decision-makers believe that they always knew what they currently know (Fischhoff, 1975; Hawkins & Hastie, 1990). Hindsight bias presents a challenge to the conventional notion of learning from experience because decision-makers exhibiting it fail to appreciate that they have learned something (Bukszar & Connolly, 1988).

Research has shown that hindsight bias is larger for negative and unexpected outcomes than it is for positive and expected ones (Schkade & Kilbourne, 1991). Some of the settings in which this bias has been observed include auditors' going concern judgments (Anderson et al., 1993), business decisions (Connolly & Bukszar, 1990), eyewitness identification of suspects (Wells & Bradfield, 1999), and general retrospective likelihood judgments (Tversky et al., 1992).

In general, hindsight bias is attributed to the reconstructive nature of memory (Carli, 1999; Hoffrage et al., 2006; Stahilberg & Maass, 1998). Individuals are most likely to exhibit hindsight bias when they are motivated and able to claim they always knew what history has demonstrated to be true (Louie, 1999). This bias can be mitigated by increased effort during the choice process (Creyer & Ross, 1993) and by timely feedback (Hoch & Loewenstein, 1989). However, prior instruction to avoid the bias seems to be fruitless (Kamin & Rachlinsky, 1995).

Post-commitment Challenges to Skilled Performance

Regret

Even if decision-makers avoid post-decisional bolstering and hindsight bias, they still must cope with the emotional burden of having made mistakes, at least some of the time. These mistakes include both failing to select the best course of action and selecting an inferior one.

Assuming that decision-makers recognize, learn from, and account for their mistakes, the issue of getting beyond the regret associated with these mistakes still remains. Coping with mistakes is not merely a matter of emotional maintenance, because regret can affect current and future choices (Mellers, 2000; Tsios & Mittal, 2000). Recall the result reported earlier that people were more satisfied with their choice from six items than from a much larger set of 24 or 30 items (Iyengar & Lepper, 2000). One claimed driver of this effect was the greater regret associated with the choice from the larger set. More generally, decision-makers who feel regret over a particular action (or inaction) may be more likely to be hesitant (impulsive) in a new, related choice. Thus, decision-makers should recognize how regret is manifest and under what conditions it is likely to be greatest.

Gilovich & Medvec (1995) show that people feel more regret in the short run for actions, and more regret in the long run for inactions. Though there is some debate over exactly why this difference exists (Gilovich & Medvec, 1995; Kahneman, 1995), there is consensus that regret requires consequences and that the consequences of action take less time to be realized than the consequences of inaction (Gilovich et al., 1998). The implication is that decision-makers should be wary of regret-induced hesitation in time-constrained decisions, and of regret-induced impulsivity in decisions without a time constraint.

Closely related to regret is disappointment. Regret derives mainly from realizing that a rejected alternative would have been superior to the actual choice. Disappointment follows from learning that the chosen option is worse than was expected. For a comparative discussion of both regret and disappointment, see Zeelenberg et al. (2000).

Other Emotional Responses

Regret is not the only emotion-based response to decision outcomes that has been explored. After a choice between gambles, individuals learned the outcome of the selected gamble and described their emotional response to the outcome (Mellers et al., 1997). The emotional responses revealed that unexpected wins are more pleasurable than expected wins, and any outcome is less pleasant if that which might have been was better.

Implementation

To complete Phase 5, we acknowledge two last activities, implementation and feedback. The former’s connection to decision-making is mainly in cases where the original decision may be successively refined as more details are specified (each of which may entail its own subsidiary decision) or revised as unexpected events dictate ‘midcourse corrections.’ For a brief introduction to the challenges of implementation, see Interlude C of Russo & Schoemaker (2002).

There is little empirical work that touches on the implementation of decisions. In one such study, decision-makers expressed a choice for each of two gambles that were played sequentially (Barkan & Bussemeyer, 1999). After the outcome of the first gamble was known, those decision-makers were allowed to revise their choice for the second gamble. The experience of a gain (loss) on the first gamble, even when it was fully expected, led to a shift toward risk aversion (seeking) in the second gamble – in accord with Prospect Theory (Kahneman & Tversky, 1979).
Learning from Experience

Although learning from feedback has never been a large part of decision research, it has received some attention for over two decades (Einhorn & Hogarth, 1978). There are two broad perspectives on the task of learning: causal explanation and noncausal prediction. The latter is exemplified by forecasting, on which there is an extensive literature (e.g., Armstrong & Collopy, 2001). A common error of untutored performance is not using all the feedback or outcomes that are available. A tragic example is the decision to launch the Challenger space shuttle in January 1986 based on an analysis of all past failures but omitting past successes (Dalal et al., 1989). Remarkably, a clear relation between launch success and launch temperature only emerged when the data from all past launches were plotted, including the normally less pertinent cases of successful launches. Feedback is often not available to a learning analysis for the simple reason that decision-makers do not take the trouble to keep track of it (e.g., Goldberg, 1959). Even when decision-makers do all they can to gather and use past outcomes for the prediction of future cases, difficulties remain. Sometimes the feedback is inherently incomplete, as when the VP of Marketing never learns how the rejected applicants for Director of Market Research would have performed (Einhorn & Hogarth, 1978). At other times, the quality of the feedback is degraded by noise in the environment, especially when there is a long delay between the decision and its outcome (e.g., Jennings et al., 1982). Finally, even with complete and precise feedback, delay alone can inhibit learning (Gibson, 2000).

The task of learning as causal explanation (to be distinguished from prediction-oriented learning that is noncausal or statistical) is fraught with obstacles to success. It is much easier to know what happened than to know why it happened. Errors of untutored performance include an army of ego-supporting actions. Self-serving attributions of cause outweigh the decision-maker's skill when performance is good, and overweight the role of chance when the outcome is bad (e.g., Betzman & Weitz, 1983; Curren et al., 1992; Salancik & Meindl, 1984). Decision-makers resist attributing the cause of a negative result to themselves, thereby accepting blame. They may distort their memory of earlier statements (e.g., predictions), claim that those statements were misunderstood (i.e., reinterpret them), or even change their preferences to make the outcome feel less noxious (the sour grapes effect). Finally, sometimes decision-makers confuse their decision with its implementation. That is, a causal analysis of the outcome must distinguish between the quality of the decision (which, in this chapter, means the quality of the decision process) and of the implementation. Failure to appreciate the role of implementation is a kind of 'treatment effect,' with the most extreme case (known as self-fulfilling prophecy) occurring when a treatment (or implementation) is totally ignored as a cause of the decision's outcome (Jussim, 1986; Kierin & Gold, 2000). In summary, the challenges to effective learning of multiple partial causes are aggravated by several self-imposed obstacles.

Conclusion

This chapter adopted a process view of decision-making with goals as the drivers of the decision process. A five-phase structure and a distinction between the correctable and unavoidable obstacles facing decision-makers was used to organize the task of effective decision-making, as well as some of the known findings of the field. This concluding section addresses two questions. First, how far can this process view be taken or, more specifically, what would be required to raise its status from framework to theory to model? Second, what intellectual paths have decision researchers traveled and which way do these paths point as we look towards the future?

Completing the Framework

What’s Missing?

Even a casual inspection through the lens of our framework reveals many gaps in our knowledge of decision processes. For instance, we know relatively little about the formation of a problem representation, as crucial as it is. Furthermore, systematic experimentation has been focused on such specifics as the reference points of components of the alternatives, with much less exploration of full mental models. Similarly understudied, at least in the domain of decision-making, is the generation of options (Phase 2). The bulk of research has focused on the information collection and resolution activities of Phases 3 and 4.

Goals: We argued for the central role of goals as the guiding force of the entire decision process. Yet goals played only a minor role in our discussion of Phases 2 through 5. And this role was limited largely to theorizing, because there is so little direct empirical evidence on the activation of specific goals during the decision process. Before decision research can be reliably linked to goals, we need direct evidence of goal activation during the decision process. Unfortunately, as mentioned above, attempts to recover goals directly during the decision process have largely failed. For instance, Chaturand & Bargh (1996) showed that even though participants assigned to different goal-prime conditions assessed information consistently with their condition, they were unable to retrospectively report goals as differentially active across those
same conditions. Similarly, Markman & Brendl (2000) report little success recovering the goals that drive consumers' choice processes, whether participants were queried during or after the choice process. Only when consumers were asked to report why attributes were important did they begin to reveal goal-relevant information.

Using a newly developed method, Carlson (2001) has successfully recovered decision-making goals. He tracked the activation levels of 15 general decision process goals (viz., achieve certainty, avoid the worst, be consistent, choose the best, conserve effort, consider all information, develop an impression, enjoy the process, justify, learn about the options, learn my preferences, narrow the set, pick at random, remember the information, separate the options). His method conjoins training for goal recognition with retrospective memory prompts to aid goal recall. These substantial prompts include the original choice alternatives, the responses to progress questions answered during the choice process, and playback of a videotaped verbal (and visual) protocol. Results revealed that decision-makers can report the activation levels of multiple goals at several points during the choice process and that these reports varied with individual expertise, composition of the choice set, and phase of the decision process. Perhaps methods that enable the measurement of the goals active during the decision process will encourage development of the goal component of the framework.

Theory and Model

Can a theory be based on an organized collection of validated cognitive processes or must it be fully computer-implemented as Simon (1992) has urged? If the latter is to be achieved, what must be added to the framework to create a complete theory? Maybe the most glaring inadequacy of the current framework is the lack of specification of the transitions. Given how little is known empirically about the transition decisions, this is understandable. A complete theory will require something like rules that specify the computations on which the transitions are based.

Two other elements that are almost entirely missing are memory and emotion. A model for the former is provided by Dougherty et al. (1999); see also Hastie & Park (1986). As illustrations of the potential value of integrating a memory mechanism into decision-making, see Dougherty's (2001) application of his memory model to account for aspects of overconfidence, and Seifert & Patalano's (2001) predictive encoding model to explain goal activation. The topic of emotion is more complex and pervasive than memory. Fortunately, more is known about the role of emotion in decisions. See the extensive work of Luce et al. (2001) and, more generally, the special issue of *Cognition and Emotion* (Schwarz, 2000) and the volume edited by Martin & Clore (2001).

The final aspect of behavior, and maybe the most difficult, is nonconscious processes (Alba et al., 2002). Like goals, they have been difficult to study empirically, but their importance is becoming clear. One such phenomenon is the mere-measurement effect, in which merely responding to a question about the intent to perform a behavior increases the likelihood of that behavior (Sherman, 1980). For example, Morwitz et al. (1993) found that when over 40,000 consumers were asked, 'When will the next new car be purchased by someone in your household?,' the proportion of automobiles purchased over the next six months rose from 2.4% to 3.3%. The mere-measurement effect is primarily due to nonconscious processes (Fitzsimons & Williams, 2000), which suggests that reducing it by warnings or other conscious interventions is unlikely to succeed (see also Wilson & Brekke, 1994, and Fitzsimons & Shiv, 2001). Because other nonconscious phenomena will undoubtedly be found to affect decisions, this should remain an active area of work.

Model

A fully articulated model might take one of two forms. The first is a computational model like those described in Newell & Simon's (1972) *Human Problem Solving*. Carpenter & Just (1999) make the case for such models applied to higher-order cognition, though their several applications do not include decision-making. The alternative model form is the associative network. These models represent concepts as nodes in a network and contain some form of diffusion of activation along the connecting links between nodes (e.g., Holyoak & Simon, 1999; Janiszewski & van Osselee, 2000; Leven & Levine, 1996; Roe et al., 2001; Simon et al., 2001; Thagard & Millgram, 1995; West et al., 1997). Any interest in speculating which of these two directions might be more productive must be dampened by how much detailed empirical evidence is still lacking. It may well be that more specifics of the process of making decisions need to be revealed not only before one direction can be chosen over the other, but before the superior model can be adequately specified.

**Past and Future**

In the beginning, there was only the guidance of the Ancients. Plato urged decision-makers to 'choose that course of action in which the painful is exceeded by the pleasant' (Jowett, 1953: 184). Two millennia later the economists who addressed value and the mathematicians who addressed likelihood
began to formalize that ancient advice into numerically precise measurements and rigorous theories of rational decision-making. Their efforts culminated in von Neumann & Morgenstern's axiomatization of Expected Utility (1944, 1947). This theory was extended to subjective probabilities (Edwards, 1954), augmented by Bayesian updating and, to a lesser extent, combined with a general additive utility structure. Taken together, this conceptual corpus formed the theoretical content of the optimality paradigm (Schoemaker, 1982) that dominated decision research in the 1950s and 1960s.

The descriptive failures of the various manifestations of this source of models were also beginning to be exposed in these decades. Joining these empirical shortcomings were the obvious invalidities of the behavioral assumptions made or implied by the economists. In terms of the decision process, the economists presumed that every course of action could be valued accurately (and precisely) and, of course, that the one with the greatest overall value would be chosen. Even when this valuation process was composed of a fully specified sequence of mathematical operations, there was no serious claim that the operations described a cognitive process. As Simon (1951; 366) noted: 'Economics dodged the problem of a theory of the mind for two centuries with its a priori assumptions of human rationality. But those assumptions are no longer fruitful; they must be replaced by a more veridical theory of the human mind.'

After behavioral researchers began exposing the descriptive failures of the economic/statistical models, they naturally speculated on the actual cognitive reasoning or processes. They proposed conservatism (Edwards, 1968; Phillips & Edwards, 1966), anchoring (Slovic & Lichtenstein, 1971), overconfidence (Adams & Adams, 1961; Lichtenstein et al., 1977; Oskamp, 1965), and so on. Most of this work demonstrated some violation of a rational standard (Ardes, 1991). They became known first as biases and later as anomalies (Thaler, 1994). While some went no further than confirming a violation (e.g., Grether & Plott, 1979), others led to 'behavioral regularities' like those that emerged from Prospect Theory (Kahneman & Tversky, 1979) and asymmetric dominance (Huber et al., 1982). In general, this work yields 'cognitive processes described at an intermediate level of generality' (Kahneman, 1991: 142), a description that echoes Robert Merton's famous 'theories of the middle range' (namely, as general as possible while constrained to the formulation of specific hypotheses vulnerable to empirical refutation). The anomalies stream has grown to dominate decision research in the last two decades (e.g., Shafir & LeBoeuf, 2002).

Other behavioral researchers have drawn less from the economics/statistics tradition of rigorous rationality, and more from the cognitive revolution of the 1970s. Their focus is primarily on increasingly detailed description. Thus, whereas the economists' decision process is straightforward and 'positivist' (Thaler, 1980) or 'paramorphic' (Doherty & Bremer, 1997) and the anomalies-focused behaviorists infer more than trace the decision process, the process-oriented behaviorists seek process-based explanations of increasing detail.

The present chapter reflects this last perspective and reveals how far this enterprise is from success. After dividing the decision process into phases and into errors and challenges within phases, many of the preceding sections are characterized by a non-coherent list of phenomena. Where will the explanations be found that unify these many phenomena into a detailed, coherent description of the decision process?

Should the trend continue of increasingly detailed analyses of the decision process? Will a unifying explanation be found there, or must our theorizing shift to associative neurocognition (e.g., Holyoak & Simon, 1999) or even neurophysiology itself (Platt & Glimcher, 1999)? This question lies at the level of paradigms (Simon, 1983). History teaches that, at some point, the fruitfulness of paradigms declines. That appears to be what has happened to the optimality view. We do not attempt to predict the future of the anomalies or process paradigms — or the emergence of any new competitors (Johnson & Russo, 1994). Instead, it may be best to recognize that the choice of a productive paradigm and the difficult shift from one to another may be at least as important to the field's progress as the normal, if formidable, challenges of theory construction, experimentation, and insightful inference.

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Notes

1. The distinction of one alternative as superior to all others is variously labeled separation or differentiation. The latter term is used to convey the dual processes of detecting differences among alternatives (in overall value) and of calibrating those differences (e.g., Svenson, 1996) until they are sufficient to justify a clear choice. The term distinction indicates only the first of those processes, namely perceiving or discovering the differences that are genuinely present. Thus, while differentiation (or separation) may more inclusively describe the processes that actually occur, distinction seems like the better description of the decision-maker's goal.

2. Chartrand & Bargh (1996) show that participants who are nonconsciously primed with a goal-relevant
concept engage in goal-consistent information processing. One interpretation of this result is that the conscious prime changed the decision-maker’s representation of the task, as well as altering the goals that were active in the decision-maker’s mind.

3. This has been called the Sherlock Holmes phenomenon, meaning that ‘if we are only clever enough, we should be able to make some elementary yet invariably accurate deductions from very meager evidence’ (Behn & Vaupel, 1982: 90).

4. When ties on one attribute are not exact, the dictionary or lexicographic rule is actually a lexicographic semi-order (Lucy, 1956; Tversky, 1969).

5. Addressing societal choices, LeGrand (1990) distinguishes between production tradeoffs and value tradeoffs. The former involve the mundane attributes of most managerial decisions such as competing new products’ expected sales, launch costs, fit with the product portfolio, etc. Value tradeoffs deal with ‘principles’ (i.e., protected values) whose potential status makes compromising them more difficult and painful.

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INDIVIDUAL DECISION-MAKING


