A constructive process view of decision making: Multiple strategies in judgment and choice *

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A viewpoint that has recently emerged in decision research is that preferences for objects of any complexity are often constructed – not merely revealed – in generating a response to a judgment or choice task. This paper reviews a program of research that traces the constructiveness of preferences to the use of multiple strategies in decision making, contingent on task demands. It is argued that individuals often build strategies opportunistically, changing their processing on the spot depending upon the information they encounter during the course of solving the decision problem.

Recently a new viewpoint has emerged in behavioral decision research, the crux of which is that preferences for objects of any complexity are often constructed – not merely revealed – in generating a response to a judgment or choice task (Slovic et al. 1990: Payne et al. 1992). March (1978) attributed the constructiveness of preferences to the interaction between the limited memory and computational capabilities of decision makers and the complexity of task environments. That is, Simon's (1955) concept of bounded rationality is seen as the basis of the constructed preferences that we observe. In March's words, 'Human beings have unstable, inconsistent, incompletely evoked, and imprecise goals at least in part because human abilities limit preference orderliness' (March 1978: 598).

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The notion of constructive preferences implies more than simply stating that observed preferences are not determined by reference to a master list of values in memory. A constructive view of preferences also suggests that preferences do not necessarily result from the use of some consistent and invariant algorithm such as expected value calculation (Tversky et al. 1988). Instead, a fundamental component of the constructive view is that decision makers have a repertoire of methods or strategies (rules) that are used to identify their preferences. [1] The set of methods or strategies can originate from both experience and training (Kruglanski 1989; Larrick et al. 1990).

In a constructive viewpoint, a major factor underlying the lability or inconsistency of preferences and choices (Fischhoff et al. 1980) is changes in the strategies used. That is, the strategy used to construct a particular choice or a preference is highly contingent upon a variety of task and context factors. Task factors are general characteristics of a decision problem, such as the number of alternatives available, the response mode, or single-play versus repeated-play gambles, which do not depend upon the particular values of the alternatives; context factors, such as the similarity of alternatives, are associated with the particular values characterizing the alternatives. Task and context factors make different aspects of the problem salient and evoke different processes for combining information. Different factors can also interact to produce differing strategies (e.g., the two task factors of response mode and single-play versus repeated-play of gambles (Wedell and Bockenholt 1990)). Characteristics of the decision problem, therefore, can lead to the use of different strategies, which at least partially determines the expressed preferences. Of course, how a solution to a decision problem is constructed will also be a function of individual difference factors such as processing capacities (Bettman et al. 1990), prior knowledge or expertise (Shanteau 1988), and the goals adopted for the decision episode, e.g., maximize accuracy or justifiability, or minimize effort, regret, or conflict (Einhorn and Hogarth 1981; Tetlock 1985).

Many current issues in behavioral decision research can be related

[1] We view a strategy as a set of operations used to transform an initial state of knowledge into a final goal state of knowledge where the decision maker feels the decision problem is solved. Different types of operations (e.g., comparing values of two alternatives on a particular attribute) are discussed in more detail below. We use the terms *strategy* and *decision rule* interchangeably in this paper.

to the contingent use of multiple strategies for solving decision problems. This paper describes an ongoing program of research concerned with the multiple strategies people use when making choices and judgments. Much of the research reviewed below has been reported elsewhere (e.g., Payne et al. 1988; Creyer et al. 1990); however, in this paper we specifically emphasize how research on contingent use of multiple strategies is an important component of the more general concept of constructive processes in choice.

The paper is organized into two main parts: First, we briefly review a series of studies that assumes that a decision maker selects from his or her repertoire of strategies that particular strategy which represents the best accuracy/effort tradeoff for the task at hand. We present data supporting such a top-down process of strategy selection based primarily on accuracy and effort concerns.

In the second part of the paper, we extend the view of strategy selection to include the construction of choice strategies during the course of making a decision (Bettman 1979). Problem solvers not only use information extracted from the original problem definition in deciding what strategy to use but also use information they have already explored to identify promising paths for further search (Langley et al. 1987). That is, as people learn about the structure of the problem during the course of making a decision, they can change their processing to exploit that structure, whether in single decision episodes or in more repetitive decision situations. Processing, in other words, can be opportunistic (Hayes-Roth and Hayes-Roth 1979). We argue that the opportunistic use of decision processes also accounts for labile or constructive preferences.

Contingent decision behavior

There have been many studies showing that the processes used to solve decision problems vary as a function of a number of task and context factors (see Payne, 1982; Payne et al., in press, for reviews). For instance, one striking example of contingent judgment and choice concerns how people adapt their decision processes to deal with task complexity. When faced with decision problems involving just two or three alternatives, people often use decision strategies that process all the relevant information and explicitly consider the extent to which

Additive Utility (a)	Additive Difference (b)
A24: O.K., the decision is now between the two rent prices A25: in accordance with the other qualitites A26: Now for apartment A has the advantage A27: because the noise level is low A28: and the kitchen facilities are good A29: even though the rent is $30 higher than B.	D238: O.K., we have an A and a B D239: First look at the rent for both of them D240: The rent for A is $170 and D241: The rent for B is $140 D242: $170 is a little steep D243: but it might have a low noise level D244: So we'll check A's noise level D245: A's noise level is low D246: We'll go to B's noise level D247: It's high D248: Gee, I can't really very well study with a lot of noise D249: So I'll ask myself the question, is it worth spending that extra $30 a month for, to be able to study in my apartment?
Satisficing (c)	**Elimination-By-Aspects (d)**
A163: The rent for apartment E is $140 A164: Which is a good note A165: The noise level for this apartment is high A166: That would almost deter me right there A167: Ah, I don't like a lot of noise A168: And, if it's high, it must be pretty bad A169: Which means, you couldn't sleep A170: I would just put that one aside right there. I wouldn't look any further than that A171: Even though, the rent is good	D289: Since we have a whole bunch here, D290: I'm going to go across the top and see which noise levels are high D291: If there are any high ones, I'll reject them immediately ... D295: Go to D D296: It has a high noise level D297: So, we'll automatically eliminate D. ... D303: So, we have four here D304: that are O.K. in noise level

Fig. 1. Verbal protocols of choice strategies. (*Source:* Payne 1976.)

one is willing to trade off less of one valued attribute for more of another valued attribute. When more alternatives are involved, people often use simpler heuristic strategies like elimination by aspects to cut

(a)	
C98:	Well, with these many apartments (six) to choose from,
C99:	I'm not going to work through all the characteristics
C100:	Start eliminating them as soon as possible.
(b)	
B1:	With just two (gambles) to choose from,
B2:	I'm going to go after all the information
B3:	It won't be that much trouble.

Fig. 2. Verbal protocol examples of task contingent processing. (a) Excerpt from Payne (1976). (b) Excerpt from Payne and Braunstein (1978).

down the number of options (Biggs et al. 1985; Billings and Marcus 1983; Johnson et al. 1989; Klayman 1985; Onken et al. 1985; Payne 1976; Sundstrom 1987).

Fig. 1 provides evidence for the use of multiple strategies in decision making in the form of excerpts from the verbal protocols (thinking aloud records) obtained by Payne (1976) in a study of choices among apartments. The protocols represent the responses of two different subjects (A and D) faced with two levels of task complexity: (1) choices with two alternatives (panels a and b), and (2) choice problems with six or twelve alternatives (panels c and d). Panels (a) and (b) suggest tradeoffs among attributes. For example, subject D explicitly asks a tradeoff question dealing with the exchange of a higher rent for a lower level of noise in panel (b). The excerpts in panels (c) and (d), on the other hand, indicate more noncompensatory processing, such as Satisficing (Simon 1955) and elimination-by-aspects (Tversky 1972), respectively. Finally, note that strategy differences are shown both within the same subject (e.g., panels (a) and (c)) and across subjects (e.g., panels (c) and (d)).

Panel (d) of fig. 1 and panels (a) and (b) of fig. 2 provide evidence that decision makers sometimes explicitly consider task demands and plan their processing in a top-down fashion. Fig. 2 contains excerpts from verbal protocols gathered by Payne (1976) and Payne and Braunstein (1978) that illustrate the selection of a decision strategy determined, at least in part, by the number of alternatives available. In panel (a) of fig. 2, the individual apparently decides to employ an elimination strategy because there are many apartments to choose from. In contrast, the protocol in panel (b) of fig. 2 suggests that a more comprehensive information-processing strategy will be employed, given that there are 'just two' alternatives to consider.

Effort and accuracy in choice

Given that people use many different strategies when making decisions, we need a theoretical framework in order to understand and predict when a particular strategy will be used to solve a particular type of decision problem. In this section, we propose such a framework. We argue that the use of various decision strategies is an adaptive response to the demands of complex task environments by a limited capacity information processor. In particular, we emphasize that the use of multiple strategies is an adaptive way to balance the goals of achieving an accurate decision and limiting the cognitive effort required to reach a decision.

The idea that decision making is influenced by considerations of cognitive effort as well as by considerations of decision accuracy (Simon 1955) and the more general idea that strategy selection involves considering the benefits of and costs of different strategies are frequently used for explaining contingent decision behavior (e.g., Beach and Mitchell 1978; Klayman 1983; Klein 1983; Russo and Dosher 1983; Shugan 1980; Thorngate 1980; Wright 1977). However, our version of this framework analyzes strategy selection at a much more detailed information processing level than the work of most other researchers and stresses the role that cognitive effort plays in strategy selection to a greater extent. Next we consider how to measure cognitive effort and present evidence validating our effort/accuracy approach.

Cognitive effort and decision strategies

Huber (1980) and Johnson (1979) independently proposed a method for comparing the effort required by different decision strategies. Based upon ideas of Newell and Simon (1972), they suggested that decision strategies could be described by a set of elementary information processes (EIPs). EIPs include such mental operations as reading a piece of information into short-term memory, comparing the values

Table 1
Elementary EIPS used in decision strategies.

READ	Read an alternative's value on an attribute into STM
COMPARE	Compare two alternatives on an attribute
DIFFERENCE	Calculate the size of the difference of two attributes for an alternative
ADD	Add the values of an attribute in STM
PRODUCT	Weight one value by another (Multiply)
ELIMINATE	Remove an alternative or attribute from consideration
MOVE	Go to next element of the external environment
CHOOSE	Announce preferred alternative and stop the process

Note: STM = short-term memory.

of two alternatives on an attribute to determine which is larger, and multiplying a weight and attribute value.

The set of EIPs that we have used in our research is shown in table 1. A particular decision strategy is defined in terms of a specific set and sequence of EIPs. For example, a Lexicographic choice strategy involves a number of reading and comparison EIPs but no adding or multiplying EIPs. In contrast, a Weighted additive strategy involves reading EIPs, a number of adding and multiplying EIPs, and some comparisons (but fewer comparisons than the Lexicographic strategy).

We argue that the cognitive effort required to execute a specific strategy in a particular task environment is reflected by the number and the specific mix of EIPs needed to execute that strategy in that environment. The mix of EIPs matters because people will find some EIPs, e.g., multiplications, more effortful than others, e.g., comparisons.

How valid is this EIP approach to conceptualizing decision effort? In Bettman et al. (1990), we examined the assumption that EIP counts provide a measure of cognitive effort by having decision makers make choices using different prescribed strategies for choice sets varying in size. Both decision latencies and self-reports of decision difficulty were obtained as assessments of cognitive effort, and these assessments of effort were then modeled using various combinations of EIP counts (see Bettman et. al., 1990, for details on the experimental method).

Overall, the results strongly supported the EIP approach to measuring cognitive effort. A model of effort based on weighted counts of EIPs provided good fits for both response times ($R^2 = 0.84$) and self-reports of effort ($R^2 = 0.59$). In addition, the fit to the data of the weighted EIP model was statistically superior to the fit of both an alternative model of effort based on simply the number of items of information acquired and to that of an alternative model using equal weights for all EIPs. These data imply that a model of cognitive effort in choice requires concern not only for the amount of information processed but also for different weights for the particular processes (EIPs) applied to that information. In addition, the estimated weights for the various EIPs were essentially the same regardless of the decision strategy in which they were used, supporting the independence of EIPs across rules.

Finally, the results showed significant individual differences in the effort associated with particular EIPs (i.e., the fit of a weighted EIP by individual model was significantly better than that of the weighted EIP model). This implies that individuals may choose different decision strategies in part because certain component EIPs may be relatively more or less effortful across individuals. In fact, the processing patterns used by subjects in an unconstrained choice environment showed that subjects for whom arithmetic operators were relatively more difficult, as indicated by the coefficients for the various EIPs, showed greater selectivity in processing.

To summarize, we found strong support for the EIP approach to measuring decision effort. Next, we illustrate how a general accuracy/effort framework can be used (1) to generate specific predictions about how the use of strategies will vary across task environments, and (2) to test the extent to which actual decision behavior adapts in ways predicted by a concern for both accuracy and effort.

Adaptive strategy selection

In this section, we present some specific process-level predictions regarding adaptivity in decision processes derived using computer simulation. More details on the simulation studies can be found in Payne et al. (1988) and Payne et al. (1990). Next, we present some process-level data on the extent to which actual decision behavior involves shifts in strategies of the type predicted by our framework.

Monte-Carlo simulation studies

To determine the effort and accuracy of various heuristics in different environments, we considered a set of several decision strategies, including the weighted additive (WADD), elimination-by-aspects (EBA), lexicographic choice (LEX), satisficing (SAT), majority of confirming dimensions (MCD), and the equal-weight (EQW) rules (see Svenson, 1979, or Payne et al., 1988, for definitions). These choice strategies can be characterized on a number of different aspects. The three major aspects we will consider are the amount of processing, the degree to which processing is consistent or selective across alternatives or attributes, and the degree to which processing is alternative-based or attribute-based. Strategies differ in the total amount of information examined, ranging from exhaustive consideration of all available information to more cursory consideration of a subset of the information. Strategies also vary in the degree to which the same amount of information is examined for each alternative or attribute (consistent processing) or the amount varies (selective processing). Finally, some strategies are more alternative-based (multiple attributes of a particular option are considered before another alternative is examined) and some are more attribute-based (values of several alternatives on a single attribute are processed before information on another option is examined).

The strategies mentioned above can be defined in terms of these aspects. The WADD strategy examines all available information, is consistent, and is alternative-based. The EBA rule is selective and attribute-based; the total amount of information considered depends upon the particular values of the alternatives and the cutoffs used by EBA. The LEX strategy is also selective, attribute-based, and the amount processed depends upon the specific values of the alternatives. SAT is selective, alternative-based, and the degree of processing is contingent upon particular values for the options and the cutoffs used by SAT. The MCD rule is consistent, attribute-based, and ignores probability or weight information. Finally, EQW is consistent, alternative-based, and also ignores probability or weight information.

We modeled each decision strategy as a production system (Newell and Simon 1972). A production system uses a collection of IF–THEN rules to represent human cognitive processes (Newell 1980). We then implemented these production system models as computer programs and ran Monte-Carlo simulations using these models of each strategy in order to estimate how the effort and accuracy of the various strategies vary with changes in decision environments. These simulation results can then provide insights into how *aspects of processing*, as exemplified by the individual strategies, might change across different task environments if processing is adaptive.

In these simulations, the alternatives were gambles with outcomes that have different payoffs but the same probability over all alternatives. That is, each alternative could have a different value for a particular outcome, but the probability of that outcome is the same for every alternative. We used such choice problems for two main reasons: first, we could easily relate consequences to choice among gambles in our later experimental work (i.e., people can play selected gambles for money); second, this particular type of risky choice problem is structurally similar to a multiattribute choice problem (Keeney and Raiffa 1976).

The effort for each strategy was calculated on the basis of counts of EIPs, as discussed above. For each heuristic, accuracy was measured in terms of the relative performance of that heuristic when compared to both the optimal choice given by the weighted additive rule (expected value for the gambles), which uses all the relevant problem information, and to the choice that would be expected if a random choice procedure (RAND) was used, which involves no processing of information. Specifically, we measured relative accuracy as follows, in terms of the values of the alternative chosen by each rule indicated: (heuristic–random)/(weighted adding–random).

Based upon a review of factors which might have important effects on either the effort or accuracy of decision strategies (e.g., see Thorngate 1980; Beach 1983; McClelland 1978), we varied several factors in the simulations to provide different choice environments: the number of alternatives and number of attributes, time pressure, the presence or absence of dominated alternatives, and the degree of dispersion of probabilities (weights) across attributes. To illustrate the latter variable, a problem with low dispersion might have probabilities (weights) on the attributes of 0.30, 0.20, 0.22, and 0.28, respectively, for a four-attribute decision problem. On the other hand, a problem with a high degree of dispersion might have probabilities (weights) of 0.68, 0.12, 0.05, and 0.15 for the four attributes. For some of the empirical studies reviewed below, the decision maker was asked to select the best gamble from a set of gambles, so probabilities for the outcomes were provided. In other studies, multiattribute alternatives with weights on the attributes were used. As noted above, these two variants of the basic problems used have similar underlying structures.

The conclusions from the Monte-Carlo simulations can be summarized as follows: First, in some decision environments, using a simplifying strategy (e.g., the lexicographic rule) may not only significantly reduce the effort needed to reach a decision but can also provide a level of accuracy comparable to that obtained by the weighted additive rule. Thus, the use of heuristic decision strategies may often make sense when both the accuracy of choice and decision effort are considered.

Second, the weighted additive rule rapidly degrades in accuracy under time pressure, while heuristics like elimination-by-aspects and lexicographic choice show much smaller accuracy decrements. In fact, under severe levels of time pressure, elimination-by-aspects is often the most accurate rule. Thus, the preferred strategy under time constraints is to process at least some information about all alternatives as soon as possible rather than to worry about processing each alternative in depth. [2]

Third, no single heuristic was the most efficient across all task environments. In the low dispersion environment where dominated alternatives can be present, for example, the equal weight strategy is quite accurate, even though it simplifies processing by ignoring weight (probability) information. In contrast, for high dispersion environments, the lexicographic rule is the most accurate of the heuristics and is substantially better than the equal weight rule. Thus, a decision maker wanting to achieve both a reasonably high level of accuracy and low effort would have to select contingently from a repertoire of strategies based upon task demands.

We have discussed the simulation results in terms of particular strategies. However, since decision makers often use mixtures of strategies (e.g., Payne 1976), we view the strategies used in the simulation as prototypical strategies that can be used to hypothesize how *aspects* of processing may change in response to properties of the choice environment. For example, since strategies such as LEX and EBA, which are selective and attribute-based, performed well under time pressure in the simulation, we hypothesize that processing under time pressure will involve examining less information and be more

[2] Interestingly, Eisenhardt (1989) reports that firms in the computer industry operating in rapidly changing environments (time pressure) did better if they used a 'breadth–not depth' strategy for evaluating options.

selective and attribute-based than processing without time pressure if individuals are adaptive. We specify such hypotheses further below when we examine some of our experimental work.

The simulation results reported above highlight what an idealized adaptive decision maker might do to shift strategies as task environments change. In the next section we discuss the extent to which actual decision behavior corresponds to the predictions of our accuracy/effort framework. In particular, we have conducted a number of experiments designed to validate our approach. Those experiments have used a computer program for monitoring information acquisitions called Mouselab to collect process-level data. This involves setting up the decision task so that the subject must use a mouse to view or select information. Data can be obtained on what information the subject seeks, in what order, how much information is examined, and how long the information is examined. Such information allows us to develop direct measures of the amount, selectivity, and extent of alternative-based or attribute-based processing, the aspects of processing we discussed above. A typical Mouselab display is given in fig. 3. Further details on Mouselab's capabilities can be found in Johnson et al. (1991).

Our first experiment examined a fundamental issue for an accuracy/effort approach, the sensitivity of decision behavior to variations in the goals for the task (emphasis on accuracy or emphasis on effort savings). Before examining specific hypotheses based upon the frame-

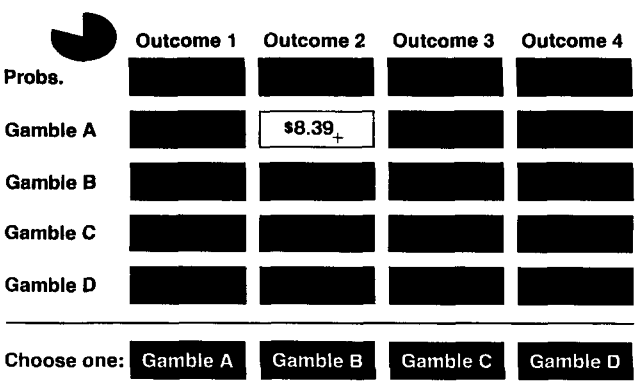

Fig. 3. A Mouselab display.

work, we first demonstrate that processing does indeed vary depending upon the relative weight placed upon accuracy versus effort concerns.

The second series of experiments uses the simulation results to hypothesize specific patterns of processing that can be put to a more detailed test. In particular, we examined the sensitivity of decision processes to variations in time pressure and to variations in the dispersion of the probabilities (weights) associated with the outcomes of the alternatives in a choice set. More complete details on each set of studies can be found in Creyer et al. (1990) and Payne et al. (1988), respectively.

Effects of accuracy and effort goals on decision processes

A major assumption of any accuracy/effort approach to strategy selection is that processing should be sensitive to the relative emphasis placed on accuracy versus effort. For example, people should utilize strategies that provide greater accuracy (often at the cost of greater effort) when the incentives for accuracy are increased. However, incentives sometimes enhance performance, sometimes have no effect, and at times may actually decrease performance (e.g., see Ashton 1990; Hogarth et al. 1991; Tversky and Kahneman 1986; Wright and Aboul-Ezz 1988).

An important concept for understanding incentive effects is the distinction between working harder versus working smarter (Einhorn and Hogarth 1986; Tversky and Kahneman 1986). Working harder involves devoting more effort to the same strategy; in contrast, working smarter refers to changing strategies appropriately in order to take advantage of a specific situation. We believe that a common response to *general* incentives is simply to work harder at the same strategy. However, we believe that *specific* incentives which explicitly change the relative salience of effort and accuracy considerations in the decision environment can lead to working smarter.

In our study, subjects used Mouselab to acquire information and make decisions for 32 sets of four alternatives, each defined by six attributes. The subjects' task was to select the alternative that they thought was best overall in each set. The sets varied within subjects with respect to (1) the dispersion of the weights provided for the attributes (high or low), (2) the explicit goal of the decision maker for the set (minimize effort or maximize accuracy), and (3) the presence or absence of effort and accuracy feedback (these feedback factors are not discussed in this paper).

We explicitly manipulated effort/accuracy tradeoffs by emphasizing either a goal of maximizing accuracy relative to effort or a goal of minimizing effort relative to accuracy for each choice set. Subjects were told that an index of overall performance would be developed based both upon the time taken and the accuracy achieved for each trial. [3] For trials when the goal was to minimize effort, they were told time taken would have a weight of three and accuracy a weight of one, whereas for trials with a maximize accuracy goal, the weights were one for effort and three for accuracy. Both accuracy and effort (time taken) mattered for all trials; we simply tried to manipulate the relative importance of those two goals.

Subjects acquired more information and took more time when the goal was to maximize accuracy rather than to minimize effort. In addition, information acquisition was less selective under a goal of maximizing accuracy. Subjects spent proportionally less time on the most important attribute, were less selective in processing over attributes, and less selective in processing across alternatives. Finally, processing was more alternative-based when the goal was to maximize accuracy. More extensive, less selective, and more alternative-based processing is more consistent with normative strategies like weighted adding and also resulted in higher performance, since subjects attained greater relative accuracy levels when the goal was to maximize accuracy.

To summarize, when we emphasized accuracy more than effort, we found a shift in strategies in the direction predicted by the effort/accuracy framework. These results provide the clearest evidence to date for the effects of differences in goals on process-tracing measures of decision strategies (see Billings and Scherer 1988; Ford et al. 1989: 101–102).

Effects of time pressure and dispersion in weights on decision processes

These experiments asked to what extent people vary their choice processes as a function of context factors such as the dispersion of probabilities and task factors such as time pressure and whether these changes in processing are in the directions suggested by our simula-

[3] Accuracy was measured relative to the weighted additive rule.

tions. As outlined above, the simulation results provide a fairly clear picture of how a decision maker might adapt to such decision environments. That is, we use the results for the various strategies to hypothesize how the major aspects of processing might change, as discussed above. Specifically, as implied by the good performance of heuristics like the lexicographic and elimination-by-aspects rules under high dispersion, the simulations suggest that an adaptive decision maker should process less information, exhibit greater selectivity in processing across attributes and alternatives, and display more attribute-based processing in a high dispersion environment.

The simulation results also show that under increased time pressure we should see aspects of processing characteristic of strategies like elimination-by-aspects and the lexicographic rule, which performed well in the simulations under time constraints. In particular, there should be less information processed, greater selectivity in processing, and more attribute-based processing under high levels of time pressure.

We conducted experiments in which subjects made a series of choices from sets of options where dominated options were possible. Each choice set had four risky options, with four possible outcomes (attributes) for each. For any given outcome, the probability was the same for all four options. After completing their choices for all the sets of options, one of the sets was chosen at random and subjects actually played the gamble and received the amount of money corresponding to the alternative they had chosen.

The sets varied in terms of two within-subjects factors: (1) presence or absence of time pressure, and (2) high or low dispersion in probabilities. In addition, half the subjects had a 15 second constraint for the problems with time pressure, while the other half had a 25 second time constraint (the average response time for the no time pressure conditions was 44 seconds). Information acquisitions, response times, and choices were monitored using Mouselab. For trials with time pressure, a clock on the display screen indicated the time left as it counted down (see fig. 3). Mouselab ensured that subjects could not collect any additional information once the available time had expired. Overall, the results validated the predictions about aspects of processing derived from the simulation. Subjects showed a substantial degree of adaptive decision making, although this adaptivity was not perfect. As hypothesized, subjects processed less information, were more selective, and tended to process more by attribute when dispersion in probabilities was high rather than low. In addition, those individuals who were more adaptive in their patterns of processing (i.e., who were relatively more selective and more attribute-based processors in high dispersion environments) also attained higher relative accuracy scores. Importantly, this increase in performance was not accompanied by a significant increase in effort. *Hence, more adaptive subjects also appeared to be more efficient decision makers.*

We also found that under severe time pressure (a 15 second constraint), people accelerated their processing (e.g., less time was spent per item of information acquired), selectively focused on a subset of the more important information, and changed their pattern of processing in the direction of relatively more attribute-based processing. This general pattern of results is consistent with the prediction from the simulation that an efficient strategy under severe time pressure would involve selective and attribute-based processing.

The effects were substantially less for subjects with more moderate time pressure (a 25 second constraint): subjects showed some acceleration and some selectivity in processing, but provided no evidence for a shift in the pattern of processing. These results suggested that individuals may have a hierarchy of responses to time pressure. People may initially try to respond to time pressure simply by working faster. If this is insufficient, they may focus on a subset of the available information. Finally, if that still does not suffice, they may switch processing strategies, e.g., from alternative-based processing to attribute-based processing.

We believe that the experiments outlined above provide compelling evidence for adaptivity in decision making. While not perfectly adaptive, our subjects changed processing strategies in ways that were appropriate given changes in context and task features of the decision problems. Individuals appear to weigh accuracy and effort concerns in selecting decision strategies. Our conceptual framework thus receives strong support in these empirical studies.

Although excited and pleased by the power of an accuracy/effort viewpoint to explain contingent decision behavior and lability of preferences, we believe that the framework we have developed to date can and should be extended. The framework presented so far assumes that preferences are constructed using different strategies selected from an existing repertoire. In the next section we explore the idea that decision behavior often reflects a more bottom-up, data-driven, or opportunistic use of decision processes. This notion implies that preferences also can be constructive because the strategy itself is being developed on the spot. Thus, differences in attention can influence preferences as well as the more common view that differences in preferences can influence what is attended to (Jay Russo, personal communication, 1991). The following section is adapted from Chapter Five of Payne et al. (in press).

Constructive processes in decision making

Several examples may clarify our view that individuals *construct* choice strategies on the spot during the course of making a decision. For instance, an individual may fully intend a priori to evaluate a set of gambles using a weighted adding (expected value) strategy. However, if the individual noted while processing the information about the gamble that the probability of one outcome was extremely high (e.g., 0.8), then that individual might drop plans to do an expected value calculation and simply look for the alternative with the best payoff on the highly probable outcome. Such a change in plans is a data-driven shift from a compensatory process to a noncompensatory, lexicographic strategy. We have observed such strategy shifts in our data (Payne et al. 1988). As another example, based on a consumer choice, suppose that a consumer begins to compare alternatives on what is a priori the most important attribute and discovers that the values on that attribute are very similar across alternatives. That attribute might then be ignored (Kahneman and Tversky 1979), and he or she may try to look at another attribute. In both these cases, individuals make spur of the moment shifts in processing direction rather than merely executing some previously selected strategy.

Elements of decision heuristics

A constructive choice process is one where the heuristic used is developed at the actual time of choice. In essence, the individual makes up the strategy as he or she goes along. Instead of having a complete rule or heuristic already stored in memory that is used for a choice, an individual may construct a heuristic using fragments or elements stored in memory; the overall strategy is built up from such pieces dynamically at the time of choice. These elements or fragments could be beliefs about alternatives; evaluations; simple heuristics or rules of thumb involving subsets of beliefs (e.g., 'compare these alternatives on attribute A to see if they differ very much'); rules for integrating information (e.g., 'count how may attributes alternative X is best on' or 'average these ratings'); rules for assigning weights (e.g., 'if the values of the alternatives on attribute B are very similar, then assign a low weight to attribute B'); and so on.

Simple processing operations such as those described above may represent the level at which decision makers store much of their information processing repertoire in memory (Bettman and Park 1980; Biehal and Chakravarti 1986). Rules such as 'If the values of the alternatives are similar on a specific attribute, then assign a low weight to that attribute' are also easily representable as productions or procedural knowledge (Anderson 1983).

Effects of the decision task on the construction of a heuristic

An individual may enter many decision situations with only a vague idea about how to construct a heuristic. Thus, constructed choice heuristics will generally vary from one situation to the next depending upon which elements are used and how they are put together. Which elements are used and in which sequence for a particular choice will be a function of such factors as what information is available (e.g., if the same pieces of information are available for all alternatives); the information presentation format (e.g., in a consumer choice, prices may not be compared if unit prices are not provided and different brands have different-sized packages); the salience of various pieces of information; intermediate processing results; and other task specific factors.

These ideas imply that events affecting the order of attention in the real world are likely to have powerful effects (see also Yates et al. 1978) on the resulting constructed decision strategies. Russo and Rosen (1975) provide an example of the effect of physical proximity of items in an information display on processing. Based on an analysis of eye movements, they found that 63% of all paired comparisons were between alternatives that were spatially adjacent, even though only 47% of the possible pairs were adjacent.

If individuals construct heuristics on the spot and which elements are used are sensitive to many task specific factors (salience, format, and so on), the resulting choice 'heuristic' may be a sequence of elements with no apparent overall coherent structure. Consider the following sequence, for example: (1) An individual compares several attribute levels to standards for each of several alternatives (a component of a satisficing rule); (2) While doing these comparisons, the individual notices an outstanding value for a particular alternative on some attribute and eliminates all alternatives still under consideration which are not 'close' to that value (like an element of an elimination by aspects heuristic); (3) Next, the individual compares two remaining alternatives to each other to determine which alternative is better on more attributes (a procedure which is part of a majority of confirming dimensions rule (Russo and Dosher 1983; Svenson 1979)), and so on. Note that each element or short sequence of elements may be used to process only a few alternatives and that different sequences of elements may be used for different alternatives.

Examples of such fragmented heuristics have been found in several studies (e.g., Payne 1976; Bettman and Park 1980). For a specific example of a choice among apartments from Payne (1976), see fig. 4. This protocol shows several features similar to those alluded to in the previous paragraph. For example, the individual eliminates several options based upon landlord attitude in lines B119–B132 and then shifts to something like a majority of confirming dimensions strategy in statements B172–B197. Thus, constructive processes imply that the resulting heuristics are likely to be extremely sensitive to specific features of the situation.

Constructive processes and labile preferences

Another implication of the use of constructive processes is that the preferences that we observe are often labile, because they reflect a constructive process in which attention to information and the methods used to combine information vary across tasks. The compatibility hypothesis of Slovic et al. (1990) provides an example of how constructive processes can lead to variability in preferences. The compatibility hypothesis states that the weight given to a stimulus attribute is enhanced by increased compatibility between the attribute and the response mode. Slovic et al. (1990) illustrate the compatibility effect in

B119: I'm going to look at landlord attitude.
B120: In H it's fair.
B121: In D it's poor.
B122: B it's fair, and
B123: A it's good.
B124: In L the attitude is poor.
B125: In K it's poor.
B126: In J it's good, and
B127: In I it's poor.
B128: So, one of them... is poor.
B129: So, that's important to me.
B130: So... that I'm living there.
B131: Which is the landlord also.
B132: So, I'm not going to live any place where it's poor.
:
B172: So, eliminate those two (A & B).
B173: And decide between these two (J & H).
B174: O.K., the kitchen facilities in H are good.
B175: In J they're fair.
B176: And that's about the same to me.
:
B186: Landlord attitude in J is better than in H.
B187: And, that's important.
:
B190: Quietness of the rooms.
B191: In H it's good.
B192: In J it's fair.
B193: And that's about the same.
B194: The rents are just about the same.
B195: In both of them the cleanliness is poor.
B196: In J the rooms are larger.
B197: So, I guess, J will be better.

Fig. 4. Verbal protocol of a constructive choice process for apartments. (*Source:* Payne 1976: 379–380.)

a study of the prediction of academic performance. In their study, subjects were presented with pairs of students and asked to choose the student in each pair who would achieve either a higher grade in history (half the subjects) or achieve a higher class rank in history (the other half of the subjects). The pieces of information used for assessing relative achievement were the students' prior performance levels in two other courses. Performance in one course was given by a grade (from A^+ to D), and performance in the other course was reported in terms of a class rank (from 1 to 100). As expected from the compatibility hypothesis, subjects choosing which student would receive a better grade in history chose the student in the pair with the higher prior grade in a course significantly more often than subjects choosing which student would achieve a higher class rank.

Compatibility also may be the basis for the fact that the weight of an attribute will be enhanced to the extent that values on the attribute can be more easily compared across alternatives (Slovic and MacPhillamy 1974). This is another case where the way information is processed appears to be partially made up on the spot. What is important is not the compatibility of an attribute with a response mode, but the compatibility of attribute information across alternatives.

The effects of both compatibility of an attribute with a response mode and of compatibility of attribute information across alternatives can be interpreted more generally in terms of cognitive effort. Noncompatible pieces of information may take more effort to process. For instance, Slovic et al. (1990: 5) suggest that 'noncompatibility between the input and the output requires additional mental operations.' We argue that decision makers may adjust their processing in order to take advantage of features of a problem that allow them to reduce cognitive effort. Further, we believe that individuals often respond to such special features as they are noticed during the course of solving a problem, not just at the beginning of the decision episode.

When will constructive processes be used?

Constructive processes are not always used; top-down use of complete heuristics is certainly much more likely in cases where there is a good deal of prior experience with a particular decision. It would be too inefficient for individuals to construct heuristics anew each time when the structure of the decision task was well known. However, constructive processes are more likely when choices are made where there is little prior knowledge.

Constructive processes may also be more likely for more complex or stressful decision problems. It may be too difficult to attempt to determine an overall strategy a priori in such situations (see also

Wood and Locke 1990; Klein and Yadav 1989). Of course, more difficult and stressful decisions will also tend to be less familiar, so the arguments above would also apply. Janis has argued that people evaluate information in a hasty, disorganized, and incomplete fashion under severe stress (Janis 1989; Janis and Mann 1977). Keinan (1987) provides experimental evidence that people do scan alternatives in a more nonsystematic fashion under stress, suggesting that we might see more data-driven processing in stressful situations.

Bettman and Zins (1977) examined the frequency of constructive choice processes using verbal protocol data gathered from two consumers over several shopping trips. Judges received transcripts of the protocols and definitions of constructive choice and were asked to categorize each choice episode. Consumers appeared to be constructing a choice heuristic on the spot in roughly 25% of the choice episodes. This amount of constructive processing seems reasonable; in most cases, individuals will develop simplified rules they can merely apply for repetitive decisions, and most everyday decisions are repetitive. However, in many experiments, individuals will be faced with unfamiliar tasks and may exhibit constructive processes.

Local accuracy / effort assessments

What does the constructive processing viewpoint imply about an accuracy/effort approach to contingent decision making? In our view, the two are perfectly consistent. When individuals construct heuristics, we believe these constructions are based upon local, momentary accuracy/effort assessments. For example, if an individual observes that the values on an attribute appear to be similar across alternatives and shifts to examining another attribute, that shift may reflect a tradeoff of the low benefits from continued processing of that attribute versus the costs. Tversky (1972; Kahneman and Tversky 1979) has argued that people often disregard components that alternatives share as one method for simplifying the choice among alternatives. Such spur of the moment shifts in processing direction are still based upon accuracy/effort considerations, even though the individual is constructing a heuristic on the spot rather than using one selected a priori. Recent work by Klein and Yadav (1989) seems consistent with such a local, bottom-up approach to accuracy/effort tradeoffs.

A dynamic view of properties of the choice task and contingency

Based upon such arguments, we can extend our notions about contingent choice processes. We have mainly used examples of contingent processing based upon relatively stable task factors (e.g., number of alternatives, time pressure) or context factors that were relatively easy to perceive quickly (e.g., dispersion in probabilities). However, our constructive view implies a more complex notion of contingency, where properties of the 'choice task' itself change as the individual progresses. The task is *not* the same for all alternatives. The specific elements of choice heuristics used to process a given alternative may depend upon which alternatives have been processed already (e.g., whether a 'good' alternative has appeared yet or not); upon the particular sequence of elements already used (e.g., after eliminating certain alternatives based on their values on a given attribute, that attribute may have a relatively restricted range when further operations involving that attribute are considered); upon which other alternatives happen to be close to a given alternative in the information display (e.g., because this will affect the magnitude of the most easily computed differences on various attributes); and so on.

The degree of intercorrelation among the attribute values defining the choice alternatives provides another example of how properties of the choice task may change during the choice process. Decision problems often include dominated alternatives or have moderately high positive correlations between attribute values (Einhorn et al. 1979). Several authors have suggested that people eliminate dominated alternatives from consideration as a first step in making a choice (e.g., Coombs and Avrunin 1977). If this is so, then at some point the intercorrelation structure for the remaining undominated options becomes more negative, and a negative intercorrelation structure may trigger the application of new decision procedures. Evidence that differences in correlation structure can influence strategy usage is provided by Bettman et al. (1992). They show that individuals face conflict rather than avoiding it and process more information, are less selective, and exhibit more alternative-based processing in negatively-correlated environments.

Thus, our constructive view implies a more detailed notion of contingency: the specific *elements* of choice heuristics used at any given time are contingent upon the properties of the choice task at that particular time. This viewpoint also suggests that context variables, reflecting specific values of the alternatives rather than more general structural properties of the choice task, can play an important role in determining constructive decision processes.

To summarize, we believe that our conceptual framework still applies if we take a constructive perspective, but at a more detailed level of analysis. Hence, we do not feel that constructive processes present a conceptual problem for our framework. However, to actually implement our simulation work at this level of detail, we need to extend the set of EIPs we use to include new operators (e.g., 'bookkeeping' operators which keep track of possible regularities in the decision environment). We would also need to implement more detailed elements of heuristics as components for our simulations, but our conceptual framework appears capable of handling such extensions.

Throughout the above discussion, one of the most important ideas is that individuals notice and exploit regularities in the decision task. That is, individuals learn about the nature of the task as they gather information and may then change the way they process in order to take advantage of what they have learned.

Noticing and exploiting regularities

The process of noticing and exploiting regularities is very similar to the idea of interrupts and reactions to interrupts (Simon 1967; Bettman 1979). After beginning to work on a particular goal or to implement some element of a strategy, individuals do not necessarily follow that original direction to completion. Rather, if conditions warrant, they can interrupt current processing, assess the situation, and switch directions if necessary. Departures from expectations generally lead to interrupts: unexpected events are noticed, assessed, and reacted to if needed.

However, as Anderson (1983) has noted with regard to the Hayes-Roth and Hayes-Roth (1979) model of opportunistic problem solving, such distractibility represents a potential cost of opportunistic decision processes. That is, if any currently interesting piece of information can easily capture the decision maker's attention, the decision maker may fail to maintain a coherent decision process due to overload of working memory. This possibility of overload necessitates a theory specifying when information will be considered or ignored and a theory for resolving conflicts about which pieces of information are most relevant to the overall goal. Anderson proposes that production system models can incorporate noticing and conflict resolution mechanisms into theories of human problem solving.

We believe that distractibility is a fairly common problem for complex decisions. Important attributes may be ignored, and too much time may be spent on irrelevant information. Also, as suggested by our earlier discussion of the use of constructive processes in more stressful decision tasks, we hypothesize that distractibility (the use of irrelevant information) will be a particular problem in stressful situations. Consequently, it may be that one of the primary benefits of using techniques such as decision analysis in complex and stressful environments is that they mitigate this problem of distractibility by forcing the decision maker to consider information in a systematic and explicit fashion. The issue of distractibility is also related to the problem of cognitive control and inconsistency in judgment (Hammond et al. 1980).

Two aspects of noticing (or interrupts) are particularly important: *what* gets noticed and *when* it is noticed. Departures from expectations are often noticed, which could include extreme values or negative information (Fiske 1980); finding that information is missing for some alternatives (Burke 1990); or having information in different formats across alternatives. There may also be differences in how easy it is to notice different types of information. Some task factors, such as time pressure or problem size, may be relatively easy to ascertain. However, context factors generally are more difficult to assess (e.g., interattribute correlation (Crocker 1981; Klein and Yadav 1989)).

The ease of noticing task properties and the concept of problem 'transparency' receiving increased attention in the decision making literature are related (Hammond 1990; Tversky and Kahneman 1983, 1986). According to the transparency notion, a particular procedure, such as eliminating dominated options, will be used in situations when its application is transparent and will not be used in nontransparent situations. According to Hammond (1990), the concept of transparency is related to the difference between surface (immediately apparent in the display of information) and depth (not displayed or not immediately apparent) properties of a task. In nontransparent situations, the surface properties of a task are inconsistent with and mask the depth properties of the task. People may fail to respond to nontransparent situations adequately because rules of mental economy often result in acceptance of a problem as presented (i.e., based upon surface properties), without the spontaneous generation or consideration of more depth-related problem representations (Tversky and Kahneman 1990; see also Slovic's (1972) concreteness principle).

The distinction between task and context factors also affects when things are noticed. Task factors are much more likely to be noticed a priori or very early in the process. Context effects, on the other hand, are often noticed only after some information has already been examined. Given the importance of noticing factors in a constructive view of choice, research on the factors related to an individual's focus of attention during decision making is very important. In the next few sections, we examine certain aspects of noticing and exploiting structure in more detail, namely editing and problem restructuring.

Editing processes in decision making

Several researchers have argued that editing processes are an important component of choice (Kahneman and Tversky 1979; Goldstein and Einhorn 1987) and that individuals edit choice problems into simpler form before choosing. Editing processes include dropping outcomes which are identical across alternatives, eliminating dominated alternatives, or eliminating redundant attributes, for example. To the extent that editing processes can change the decision task and simplify choice, they potentially can be major factors underlying adaptivity to different choice environments.

Kahneman and Tversky (1979) and Goldstein and Einhorn (1987) argue that alternatives are edited first and that simplified options are then evaluated; however, we argue instead that editing is opportunistic. That is, *whenever* individuals notice some structure in the choice environment that can be exploited, editing can occur. Hence, we view editing as a bottom-up process, driven by the data, as well as an a priori or top-down phenomenon. Editing processes are probably involved earlier in the decision process the more experience one has in a given choice environment (Johnson and Russo 1984).

Editing is also adaptive, since the particular editing operation used may be a function of the immediately preceding processing. For example, processing a pair of alternatives one attribute at a time and comparing them on each attribute would facilitate the detection of dominance, whereas processing each alternative in its entirety would discourage such detection. Hence, different choice strategies make different editing operations more or less easy, and different choice environments will affect editing because they affect processing. Information display should have particularly strong effects of this sort. According to Slovic's (1972) principle of *concreteness*, individuals tend to use information in the form in which it is displayed (see also Tversky and Kahneman (1990) and our earlier discussion of problem transparency). Display should, therefore, exert a strong influence on editing processes by encouraging or discouraging various types of processing.

Kahneman and Tversky (1979) make a similar argument regarding the order of particular editing operations. They illustrate the importance of order with the following example: the gamble ($500, 0.20; $101, 0.49; $0, 0.31) will appear to dominate another gamble ($500, 0.15; $99, 0.51; $0, 0.34) if the second components of both gambles are first edited by rounding to ($100, 0.50). Thus, 'the final edited prospects could, therefore, depend on the sequence of editing operations, which is likely to vary with the structure of the offered set and with the format of the display' (p. 275). Most important, preferences between gambles may not be invariant across contexts due to differences in the order of operations.

This view of editing is very consistent with our ideas about constructive decision processes and implies that individuals may devote effort not only to applying a heuristic but also to setting up the problem in such a way that further processing is easier. In the next section, we discuss work by Coupey (1990) which considers this tradeoff between decision processing and problem restructuring in more detail.

Restructuring decision tasks

Coupey (1990) defines problem restructuring as applying operations to a set of information to yield a new problem representation. Restructuring operations include information transformations (e.g., rounding off, standardizing, or performing calculations), rearranging information (e.g., changing the order of alternatives or attributes), or eliminating information. Fig. 5 depicts a protocol illustrating restruc-

> Okay, let's see. The information isn't in the same order for each brand. What I'm going to do is to make a table to reorganize the information. It'll be easier to decide if I can see everything at a glance, too. (Subject sets up a brand/attribute matrix.) Okay, what I did was to put down all the brands and the categories in order for each brand. Now, let's see. Hmm, number of needles – A is best with 80, then B. That's the most important category. Warranty, A is 56 months, B, 70 months, C – oh, gee, that's right – they're not all in the same units. C is weeks, so is D. E is years. Okay, what I'm going to do now is to do some math to convert them so I can compare them better (Subject does calculations in notes). Okay, that's better. Look at the others and see if I can standardize them. Quality rating, 2.2 out of 5, 8.8 out of 10, so A is 4.4 out of 10, 3.3 out of 5 is 7 out of 10, and E is oh, out of 100, so 7.2 out of 10. (Subject converts quality ratings mentally, noting transformations in matrix.) Price, well, this is hard. Price per needle or price overall? 3.39 per needle, how many needles? Eighty, so do the math. There. 5.88 times 68. Okay, now I'm all set. (Subject begins comparing brands.)

Fig. 5. An example of restructuring. (This protocol is taken from Coupey (1990). The task was to recommend a knitting machine to purchase. Restructuring is used to standardize information in order to increase processability.)

turing. While editing and restructuring are clearly related, Coupey's definition of restructuring appears to be somewhat more general than that of editing; hence, editing could be thought of as a subset of restructuring.

Presumably the decision maker restructures information to help make difficult decision problems more manageable. That is, by transforming, rearranging, or eliminating information, the decision maker may be able to use a processing strategy that will result in a fairly accurate choice with reasonable levels of effort. whereas that same strategy may have been too difficult before restructuring. In general, individuals may trade off restructuring effort and effort devoted to choosing among the alternatives in the restructured problem.

Coupey provided individuals with five decision problems with five alternatives and from four to six attributes. These decision problems were presented via the Mouselab system described earlier. She manipulated two aspects of the problems between subjects: (1) problems were either well-structured or poorly-structured, and (2) information was presented either simultaneously or sequentially. In well-structured problems, all information for an attribute was expressed in the same units, and information was presented in the same order within each alternative for any given attribute. For poorly-structured problems, the information within the same attribute was presented in different units, and information could appear in a different order within each alternative for any given attribute. Samples of well-structured and poorly-structured problems are given in table 2. For simultaneous presentations, all alternative and attribute information was presented on one screen in matrix form; in the sequential conditions, information was presented one alternative at a time. Four types of problems were created, therefore (well-structured, simultaneous; well-structured, sequential; poorly-structured, simultaneous; and poorly-structured, sequential). Each individual made five choices corresponding to one of the four problem types.

Coupey allowed half of the subjects to take notes while processing and then coded the restructuring operations evident in those notes. All individuals given the opportunity to take notes did so, and 94 percent of those taking notes restructured the information. Individuals in the poorly-structured and sequential conditions created alternative by attribute matrices using these notes. Individuals receiving poorly-structured input used transformations, calculations, and rearranging to arrive at such matrix representations. An example of notes with the coded restructuring operations is provided in table 3. Coupey characterizes this almost universal tendency to develop matrix representations as a top-down type of restructuring, since individuals apparently develop such matrices without regard for the particular values of the information. After a matrix is developed, individuals may carry out eliminations and additional transformations in a bottom-up fashion, depending upon the particular values of the information. In cases where the initial information was already in alternative by attribute form (the well-structured, simultaneous condition), individuals often developed rankings of the alternatives within each attribute. These rankings did not occur as often in the other conditions, perhaps because the individuals had already exerted some effort simply to develop an alternative by attribute representation.

Individuals who restructured (i.e., almost all those who made notes) were more likely to use alternative-based strategies when processing the restructured information then those individuals who did not have the opportunity to take notes. One way of interpreting these data is that individuals put effort into restructuring so that later they can use a more accurate heuristic with a reasonable amount of effort.

Table 2
A sample decision: Storage buildings.

(a) Well-structured presentation.

Brand	Price	Size (in square feet)	Durability (in months)	Difficulty to build (0 = easy, 5 = very hard)
Brand A	$1500	150	72	3
Brand B	$2352	168	50	2
Brand C	$1700	100	54	2
Brand D	$769.50	81	72	4
Brand E	$3388	121	120	1.5
Brand F	$1568	128	64	4

(b) Poorly-structured presentation.

Brand A	Total price: $1500	Size 151 × 10w	Difficulty to build: avg. (5-pt scale)	Durability 6 years
Brand B	Price per square foot $14	Durability 50 months	Size 121 × 14w	Difficulty to build: 4 out of 10 (0 = easy)
Brand C	Total price: $1700	Size 101 × 10w	Difficulty to build: easy (5-pt scale)	Durability 4.5 years
Brand D	Total price: $769.50	Durability 72 months	Difficulty to build: 8 out of 10 (0 = easy)	Size 91 × 9w
Brand E	Price per square foot $28	Difficulty to build: 29 (100-pt scale, 0 = easy)	Size 121 sq ft	Durability 10 years
Brand F	Total price: $1568	Size 161 × 8w	Durability 64 months	Difficulty to build: somewhat difficult (5-pt scale)

Adapted from Coupey (1990).

These descriptions of restructuring imply that restructuring occurs at early stages in the decision process, but the methodology of using notes to examine restructuring may bias the results in this direction.

Table 3
An example of notes coding. Choice among five storage buildings; attributes are ease to build, % preassembled, quality of materials, price, size, and length of warranty.

Relabeling transformation: S. converts wgt. info into ranks

	6 Warr	5 Size	3 Materials	2 Preass.	1 Ease	4 Price
A	39 mo	20 yrd^2	7.2 (10)	72%	7.5 (10)	\$2.31/H^2
B	392 wks	200 ft^2	6.7 (10)	76%	65.6 (IVO)	#390
C	326 mo	184 ft^2	7.5 (10)	56%	4.0 (5) 8.0 (10)	(\$520.72) 2.83/ft^2
D	7.7 yrs	40 ft^2	6 (10)	86%	7.1 (10)	\$384.80
E	100 wks	14.4 yrd^2	7.3 (10)	58%	3.4 (5) 6.8 (10)	\$499.20

2.31 × 20 = 46.20

2.83 × 184: 1132, 2264, 283, 520.72

Brand rearranging: attribute info. was originally presented in varying orders. S. has organized info. by brand into a b/a matrix

Calculation: S. multiplies unit price by # of cu. ft. to get total price

Brand elimination: S. removes B and E from consideration.

Standardizing transformation: S. rescales info. to common 10 pt. scale.

Calculations = 2
Relabeling transformations = 6
Standardizing transformations = 2
Brand rearranges = 5
Brand eliminations = 2

Source: Coupey (1990).

That is, individuals probably take notes and then do further processing based upon those notes. Therefore, although we agree that restructuring often occurs in early stages of a choice process, we also believe that restructuring can occur at any time that some exploitable aspect of the choice is noticed.

Conclusion

This paper reviews a program of research aimed at understanding the contingent and constructive use of strategies in decision making.

We argue that the observed flexibility in the use of decision strategies often reflects adaptive behavior when both the effort and accuracy of decisions are considered. Evidence in support of an accuracy/effort framework is presented. We also argue that individuals often build strategies opportunistically, changing their processing on the spot depending upon the information they encounter. Whether this constructive processing is to make a choice or involves editing or problem restructuring, however, such opportunistic processes still involve accuracy/effort tradeoffs. Both contingent strategy usage and opportunistic strategy construction lead to labile or constructive preferences.

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