Aiding judgment and decision making

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Introduction

Judgment and decision-making skill is a central theme of this book. This implies that people sometimes consistently carry out judgment and decision-making tasks poorly. In some instances, normal psychological development, practice, and training can be expected to yield stronger skills and thus better performance over time. But there remains the challenge of achieving good judgments and decisions for pressing current situations – “right now.” Moreover, some problems are so difficult that it is unrealistic to expect that any human being, left to his or her own devices, could ever acquire the ability to produce adequate decisions. These facts have motivated the development of “decision aids,” which are procedures or devices that are intended to improve the quality of people’s decisions and are the subject of this chapter.

The chapter addresses several questions, which are considered in successive sections: This is the focal question for the first section: “What do common decision aids look like?” The next section considers this query: “What is the significance of decision aids for scholarship on fundamental judgment and decision-making phenomena – including skill?” The third section pursues the following question: “What exactly are ‘decisions,’ ‘judgments,’ and the high level of ‘decision quality’ that decision aids (should) seek?” The fourth and largest section is the heart of the chapter, and it confronts this question: “How can we determine what, specifically, a decision aid needs to accomplish in a given situation?” The last section summarizes the chapter. It also offers reflections on a final question that challenges every decision aid developer: “How can we ‘sell’ decision aids to the people who need them most?”

Decision aid examples

What is the nature of existing decision aids in professional as well as personal contexts? Many of the best known decision aids described as
such are found in medicine and are intended to help patients make decisions about disease screening or treatment (Leatherman & Warrick, 2008). Such aids take many forms, such as computer programs or websites (e.g. Adjuvant, Inc., 2010; University of Sydney, Screening and Test Evaluation Program, 2003), videos (e.g. Health Dialog, n.d.), pamphlets (e.g. US Department of Health and Human Services, Centers for Disease Control and Prevention, 2010), or oral presentations/counseling (e.g. Hunter et al., 2005). Because of the increasing emphasis on patient autonomy and involvement in health-related decisions, such decision aids have abounded in recent years; the Ottawa Hospital Research Institute (2009) maintains an ever-growing inventory of them.

Outside of health care, there are many other decision aids that are often not explicitly called “decision aids.” Various specialties characterize themselves as providing valuable, even necessary, support for decisions in the business world. Consider the opening sentence in a well-known standard financial accounting textbook (Danos & Imhoff, 1994, p. 4): “Above all else, accounting is a decision-making tool.” Or take the fact that every finance student eventually is exposed to net present value formulas that are used to guide companies’ decisions about investing in new equipment or facilities. Many business students also learn to apply linear programming and related techniques for settling questions such as optimal mixes of supplies to acquire from vendors that have different prices but also are located at different distances from where the supplies are needed. The requisite algorithms are readily available as add-ons for popular spreadsheets such as Excel.

Monte Carlo simulation programs are among those spreadsheet options, too. These are tools that allow the decision maker to anticipate the probability distributions of the long-run consequences of a decision whose potential outcomes are statistical consequences of more elementary processes that are themselves probabilistic. A concrete example of a decision problem suitable for such tools would be determining when a company should begin filling a pharmaceutical manufacturing order when it is uncertain (a) how long it will take to finish each batch, (b) what percentage of each batch will be intact, and (c) whether the intact items in a given batch will pass a quality inspection (Winston & Albright, 2009, pp. 661–6).

Some business students even become proficient in expected utility theory-driven decision analysis methods (see Raiffa, 1968, for an early source). These are techniques for making choices among alternatives at least some of which have outcomes that are not guaranteed. A key feature of these techniques is that they take the decision maker’s personal attitude toward risk into account. Choosing whether to deposit a fund’s money in a
bank account or instead invest it in a new restaurant is an example of a problem considered appropriate for decision analysis.

When you hear a "funny noise" in your car's engine, you take it to your favorite mechanic to be repaired. Before she decides how to proceed, she first runs various diagnostic tests—probably with a computer—in an effort to determine exactly what the problem is. These tests and the computer programs guiding them are decision aids, too. Or imagine a high school senior trying to decide where to apply to college. Many US students consult the best-selling annual issue of the magazine *U.S. News & World Report*, devoted to college reviews. (This special issue was inspired by the kinds of consumer product reviews published in *Consumer Reports* magazine, which are immensely popular decision aids themselves.) There students see descriptions and ratings of each college on a host of dimensions, such as average class size, percentage of applicants admitted, and the proportion of faculty members holding terminal degrees, such as Ph.D.s. The reports also rank-order the colleges in overall quality, as when Harvard and Princeton were tied for the number 1 rank in 2010 (*US News & World Report*, 2010). Another kind of everyday decision aid growing in popularity is represented by online dating services such as eHarmony and Chemistry.com. These services take their users' self-reported personal characteristics, and via formal algorithms or intuition, use them to create dating matches that increasingly result in marriages these days. By one survey-based estimate, nearly 17 percent of recent marriages in the United States were between individuals who had met through online dating sites, many more than those who met at bars, clubs, or social events (Chadwick Martin Bailey, 2010).

**Significance of decision aids for fundamental research**

Why should researchers interested in fundamental judgment and decision-making processes concern themselves with decision aids? Some decision aids are designed to augment or "support" particular simple elements of people's natural processes. The primary aim is to reduce the decision maker's labor burden or the odds of random error, including forgetting. Such is part of the rationale for structured employment interview checklists (van der Zee, Bakker & Bakker, 2002) and for electronic employment screening programs (bestresumewriting.com, 2010). The latter are devices that scan applicants' resumes for keywords, such as, say, "sales." They eliminate from further consideration all candidates whose resumes omit those terms.

Other decision aids completely replace the decision maker in performing more complicated, non-trivial tasks within the overall decision-making
enterprise — perhaps even the entire process altogether. The kinds of linear programming spreadsheet programs mentioned previously are a good illustration. Although the decision maker supplies the inputs, the given program is responsible for the integration of all those inputs, resulting in a recommended decision, e.g. “Buy X units from A, Y units from B,” and so on.

Regardless of whether a decision aid supports or replaces a human decision maker, the design of the aid entails assumptions as to the limits of current or even potential human decision-making skills. Thus, among perhaps the simplest cases, interview checklists acknowledge human attention and memory constraints. At another extreme, contemporary linear programming spreadsheet modules do not require the user to know anything about the mathematics of the underlying algorithms. It is plausible that sometimes this is because the designers assume that the reasoning is beyond the intellectual capacity of many decision makers — the capacity to carry out the required operations in their heads, or even to comprehend the principles involved.

Now, suppose that a decision aid is shown to yield better decisions. Then, all other considerations held constant, this constitutes at least minimal evidence that the skill and process assumptions — the theories — underlying that aid’s design are valid. That is, the aid has shed light on the nature of fundamental human decision psychology. More generally, it is clear that decision aids have both scientific as well as practical significance.

**Core constructs: “decisions,” “judgments,” and “quality”**

Preciseness about the meanings of core constructs is essential in all serious research, but it is especially important in decision aiding scholarship. That is because the aids are intended to facilitate decisions that sometimes jeopardize enormous sums of money, and even people’s lives. Therefore, ambiguity should not be allowed in any way to obscure developers’ clarity of purpose or to encumber the integrity of their analyses. In order to avoid that possibility, the present section seeks to make clear key terms whose meanings are often surprisingly slippery.

**Decisions**

Among the first questions that a decision aid developer must confront are ones like these: “Just what is a ‘decision?’ Isn’t ‘decision making’ the same thing as ‘problem solving?’ Why don’t you just consult the problem solving literature to figure out what to do?” Decision making is a
fundamental human endeavor. It is therefore not surprising that there is significant decision-making scholarship in many traditional disciplines, from psychology to personal counseling, economics, philosophy, marketing, medicine, law, political science, finance, and engineering. The following is a definition of the term “decision” synthesized from usage in the diverse literatures of such fields (cf. Yates, 2003, p. 24): a commitment to a course of action that is intended to serve the interests and values of particular people. In contrast, this is a consensus definition of a “problem” (cf. Glass & Holyoak, 1986, p. 385): a circumstance in which a person wants something that is not immediately attainable.

Implicit in these definitions is the fact that decision making is a special case of problem solving. The key, distinguishing features of a typical decision problem are (a) that the solution entails making a commitment to undertake some action, and (b) that the aim is to bring about consequences that are good for and also satisfying to specified individuals. That is, the intended “beneficiaries” of that decision include some people, but not necessarily others. The general problem-solving literature tends to focus on problems with universally accepted “correct” solutions. However, decision research often concentrates on problems where that is not so. Every trained mathematician would agree that a proposed solution to any geometry problem either is or is not sufficient, for anybody. But sufficient decisions typically differ for diners pondering a meal to be chosen from a restaurant menu. After all, people often have markedly different nutritional needs (e.g. minimal sodium) and also distinct tastes in foods (e.g. for salty vs. sweet snacks).

**Judgments**

In traditional decision scholarship, the most common meaning of the term “judgment” is that it is an opinion as to what was, is, or will be some decision-significant state of the world (cf. Yates & Chen, 2009, p. 645). In a used car scenario, a “was” judgment might concern the car’s accident history, e.g. “Has this car ever been in a major crash?” The request is for a “categorical judgment,” where the discrete alternatives are “Yes” and “No.” An illustrative request for an “is” judgment, where the target is “quantitative,” would be: “What percentage of the front brake pad thickness remains?” A frequently sought “will be” judgment in probabilistic form might go something like this: “What’s the probability that the resale price of this car in five years would be at least a third of its current price?” As these examples suggest, judgments are essential, although not the sole, contributors to most real-life decisions. That is one reason that researchers often speak of their field as being about “judgment and decision
making,” not simply “decision making.” And a careful examination of published papers would reveal that a high percentage of work in the field actually addresses judgment (e.g. judgmental heuristics, overconfidence) rather than other aspects of the decision-making enterprise.

It is important to recognize that real-life judgment situations often entail subtle yet significant relationships among particular judgments and decisions. In a given setting, a person might hold a certain “true” judgment in her head, yet announce a different “reported” judgment to others. Such is the case, for instance, when a physician truly believes that a patient’s chances of full recovery from his current condition are “poor,” but tells the patient and his family that the chances are “not bad.” The physician made a decision about what to report the recovery chances are. That decision took into account the doctor’s true judgment – “poor” but also other considerations, too, such as the doctor’s desire to avoid discouraging the patient’s efforts to achieve recovery. The spirit of this distinction between true and reported judgments is the same as that underlying signal detection theory (Green & Swets, 1966).

Quality

At some point, every decision aid developer is confronted with questions like these: “Does it really work? How well does it work?” These questions sometimes come from the developers themselves, from the sponsor paying for the development efforts, or from decision makers who are considering whether to use the aids. These are questions about decision aid quality. Decision aid evaluators have sought to answer such questions in a surprisingly wide variety of different ways. For instance, Kennedy (2003) and Leatherman & Warrick (2008) reported in their reviews of medical decision aid evaluations that the metrics often include:

- the patient’s relevant knowledge (e.g. about prostate surgery’s incontinence side-effect risk statistics);
- the patient’s subjective experience of the decision-making process (e.g. feeling anxious and conflicted or else comfortable and autonomous in determining whether she has a radical mastectomy);
- the patient’s health behavior (e.g. choosing to have a mastectomy or regularly monitoring her blood pressure);
- the patient’s health status (e.g. his insulin level or, in the extreme, his diabetes-induced blindness or death);
- the costs of the patient’s chosen health services (e.g. the expense of the hormone replacement therapy she selects);
Aiding judgment and decision making

- the amount and cost of staff time required to assist the patient in arriving at her decision (e.g. the longer or shorter amount of physician or less expensive nurse interaction time needed);
- the patient’s satisfaction with the decision or with the process by which it was made (e.g. his belief that his choice of heart surgery was wise or his feeling that interaction with the staff was pleasant).

Some researchers (e.g. Kennedy, 2003) see it as significant that any given decision aid evaluation study considers only a small number of these varied considerations, not the entire ensemble. They take that as evidence that the community of medical decision aid developers lacks consensus about what decision aid quality means and, implicitly, what they should design their decision aids to achieve.

Arguments like these are highly plausible. But there is a perspective on decision-related quality constructs that offers a somewhat different interpretation of common practice in evaluating decision aids in medicine and elsewhere (Yates, 2003, pp. 31–9). More importantly, that perspective also arguably provides a more coherent and productive means of thinking through quality considerations generally.

Recall the consensus definition of a “decision” sketched earlier, viz., a commitment to a course of action intended to serve the interests and values of particular people. Implicit is the following conception of decision quality (cf. ibid., pp. 31–2): a decision is “effective” to the extent that it in fact serves the interests and values of its intended beneficiaries. The term “effective decision” rather than “good decision” is chosen deliberately. That is because, over the years, the latter expression has sparked heated controversy that distracts from present purposes.

Also, recall our convention that a “decision aid” is any procedure or device intended to improve decision quality. It therefore follows that a decision aid is “effective” – has high quality – to the degree that it tends to yield decisions that are more effective than they would have been otherwise, i.e. decisions that better serve the beneficiaries’ interests and tastes. Imagine that your auto mechanic replaces her old diagnostic computer with a new one. And suppose that your mechanic’s repair choices predicated on diagnoses from her new computer result in happier customers whose cars run better. Then, assuming that all else remains the same (e.g. your mechanic’s technical skills), we would legitimately consider the new computer to be a more effective decision aid than its predecessor, otherwise not.

Note that the previous example actually implicates the notion of quality for judgments as special kinds of decision contributors. The overriding (although not sole) quality concern for judgments is “accuracy,” the correspondence between the judgments and the true states of
the world (see, e.g. Yates, 1982). Consider automobile diagnostic computers A and B. Suppose that an audit is made of the closeness between A's diagnoses and the actual causes of cars' malfunctions, and that a similar assessment is made for B's diagnoses. If the average measure of diagnosis-truth closeness is better for A than for B, then A's diagnoses—a special class of judgments—are considered more accurate. Moreover, ceteris paribus, we should expect more effective repair decisions to result from those diagnoses.

It is important to acknowledge two broad dimensions of decision and, hence, decision aid effectiveness, as depicted in Figure 10.1. First are effectiveness elements tied to a decision's outcomes per se, ones that are produced by the course of action the decision maker eventually pursues. In a home purchase decision, these would be outcomes of owning the house you actually buy, e.g. its proximity to your favorite restaurants. Such outcomes can spark evaluative reactions in beneficiaries in several ways. (Bear in mind that one of those beneficiaries is virtually always the decision maker, since people almost never knowingly decide against their own interests and values, even when they are ostensibly deciding for others.) One source of those reactions rests on whether the outcomes
fulfill the decision maker's aims, e.g. whether your mortgage payments prove to be within your financial means. Another is tied to comparisons between the outcomes actually experienced and those that would have been achieved had a different, rival course of action been pursued, e.g. regretting not buying the house down the street after realizing that it is more comfortable than the one you actually picked. Yet another contributor to beneficiaries' feelings about outcomes rests on side effects, the multitude of pleasant and unpleasant decision outcomes beyond those that were explicitly sought or otherwise considered, e.g. helpful, friendly neighbors. Such side effects virtually always occur and can spell the difference between a decision that, on balance, succeeds or instead fails.

The second broad dimension of decision effectiveness consists of decision process costs and benefits. These include outcomes that will be experienced regardless of the action pursued by the decision maker, as a result of the activity of deciding itself. Some costs are material, such as money or resources that can be translated fairly directly into money, e.g. the amount of time it takes to make the decision. Other costs and benefits are non-material, for instance, psychological. Stress and the aggravation of interpersonal discord, as when joint decision makers become angry when they cannot reach agreement, are important examples. Feelings of independence, control, and achievement are benefits often emphasized in medicine, politics, and governance. Another is learning, frequently mentioned in the development of managerial expertise.

As suggested by the last remark, in practice, there are tradeoffs between outcomes per se, on the one hand, and decision process costs and benefits, on the other. Thus, decision makers are sometimes willing to sacrifice some measure of decision adequacy in terms of outcomes per se in exchange for lower process costs or better process benefits. Consider, for instance, the complaint processing procedures that many companies administer through their automated telephone systems. These procedures require customers to work their way through elaborate and tedious queries in an effort to isolate and decide how to deal with a service issue: "If you are having a problem with ... , then press or say 1, ..." The companies' managers are fully aware that human operators, on average, can make the necessary decisions better and faster (as well as less annoyingly) than these automated procedures. But they are also fully aware that human decision makers cost more money to employ.

What does all this say about how to interpret the seemingly scattershot character of decision aid evaluation research, for instance, in medical care? Our sense is that evaluators implicitly appreciate and accept the core ideas in the present characterization of decision and decision aid effectiveness. Each of the medical decision aid evaluation metrics
identified in the reviews by Leatherman & Warrick (2008) and by Kennedy (2003) can be mapped onto particular classes of effectiveness dimensions distinguished in Figure 10.1. For example, the primary aim in almost every medical decision problem is improving, or at least maintaining, the patient's health status. And in today's economic climate, patients and their providers are forced to pay close attention to all costs, including the material costs associated with deciding on their treatments. At the same time, though, patients faced with painful choices (e.g. mastectomies vs. less drastic breast cancer treatments) experience enormous non-material costs, such as stress, that somehow need to be addressed. In any given evaluation study, however, the investigators focus on only a small number of the effectiveness dimensions that might be affected by a decision aid. The question is, why?

One plausible possibility is that the evaluators in any given study only rarely think about the complete big picture, in the manner of Figure 10.1. Another is that practical concerns channel attention to some aspects of decision effectiveness rather than others. Consider the fact that, despite the obviously paramount importance of the patient's health status, fewer than half the medical decision aid evaluations reviewed by Kennedy (2003) included health status among their metrics. Kennedy's speculation (p. 262) might be correct, that this is because the developers and evaluators realized that the decision aids in question had little chance of affecting health status, or that such effects would emerge too slowly to be addressed in a short-term evaluation effort. There is a third potential—and legitimate—explanation for evaluators' narrow focus, too, which is considered in the next major section of the chapter. But before examining that idea, it is worthwhile to comment briefly on a frequently discussed quality perspective not mentioned so far here.

The present perspective on decision and decision aid quality emphasizes outcomes. Some decision scholars pointedly reject this point of view. Consider the remarks of Hammond, Keeney & Raiffa (1999, p. 110): "Although many people judge the quality of their own and others' decisions by the quality of the consequences—how things turn out—this is an erroneous view." Those who share this sentiment generally argue that decisions should be evaluated according to the quality of the procedures by which they are made. They further submit that good decision procedures are ones that are "coherent," "internally consistent," or "rational" (in a special sense of the term). This means that the decision maker's reasoning does not contradict itself in particular ways.

The intuitions of Hammond, Keeney & Raiffa (1999) about how real-life decision makers think are correct. In practice, people overwhelmingly assert that "good" decisions are ones that yield good outcomes and that
Aiding judgment and decision making

"bad" decisions are those that do the opposite, as verified by Yates, Veinott & Patalano (2003). They therefore seem to want assurances that the decision aids they use would be more likely to deliver better outcomes than their competitors, consistent with the statistical, outcome-focused conception of quality advocated here. There is reason to expect that, in principle, a decision procedure's coherence can indeed justify some modest degree of confidence that resulting decisions will serve beneficiaries' interests, e.g. it will provide protection against "Dutch books" (cf. Yates, 1990, Chs. 5 and 9). But we are unaware of evidence that coherence per se provides the strong warrants people crave.

A reasoned strategy for designing and evaluating decision aids

Imagine a prospective decision aid developer who is greatly concerned about how badly people seem to be making decisions in some arena. Consider, for example, developers concerned about patients deciding whether to undergo genetic testing for an incurable, progressively debilitating disease, researchers picking their next grant application topics, or young adults selecting their spouses. The developer wonders: "We can't do everything, and we don't want to waste our meager resources on features decision makers neither need nor want. So how can we best target our decision aiding efforts? And once we put something in place, how can we tell whether it's actually working?" In this section we describe what seems to be a systematic, comprehensive, and reasoned approach to such challenges, unlike any we have seen elsewhere. Is there a need for such an approach? Decision maker indifference to many thoughtful and well-intentioned decision aids suggests that there surely is (cf. Brown, 2010; Yates, Veinott & Patalano, 2003).

The air transport safety model

In the United States, when an airline (or major marine) accident occurs, an effort is launched immediately by the National Transportation Safety Board (the NTSB) to establish why the crash happened (see National Transportation Safety Board, 2004). Almost invariably, the investigators eventually announce probable causes for the tragedy. After that, the investigators and regulators (the Federal Aviation Administration) focus on the particular causes or contributors that (a) played the most significant roles in the crash, and (b) are subject to influence by the tools that are available and affordable. Suppose the crash was due mainly to a certain kind of pilot error. Then the regulatory agency might require that pilots for
the model of aircraft involved complete a special training module. That module would be designed to equip pilots with skills and habits that reduce the odds of similar mistakes in the future. This kind of investigation/regulation cycle is a good illustration of the logic and techniques of “root cause analysis” (e.g. Ammerman, 1998). Note that when an airplane crash occurs, regulators do not try to overhaul the entire air transport system: instead, they take a more focused, incremental approach. They make only local changes to the system, ones directed toward the specific weaknesses in the current system determined to have contributed to the incident investigated. It appears that, over time, this approach has helped make air transportation in most of the world safer and safer (e.g. Savage, 1999).

Whether described that way or not, over time crash investigators have also developed a high-level "theory" of how and why the air transport system works and therefore sometimes fails. That theory is embodied in a taxonomy of major classes of crash contributors that investigators have come to recognize through years of inquiries. It starts with top-level broad categories such as "Weather," "Crew Impairment," "Equipment Failure," and "Pilot Error." Such categories provide a systematic and efficient means of starting and steering productive investigations – a checklist. Over the years, many, many cases have been examined and much more has been learned in related research (e.g. about weather phenomena, substances that can impair performance, aircraft materials, and human performance limits). Thus, the constantly evolving high-level theory has become richer and richer and it promises to do so indefinitely. The remarkably successful history of air crash investigations can serve as a model for decision research and decision aid development, as we discuss presently.

**Decision stories: The evolution of the cardinal decision issue perspective**

For a good number of years, we have actively sought out real-life “decision stories” in order to approximate a crude parallel to the NTSB’s investigatory experience, but in the decision-making domain. These stories are accounts of distinctive and consequential real-life incidents in which decisions played key roles. Some of these stories have been gathered in controlled research (cf. Yates, Veinott & Patalano, 2003). Others have been provided by projects in various decision psychology and decision management courses. And more still have come from published descriptions of newsworthy contemporary and historical events, big and small. Such stories are endless, for they are part of the fabric of daily life everywhere. Most stories have been “negative” in the sense that the decisions
Aiding judgment and decision making

involved were conspicuously dysfunctional; but a few have been “positive,” recounting distinctly outstanding decisions. The constraints on trying to mimic true root cause analyses are obvious. Usually (though not always), we are not on the “crash scene” and therefore cannot guide the inquiry in the directions it ideally should go. Instead, we must draw inferences from the accounts as given to us. Nevertheless, over the years, the inferences have consistently pointed toward conclusions that make sense and cohere. The stories have been numerous and diverse. Thus, there is some reason to believe that the emerging picture of decision making generally and of decision aiding needs, in particular, is reliable and comprehensive.

Recall that, over time, air crash investigators came to recognize that certain categories of contributors tended to recur in many different crashes, e.g. “Pilot Error,” “Weather.” A similar experience occurred with our story analyses. It became apparent that particular issues come up repeatedly in decision making, in fact, appearing in some form or another in every narrative. That is why those issues have been labeled “cardinal”; they are necessarily resolved in some fashion or another in every decision episode, even if not deliberatively, and perhaps only by default. It is useful to think of “decision processes” broadly as consisting of the decision maker’s means for resolving each of the cardinal issues as it arises in a given decision situation. Further, how well every issue is resolved determines the eventual adequacy of the resulting decision. Put another way, the poor resolution of particular cardinal issues amounts to a high-level way of explaining failed decisions. Figure 10.2 provides a schematic representation of the resulting “cardinal issue perspective on decision making,” including a listing of the issues themselves (Yates, 2003).

Before we proceed, first note the arrangement of the cardinal issues in Figure 10.2. In practice, the issues do not present themselves in a strict order. In fact, in a single decision episode, each issue can easily arise more than once, being repeated after other issues have been addressed in the interim. Nevertheless, in natural decision situations, the issues do not come up entirely haphazardly either. Roughly, each issue can usefully be seen as typically occurring in one of three major phases in a decision episode: preliminaries, core, and aftermath. The “core” refers to deliberations about specific alternatives under consideration. The foci of these deliberations include constructs that are mainstays of traditional decision research, including judgments and tradeoffs. The “preliminaries” encompass activities that set the stage for those in the core, including the recognition of an occasion to make a decision. The “aftermath” entails events that occur after a decision has been rendered, including the enactment of that decision. They are legitimately considered part of the
decision episode in question because they follow from that decision and their character depends on how and how well the decision was made. What exactly are the cardinal issues? The names are fairly intuitive. However, more is required, and it is provided in the ensuing discussion of how the cardinal issue perspective can be used productively in decision aid planning and evaluation.

**Decision process analyses**

A class of tool has been evolving from our decision story work: “decision process analysis.” Decision process analyses (DPAs) can serve several broad purposes, implicit in the kinds of questions they seek to answer:
Aiding judgment and decision making

Description: “How did this decision come about? How was it made, at the level of easily observed overt actions?”

Explanation: “Why was this decision made the way that it was, at the level of non-obvious remote or underlying mechanisms?”

Prescription: “How can we improve (reduce) the odds of decisions like this in the future?”

As the name suggests, DPAs focus on the processes by which people decide. The ultimate intent is to understand those processes, or to both understand and improve them, as is the objective of decision aids.

The basic script for a DPA, modeled after the protocols for the kinds of root cause analyses carried out by the NTSB when investigating airplane crashes, is as follows (and made concrete with everyday-language references to a fictional marriage decision):

- **Parties:** Identify the key participants in the decision process (including the decision maker, the intended beneficiaries, and the stakeholders, e.g. the prospective bride, Sara, her parents, and her friends).

- **Decision problem:** Specify the nature of the decision in question (e.g. reaching and carrying through on an agreement to marry a prospective husband).

- **Decision:** Describe the decision actually made (e.g. to marry Dan).

- **Results:** Characterize the quality-significant results of the decision — outcomes per se as well as process costs and benefits — analogous to the details of an airplane crash scene (e.g. “easy choice,” spectacular wedding, many great times, later fights, bitter divorce).

- **Cardinal issue “checklist” review:** For each of the 10 cardinal decision issues:
  
  - **Articulate** the form the issue took in the decision episode (e.g. **1 - Need:** “How did Sara come to find herself making a decision about getting married? Why not sooner, later, or not at all?”)

  - **Evaluate** how well (or poorly) the issue was addressed and in what particular respects (e.g. “Sara arguably would have been better off if the idea of making a marriage decision had never come to mind at that time”).

  - **Describe** how the decision maker resolved the issue (e.g. “Sara simply responded to every marriage overture as it came along”).

  - (Explanation) **Determine and sketch** what led the decision maker to seek to resolve the issue as he or she did, asking successively, “And why did that happen?” (e.g. “It never occurred to Sara to do it any other way. That’s because that is how things were always done in her family. … And that, in turn, is plausibly because of tradition in her
family's culture, according to the literature"). Note that the explanations sought here include the various "Precursors" suggested in Figure 10.2.

* (Prescription) Propose (and rationalize) better, feasible alternatives for each of the decision maker's problematic approaches to the issue (or to the events or circumstances that led to those approaches), including ones indicated by the literature (e.g. "Adopt a more 'vigilant' approach to the need issue, actively seeking to anticipate or even encourage appealing marriage overtures"). As also suggested in Figure 10.2, such prescriptions, which might be carried out via decision aids, could be applied directly to the decision maker's current means for addressing various issues or indirectly via precursors of those means.

A descriptive DPA entails each of the activities in the above script before that preceded by "(Explanation)." If that item is added to the script, we have an explanatory DPA as well as a descriptive one. Implicitly, what we mean by "explanation" for an occurrence in this context is simply that at least one prior or underlying cause or contributor is established. (Bear in mind that if the concern is beyond a specific decision maker on a specific occasion, say, decision makers generally, then many representative DPAs must be performed.) A prescriptive DPA encompasses all the elements of a descriptive DPA and possibly (ideally?) those of an explanatory DPA, too. In addition, though, its script also includes the feature above labeled "(Prescription)."

**Focusing decision aids via cardinal issue reviews: What are those issues?**

Let us return to our prospective decision aid developer seeking guidance on where to focus his efforts and how to evaluate them. Our recommendation is to start with prescriptive DPAs. These exercises should help discriminate specific elements of the decision process that most need attention from those that do not. The prescriptive aspects of the analysis, in particular, can be expected to point directly to how the requisite decision aids should be crafted, i.e. per the DPAs' prescriptions. Note that this approach to decision aid development represents a third – and justifiable – possible explanation for medical decision aid evaluators' narrow focus on just a few of the wide array of common quality metrics cataloged by Kennedy (2003) and Leatherman & Warrick (2008): arguably well-designed decision aids often target only a small number of very specific suspected contributors to deficient decisions, such as those that
Aiding judgment and decision making

can be isolated in DPAs. The kinds of Monte Carlo simulations discussed earlier, which focus on the judgment issue, are an example.

The heart of the isolation process in the requisite DPAs consists of the "cardinal issue ‘checklist’ reviews" described above. We now provide the necessary specifics about the cardinal issues, which we have postponed until now. We first articulate and explain each issue. And, in each case, we identify and illustrate distinct ways that decision makers often fall short in addressing that issue — pointers toward potential decision aid foci. The discussion is organized according to the location of the issues in the scheme displayed in Figure 10.2, shown earlier.

Issues in the preliminaries

1 – Need: "Is there an opportunity or a threat approaching which warrants an effort to decide how to deal with it?" The need issue is the gateway to a decision episode. Its resolution determines whether there is further "real" decision making activity at all. Suppose the decision maker never even acknowledges the need issue, i.e. that an opportunity or threat is impending. Then there is no decision of any sort, since there is literally no perceived need for one. (It is important to recognize that "no decision" is not the same as deliberately "deciding to do nothing" once one has undertaken a decision making effort.) One way the resolution of the need issue can turn out badly is that the decision maker fails to decide when a decision could have left the prospective beneficiaries better off than otherwise. Such is the case, for instance, when a person with hypertension has no clue of that fact, therefore leaves his condition unattended, and consequently is surprised or "blindsided" by a stroke. Another kind of poor resolution of the need issue is the opposite: the person makes a decision, but things would have been better had there been no decision at all. For example, frequent MRI examinations can now readily detect oddities in people’s bodies that can be interpreted as indications of early-stage, slow-growth cancers (e.g. Parker-Pope, 2008). Such signals are so terrifying to some people that they feel compelled to demand invasive biopsies and even surgical treatments that leave them worse off — perhaps even dead — than they would have been had the idea of testing never occurred to them. Computerized reminder systems that automatically send postcards or even e-mail messages to medical or dental patients are a good example of decision aids that focus on the need issue.

2 – Mode: "Who (or what) should become involved in making this decision, and how should they approach their tasks?" Decision "modes" are qualitatively distinct means for carrying out the work required in reaching a decision. The phrase "or what" in the issue
statement acknowledges that, increasingly these days, at least part of the work of making decisions is carried out by devices – decision aids! – rather than people. The “who/what” aspect of the mode issue is about the metadecision of assigning decision making tasks to one person or group of people rather than some other. For instance, although an executive has the authority to personally make a certain budget decision, she might, for better or worse, choose to delegate that chore to a subordinate who serves as her “agent.”

The “approach” part of the mode issue concerns the details of how those designated to become involved in making a decision go about their work. At one extreme, they might approach their work “analytically.” That is, they might call upon any facts and reasoning that seem useful in arriving at a decision that “makes sense.” This is what most people think of when they bring to mind the concept of decision making. At another extreme, contributors to the decision making effort might proceed in an “experience-based” manner (Epstein, 1994). One variety of experience-based decision making is such that the relevant type of decision problem has been encountered – experienced – so many times previously that the procedures for making the necessary decisions become automatized. Thus, whenever certain conditions arise, one particular course of action just emerges automatically: (a) requiring virtually no effort, (b) being subject to no control, and (c) often lying beyond the decision maker’s ability to explain (and therefore sometimes called “intuitive”). The behavior of an experienced tennis player at the net responding to a rapid-fire return by her opponent would be an apt illustration. The distinction between analytic and experience-based decision making is a subject of considerable discussion in current decision research, often under the rubric of “System 1” vs. “System 2” thinking (e.g. Evans, 2008).

Another major decision mode that is intermediate between analytic and experienced-based varieties is “rule-based” decision making. In this mode, whenever the decision maker encounters a particular set of conditions, labeled C, say, the decision maker follows a rule which specifies that, under those conditions, action A should be taken: C → A. Such rules are ubiquitous in medicine and business and are sometimes legitimately described as decision aids. But they have been around much longer than the “decision aid” expression. And some would argue that they are part of the very fabric of medical and business practice. These observers cite standard medical training as illustrative, whereby medical students are repeatedly taught to memorize and apply rules of this form: “If the patient has characteristics C1, C2, C3, . . . , then treat as follows: . . .” To make such treatment decisions analytically would be prohibitively expensive and would almost certainly be less effective. What is the difference
between rule-based and automatic experience-based decision making? Mainly the automaticity of the latter — its speed, lack of control, and cognitive inaccessibility. In rule-based decision making, the decision maker has the discretion of ignoring the rule when the triggering conditions arise. Not so with automatic decision making.

When is the mode issue mishandled — thus pointing toward the need for a mode-focused decision aid? When ineffective decisions can be traced to any of the remaining cardinal issues that would have been addressed better via a mode other than the one actually pursued. One of the simplest mode-focused issue decision aids consists of the rules most large organizations have whereby decisions about expenditures above certain cost thresholds are reserved for officials beyond a specified rank, e.g. “In your new position, you are allowed to make, without prior authorization, any purchase under $1000.”

3 – Investment: “What kinds and amounts of resources should be spent on — invested in — the process of making this decision?”
Clearly, this issue speaks most directly to the process costs and benefits dimension of decision quality. Decision making is never entirely “free,” that is, without expense. There are typically both material (tangible) and non-material costs, as reviewed in our earlier discussion of decision quality. The investment issue is about assuring that essential decision process elements are not “underfed” in terms of both the kinds and amounts of resources they require in order to maximize their chances of delivering effective decisions. But the issue is about avoiding wasting resources, too. Implicit in these observations are specifications of how decision makers might get the investment issue “wrong”: applying inappropriate kinds of resources, or else being too stingy or too extravagant in allocating those resources.

As implied in our earlier discussion of illustrative decision aids, many familiar, everyday decision aids have been motivated partly by the desire to reduce decision process costs. Such is the case for Consumer Reports reviews for almost any class of product, such as washing machines. These reviews eliminate much of the consumer’s burden in identifying viable alternatives as well as appraising them. Decision process costs have been a prominent theme in decision behavior research since Simon (1956) introduced his ideas about satisficing over 50 years ago. A significant portion of that research can be seen as aimed toward decision aiding. Consider, for instance, research on so-called “fast-and-frugal” heuristics (e.g. Gigerenzer, Todd & the ABC Research Group, 1999). Much of that work has sought to demonstrate that employing such heuristics can yield judgments that have accuracy levels comparable if not superior to those of far more labor-intensive procedures. Relatively recent research has
examined individual differences in decision process cost expenditures. Take, for example, studies examining individual differences in tendencies toward maximization vs. satisficing (e.g. Schwartz et al., 2002) along with their implications for phenomena such as anxiety and depression. A next logical step in work like this is the development of decision aids that can alter such tendencies.

**Issues in the core**

4 – Options: “What are the candidates that should be considered as potential courses of action to pursue?” This is a common refrain in decision-making meetings: “Consider every alternative, leave no stone unturned!” It is also a bad plan for addressing the options issue, which is about assembling the set of alternatives that are seriously considered as solutions for the decision problem on the table.

If a possible course of action goes unrecognized, this could be either good or bad in terms of the adequacy of the eventual decision. Suppose that a certain superb alternative never comes to mind, but instead weak ones do. Then the decision maker necessarily must make a decision that is worse than it could be. On the other hand, when poor alternatives are recognized even in the midst of good ones, there is often significant “appraisal risk.” That is, for myriad reasons, one of the poor options could be picked. Such is the concern of parents who worry that their teenage children will choose their friends badly from among the candidates who just happen to be within the children’s presence.

In addition, no matter what their quality is, the more options there are that are brought to the decision maker’s attention, the more work the decision maker must perform in order to appraise them, thereby increasing—and often wasting—decision process costs. This is a seldom acknowledged downside to various brainstorming and nominal group methods, which can be remarkably prolific at helping people generate large numbers of alternatives, the vast majority of which necessarily will (and should) never be chosen (e.g. Diehl & Stroebe, 1987; Galupe & Cooper, 1993). This fact highlights the need for such option-focused decision aids to be enhanced by features that address this added cost.

5 – Possibilities: “What are the various significant things that could happen if these courses of action were pursued, things that would matter to the parties associated with this decision?” This issue is mainly concerned with a form of blindsiding that is different from the variety discussed in connection with the need issue. It is implicated in failed decisions after which the decision maker says something like this: “I didn’t miscalculate the chances of that happening. The very possibility
of it happening simply never crossed my mind at all.” Such is the case when, after living in his new home for six weeks, one day a home buyer discovers that his street is completely flooded and blocked off after a heavy rainstorm. He is dismayed when neighbors tell him, “Oh, this usually happens at least a couple of times a year.” Two kinds of oversight are implicated in cases where the possibilities issue is resolved poorly. In “momentary oversight,” the decision maker fails to acknowledge the relevant considerations at the moment of decision but would be likely to do so if given enough time to think about the matter. In “fundamental oversight,” the decision maker is unlikely to bring to mind the pertinent considerations no matter how much time is allowed, perhaps because the decision maker is a novice in the pertinent domain, e.g. in recognizing flooding-prone streets. Various checklists, such as those sometimes included in home buyer manuals, are decision aids intended to help reduce the neglect of significant possibilities.

6 – Judgment: “Which of the various things that matter to this decision really would prove to be true?” Recall that in this chapter we adopt the traditional meaning of a “judgment” as an opinion as to what was, is, or will be the state of some decision-relevant aspect of the world. A good example would be a prediction of the eventual job performance level exhibited by a candidate for a university’s presidency. The judgment issue is about the accuracy of such assessments: the more inaccurate the judgments are, the lower is the potential for the pertinent decisions to serve the interests and values of the intended beneficiaries, say, a university’s students. “Judgment accuracy” (another decision-related quality concept, as discussed earlier) is a multifaceted construct. Common overall accuracy measures are known to be decomposable into constituent measures reflecting quite distinct elementary judgment skills, such as “calibration,” “discrimination,” “matching,” “reliability,” and “noise” (e.g. Cooksey, 1996; Lee & Yates, 1992; Yates, 1982; 1990, Ch. 3). Decision aids directed toward alleviating weaknesses in these different varieties of accuracy demand markedly different remedies. Consider, for instance, nomographs that are sometimes used to assist parole boards predict inmate violence risk upon release. These devices remind boards of various prisoner characteristics that have been related statistically to violent recidivism among past parolees and suggest how those characteristics should affect boards’ recidivism predictions (cf. Webster, 2005). Depending on the nature of the tool in question, judgments arguably should be improved with respect to their consistency and their ability to discriminate recidivists from non-recidivists. However, there is little reason to expect improvements in boards’ tendencies to over- or under-predict violent recidivism across the board.
7- Value: "How much would the parties to this decision care – positively or negatively – if they actually experienced various potential outcomes of this decision?" The value issue is actually a special case of the judgment issue, one in which the events being anticipated are people's evaluative reactions to experiences they and others might have, particularly as consequences of the decisions at hand. Such judgments are sometimes much less accurate than might be expected, given people's opportunities for learning. Consider, for example, long-term spouses' limited ability to predict their partners' end-of-life treatment preferences (Fagerlin et al., 2001). There are even highly consistent biases in people's predictions of their own values (e.g., Wilson & Gilbert, 2005). Since they are, in fact, judgments, it is reasonable to expect that decision makers' forecasts of people's values might often be deficient for the same reasons that other judgments can be inaccurate. But the literature has shown that such predictions sometimes consistently exhibit shortcomings that seem peculiar to the value domain. One example is the excessive projection of one's own values onto others (e.g., Fagerlin et al., 2001). There are also "entailment" and "reactivity" errors (Yates & Stone, 1992, p. 65). In the former, the decision maker misjudges how much she would like or dislike an experience because she fails to realize what that experience entails, e.g., working at a job that includes duties she never imagined were required. In the latter, the decision maker errs because her visceral response to an event she fully expected to occur is different from what she anticipated, e.g., a medical student's failure to experience a satisfying warm glow every time she relieves a patient's pain, contrary to what she always dreamed would occur. Recent work has pointed toward techniques that should be effective as tools for reducing the severity of valuation misjudgments (e.g., Wesp et al., 2009). However, we are unaware of concerted attempts to develop aids to help people improve such judgments in actual practice.

8- Tradeoffs: "Every prospective action has both strengths and weaknesses. So how should we make the tradeoffs that are required to settle on the course of action we will actually pursue?" Suppose that: you are shopping for a car and have reduced your options to Car A, which, in your view, has "beautiful" styling but terrible fuel economy, and Car B, which you feel is "rather ugly" yet has outstanding fuel efficiency. None of the other differences between the cars matters to you. You are in a situation of "feature conflict": neither of the available alternatives "dominates" its competitor in the sense that it is uniformly at least as attractive as that competitor with respect to both of the features that matter to you. It seems that, in order to decide, you must trade off or exchange a strength on one feature dimension for a strength on another
Aiding judgment and decision making

(e.g. fuel economy for attractive styling); you cannot have both. Such conflict situations are painful partly because they appear to demand that one make at least some kind of unpleasant sacrifice. The tradeoffs issue is about how to deal with such situations, which eventually arise in every decision episode, typically just at the point where the decision maker is about to make a commitment.

The Car A-vs.-Car B example illustrates just one kind of feature conflict, the "outcome × outcome" variety, where it is assumed that all the features of every alternative are known for sure (e.g. there is no doubt about Car A's good looks or its awful efficiency). In the "outcome × uncertainty" type, the conflict is between the attractiveness of prospective outcomes and their chances of actually being delivered. An investment opportunity that will pay off big if the venture is successful but has minimal chances of actually doing so is illustrative. The third major kind of feature conflict is "outcome × time." In this variant, attractive outcomes are forthcoming, but only after a delay of some time. Consider, for instance, choosing between remaining in a "decent" job right now and going to night school for three years in order to qualify for a higher-paying, more satisfying position upon graduation.

What would it mean to say that your resolution of the tradeoffs issue for the Car A-vs.-Car B problem was deficient, where we can represent the alternatives like so: A = (+: Beautiful, -: Terrible Efficiency) and B = (−: Rather Ugly, +: Outstanding Efficiency). Suppose that you pick Car A over Car B. In effect, this says that you consider Car A’s esthetic advantage to more than offset its fuel economy disadvantage; that is your implicit tradeoffs issue resolution. But now let us imagine that a clairvoyant is able to look into the future and picture you owning Car A. She does the same for an alternative future in which you instead own Car B. The clairvoyant discovers that you are, overall, more satisfied with Car B than with Car A. Therefore, your resolution of the tradeoffs issue was improper (and actually a special kind of valuation misjudgment). It led you into a decision that left you worse off – less satisfied – than you could have been (see Yates, 2003, pp. 152–67). Other interpretations of inappropriate resolution of the tradeoffs issue for the outcome × outcome case focus on coherence (e.g. Keeney & Raiffa, 1976).

The character of the tradeoffs issue differs markedly for outcome × uncertainty and outcome × time situations as opposed to outcome × outcome ones. But all three varieties are such that it is hard to tell after the fact, as in a DPA, whether the tradeoffs issue per se was dealt with suitably. Recall that in the Car A-vs.-Car B example, we had the services of a fictional clairvoyant who could directly observe your overall satisfaction with each car. In real life, if you chose Car A, you would not also have the actual experience of living with Car B. So there would be no way for you to be
certain that your Car A experience is better, worse, or equivalent to what your Car B experience would have been – on the “path untaken.”

This presents a conundrum. Decision aids that focus on the tradeoffs issue abound. Some examples: outcome × outcome – the additive value-based rules underlying rankings such as those published in U.S. News & World Report’s annual college review issue or the reviews in Consumer Reports; outcome × uncertainty – the expected utility theory-based routines in decision analysis; outcome × time – the net present value-based rules in financial analysis (e.g. Higgins, 1998). Why are these aids so popular if typically no one definitively documents that they reduce the odds of improper tradeoffs, or even tries to do so? We conjecture that that is probably largely because the aids relieve the decision maker of the tension associated with tradeoff dilemmas and in a face-valid way; they are presented in an authoritative manner and at least superficially seem to make sense. We recommend that current practice be complemented with genuine efforts to verify the legitimacy of decision makers’ aided and unaided resolutions of the tradeoffs issue, in the spirit of trying to mimic the efforts of our fictional Car A-vs.-Car B clairvoyant (e.g. via high-fidelity simulations of the experiences, as in short-term rentals of cars being considered for purchase).

Issues in the aftermath

9 – Acceptability: “How can we get them to agree with our decision and also how we arrived at that decision?” The acceptability issue has special importance, because many real-life decisions are made within social contexts where, if certain people are displeased with a decision or even how it was reached, there can be serious consequences. Those people can and often will exercise their displeasure by acting against the interests of those the decision was intended to serve. Negotiation situations are a classic example. But there are many others, too, such as a famous case in which General Motors lost a $4.9 billion personal injury lawsuit brought by six people severely burned when a fuel tank ruptured in the crash of a GM-built car (Pollack, 1999). A crucial consideration in jurors’ imposition of massive punitive damages was evidence that GM had previously decided against making their fuel tanks stronger because of a decision analysis performed by the company’s engineers. One element of that analysis required that a dollar figure be assigned to instances in which an accident resulted in a loss of life. The amount entered into the analysis was the average settlement awarded in previous cases up to that time. Jurors were enraged that GM would be so seemingly callous as to put a price tag on a human life, and they acted accordingly.
Aiding judgment and decision making

There appear to be almost countless, non-obvious ways that decision makers can run afoul of the acceptability issue, including failing to appreciate differences in local norms for what is considered respectful behavior (see Yates & Alattar, 2009). That is why the promise of decision process analyses focused on acceptability seems significant and readily apparent. That is plausibly one of the reasons that negotiation courses (built around texts such as that of Thompson, 2008) are so popular in business schools.

It is not a stretch to view such courses as equipping students with decision aids derived from years of experience and research similar to decision process analyses.

10—Implementation: “We’ve decided what to do. Now, how can we get it done, or can we get it done, after all?” Making some decisions is tantamount to implementing them. Buying an ice cream cone is an example. Other decisions are different; they call for the execution of a “project.” Deciding to lose weight is illustrative. It is easy to cite cases in which both personal and non-personal decisions have failed to be implemented. In most of those cases, this means that the decisions failed, too, since the intended beneficiaries’ interests and values were frustrated. When a decision goes unimplemented, it is often because the process of making that decision was flawed in particular ways. In organizational situations, this is frequently because the acceptability issue was mishandled; influential people within the organization found the decision objectionable and purposely blocked its implementation. Or, paradoxically, the decision maker’s own efforts to push for implementation might have been undermined by how easily he made the decision (Dholakia & Bagozzi, 2002). Until recently, studies of decision implementation were rare. Fortunately, the theories and findings from broader research on implementation plans (e.g. Gollwitzer, 1999) are gradually capturing the attention of decision researchers. The results of such work are slowly finding their way into decision aiding efforts (e.g. Nardkarni et al., 2010).

Summary and a look ahead

Decision aids are procedures and devices that are intended to improve the quality of people’s decisions. They occur in a variety of forms, from simple pamphlets and oral presentations to decision making protocols, computer programs, and websites. Decision aids are typically motivated at least partly by assumptions as to the limits of people’s decision-making skills and even their inherent capabilities. Thus, to the extent that the aids achieve their aims, this constitutes evidence supporting those assumptions.
A surprising variety of metrics have been used to assess decision aid efficacy, particularly in medicine. This fact highlights the importance of rigor and clarity in defining constructs such as "decision quality." It also speaks to the multidimensional character of quality notions and the challenges of building decision aids that address the full range of benefits that people might reasonably desire from their decisions and the decision aids intended to facilitate them.

The “cardinal issue perspective” is a characterization of decision processes as people’s means for resolving each of 10 “cardinal issues” that arise in some form or another in every decision problem that presents itself. It forms the foundation for an emerging class of tools called “decision process analysis,” which offers a systematic and comprehensive approach to developing and evaluating decision aids that are targeted to the specific reasons that people’s decisions in a given arena might commonly fail.

Beyond the decision aiding questions addressed in this chapter is one that lurks in the background and arguably should have priority in future research. Decision aid specialists often remark that prospective users are indifferent to many (though not all of) the decision aids available to them. A frequent assumption is that people fail to realize that they actually need those aids and thus the challenge is to somehow convince them of that fact—to better “sell” the aids, in effect. This perhaps has some measure of truth to it. But the challenge additionally could be seen as an important scientific one: how can we begin to better understand how people perceive—and perhaps occasionally misperceive—when and why their decisions sometimes go awry. A program of research on such meta-decision making could have substantial scholarly and practical impact (cf. Yates, Veinott & Patalano, 2003).

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