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Efficient Social Engineering and Realistic Cognitive Modeling: A Psychologist's Thoughts

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Two decades ago, in 1985, an illustrious group of economists, psychologists, and other social scientists convened at the University of Chicago to discuss the implications of a growing body of experimental evidence documenting systematic departures from the dictates of rational economic behavior. The conference's proceedings, *Rational Choice: The Contrast Between Economics and Psychology*, included contributions from no fewer than two Nobel Prize laureates for economic sciences (Herbert A. Simon and Kenneth J. Arrow) and three future laureates (Daniel Kahneman, Robert E. Lucas, and Merton M. Miller). The book's two editors prefaced the contributions as follows:

> The modern disciplines of economics and psychology are the direct descendants of a common body of philosophical ideas. As a result of their separate evolutions, however, the two disciplines interpret their ideas quite differently and generally pursue different research objectives using *disparate* methods of investigation and analysis. Nonetheless, since there are many areas of human activity where economists and psychologists study the same phenomena, it seems natural to ask whether the *present separation* is in the better interest of both disciplines.... *In other words, can the modern disciplines of psychology and economics learn from each other, and, if so, what?* (Hogarth and Reder 1987, 1; emphasis added)

This depiction of a somewhat estranged relationship between psychology and economics is a vivid reminder of a recent past in which, by conceptualizing rationality purely in terms of observable choices (substantive rationality), economics, according to Simon (1987, 26), took a path different from all other social sciences. In contrast, asserted Simon, psychology understands rationality in terms of the processes it employs, including "nonrational processes" (procedural rationality). These involve motivations, emotions, and simple approximate strategies used in reasoning to permit limited information-processing

measured, but only assessed from behavior, they were eventually seen as useless intervening constructs. As Camerer, Loewenstein, and Prelec (2005) recounted:

> In the 1940s, the concepts of ordinal utility and revealed preference eliminated the superfluous intermediate step of positing immeasurable feelings. Revealed preference theory simply equates unobserved preferences with observed choices. Circularity is avoided by assuming that people behave consistently, which makes the theory falsifiable; once they have revealed that they prefer A to B, people should not subsequently choose B over A. Later extensions . . . provided similar "as if" tools which sidestepped psychological detail. The "as if" approach made good sense as long as the brain remained substantially a black box. (10)

This condensed history of psychology and economics suggests there was a brief window in the middle of the last century during which, for different reasons, both disciplines espoused the study of observable behavior at the expense of unobservable, immeasurable mental events such as thoughts and feelings. In fact, the study of thoughts and feelings was at best perceived as unnecessary, at worst as unscientific. This epistemological parallelism, however, did not last long. It began to end when the young Noam Chomsky set out to strike what proved to be a severe blow to the supreme reign of behaviorism in American experimental psychology.

In 1957, Skinner, the most prominent behaviorist of his time, published a behavioristic account of language and communication, thus responding to Alfred North Whitehead's assertion that simple learning principles cannot account for verbal behavior. Chomsky, a young linguist at MIT, happened upon Skinner's *Verbal Behavior* and in a review of it (1959) challenged many of the assumptions therein. Generally speaking, he criticized Skinner's explanation of language acquisition as completely devoid of any reference to the built-in information-processing structures of the speaker. Skinner conjectured that external factors—in particular, the presence versus absence of reinforcing stimuli, their frequency, and their arrangement—suffice to explain how children master complex verbal behavior. In contrast, Chomsky concluded that "the fact that all normal children acquire essentially comparable grammars of great complexity with remarkable rapidity suggests that human beings are somehow specially designed to do this" (57).

Chomsky's critique of Skinner's attempt to generalize laws of operant behavior to linguistic behavior has often been viewed as the beginning of the end of behaviorism, a protracted process that was then advanced by events such as Garcia and Koelling's (1966) challenge to behaviorism's equipotentiality assumption, according to which any event could be associated equally well with any other event. As Miller (2003) recounted, in the wake of these criticisms it became apparent that behaviorism could not succeed: "If scientific psychology were to succeed, mentalistic concepts would have to integrate and explain the behavioral data" (142). And, indeed, that is what happened. Whereas in economics the notion of revealed preference, without reference to any mentalistic concept, was advanced and became triumphantly successful, psychology lived through the second conceptual shift of the twentieth century, the cognitive revolution. As a consequence, psychologists restored mental events as a legitimate object of study. The brain was no longer to be an impenetrable black box. But—and this is the thesis I would like to advance—in turning to the mental processes of the individual mind, psychology has also abandoned its behavioristic competence in engineering social institutions.

10.2 Social Engineering: A Forgotten Goal in Psychology

In reading this volume's chapters as a psychologist, I was struck by economists' potent analyses of issues regarding the efficient organization of social institutions. For instance, how can one increase people's willingness to contribute to a public good, a question that Stephan Meier (chapter 3) posed. Specifically, he studied whether an institutional arrangement, a matching mechanism, can foster people's willingness to donate money, certainly a key concern of many nongovernmental as well as governmental organizations (such as public universities). His study involved students at the University of Zurich who are asked at the beginning of each semester to donate money to two different causes, one supporting foreign students and one for students experiencing financial troubles. Anonymously, students can decide to donate nothing or to donate prefixed amounts of money to one or both funds. Can their willingness to donate at all, or to donate to two funds rather than just one, be boosted?

From the point of classic economic theory, the fact that people donate anything in a context in which their donation remains anonymous is difficult to explain. Yet, to the extent that people care for the well-being (utility) of others, reducing the costs of a donated monetary unit should stimulate donations, thus raising more money. The price of a

donated unit is rendered cheaper either by a rebate (i.e., tax deductions for charitable contributions) or by a matching mechanism. Meier (chapter 3) focuses on the latter. You may be familiar with this mechanism if you listen to the United States' National Public Radio (NPR). A considerable part of NPR's operational expenses and infrastructure is financed by donations from its listeners. To encourage such donations, foundations or rich philanthropists offer to match listeners' contributions. In Meier's field experiment, students learned that an anonymous donor would match 50 percent (or 25 percent) of their contributions, but only if they decided to donate to both causes. Would this offer increase their willingness to donate to both causes? And, if so, would they continue to be generous even after the offer to match expired?

Meier (chapter 3) finds that although matching can hardly transform a previous nondonor into a donor, the 50 percent matching mechanism turns some of the *frugal* donors (giving money to only one cause) into *generous* donors (giving money to both causes). Interestingly, however, after the matching ends generous donors do not go back to being frugal donors, but stop donating altogether in the subsequent semester. Even people who were generous donors before the matching period stopped donating in the subsequent semester. Meier discusses different explanations of these results. The one most consistent with donors' behavior assumes that monetary incentives may crowd out pro-social behavior.

Regardless of any reservations one may have,[3] I was for several reasons excited to learn about this and related analyses of the impact of matching and other mechanisms on people's willingness to donate to a public good. One reason is that this research illustrates economists' readiness to tackle questions that are of immense importance for how a society organizes its institutions. Second, as well as studying institutions in the wild, economists have succeeded in finding ways to replicate these institutions in laboratory and field settings, thus enabling control of the myriad factors that are confounded with different real-world institutions (for instance, see Eckel and Grossman's 2003 laboratory experiment investigating the impact of a rebate and a matching mechanism on charitable giving). Third, economic theory provides a coherent framework and language, ranging from constructs such as price elasticity to the signal value of institutional arrangements, for analyzing and studying the behavioral impacts of a rebate and a matching mechanism. For illustration, take the notion that different institutions may signal different information. Monetary incentives to

behave pro-socially can signal information about the nature of the task (see Bénabou and Tirole 2003). Matching, for instance, may signal that a charity has not been successful in raising money in the past, and now needs to resort to providing extra incentives. Alternatively, the fact that a donor matches people's contributions may be taken as a signal that the fund is trustworthy. Both interpretations imply that an institutional arrangement conveys information about the merits of the charity's cause, as well as about other people's willingness to donate money to this cause.

As has probably become obvious by now, psychologists are rarely, if ever, concerned with the analysis of institutions. Although we have a very rich theoretical framework to analyze and model the working of the mind, we have little to no language for describing institutions. Although we have gained a high level of experimental sophistication, we have rarely turned to the study of institutions in the laboratory. Although we are successful engineers of such diverse domains as people's workspace, their relationships, or their mental health, we appear to have no aspirations to efficiently engineer social institutions. This theoretical and experimental neglect of institutions, however, was not predestined. Possibly it was a little-noticed side effect of the cognitive revolution in psychology and the subsequent displacement of the behaviorist framework.

To appreciate this conjecture, let us again turn to history. From the outset, behaviorists defined their scientific objective not in terms of Dilthey's distinction of explanation and understanding (*Erklären und Verstehen*; von Wright 2004). Rather, they defined it in the terms used by Watson (1913): "Psychology as the behaviorist views it is a purely objective experimental branch of natural science. Its theoretical goal is the *prediction* and *control* of behavior" (158, emphasis added). True to this dictum, Skinner's (1957) analysis of "operant conditioning" focused on observable environmental events that predict and control behavior, in particular events preceding (e.g., discriminative stimulus) and succeeding (e.g., reinforcer) the target behavior.[4] In what behaviorists refer to as an experimental analysis of behavior, behavior is described in terms of a rich conceptual framework encompassing concepts such as punishment, avoidance, escape, discrimination, generalization, acquisition, and extinction—to name just a few. One of the key terms, "reinforcer," was defined by Skinner in *Beyond Freedom and Dignity* (1971) as follows: "When a bit of behavior is followed by a certain kind of consequence, it is more likely to occur again, and a consequence having this

effect is called a reinforcer. Food, for example, is a reinforcer to a hungry organism; anything the organism does that is followed by the receipt of food is more likely to be done again whenever the organism is hungry" (27). In other words, whenever the consequence of behavior increases the frequency of behavior, the consequence is called a reinforcer. Analogously, when a consequence decreases the probability of behavior, the consequence is a negative reinforcer.

Based on his experimental analysis of behavior, Skinner (1971) was convinced that attributing human behavior to intentions, purposes, aims, and goals was futile. Instead, as he saw it in *Beyond Freedom and Dignity*: "We shall not solve the problems of alcoholism and juvenile delinquency by increasing a sense of responsibility. It is the environment which is 'responsible' for the objectionable behavior, and it is the environment, not some attribute of the individual, which must be changed" (122).

To the extent that environmental structures and, among these, institutional structures, underlie undesirable behavior, altering them is key in altering behavior. In other words, analysis and design of institutions is true to the behaviorist perspective. In fact, in his utopian novel *Walden Two*, Skinner (1948) went so far as to describe in detail the institutional structures of a small-scale community—its childcare facilities, its economic structures, and its political self-organization—that he thought to be conducive to the pursuit of happiness under conditions that, in today's jargon, are called sustainable. Indeed, his commentary to the second edition of *Walden Two* epitomized his unyielding aspiration to engineer efficient institutions. In words that sound eerily prescient of today's worries, Skinner (1976) wrote:

> It is now widely recognized that great changes must be made in the American way of life. Not only can we not face the rest of the world while consuming and polluting as we do, we cannot for long face ourselves while acknowledging the violence and chaos in which we live. The choice is clear: either we do nothing and allow a miserable and probably catastrophic future to overtake us, or we use our knowledge about human behavior to create a social environment in which we shall live productive and creative lives and do so without jeopardizing the chances that those who follow us will be able to do the same. (xvi)

These quotes illustrate that in the heyday of behaviorism, scientists such as Skinner were committed to the engineering of environments and institutions. No doubt, by escaping into more applied fields such as clinical and educational psychology, some of this commitment has survived the demise of behaviorism. On a theoretical level, however, once it freed itself from behaviorism, mainstream experimental psychology resigned from the analysis and design of institutions. In other words, restoring cognition to scientific respectability exacted the price of losing sight of the world outside of the individual mind. The battle between behaviorism and cognitive psychology, however, has long been decided. Today psychology is a discipline that has greatly contributed to the understanding of the cognitive capacities and processes of the human mind. Bolstered by this achievement, it may now be more feasible than ever for psychologists to join economists in the analysis of behavior and cognition in institutional contexts, and to contribute constructs beyond the utility function.

10.3 Matching and Charitable Giving: A Look from a Behavioristic Framework

From psychology's point of view, one could begin such a return to institutional analysis by first investigating which of the behaviorist constructs could complement and enrich the economic analysis of institution. Take, for instance, the question of how a matching mechanism should be designed to bolster long-term charitable giving. In analyzing this question, it may be heuristically fruitful to treat the "offer to match" akin to a reinforcer.[5] To wit, matching is a reinforcer applied with the goal of increasing the frequency of pro-social behavior in terms of the likelihood of and the amount of donations. Matching is thus an instance of the most common type of instrumental conditioning, namely, positive reinforcement (as opposed to punishment and negative reinforcement), in which the display of the instrumental response yields a positive reinforcer (i.e., reward). Candy, money, praise, sensory stimulation, and social approval all may be strong rewards or reinforcers for some behaviors. One way to interpret the offer to match is in terms of a social reinforcer. This is a reinforcer that is socially mediated by others—for instance, teachers, parents, or peers—who express approval and praise for appropriate behavior.[6] In analogy, by offering to match a person's offer, an institution can express its appreciation of pro-social behavior. Metaphorically, it pats the donor on the back. At least during the period in which matching is offered, the pat seems to work: it fosters the desired instrumental behavior (Meier, chapter 3).

Having thus framed matching as a social reinforcer, one can now analyze the momentum of charitable giving using what behaviorists

know about the factors influencing positive reinforcements, such as reinforcement schedule, reinforcement delay, or contrast effects. Perhaps the most important influence on instrumental conditioning is the reinforcement schedule, which determines how often a behavior results in a reward. In natural settings, many rewards occur intermittently—once a month, as with a paycheck, or after a variable number of days, as with a return call from a friend, and so forth. Whether rewards occur constantly or intermittently has a profound impact on the rate and probability of the desired behavior. For instance, the response rate in a "variable ratio schedule" (e.g., a variable ratio of 1:3 means that *on average*, one out of every three behaviors will be rewarded) tends to be higher than in other reinforcement schedules in which reinforcers are presented after a fixed number of responses or within a fixed time interval (Tarpy and Mayer 1978).

The reinforcement schedule under which behavior is learned also affects how robust it is. For instance, one of the most reliable phenomena in learning research is the partial reinforcement effect (Tarpy and Mayer 1978). It describes the fact that resistance to extinction is stronger when behavior was originally acquired under intermittent rather than continuous reinforcement. One possible reason is that under intermittent reward organisms have been conditioned to perform in the presence of frustration. In contrast, the continuously reinforced organisms experience the full impact of aversive frustration for the first time during extinction. Thus, according to one plausible speculation, they cease to respond rather quickly.

If one accepts the analogy that matching donations acts like a reinforcer, then the partial reinforcement effect has immediate implications for the matching regime. One prediction is that if the target behavior —contributing to a public good—was learned under intermittent reinforcement—here intermittent matching—then it will prove more robust once all matching is removed. In other words, if making a charitable contribution is sometimes but not always reinforced by a matching offer, people will continue to contribute even if at some point matching is no longer offered.

As the frequency of reward changes in real-world settings, the magnitude can fluctuate as well, thus creating a contrast effect. "Contrast" is the term for what occurs when an organism learns a behavior under one set of reward conditions and is then switched to a different set. In a typical experiment, two groups of organisms are trained to make a response for a small reward, while two other groups receive a large

reward. Once the behavior is stabilized, one group in each reward regime receives the alternate reward magnitude, whereas the other group continues with the same reward. How does the learned behavior change as a consequence of the reward reversal? The typical result is that behavior in the alternate groups changes appropriately: the organisms who are shifted from low to high improve, while performance for those who are shifted from high to low deteriorates. More interesting, however, is the observation that the alternate organisms tend to overshoot and undershoot, respectively (compared to the high-high and low-low organisms). That is, after the shift, the low-high group performs even better than the high-high group. Similarly, the high-low group performs worse than the low-low one (Tarpy and Mayer 1978). This finding echoes Meier's (chapter 3) observation that when matching donations are stopped—thus switching from high reward to no reward—people appear to "overcompensate;" that is, they donate less than they did before.

Looking at the act of matching donations through the eyes of a behaviorist gives rise to still another interesting observation: the promise by the University of Zurich (in Meier's analysis, chapter 3) to match donations and the donors' responses may evolve into two mutually reinforcing behaviors. To appreciate this possibility, let us again assume that the offer to match fosters individuals' willingness to donate. At the same time, however, the behavior of the institution may also come to be controlled, at least partially, by donors' behavior. The increased likelihood of donations in response to the matching offer is likely to reinforce the behavior of the university, thus increasing the likelihood of matching donations in the future.

These few examples illustrate, I believe, that the rich behavioristic framework can be used as a heuristic tool when considering the efficient design and impact of social institutions such as matching mechanisms. To avoid misunderstandings, I am not pleading for a revival of behavioristic dogmatism in psychology, nor do I wish to imply that behavioristic constructs ought to supplant economic ones. Rather, I am convinced that by revisiting the behaviorist paradigm, cognitive psychologists will come across many theoretical constructs *and* empirical findings that promise to complement and enrich the economic analysis of institutions. Economists and behaviorists share the credo that behaviors are selected by their consequences. Perhaps this joint belief has given rise to theoretical frameworks offering commensurable sets of conceptual lenses. It is time to see whether they can be used in tandem.

In doing so, psychologists would also be offered an opportunity to make a larger contribution to the efficient engineering of the world.

10.4 Cognitive Modeling: A Neglected Goal in Economics

It is ironic that around the time economists turned away from psychological forces to focus on behavior, psychologists turned from overt behavior to psychological processes. Like behaviorists before them, economists became skeptical that psychological entities could be measured in any way other than inferring them through the observation of behavior. To escape from this tautology economists adopted another one that proved to be very productive, namely, that between unobserved utilities and observed (revealed) preferences. One price economists have paid for this premise is well known, at least in the eyes of many psychologists: a disregard for the psychological reality of people operating under constraints of time, information, and computational capacities. Simon (1987), perhaps the most outspoken critic of this neglect, wrote of neoclassical economics that, in its treatment of rationality, it differs from the other social sciences in its neglect of the "processes, individual and social, whereby selected aspects of reality are noticed and postulated as the 'givens'... for reasoning," and in its neglect the "computational strategies that are used in reasoning, so that very limited information-processing capabilities can cope with complex realities" (26).

One may fault the above depiction for outlining a view that was perhaps common early in the evolution of the field but is now long gone. Today many economists would agree that cognitive resources, time, and money are limited and would assert that economic models explicitly take such limits into account by, for instance, assuming a limited rather than unlimited search for information. Limited search requires a stopping rule, a way to decide when to stop looking for more information. Often put under the rubric of "optimization under constraints," one class of economic models assumes that the stopping rule *optimizes* search with respect to the constraints of time, computation, money, and other resources. According to this view, the mind should calculate the marginal benefits and the marginal costs of searching for further information and stop searching as soon as the costs outweigh the benefits (e.g., Sargent 1993; Stigler 1961). Although the rule "stop search when costs outweigh benefits" sounds plausible at first glance, optimization under constraints can demand even more knowledge and computation than classic models of unbounded rationality. This is because they assume that the decision maker takes into account not only cost-benefit calculations, but also opportunity costs and second-order costs for making those calculations (Conlisk 1996; see also Gigerenzer et al. 1989, 10–12).

It thus does not seem controversial to conclude that not only neoclassical economics but also many contemporary economic models pay little to no attention to the limited information-processing capabilities of the human actor. Psychologists, in contrast, often do. In fact, in doing so they have amassed a solid understanding of the cognitive constraints (e.g., in memory, processing capacity, and attention), as well as the cognitive processes that may have evolved in tandem with these constraints (see Hertwig and Todd 2003). In addition, psychologists have proposed models of cognitive processes underlying a wide range of behavior such as judgments, choice, inferences, and categorization. In what follows, I describe a very recent process model for risky choice, which, I believe, enriches our understanding of both the processes and the outcomes of judgments under risk and amplifies our predictive power. The same benefits, according to my thesis, could also be reaped in investigations that have enormous implications for economic theorizing, such as whether people mispredict future utilities.

10.5 The Priority Heuristic: Making Choices without Trade-Offs Heuristics in Risky Choice

One of the most consequential events in the history of decision theory occurred in the early eighteenth century and involved a perplexing gamble and two members of perhaps the most prominent family in the history of mathematics. In an epistolary exchange with Pierre Rémond de Montmort, Nicholas Bernoulli, a professor of law in Basel, Switzerland, posed the St. Petersburg gamble. In this gamble, a coin is tossed until heads occurs. If heads occurs on the first toss, the person will receive two coins; if it occurs on the second toss, the person will receive four coins. Thus the gamble's payoff is 2^k, where k is the number of tosses until heads comes up. Although this gamble has an infinite expected value (but see Jorland 1987), hardly anybody cared to pay more than small sums for the right to play the gamble.

To resolve the discrepancy between what was the then-dominant psychological theory of reasoning of the educated *homme éclairé* and people's good sense, Nicholas's cousin Daniel Bernoulli (1954) retained

the core of the expected value theory—that is, the multiplication of monetary outcomes and their probabilities and maximization—but suggested replacing objective money amounts with subjective utilities. In his view, the pleasure or utility of money did not increase linearly with the monetary amount. Instead, the increases in utility declined (diminishing marginal utility), and he modeled this decline by assuming that the relation between objective and subjective values of money obeys a logarithmic function.

Daniel Bernoulli's resolution of the St. Petersburg paradox provided nothing less than the foundation of expected utility (EU) theory; however, it also introduced an influential precedent of how to solve discrepancies between theories of risky choice and behavior. As Bernoulli demonstrated so successfully, one can do this by adding one or more adjustable parameters to the original theory—in Bernoulli's case, the concept of utility—while retaining the original framework, that is, the notion that people behave as if they multiplied some function of probability and value, and then maximized.

To this day, myriad theories of risky behavior have been proposed that have wittingly or unwittingly adopted Bernoulli's strategy. Examples include disappointment theory (Bell 1985; Loomes and Sugden 1986), regret theory (Bell 1982; Loomes and Sugden 1982), the transfer of attention exchange model (Birnbaum and Chavez 1997), decision affect theory (Mellers 2000), prospect theory (Kahneman and Tversky 1979), and cumulative prospect theory (Tversky and Kahneman 1992). They represent a "repair" program that introduces psychological variables such as emotions and reference points in order to rescue the Bernoullian framework (Selten 2001). The originators of prospect theory, for instance, set themselves the goal "to assemble the minimal set of modifications of expected utility theory that would provide a descriptive account of... choices between simple monetary gambles" (Kahneman 2000, x). Despite the additional dose of psychology, however, many of these modifications of EU theory have typically been interpreted to be as-if models because of the complex computations involved in them. That is, they describe and ideally predict choice outcomes, but do not explain the underlying process.

There is, however, a completely different way to react to empirical demonstrations that human behavior often contradicts EU theory. Rather than adding more psychology to the Bernoulli framework by way of more adjustable variables, one can step outside of the time-honored framework and explain people's choices as the immediate

consequence of the use of a heuristic. That is the approach that Brandstätter, Gigerenzer, and Hertwig (2006) have taken (for a related approach see Payne, Bettman, and Johnson 1993). Specifically, they investigated whether a sequential heuristic, the "priority heuristic," can predict both classic violations of EU theory and major bodies of choice data. Unlike outcome models, heuristics aim to model both the choice outcome and the process. To this end, they require a specification of (1) a process rule, (2) a stopping rule, and (3) a decision rule.[7]

To illustrate the priority heuristic, let us consider simple monetary gambles of the type "a probability p to win amount x; a probability $(1 - p)$ to win amount y" $(x, p; y)$. Here the decision maker is given four reasons: the maximum gain, the minimum gain, and their respective probabilities. All reasons are displayed simultaneously and they are available at no cost. The resulting choices are thus "decisions from description" and not "decisions from experience" (Hertwig et al. 2004). The "priority rule" refers to the order in which people go through these reasons, after screening all of them once, in order to make their decision. The heuristic describes the psychological process underlying a choice between two simple monetary gambles in terms of the following three steps:

1. *Priority rule* Go through reasons in this order: minimum gain, probability of minimum gain, maximum gain.

2. *Stopping rule* Stop examination if the minimum gains differ by 1/10 (or more) of the maximum gain; otherwise, stop examination if probabilities differ by 1/10 (or more) of the probability scale.

3. *Decision rule* Choose the gamble with the more attractive gain (probability).

The term "attractive" refers to the gamble with the higher (minimum or maximum) gain and the lower probability of the minimum gain (see Brandstätter, Gigerenzer, and Hertwig 2006 for details on how the rules were derived from empirical evidence). The heuristic combines three different features. Its initial focus is on outcomes rather than on probabilities (Deane 1969; Loewenstein et al. 2001; Sunstein 2003). It is based on the sequential structure of the fast and frugal heuristic for inferences (see Gigerenzer 2004). Finally, the priority heuristic incorporates aspiration levels into its choice algorithm (Luce 1956; Simon 1983). The generalization of the priority heuristic to

nonpositive and mixed prospects and to more than two outcomes is straightforward (see Brandstätter, Gigerenzer, and Hertwig 2006).

10.5.1 Certainty Effect

To illustrate how the priority heuristic works, let us turn to the certainty effect, a well-known violation of EU theory. According to Allais (1979, 441), the certainty effect captures people's "preference for security in the neighborhood of certainty." A simple demonstration is the following (Kahneman and Tversky 1979):

A:	4,000	with $p = 0.80$
	0	with $p = 0.20$
B:	3,000	with $p = 1.00$

A majority of people (80 percent) selected the certain alternative *B*.

C:	4,000	with $p = 0.20$
	0	with $p = 0.80$
D:	3,000	with $p = 0.25$
	0	with $p = 0.75$

Now the majority of people (65 percent) selected gamble *C* over *D*. Note that the choice of *B* implies that $u(3{,}000)/u(4{,}000) > 4/5$, whereas the choice of *C* implies the reverse inequality.

The priority heuristic starts by comparing the minimum gains of the alternatives *A* (0) and *B* (3,000). The difference exceeds the aspiration level of 1/10 of the maximum gain (4,000), thus examination is stopped, and the model predicts that people prefer option *B*, which is in fact the majority choice. Between *C* and *D*, the minimum gains (0 and 0) do not differ; in the next step, the heuristic compares the probabilities of the minimum gains (0.80 and 0.75). Because this difference does not reach ten percentage points (the threshold for the second reason), the last reason will be examined, and this reason—maximum gain—favors the choice of *C* over *D*.

The priority heuristic is simple in several respects. It typically consults only one or a few reasons; even if all are screened, it bases its choice on only one reason. Probabilities are treated as linear, and a 1/10 aspiration level is used for all reasons except the last, where the amount of difference is ignored. No parameters are built in for overweighting small probabilities and underweighting large probabilities, or for the value function.

10.5.2 Empirical Tests of the Priority Heuristic

Does this simple model account for people's choices as well as multiparameter outcome models do? Brandstätter, Gigerenzer, and Hertwig (2006) found that the heuristic can account for a wide range of phenomena at variance with EU theory. Like the certainty effect, it can, for instance, predict the Allais paradox, the possibility effect, and intransitivities. To investigate the extent to which the heuristic can predict choices across a wide range of gambles, Brandstätter, Gigerenzer, and Hertwig tested the heuristic against four classes of gambles, namely, (1) simple choice problems (no more than two nonzero outcomes; Kahneman and Tversky 1979), (2) multiple-outcome gambles (Lopes and Oden 1999), (3) gambles inferred from certainty equivalents (Tversky and Kahneman 1992), and (4) randomly sampled gambles (Erev et al. 2002).

The four classes of gambles amounted to a total of 260 problems. The performance of the priority heuristic in predicting the modal choice in each of the 260 problems was compared to the performance of three modifications of expected utility theory: cumulative prospect theory (Tversky and Kahneman 1992), the security-potential/aspiration theory (Lopes 1987, 1995; for details, see Lopes and Oden 1999), and the transfer of attention exchange model (Birnbaum and Chavez 1997). Despite differences in their number and nature of parameters, all modifications retain the assumption that people behave as if they multiplied some function of probability and value, and then maximized. The priority heuristic was also compared to classic heuristics that have previously been proposed (see Thorngate 1980; Payne, Bettman, and Johnson 1993). For each strategy, its mean frugality (defined as the proportion of pieces of information that a model *ignores* when making a decision), and the proportion of correct predictions (i.e., prediction of the modal choice) were determined.

Figure 10.1 describes how well the different strategies can account for people's choices. Three clusters of strategies emerge: the modifications of expected utility and tallying, the classic choice heuristics, and the priority heuristic. The first cluster, involving the modifications of expected utility and tallying, could predict choice fairly accurately, but required the maximum amount of information. Specifically, security-potential/aspiration theory, cumulative prospect theory, and the transfer of attention exchange model correctly predicted 79 percent, 77 percent, and 69 percent of the majority choices, respectively. The second cluster, the classic heuristics, was fairly frugal but performed

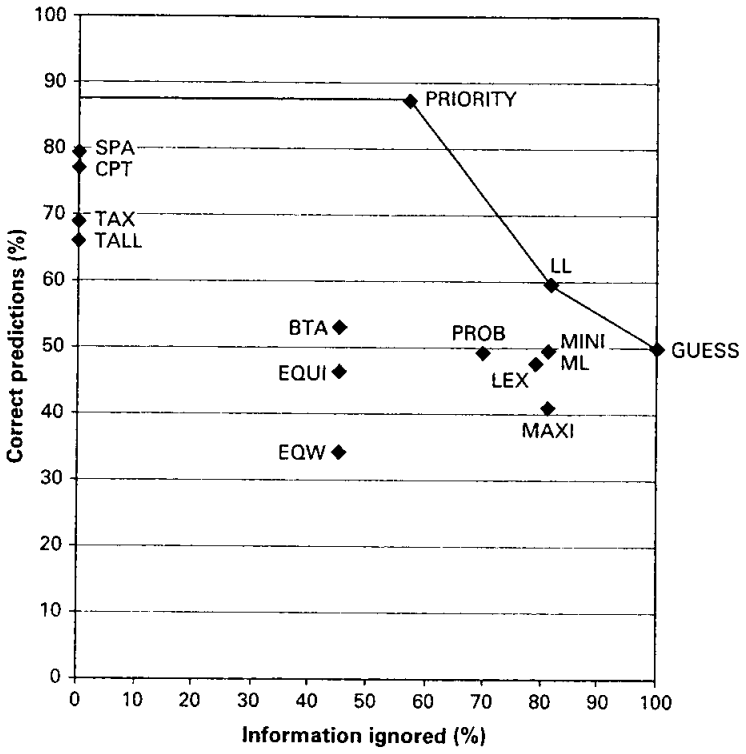

Figure 10.1
Predictability/frugality trade-off, averaged over 260 problems. The percentage of correct predictions refers to majority choices (including guessing).
PRIORITY: Priority heuristic
CPT: Cumulative prospect theory
SPA: Security-potential/aspiration theory
TAX: Transfer of attention exchange model
TALL: Tallying
LEX: Lexicographic heuristic
EQW: Equal-weight heuristic
LL: Least likely heuristic
ML: Most likely heuristic
BTA: Better than average heuristic
EQUI: Equiprobable heuristic
PROB: Probable heuristic
GUESS: Pure guessing
MINI: Minimax heuristic
MAXI: Maximax heuristic.
For a description of the heuristics, see Brandstätter, Gigerenzer, and Hertwig (2006).
Source: Brandstätter, Gigerenzer, and Hertwig (2006). Reprinted with permission of the American Psychological Association.

dismally in predicting people's choices. Indeed, with the exception of the least likely heuristic (LL) and tallying (TALL), most classic heuristics' performance did not exceed chance level. For instance, the performances of the minimax and lexicographic rules were 49 percent and 48 percent, respectively. The priority heuristic represents the third and final cluster. This heuristic achieved the best predictive accuracy of all strategies (87 percent) while being relatively frugal.

To conclude, Brandstätter, Gigerenzer, and Hertwig's (2006) goal was to derive from empirical evidence a model that both predicts risky choice and spells out its underlying psychological processes. It does so by specifying (1) the order in which reasons—minimum outcomes, probability of minimum outcome, and maximum outcome—are examined, (2) the condition under which examination of reasons is stopped, and (3) a decision rule. Each of these process assumptions gives rise to empirical predictions over and above the predictions of outcomes. As a consequence, this model can be tested on two levels, on the level of choice and the level of processes (see Brandstätter, Gigerenzer, and Hertwig (2006) for a test of the latter). Notwithstanding its excellent performance in predicting people's choice in the examined set of gambles, the priority heuristic has, of course, limitations. For instance, additional results suggest that the priority heuristic does best when choices are difficult, due to similar expected values of the alternatives. In contrast, when choices become easy—due to widely discrepant expected values—expected value theory predicts choices as well as or better than the heuristic (see Brandstätter, Gigerenzer, and Hertwig 2006 for a discussion of this and other limitations).

10.6 Models of Heuristics for Predictions of Future Utilities

The priority heuristic is an instance of what Payne and Bettman (2004) describe as the "information processing approach to decision research." In contrast to the information-processing approach, the traditional focus in economic theorizing is on *what* decisions are made. This focus remains paramount even when economists challenge the standard economic model of rational choice, as Stutzer and Frey (chapter 7) do in their intriguing investigations of the economic consequences of misprediction utility. Standard economic theory assumes that individuals are able to accurately compare and predict the future utilities bestowed by consuming goods and activities, simply by determining the sum of the weighted values of the alternatives' characteristics, and then choosing

the alternative promising the maximum predicted utility. In this view, people do not make systematic mistakes in their choice of goods and activities. People know what is good for them, now and in the future. In their incisive analysis, which is of utter relevance both for economists and psychologists, Stutzer and Frey challenge this dictum. Rather than consistently maximizing their utility, people, according to Stutzer and Frey, can and do make suboptimal consumptive decisions. The authors discuss such suboptimal consumer choice in the context of tobacco use, eating habits, TV watching, and commuting.

Why is that? According to Stutzer and Frey (chapter 7), people may do so because they struggle with self-control or lack thereof, or because they sometimes mispredict utilities in the future. Henceforth I will focus on the issue of misprediction. Drawing from research in psychology, Frey and Stutzer (2004) distinguish between intrinsic and extrinsic attributes of goods and activities. The former are associated with intrinsic needs such as relatedness and self-efficacy, whereas the latter are associated with extrinsic desires such as material possession and fame. In relation to extrinsic attributes, the intrinsic attributes are undervalued in the process of predicting future utility. Such undervaluation may arise because (1) adaptation (i.e., the fact that our affective responses to events wear off) may be more likely to be underestimated for extrinsic attributes than for intrinsic ones, (2) extrinsic attributes may yield briefer, yet more intense and thus more memorable, affective responses, (3) people may find it easier to justify extrinsic rather than intrinsic attributes toward themselves and others, and (4) people with predominantly extrinsic needs may be more likely to rely on false intuitive theories regarding the causes underlying their subjective well-being.

Among other contexts, Frey and Stutzer (2004) test their thesis of the relative neglect of intrinsic attributes in predicting future utilities in the context of an ubiquitous decision, namely, that of deciding between two jobs, one that offers more income but necessitates a longer commute, and the other that pays less but requires less time spent commuting. They hypothesize that commuting time and associated intrinsic attributes such as time spent with friends and family are underweighted, and extrinsic attributes such as more income and lower housing costs (thus enabling a higher level of consumption) are overweighted. Based on a maximization analysis (using commuters' reported life satisfaction as a proxy for individual utility), they then find that people who spend more time commuting are not fully compensated for their displeasure by higher income, lower rent, or nicer housing. Consistent with the notion that people overestimate the future utility from extrinsic attributes, when compared against their own preferences, people are not as content as they could be.

What would Frey and Stutzer's (2004) investigation have gained if they had aimed to model not only the outcome but also the process of choice? My conjecture is that a model of the process promises an even better understanding of *why* people systematically misjudge future utilities, and also of how and why people differ in this judgment. To illustrate this conjecture, let us do a thought experiment in which we look—in analogy to the choice between two gambles—at people's choice between two jobs. For the purpose of simplicity, let us assume that each job can be described with just three reasons: two tangible reasons, salary and commuting time (as a proxy for time lost on social activities), and a less tangible one, namely, anticipated social status. Job *a* pays more and promises more social status but requires a long commute. Job *b*, in contrast, pays less and promises less social status, but it offers a short commute. Which decision processes would lead people consistently to select job *a*, thus overweighting the satisfaction derived from the extrinsic attributes, income, and status?

The answer to this question depends on the class of heuristics used to examine the reasons. One class of heuristics examines reasons in order (a simple form of weighting)—the priority heuristic is an example—and then makes a decision on the basis of the first reason that discriminates. This is the class of "one-reason decision-making" heuristics (Gigerenzer 2004). Herein, extrinsic reasons would be privileged if they topped intrinsic reasons in the order of reasons. For instance, if salary is ranked higher than commuting time, and if the difference in salaries is good enough ("satisficing"), then examination of further reasons will be stopped. Consequently, other reasons such as commuting time will not enter the decision-making process. Within this class of heuristics, individual differences can enter through at least two sources. One source is the order of reasons. Some people—those who value intrinsic needs—may rank commuting time rather than salary as the most important reason. Another source is the aspiration level that stops examination. For instance, one may speculate that those who value extrinsic needs are satisfied with smaller salary differentials than those who value intrinsic needs.

A second class of heuristics dispenses with the simple ordering of reasons and simply adds up all reasons (until a threshold is met). This

is the class of "tallying" heuristics (Gigerenzer 2004). In this class, extrinsic reasons would have an edge if more extrinsic than intrinsic reasons entered the decision-making process. Then, *ceteris paribus*, positive values on all intrinsic reasons for one job cannot make up for the other job's positive values on all extrinsic reasons. Alternatively, extrinsic reasons would also have an edge if they proved to be immediately available and quantifiable. Indeed, one typically knows the salaries of both jobs one is deciding between, but one may be less certain about each job's hours and how working overtime, for instance, would affect one's social life, and by extension, one's subjective well-being. If such an information asymmetry between intrinsic and extrinsic reasons exists, then extrinsic reasons, *ceteris paribus*, may have an edge simply because people are less likely to know the values for the intrinsic reasons.

These are just two classes of heuristics; others exist (see Payne, Bettman, and Johnson 1993). However, our thought experiment has already turned up some insights. For one thing, it shows that the reasons why people may misjudge future utilities can be manifold. Depending on the class of heuristics, the causes may lie, for instance, in the order of reasons, the ecological frequency of extrinsic and intrinsic reasons, or the lesser certainty and predictability of intrinsic reasons. Second, it is not so clear whether people's "misjudgment" is an instance of a cognitive bias: for instance, if people indeed possessed less reliable and certain knowledge of the intangible, intrinsic reasons than of the tangible, extrinsic reasons, then the relative edge of extrinsic over intrinsic reasons is due to this information asymmetry and not to erroneous processing of information. Third, by spelling out possible processes, various sources of interindividual differences become manifest: order of reasons, aspiration levels, relative number of intrinsic versus extrinsic reasons, and so on. Finally, the different heuristics give rise to different possible interventions: that is, if one aimed to enable people to make better choices—"better" measured in terms of their own preferences—then a person who systematically ordered extrinsic reasons over intrinsic would benefit from different feedback as compared to a person who examines reasons in no specific order but "suffers" from the uncertainty integral to intrinsic reasons.

10.7 Conclusion

For a very brief window of time during the twentieth century, psychology and economics shared, for related reasons, a focus on observable behavior. How would the two disciplines have cooperated had psychology not abandoned its behaviorist focus, or, alternatively, had economics not decided to sidestep psychological processes in favor of observed choices? We will never know. But perhaps there are ways of making up for some of the possibly missed interdisciplinary endeavors. In this chapter, I have described two, in my view particularly important and promising, future avenues. First, by reconciling with their behavioristic past, psychologists could access a rich theoretical repertoire of learning theories and empirical findings. By recruiting this framework and investigating how it maps onto, complements, and, perhaps, sometimes contradicts the constructs economists use to analyze and design institutions, they could join economists in a task as important as ever—social engineering.

Second, by recognizing constructs other than the utility function as worthy of consideration, economists could exploit psychology's existing and ever-evolving theories of cognitive processes—for instance, the science of heuristics. By opening up the black box of the human mind, economists and psychologists are likely to arrive at a more comprehensive understanding of, for example, whether, why, and when people mispredict future utilities. Augmenting our models by process assumptions renders it possible to test them both on the level of overt behavior as well as on the level of cognitive and affective processes. Last but not least, elucidating the processes driving suboptimal choice may also provide us with new tools to foster people's predictions of future utilities, thus fostering their well-being.

Notes

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1. The practices of experimentation, however, are surprisingly different in economics and in areas of psychology relevant to both economists and psychologists, such as behavioral decision making (see Hertwig and Ortmann 2001; Ortmann and Hertwig 2002).

2. In 1913, J. B. Watson gave a lecture at John Hopkins University, Baltimore, that was to become one of the most famous lectures in the history of psychology. He called for a radical revision of the scope and method of psychological research.

3. All explanations discussed—intertemporal substitution, mental accounting, and crowding out—implicitly assume that six months later, people can still remember that in the previous period their donations were matched. But can they? Or does a person's behavior differ as a function of whether one is cognizant of this intervention?

4. Skinner's term "operant" reflects the idea that the organism actually operates, that it can have an effect on the environment.

5. Here I intentionally use the notion "heuristically fruitful" because there may be different ways of conceptualizing the offer to match from a behaviorist perspective. The institutional promise to match a person's offer can be seen as a contract between the donor and the benefactor in which the promise takes the form of a conditional reinforcer. I treat the offer to match as a positive reinforcer. But this mapping is not without problems, and conceivably there are other, better behavoristic models of the link between the matching offer and donors' behavior.

6. Verbal and written comments (e.g., "good job," "super") as well as nonverbal expressions of approval (e.g., smiling, a pat on the back) are all instances of social reinforcers.

7. The following paragraphs describing the priority heuristic are adapted from Brandstätter, Gigerenzer, and Hertwig (2006).

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