

**Context, Process, and Experience:  
Research on Applied Judgment and Decision Making**

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## **Context, Process, and Experience: Research on Applied Judgment and Decision Making**

Human judgment and decision making research has made inroads through applications to business, government, social policy, and medical decision making. Recent trends in applied decision research, as Cooksey (1996) suggests, have begun to “incorporate the constraining impact that the human condition has upon decision processes unfolding in their natural context.” This constraining impact reflects such variables as situational context, cognitive processing modes, and personal experiences.

Research on decision making had its roots in the 1950’s and 1960’s in economic theory. Often called the “rational man” approach, normative decision theory is concerned with the discrepancies between how choices under risk should be made and how they are actually made. With the introduction in the 1970’s of multiattribute utility (MAU) analysis, decision theoretic researchers also began investigating subjective values and weighting functions. At the same time, other psychologists were exploring how people make judgments and draw inferences. Descriptive research focused on the variables that influence various types of judgments. These analyses provided numerous insights into how judgments are formed and how they can be modeled.

More recently, research on heuristics and biases (H & B) combined elements of these two traditions. Studies in the H & B tradition examine heuristics (rules of thumb) used by decision makers and the biases that can arise from the use of heuristics<sup>1</sup>. Specifically, H & B looks at how individuals’ responses in specific decision situations deviate from normatively expected outcomes. As noted by Dawes (1996), H & B research is the study of anomalies of decision making that can occur when subjects systematically solve a problem other than the one they want to solve.

In a recent review, Mellers, Schwartz, and Cooke (1998) ask “why” deviations from normative expectations are observed. The contextual, cognitive, and personal elements of the judgment or decision process become likely candidates for the answer to this question. “Con-

textual” elements refer to environmental variables that are external to the individual and have an impact on cognitive processes. “Cognitive” elements refer to the information processing strategies used to evaluate and combine various sources of inputs. “Personal” elements refer to the influence of internally developed mechanisms for handling a given situation. The integration of contextual, cognitive, and personal elements is an essential component in the study of judgment and decision making, particularly as seen from the perspective of applied research.

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Insert Figure 1 About Here

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Our focus is on research that examines how contextual, cognitive, and personal variables (and their interaction) influence the decision process. As illustrated in Figure 1, this chapter is categorized by: 1) context, 2) process, and 3) experience. Section one covers research looking at the influence of context on the perceived relevance or irrelevance of information in various decision situations; some issues included are strategy selection, framing, and the environment. Section two describes work on mental models, risk, and affect; this includes studies that provide evidence of policy use, the effects of feedback, and cognitive capacity. The third section covers research focused on the knowledge, skills, and preferences an individual brings to a decision situation; these variables contribute to the development of decision processes and are precipitated by factors such as expertise and individual differences. Each section includes examples of research and application.

### **Context**

In this section we discuss three major concepts: 1) the impact on critical elements in a decision situation, including *image* and *utility theory*, 2) applications and limitations of *framing effects*, and 3) assessment of *environmental factors* and training to cope with environmentally-induced difficulties. However, except for image theory, little effort has been made to integrate these concepts into a more comprehensive structure.

### ***Contextual impact***

Traditional decision research has disregarded the impact of context on problem perception, outcomes, and methods used in the study of decision making. This oversight can result in meaningless data or responses to questions other than those asked in the study. When context is ignored in the choice of decision research methods, the results can be quite misleading.

As an example, Fischhoff (1996) examined risk taking among adolescents. The first step in his study was to replicate experiments previously conducted using adults. Results showed a similar pattern of observed responses between teens and adults. Considering the real world behavior of teens, the results "...were so similar as to raise the suspicion that the method had shaped the message" (p. 233). Fischhoff went on to say that "we set minimalist problems before subjects and expect them to resist the temptation to impute a context." Payne, Bettman, and Johnson (1992) as well as many other researchers agree that the environment, stimulus context, and other factors have a major influence on decisions. Many researchers have begun to include context in their models of decision making but few studies attempt to explain which contextual components are important in a decision situation and why some contextual components are more relevant than others.

**Image Theory.** Einhorn and Hogarth (1981) argued that individuals make use of mental simulation to evaluate options by making adjustment strategies from known situations to new situations. Klein and Crandall (1995) incorporate this concept into the *Recognition-Primed Decision Model* (RPDM). They argue that events are perceived as either typical or not typical and a course of action is evoked based on that perception. *Image theory* (Beach, 1990) makes use of a similar idea. This descriptive theory assumes that the decision maker possesses an image of the goal and an image of the strategy to reach that goal. The screening of options occurs based on the compatibility of an option with standards established by the goal and strategy images. The work of Dunegan (1993) provides evidence that environmental condition or context affects the perceptions of compatibility between options and strategies. More precisely, cognitive modes shift from controlled processes under negative or stressful conditions

to more automatic processes under positive conditions.<sup>2</sup>

Utility theory can be invoked to describe the changes an individual makes in the utilities and/or weights of decision options (Mellers & Cooke, 1994; Tversky & Simonson, 1993). Utility theory states that individuals consider the values of potential outcomes and the chance of those outcomes being delivered. A study by Beach, Puto, Heckler, Naylor, and Marble (1996) provided evidence that differential weighting of options in image theory accounted for observed screening decisions more accurately than other weighting techniques. Tversky & Simonson (1993) suggested that changes in global context would affect attribute weight. The global context in image theory would come from the set of options being screened. Therefore, if the set of options differ in size or composition between similar decision situations, the attribute weight of a given option will differ. Image theory assumes context within imagined courses of action and thus can identify the impact of context on the decision maker's response.

**Utility theory.** The Simple Multi-Attribute Rating Technique (SMART)<sup>3</sup> may also identify the impact of context if the assumption is made that context influences the ranking or weighting of attributes. As described by Edwards and Barron (1994), SMART is prescriptive in nature and designed to provide the "best" choice. Edwards has clearly stated that SMART is not descriptive. The specification of alternatives, attributes, and ranks in its various forms is an effort to determine what is relevant to the decision maker and situation. The reduction or elimination of judgmental errors and the simple forms of elicitation used allow for the application of SMART in areas such as market research or policy analysis (Edwards & Barron, 1994).

A need to design studies and use methods that account for the impact of context has recently been recognized in the study of decision making. The approaches mentioned can be useful for inclusion of context in the measurement of behavior in applied situations. The contextual relevance is reflected in the decision maker's responses or choices. However, misinterpretation of information or behavior may occur when the influence of context on problem perception is ignored or assumed. Specifically, making assumptions based on normative stan-

dards can be problematic.

### ***Framing Effects***

Research on *framing effects* has provided evidence of how normatively irrelevant variables can affect decision making. A frame includes the context provided by the stimulus. Typically, the researcher defines the context included in the decision situation. Framing or the editing phase of a choice process, according to Kahneman and Tversky (1979), consists of the preliminary analysis of options, their outcomes and contingencies, and the coding of those outcomes as gains or losses. Tversky and Kahneman (1981) also refer to framing in a more general context as the description of options. This "description" does not change the value of the cues but does change the reference point from which cues are judged. Framing effects were first studied using verbal scenarios such as the "Asian disease" problem (Tversky & Kahneman, 1981). Later studies provided evidence of these same effects under other conditions.

**When they occur.** Johnson, Hershey, Meszaros, and Kunreuther (1993) described the preferences for automobile insurance coverage of drivers from New Jersey and Pennsylvania. Drivers in both states were offered approximately the same coverage at the same rates. In New Jersey the drivers had to purchase the right to sue for an additional cost and in Pennsylvania declining the right to sue was presented as a cost reduction. Seventy-five percent of drivers in Pennsylvania paid for the right to sue whereas less than 50 percent of New Jersey drivers paid for the right to sue. This demonstrates framing since, based on normative standards, there should be no influence from the format in which insurance information was presented. Framing effects have also been reported in studies of product price displays in supermarkets (Kleinmuntz & Schkade, 1993), economic business threats (Highhouse, Paese, & Leatherberry (1996), health care financing (Schweitzer, 1995), group decision making (Paese, Bieser, & Tubbs, 1993), auditing (Johnson, Jamal, & Berryman, 1991), and other situations (see Schneider, Levin, Gaeth, & Conlon, 1995, for a review).

**Why they occur.** Previous research has identified various types of framing effects (Schneider, Levin, & Gaeth, 1997). Recent efforts are directed at methods by which these

framing effects might be reduced or eliminated. One such method is the introduction of a causal schema (Jou, Shanteau, & Harris, 1996). Schemata or general knowledge structures provide individuals with a referent about events and relationships between events. Relationships between events may not be understood when an event occurs that does not fit the individuals' knowledge structures. When this occurs, according to Berkeley and Humphreys (1982), mental representations are constructed by the individual that differ from that of the experimenter, which results in framing effects. Jou, Shanteau, and Harris, (1996) found that framing effects were reduced or eliminated when subjects were provided with a causal schema in conjunction with the decision problem.

Dawes (1996) refers to frames in terms of the category in which problems are placed. These categories are a form of mental accounting and are dependent on how an individual views a decision situation. For example, the purchase of an item may create budget categories in which the purchase could be considered a gift for a loved one or a luxury item for themselves. The cost is the same, but individuals are more likely to make the purchase when it is a gift. In gambling, an individual is often more willing to spend "house money" than their own - without considering that the "house money" is theirs. Another important category mentioned by Dawes is the *status quo*. The desire to leave the current state unchanged is more frequently endorsed when it is the default option. In this case, individuals are less willing to make a change. A person may express concern for getting a flu shot when they have been receiving a shot for years because it has become the status quo. This decision to obtain the shot is therefore based more on the status quo than on consideration of the risks and benefits from the shot. The cumulative evidence from these studies show that the effects of framing can be modeled by judgment analysis based on cognitive modes and levels of thought.

Recent meta-analysis by Kuhberger (1997) and Schneider, Levin, and Gaeth, (in press) show that the strength of framing effects is less in applied settings than under laboratory conditions. The typical framing study involves presentation of risky and riskless choices in a hypothetical decision scenario. The choices are mutually exclusive and subjects choose a single

option. The positive and negative framing of the independent options generally result in different choices. Applied settings seldom offer this dichotomy of choices. However, studies conducted in applied settings commonly frame risk in terms of action versus inaction where the choices are not independent, e.g., Meyerowitz and Chaiken's (1987) presentation of the consequences of doing a breast self-exam or not doing a self-exam where the consequences are not dichotomous. As deviations from typical independent choice tasks increase, therefore, it appears the impact of framing effects decreases.

### ***Environment***

The context in which information is presented or made available has a strong influence on the response to that information. Factors such as preexisting response patterns, time pressure, saliency, affect, and perceived risk can all impact the decisions made. The work of Slovic (1975) and Tversky, Sattath, and Slovic (1988) provided evidence that reasoning played a prominent role in the formation of responses. "Reasoning" was defined as the consideration of arguments and justification in a choice. Participants were asked to match different pairs of options so that they became equal in value and were then to choose between these options. Their choice often did not agree with matching – a *preference reversal*. Instead, the chosen option was justified as superior on the most important dimension or attribute. Thus, seeing how participants justify their choices provides an indication of what is relevant and what is not.

Based on this line of research, Tversky, Sattath, and Slovic (1988) formulated the *prominence hypothesis*, which says that more prominent attributes are given greater weight in choice than in matching. Slovic (1995) cites the influence of prominence on decision construction, risky choice, and preference reversal. This shows that some attributes in a choice situation are more relevant to the decision maker, where relevance is determined by the context in which attributes are presented (Tversky, Sattath, & Slovic, 1988).

**Assessment.** Kleinmuntz and Schkade (1993) examined the impact of context and suggested that improvements in decision making could be made by evaluating and changing the environment. This view is reflected in the *Naturalistic Decision Making* (NDM) approach

(Klein, 1997). NDM emphasizes the interface between decision makers and their environment (Klein, Kaempf, Wolf, Thordsen, & Miller, 1997). A key step is the identification of decision requirements through a *cognitive task analysis*. Such an analysis identifies the key decisions (go–no go, buy– sell, launch–hold, etc.) and determines from experts how the decision is made or how relevant information is identified and integrated into the decision process.

Recently, NDM was applied to study the decision making of Navy AEGIS cruiser commanders. Decisions regarding the intent of an unidentified approaching aircraft require the rapid and accurate assessment and integration of relevant information (i.e., *situation awareness*). After identification of tasks involved, a cognitive task analysis was performed using the *critical incident method* (Klein, Calderwood, & MacGregor, 1989). This method makes use of participant interviews, including clarification of cues and actions in previously experienced nonroutine events. All events were charted according to time and sequence of decisions. The identification of critical decision requirements helped designers better understand how AEGIS operators used workstation displays. Researchers have successfully applied this method to nursing (Crandall & Getchell-Reiter, 1993) and software programming (Riedl, Weitzenfeld, Freeman, Klein, & Musa, 1991).

**Training.** Applied research such as NDM attempts to identify environmental factors that are most relevant in a given decision situation. However, the approach is only applicable to problems with clearly defined goals. The use of ad-hoc interviews and verbal protocols can lead to reliance on untestable assumptions about cognitive processes (Shanteau & Pounds, 1996; see Payne, 1994, for a discussion of the strengths and weaknesses of verbal protocols). Training to improve assessment can focus on either 1) the identification of key decision elements or 2) the elimination of irrelevant information. As an example of the former, Crandall and Getchell-Reiter (1993) determined the critical assessment indicators in the recognition of stressed neonatal infants. These key decision elements were then incorporated into a training program for new NICU nurses.

To illustrate the latter approach, Gaeth and Shanteau (1984) attempted to improve decision

making by eliminating irrelevant decision elements. They looked at evaluations by soil judges based on the recognition of extraneous factors, such as excessive moisture, which often interferes with accurate identification. Soil judges were given training sessions in which the interfering element was identified, formal definitions of irrelevant information were provided, and suggestions were given to help the judges minimize the impact of irrelevant information. Significant increases in soil identification accuracy were found both immediately after the training and in follow-up studies over a 12 to 21 month period. Shanteau, Grier, Johnson, and Berner (1991) reported similar results from a parallel effect to train student nurses.

Regardless of the training methods used, information is a key element in the decision process. Fischhoff and Downs (1996) stated that people can only act in their own best interest when they have the right information and they know how good that information is. The difficulty is in determining how an individual identifies the "right" information. Image theory (see above) provides one answer: compare goal and strategy images to select relevant information and appropriate strategies. When context is taken into account, decision theory can provide another means for determining the "goodness" of information.

### **Process**

Mellers, Ordonez, and Birnbaum (1992) argue, "the process by which subjects combine information depends on the task, the stimulus context, and individual difference factors" (p. 367). The impact of these factors is covered in the following section that discusses: 1) models of decision making based on memory, personal policies, justification, and feedback; 2) effects of risk on the decision making process; and 3) influence of affect on the decision process. Some of the research cited in this section has yet to be applied to real world settings. However, the influence of task and context consideration is evident. This influence should lead to an understanding of decision processes and has the potential for use of these process models in applied settings. Many of the models and approaches discussed in this section describe the impact of personal relevance. That is, individuals bring to any decision problem an internal mental process influenced by memory and emotions that interact with the external environ-

ment and problem context.

### ***Decision Models***

The work of Gigerenzer (1996, 1997; Gigerenzer & Goldstein, 1996) focuses on a domain specific theory about how inferences are made in social contexts. Using Simon's notion of satisficing<sup>4</sup>, Gigerenzer and Goldstein (1996) contend that a set of *fast and frugal* algorithms (although non-optimal) can produce as many correct inferences in less time as traditional models of rational inference. To provide evidence for this contention, a "take the best" (TTB) algorithm was compared with rational algorithms in making inferences in a two alternative choice task. This algorithm makes use of a framework that Gigerenzer and Goldstein (1996) call a theory of *probabilistic mental models* (PMM). "A PMM is an inductive device that uses limited knowledge to make fast inferences" (p. 652).

The results of their studies provide empirical evidence that TTB outperforms traditional methods (such as weighted linear models). While this approach takes into consideration the effects of memory and cognitive load, it is parsimonious when compared to attempts that include a broader range of complexities to describe behavior (e.g., Busemeyer & Townsend, 1993; Cooksey, 1996).

**Memory.** The work of Dougherty et al. (in press) outlines a cognitive processing model for judgments of likelihood that also accounts for major heuristics. The theory addresses prior probability or "category likelihood," conditional probabilities or "category membership" based on multiple data, and compound or chained likelihoods. They propose that memory involves two subprocesses: 1) a decomposition mechanism that functions as a conditional memory search, and 2) recall in the form of schema-based memory activation. The conditional memory component of the model and memory activation values or "echo intensity" can simulate many of the heuristics. While this model is still in its development stage, it is a commendable effort to create an integrated theory of the underlying cognitive processes of likelihood judgments. They have moved beyond the isolated explanations found in work on heuristics and have begun the process of integrating decades of memory research into the field of judg-

ment and decision making.

**Policy use.** The environment in which a decision is made can dictate the type of internal decision processes that takes place. Decision behavior has been separated into three distinct classes: *automatic*, *intuitive*, and *deliberative* (Beach, Jungermann, & DeBruyn, 1996). *Automatic* is the rapid activation of a preexisting decision process in response to recognition of a familiar situation; this method is called rule or policy following. *Intuitive* is a process that identifies the compatibility of a decision option's most salient features with the decision maker's standards and involves the ability to imagine what would happen if each of the options is adopted. *Deliberative* requires the most elaborative use of structured imagination – decision options are screened and incompatible or unacceptable options are eliminated; the decision process does not always involve clearly defined problems or alternatives and the decision maker may find it easier to rely on policy driven action by doing what was done previously in similar situations. Each class of decision behavior is dependent on the interaction of the environment and problem context with the availability and activation of specific cognitive processes.

When no policy is available, mental representations or cognitive scenarios must be constructed (Jungermann, 1985) to represent possible actions or events that can connect the present situation with an expected or desired future situation. Thuring and Jungermann (1986) present a four-stage model that includes activation of situation relevant knowledge, followed by construction of a mental model, simulation of possible scenarios, and ending with selection of a single plan of action or decision. Activation of situation relevant knowledge is dependent on past experience and other internal variables. The concept of personal relevance can account for why an individual might identify specific knowledge as salient to the situation.

Policy driven decisions are produced by familiar tasks such as driving to work everyday or assembly line work. This familiarity can also lead to reduced awareness of the environment and potential hazards. Research on the development of internal decision processes and the determinants of relevant factors that trigger those processes is needed to identify methods of

overcoming automatic policy activation or encouraging a more deliberative process appropriate to the situation.

**Justification.** A concern for justification can lead to inappropriate support of continued expenditures based on previous investment rather than expected benefit. This has been labeled the *sunk cost effect*. According to economic analysis, previously incurred costs should be ignored when they do not effect the outcomes of future decisions (Yates, 1990). However, people often allude to previous costs when giving reasons for future investment. Hogarth and Kunreuther (1995) refer to this reasoning as the process of *decision justification*. This is an example of how the decision process can influence reliance on irrelevant factors. Prior investment can change the process from normative to one that places greater importance on justification of prior behavior.

The sunk-cost effect was explained by Arkes and Blumer (1985) in terms of wastefulness – individuals are unwilling to change a course of action because of previous investments of time or money. For their study, participants were presented with one of two scenarios. In one scenario, the owner of a printing company spends \$200,000 on trucks instead of modern printing equipment; one week later a bankrupt competitor offers to sell the owner modern printing equipment for \$10,000 that is better than the equipment the owner could have bought for the \$200,000. In the second scenario the \$200,000 is spent on the modern printing press equipment. Participants were asked to take the place of the owner and decide whether \$10,000 should be taken from savings to purchase the printing equipment. In the truck purchase version 77% of participants said they would buy the printing equipment but only 53% of participants said that they would in the second version. The decision process used by many subjects was influenced by the desire to avoid appearing wasteful.

Harrison and Shanteau (1993) found that advanced accounting students, who were familiar with differential-cost concepts, were also susceptible to the sunk cost effects reported by Arkes and Blumer (1985). However, these students were able to avoid the effect when familiar accounting formats were used. This familiarity may provide a match between the problem

context and the activation of appropriate and relevant decision policies.

**Effects of Feedback.** Feedback during the decision process can be either detrimental or beneficial. Doherty, Schiavo, Tweney, and Mynatt (1981) examined data selection in complex tasks in which irrelevant information interfered with data selection (also see Shanteau, 1975). Results of their study provided evidence that feedback reduced but did not eliminate selection of non-diagnostic data. However, Diehl and Serman (1995) found that cognitive capacity could be taxed by feedback. They asked participants to handle product sales by managing an inventory. As time delays and the complexity of feedback increased, participants' performance deteriorated. These effects have also been observed in studies of perceived medical risk. One interpretation of such results might be that feedback can increase cognitive load beyond an individual's capacity to make use of the information (Hammond, 1996).

The results of these studies provide information regarding the maximum amount of information useful to a decision maker in specific tasks. A key question is what determines the relevant factors participants use when they reach maximum cognitive load? McClelland, Stewart, Judd, and Bourne (1987) reported better memory for chosen alternatives and suggested that the process used to select alternatives was critical to making the choice. If this is the case, then identification of processes for the selection of information in decision situations would integrate research on justification, feedback effects, risk, and many other areas covered in this chapter.

### ***Risk***

Studies of risk are most commonly performed under laboratory conditions in which subjects make choices between uncertain options. In an effort to identify the generalizability of laboratory studies on risk, Wiseman and Levin (1996) examined whether risky choices differed between real and hypothetical situations. They found no significant differences in choices.<sup>6</sup> In contrast to Wiseman and Levin, marketing research shows that people say they are interested in risk information in hypothetical settings, but actually make little use of this information in real situations (Anderson 1983). The difference between what an individual

states or chooses hypothetically and what is stated or chosen in reality depends on the context. The relevant factors differ between the situations (real and hypothetical) and across different types of situations. In the studies mentioned, consequences change from short term in the Wiseman and Levin study to long term in the Anderson study. The length of time between an action and its consequence is obviously relevant.

Jungermann, Schutz, and Thuring (1988) found that many people do not understand information on drug package inserts. Fischer and Jungermann (1996) conducted an experiment to investigate whether the format of information about drug risks affected the perceived risk. Leaflets about the risks of drug use were prepared in either a numerical format or an equivalent verbal format. Interactions were found between mode of presentation and seriousness of risk. With mild side effects, numerically described formats were rated riskier than verbally described formats. With severe side effects, the opposite was observed. Wallsten, Fillenbaum, and Cox (1986) suggested that representation of numerical information with verbal labels is more vague with high and medium probabilities and that people prefer to avoid vagueness. This provides evidence that although relevant information may be desired by the decision maker, it may be obscured by the context.

**Source.** Jungermann, Pfister, and Fischer. (1996) investigated the credibility of sources of information about chemical risks in five European countries. The sources' trustworthiness depended on perceived honesty and competence. Political and administrative sources were among the least trusted. However, type of information influenced preference. For example, respondents preferred information about the risks of a product from the company making the product. In contrast, respondents preferred information regarding the health risks from scientists. Clearly, knowledge of the role that information sources play in risk judgments is necessary for understanding of the decision process.

**Divide and conquer.** The primary method used to improve decision processes involves ranking and weighting of the separate risks, attributes, and alternatives. Fischhoff (1996) suggests a six-stage process for risk evaluation that includes; defining and categorizing, identify-

ing relevant attributes, describing the risks, selecting rankers, performing the rankings, and providing detailed descriptions. These procedures were initially designed as a method for federal agencies to prioritize risks by separating technical risks identified by experts and perceived risks identified by citizens (Hammond & Adelman, 1976).

Perceived risks are characterized by three primary dimensions (Fischhoff, 1996). Response to risk is mediated by the number of people affected; you may not be willing to use a drug if one person in a hundred is harmed, but if that number is one in 10,000 you might feel safe taking the drug. Knowledge or lack of information also affects response to risk; people have a strong desire for knowledge and often feel more confident when they can obtain more information. Dread can be defined by the potential for catastrophe an individual or group feels about an event or act; while the definition is dependent on the context of the situation, its inclusion as a measure of negative response to the risks involved is essential to any comprehensive model.

Connolly and Srivastava (1995) found that tasks affect the causal structure connecting attributes and overall evaluations or ranks. Mediating dimensions or elements in the decision process can be identified as perceived levels of risk, knowledge, control, and sense of dread or other emotional components. Each element may have a level of acceptability to the individual. The point at which any of these elements becomes acceptable or unacceptable is established by relevance to the individual.

### *Affect*

The work of Kahn and Isen (1993) and Nygren, Isen, Taylor, and Dublin (1996), provide evidence that positive affect promotes such things as variety seeking, including seeking additional options. Moreover, positive affect can lead to overestimating the likelihood of positively perceived events while underestimating the likelihood of negatively perceived events. People in positive moods deliberate longer and use more information, while those in negative moods generally employ simpler decision strategies (Mano, 1994). Also, negative affect increases use of attribute-based comparisons over alternative-based comparisons (Luce, Bett-

man, & Payne, 1997).

Research has clearly shown the impact of affect on decision processes. However, work is needed on individual susceptibility to the manipulations of affect as well as how affect interacts with other influences. Work on affect should be integrated with a more complete model of decision behavior that describes how affect is influenced by what an individual brings to the decision situation.

In this section we have discussed decision making in terms of behavioral models, including attempts to account for the influence of memory on the decision process. The determination of what is relevant to the decision and to the individual becomes more difficult when policy use, risk, and the source of information are taken into account. These and other factors, such as experience, are necessary components for a complete model of applied decision making that describes the interaction of contextual, cognitive, and personal elements.

### **Experience**

Hamm (1993) suggested investigating the processes by which task characteristics influence the use of particular decision strategies. This in turn requires attention to individual differences in weights, values, risk perceptions, and preferences. However, particular attention should be paid to differences that result from personal experience, including expertise. This section 1) looks at research that describes experts and seeks to identify measurable qualities of expertise, 2) identifies some effects of experience on decision making in applied settings, and 3) describes research strategies for investigating the impact of individual differences on decision behavior.

### ***Experts***

The study of experts provides an excellent example of individual-difference research in judgment and decision making. Experts necessarily are experienced individuals, although not all experienced individuals are experts. Experts are usually identified as the most experienced, capable, and successful individuals within a specific domain. Shanteau (1992) found that superior performance of experts was reflected, in part, by their ability to distinguish relevant

from irrelevant information.

The growth of information technology and the cognitive sciences has generated an intense interest in the identification and elicitation of expert knowledge. Studies of experts have ranged from preschool children (Means & Voss, 1985) to chess masters (Chase & Simon, 1973), but as Hoffman, Shadbolt, Burton, and Klein (1995) have suggested, “expertise is not a simple category.” Shanteau (1988) outlined a partial list of characteristics of expert, including: 1) highly developed perceptual/attentional abilities, 2) an ability to decompose and simplify complex problems, 3) greater creativity when faced with novel problems, 4) ability to communicate their expertise to others, 5) strong sense of self-confidence in their abilities, and 6) extensive, up-to-date content knowledge.

Research on experts has been conducted simultaneously in two nonoverlapping research streams. The first, primarily conducted by cognitive psychologists, involved analyses of memory and problem solving skills of experts. Since the early work with chess masters (de Groot, 1965), experts were believed to hold sway within their domain because of their superior ability to recall patterns of relevant information from that domain (Chase & Simon, 1973). To identify the limitations of this ability, later researchers used the presentation of random domain information. Results suggest that experts’ memory recall advantage over novices is eliminated under these conditions (Cooke, Atlas, Lane, & Berger, 1993; Ericsson & Charness, 1994). A more extensive discussion of this line of research appears in the chapter by Charness and Schultetus (In press).

The other research stream flowed from analyses conducted by decision researchers. The early work on *clinical judgment* focused on a search for rules or formulas (Elstein, 1976). In an early study of experts, Hughes (1917; also see Wallace, 1923) analyzed the judgment strategies of corn judges. Later work shifted to psychometric analyses, often reporting that clinical judgment had low levels of validity and reliability (e.g., Oskamp, 1962). In contrast, the focus of more recent studies is on calibration and information use.

More recent research has focused on calibration and information use. Calibration is a

measure of the goodness of fit between the quantity of correct responses and the individual's probability estimates of that quantity (Spence, 1996). Early research revealed mixed results for experts. Weather forecasters appear to be very well calibrated (Murphy & Winkler, 1977) with values approaching 1.0 (Stewart, Roebber, & Bosart, 1997). However, doctors' diagnoses tend to be poorly calibrated and are instead overconfident (Christensen-Szalanski & Bushyhead, 1981).

Many suggestions have been offered to explain these disparate findings. O'Connor (1989) argued that experts dealt with different loss functions, e.g., doctors might perceive a greater risk in a false negative response. Another possibility stems from possible methodological differences or familiarity with elicitation measures (Spence, 1996). Mahajan (1992) suggested that experts were "cognitive misers." That is, they truncate their information searches and overlook diagnostic information. Spence (1996) provided evidence that experts' best estimates were better than novices', but when asked to provide confidence ranges around those estimates, their ranges were often too narrow.

Shanteau (1992) offered an account that may help to explain some seeming inconsistencies in studies of experts. He argued that the performance of experts is closely connected to the domain. In some domains, such as weather forecasting, experts perform quite well (Stewart, et al., 1997). In other domains, such as clinical psychology, experts perform less well (Dawes, 1988). He attributed these differences, among other things, to stability of stimuli and availability of relevant information.

Another issue concerns how the public perceives information from experts. Fischhoff (1994) relates a story of severe weather conditions that, based on strong indicators, had been clearly forecast and broadcast to the public. In spite of the warnings, there were numerous deaths, injuries, and accidents. Subsequently, efforts were made to discover how best to communicate information such that the user understands what the expert means. Errors of communication can occur from ambiguity regarding the predicted event, relevance to the user, and issues of trust and context. A key message in Fischhoff's (1994) work is that when expert in-

formation is provided to the public, the recipient's understanding of this information should be elicited and identified to establish its concurrence with the presented information.

### *Experience effects*

Aside from studies of experts, there have been numerous other studies of how experience influences decision making. The work of Weber (1997) provides one example. Structured interviews were used to identify farmers' beliefs regarding climate changes and expectations of future changes in precipitation and temperature over the next 20 to 30 years. The data covered a broad range of information including a section on the farmer's attitudes and opinions, years of experience as a farmer, and recollections of weather in past years. Farmers with more experience, and who had seen many more fluctuations in the weather, were less likely to believe in contributors to current weather patterns or future climate change. A significant association was found between belief in global warming and predictions of temperature changes. Weber (1997) concluded that prior expectations are a determining factor for identification of relevant personal and contextual variables.

There have been many studies of the diagnostic ability of doctors. For example, Weber, Bockenholt, Hilton, and Wallace (1993) found that experience affected the diagnostic hypothesis generation of physicians by increasing the availability of similar cases. The strength of a hypothesis increased when similar cases with the same hypothesis had been seen before. The generation of hypotheses by physicians proceeded from general to more specific in nature consistent with the frequency of experience. This experience effect has also been revealed in expert-novice studies by Camerer and Johnson (1991) and Joseph and Patel (1990).

Kirschenbaum (1992) observed an effect of experience on the information-gathering strategies of naval officers. Increased decision accuracy was found in sonar detection tasks for experienced officers compared to officer candidates. Experience can both broaden and focus the recognition of available options, as found in Beyth-Marom and Fischhoff's (1996) work on adolescent risk decisions. As adolescents increase their knowledge or experience, they become better at option generation and consequence production.

However, the acquisition of new knowledge is heavily influenced by the individual's current domain knowledge (Arkes & Freedman, 1984). Anderson, Marchant, Robinson, and Schadewald (1990) provided evidence that knowledge also affects the integration of new information. Using three different instructional methods (presentation of cases, concepts, or examples), Anderson, et al. provided new tax-related information to accounting participants with different levels of accounting knowledge. Results of the application of this new knowledge indicated that prior knowledge affected the impact of various instructional methods.

Studies of experts provide a notable example of individual differences in decision performance. The impact can be seen in the ability to identify relevant information, the structured generation of hypothesis, the application of content knowledge, and superior information gathering strategies.

### ***Individual differences***

The importance of individual differences varies by area of study. In the field of career choice and counseling, for instance, individual differences are the cornerstone of research. Topological methods are used to categorize individuals according to preference, skill, and ability. This information is integrated with skill and ability requirements of various occupations to provide an individual with viable career options. Unlike most research in judgment and decision making, career decision research seldom goes beyond topological methods to describe or prescribe the choice process.

Rohrbaugh (1996) investigated the impact of two instruments used as career decision aids on college students who were uncomfortable with their current career status. One instrument was an adaptation of multi-attribute rating techniques and the other asked students for comparisons between career desires and preferred television characters. The latter is a more socially integrative approach, while the former uses formal decision analysis. Results indicated an interaction between gender and instructional method. Gender differences have also been shown to affect the relative importance of career related attributes (Gati, Osipow, & Givon, 1995). Results of such studies indicate the need for a better understanding of gender-specific

differences in the identification of relevant information during the decision process.

Individual differences can be categorized as an individual's problem construction ability (Reiter-Palmon, Mumford, Boes, & Runco, 1996). Participants were presented with a series of ambiguous and poorly defined problem solving tasks. Problem construction ability was measured by the quality and originality of problem restatement. Results show that individuals with greater problem construction ability produce solutions of higher quality. The researchers suggest that this is at least partly due to metacognitive skills.

Lopes (1996) advanced a theory of *Security-Potential and Aspiration* (SP/A) to describe the preferences and reasoning of individuals making risky decisions. The aspiration component of SP/A involves maximizing probability for achieving some aspiration level. This suggests that individuals establish self-imposed targets of success (or goals) and that differences between individuals might be measured by this aspiration level. Although Lopes' focus is on risk, her research confirms the need to include the effects of individual differences in any descriptive theory of decision making.

Smith and Levin (1996) examined the effect of levels of cognition on decision making. Assuming that increases in thinking reduces susceptibility to irrelevant variables, Smith and Levin (1996) identified individuals with a high/low *need for cognition* (NFC). Both groups were given a situation based on Tversky and Kahneman's (1981) "ticket problem." Participants in the low NFC group displayed significantly greater susceptibility to the effects of problem framing. In a related study by Cacioppo, Petty, and Kao (1984), participants were randomly assigned to one of two frames in a medical problem taken from McNeil, Pauker, Sox, and Tversky (1982). Results showed that individuals with high NFC are less susceptible to effects of framing.

The importance of individual difference research is evident in the work of Saks and Hastie (1978). Research in the judicial system has shown inconsistency among judges for sentencing in criminal cases with identical circumstances. Sentencing policies are related to such individual differences among judges as political, religious, and educational background. Hastie

(1993) also examined work on individual decision criteria in jury decision making and found an individual's story structure to be the most predictive of the verdict<sup>7</sup>.

The studies discussed in this section all relate individual differences to cognitive processing strategies. These differences relate to experience, need for cognition, and problem construction ability. The effort to measure and categorize individual differences produces questions such as: What constitutes a meaningful category of individual difference in decision making? And should cognitive process, independent of outcome, be used as a measure of individual difference? The connecting theme of individual differences is what the decision makers consider relevant to their problem.

### **From context to cognition: How does it come together?**

The growth of decision research is dependent on an empirically supportable structure that will not isolate applied research from basic research (or descriptive methods from prescriptive methods). We have provided examples of several research issues and suggested the unifying concept of relevance as central to the integration of research approaches. The importance of this integration rests on a clearer understanding of what constitutes relevant factors and what influences those factors have before, during, and after the decision process.

We have also argued that the application of what is learned from research will benefit from a recognition of the interrelationship of context, process, and experience. The ability, for example, to map common decision elements using "fast and frugal" methods could lead to identification of key environmental variables. These three variables cross all domains and could find application to any situation that requires a decision. Our view of how the relevance of information is influenced by context, process, and experience is illustrated in Figure 2. As can be seen, we believe that relevance (or diagnosticity) of information is key to understanding applied research on decision making. And relevance is, in turn, influenced by the interaction of context, process, and experience.

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Insert Figure 2 About Here

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Svenson (1996) makes the distinction between a *process* approach that examines changes in the rules, representations, and values and a *structural* approach that relates input variables to choices. The more common structural approach has provided a useful framework for decision research. However, greater effort is needed to investigate the processing aspects of decision making.

Currently, the field of decision research would benefit from a research approach that, first, identifies relevant problem context and considers the influence of context on the decision process. Second, research approaches should consider a wider variety of variables, such as memory and feedback in addition to risk and utility. Third, greater effort is needed to identify variables such as experience and individual differences that influence decision processes.

The applied research of Hammond and his colleagues (summarized in Hammond, 1996) nicely illustrates the importance of an interactive view of applied research. Based on Brunswik's (1956) analysis of perceptual processes, Hammond (1966) developed *cognitive continuum theory* (CCT). According to CCT, judgments fall along a continuum ranging from *analytic* at one end to *intuitive* at the other, with *quasi-rational* in between. Hammond, Hamm, Grassia, and Pearson (1987) argued that accuracy of expert judgment will be greatest when there is a correspondence between task properties and cognitive properties: "At some point on the cognitive continuum, performance will be best and accuracy will fall off as the expert becomes either more analytic or more intuitive."

The element that ties all of the issues in this chapter is the transition from basic to applied research. From a decade of subjective expected utility (1960' s) to two decades of H& B (1970' s and 1980' s), basic research has dictated what would find its way into applicationnU fortunately, findings that were strong and consistent in basic research often proved to be weak and inconclusive in applied research. The connection between applied and basic research has been tenuous.

However, the tables may be turning – applied research may now be leading the way. For

instance, applied researchers have long faced the problem of individual differences; basic researchers are just now beginning to notice. We believe an integrated basic/applied research approach will take the lead in the next decade of decision research.

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**Footnotes**

<sup>1</sup> Much of the H & B work is concerned with the affect of task stimulus manipulation. However, the work of Fischhoff (1975) and Fischhoff and Beyth (1975) on hindsight bias is an example of H & B work that focuses on evidence of the use of heuristics to solve decision problems that appear to be unaffected by task stimulus.

<sup>2</sup> In contrast to the work of Dunegan (1993), the manipulation of positive and negative environmental conditions did not have a significant effect when Beach et al. (1996) used a similar manipulation. Beach suggested that the between-subject manipulation used in their study and the within-manipulation used in the Dunegan (1993) study may be the source of difference in results.

<sup>3</sup> Revised versions of SMART include the Simple Multi-Attribute Rating Technique with Swing weights (SMARTS), and the Simple Multi-Attribute Rating Technique Exploiting Ranks (SMARTER) (Edwards and Barron, 1994).

<sup>4</sup> Simon (1990) suggested that individual use heuristic decision procedures to overcome limitations of memory and time. One of these procedures involves making decisions based on selecting the first option that is satisfactory to the decision maker rather than selecting the optimal of best choice.

<sup>5</sup> While much of the work covered in this chapter refers to the decision process as choices between alternatives, the imposition of a framework or broader theory requires a more inclusive definition of process. Svenson (1996) suggests that the search and creation of decision alternatives are a significant process in real-life decision making. This process approach is described in his *Differentiation and Consolidation Theory* that outlines a generic framework and includes both pre- and post-decision processes.

<sup>6</sup> In the ‘real situations,’ participants were exposed to the consequences of their choices. The consequences involved proofreading for shorter or longer periods of time based on the flip of a coin. In the hypothetical condition, participants were not required to proofread for a specified period of time based on a coin flip.

<sup>7</sup> Space restrictions have prevented the inclusion of group decision research in applied settings.

This research has influenced jury selection, committee decision making styles, and government policy. See Hastie (1993) for a review on theories of jury decision making and Steckel, Corfman, Curry, Gupta, and Shanteau (1991) for an outline on problems in modeling group decisions.

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**Figure Captions**

**Figure 1.** Chart shows how applied research on judgment and decision making leads to consideration of the separate influence and joint integration of context, process, and experience.

**Figure 2.** Diagram of how variables that influence context, process, and experience combine to determine relevance in applied decision making.