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Group Report: Are Heuristics a Problem or a Solution?

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ABSTRACT

This chapter surveys a range of methodological, descriptive, and prescriptive issues concerning the implications of cognitive psychology for law. Included are (a) a general introduction to the subject of heuristics in decision theory, with particular attention to the distinction between optimality-based and heuristic-based decision making models within psychology; (b) an attempt to synthesize these two psychological research paradigms into a single conceptual framework that helps to identify important areas in which further research and understanding are needed; (c) an overview of scholarship to date on heuristics and the law, including an observation that this scholarship has ignored certain significant lessons of the heuristics research tradition in psychology; and (d) a compilation of suggestions for future interdisciplinary research concerning both the use of heuristics by legal subjects whose behavior the law is attempting to influence and the use of heuristics by policy makers as a model for the substantive design of legal rules.

INTRODUCTION

Between 1889 and 1908, famed Catalan architect Antoni Gaudi designed the *Colonia Güell* chapel, a remarkable structure that one expert described as a "[t]echnologically brilliant" combination of "the magic of traditional religious architecture with the originality of an isolated genius" (Sharp 2002, p. 54). At a time when contemporary designers were committed to the rationalist tools of two-dimensional drawing and mathematical calculation, Gaudi struck upon an innovative design method that was both startling in its simplicity and revolutionary in the possibilities that it unveiled. He began by drawing a scale outline of the church's foundation on a wooden panel, which he then hung upside-down from the ceiling of a small house near the work site. Beneath the inverted wooden panel, Gaudi suspended an elaborate system of ropes and weights,

which, when viewed through a mirror, revealed the shape, dimensions, and load-bearing capacities of a massively complex, yet aesthetically beautiful design for the proposed structure. Photographs of the upside-down model also were taken which, when turned right side up, provided Gaudi with the perfect template for painting various architectural details to adorn the church's ingeniously derived form. Between the painted photographs and the inverted rope-and-weights model, Gaudi obtained an unorthodox, but architecturally flawless set of plans for his famous chapel, one that no engineer of his time could have derived using traditional methods.[1]

The real genius in this example rested in Gaudi's willingness to allow the form of the church to be chosen in part by nature, through gravity, rather than by the conventional give-and-take between an artist's vision and an engineer's computational abilities. At other times, however, the choices of nature are less felicitous. Health researcher Michael Tordoff, for instance, has uncovered evidence that a simple—and ordinarily reliable—behavioral heuristic found in rats can become lethal when experimenters alter the animal's environment such that the heuristic no longer provides a good "fit" with surrounding circumstances (Tordoff 2002). In Tordoff's experiment, rats provided with equal amounts of solid carbohydrate, fat, and protein automatically selected a healthy mix of nutrients, reflecting the "nutritional wisdom" that researchers long have believed exists as an innate physiological ability in animals. However, rats provided with "extra" servings of fat shifted the composition of their diet to such a degree that life-threatening protein malnutrition resulted, despite the ready availability of protein in their cages. In another experiment, when sucrose solution was made available to groups of rats in addition to water, the exposed rats gained significantly more weight than control group rats that were provided only with water as a source of liquid. Those rats with sucrose solution available decreased their intake of other nutrients compared to the control group, yet actually gained more weight as a result of their increased sugar intake. As Tordoff dryly concluded, these results provide evidence for the existence of consumption heuristics that may have implications beyond the world of rodents: "The finding that laboratory animals choose to eat what is abundant has obvious relevance for husbandry and for animals in the wild, including humans confronted with many products in the supermarket" (Tordoff 2002, p. 539).

Gaudi's model provided a heuristic device that was both cognitively frugal and well-adapted to his environment, enabling him to exploit the natural laws of physics in an inductively brilliant fashion. Tordoff's rats, on the other hand, employed a behavioral heuristic that no longer matched their altered environments,

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[1] As physicist Gorit Aharonov observed, "Since the plan of the church was so complicated—towers and arcs emerging from unexpected places, leaning on other arcs and towers—it is practically impossible to solve the set of equations which corresponds to the requirement of equilibrium in this complex. [But through Gaudi's model] all the computation was instantaneously done by gravity! The set of arcs arranged itself such that the whole complex is in equilibrium, but upside down" (Aharonov 1998).

demonstrating the potentially deadly consequences of an "eat fat or sugar when they are available" decision rule in an environment where such nutrients can be found in super-sized portions. Although emerging from quite different fields and utilizing distinct notions of "heuristic" (which, as will be seen, is not uncommon), these two examples nevertheless suggest the answer to our assigned question of whether heuristics are a problem or a solution: They are both, obviously. The real challenge for scholars working at the intersection of law and heuristics research is to determine when heuristics might be thought especially likely to act as problems and when as solutions. As this chapter will detail, resolution of that challenge in turn requires specifying what is meant by the concepts of "problem" and "solution." Although neither of these tasks admits of tidy resolution, as a general principle one might say that the value of a heuristic depends on the degree of its adaptive suitability to the relevant decision-making environment and the social appropriateness of the aim to which it is adapted. The first criterion, adaptive suitability, reminds analysts that the usefulness of heuristics must be evaluated in relation to the particular environment or institution within which they are being employed (Gigerenzer et al. 1999). The second criterion, social appropriateness, reflects the fact that legal theory is often concerned not only with asking whether particular behaviors achieve their goals, but also with evaluating the social desirability of the goals themselves.

This chapter expands on these themes in the following manner. The next section (HEURISTICS IN DECISION THEORY) provides a general introduction to the subject of heuristics in decision theory, with particular attention to the role of heuristics in two major research paradigms within psychology. As will be seen, one program, which will be called the heuristics-and-biases program, has sought to identify cognitive heuristic processes by observing ways in which experimental subjects fail to conform to expected utility maximization or other rational choice theory ideals in their judgment and decision making. Within this program, departures from rational choice theory are thought to provide an evidentiary fingerprint of the operation of particular cognitive heuristics by individuals. A second program, which will be called the heuristics program, has focused on real decision-making environments or more elaborately specified experimental environments and has compared the use of heuristics within these environments to other realistically available decision-making techniques. From this perspective, researchers have uncovered evidence that heuristic decision making—whether understood as evolved cognitive processes or as deliberately adopted decision-making tools—is often well-adapted to the actual tasks faced by actors in concrete settings. After introducing these two research programs and related theoretical points, the section concludes by organizing them within a single conceptual framework in order to identify important areas in which further research and understanding are strongly needed.

The following section (HEURISTICS IN LEGAL THEORY) then turns to the role of heuristics within legal theory. It will be shown that legal theory to date has been heavily influenced by the heuristics-and-biases research program,

primarily because legal theory more generally has been dominated by the neo-classical economic tradition which takes expected utility maximization as its prescriptive ideal. Because the heuristics-and-biases program focuses on experimentally observed behavior that contrasts with rational choice ideals, the program offered a natural springboard for legal scholars interested in improving the behavioral models that underwrite legal policy prescriptions within the law and economics tradition. As this section also observes, however, this focus has handicapped legal scholars in their efforts to learn from researchers working in the heuristics program, whose independent lessons and observations have much to offer legal theory. The next two sections point the way toward some of that fruitful unexplored territory by focusing, respectively, on the use of heuristics by legal subjects whose behavior the law is attempting to influence and on the use of heuristics by policy makers as a model for the design of legal rules. In both of these broad contexts, the heuristics program offers opportunities to progress toward deeper understandings of how the law should be constructed in order to best achieve its social aims.

HEURISTICS IN DECISION THEORY

The term *heuristic* invites multiple interpretations. Its Greek origin meant simply, "serving to find out or discover." In most modern English uses, it has signified "useful, even indispensable cognitive processes for solving problems that *cannot* be handled by logic and probability theory." Consistent with that meaning, the heuristics program led by Gigerenzer and others views a decision- making heuristic as "an approach to a problem that is necessarily incomplete given the knowledge available, and hence unavoidably false, but which is useful nonetheless for guiding thinking in appropriate directions" (Gigerenzer et al. 1999, pp. 25–26). Within cognitive psychology, the term *heuristic* also has been strongly associated with the heuristics-and-biases research program pioneered by Kahneman and Tversky (1974, p. 1124), in which heuristic processes are understood to be "principles which reduce the complex tasks of assessing probabilities and predicting values to simpler judgmental operations" and which "are quite useful, but sometimes … lead to severe and systematic errors." Hence, heuristics have been viewed as a solution, as a problem, and, sometimes, as both. Unraveling these overlapping and contested meanings requires some basic remarks about modeling conventions within decision theory.

Optimality-based and Heuristic-based Decision Making

Two important categories of decision-making models include optimality-based and heuristic-based models. The former constitute fully specified analytic systems in which the processes of decision making are given by formal rules of logic and computation that can be described with mathematical precision,

replicated over multiple trials, and extended across diverse tasks. Optimality-based approaches derive generally from rational choice theory and seek to identify the solution or solutions to a problem that are singularly optimal according to a desired criterion, such as expected utility maximization. Optimization models can be prescriptive, in the sense that they aim to identify the solution that individuals or other decision makers *should* adopt for a given problem, or they can be simply descriptive, in the sense that they aim to predict the choices that decision makers *will* adopt for a given problem. Descriptive models may be further subdivided according to whether they purport to describe the actual processes that decision makers utilize to solve problems, or whether instead they merely aim to predict the outcomes of decisions, while remaining agnostic on the particular cognitive processes that individuals employ in order to produce such outcomes. The latter form of descriptive model is often referred to as an "as-if" model. For instance, individuals may be thought to behave "as-if" they are seeking to maximize expected utility, whether or not they actually undergo the calculative processes modeled by Bayesian decision theory.

Heuristics researchers in contrast seek to model and understand directly the cognitive processes that individuals use to make decisions, although such researchers differ in the extent to which they believe that heuristic models supplement, as opposed to supplant, optimization models. The heuristics-and-biases research program, for instance, has used experimentally observed departures from rational choice theory to glean insights about the mental processes that individuals utilize when evaluating options and making decisions. Thus, many view the heuristics-and-biases program as constituting a "repair model" research agenda, in which heuristics are thought to offer exceptions or additions to the basic theoretical engine of decision making which remains premised fundamentally on expected utility maximization. The heuristics program, on the other hand, seeks to understand decision making from the "bottom up," by identifying and modeling the actual cognitive processes that individuals are believed to use for a given decision-making task and without regard to any basic underlying model of rational choice. Obviously, this level of ambition in the heuristics research agenda carries the risk that the program may for some time appear incomplete to theorists who are accustomed to the parsimonious scalability of rational choice theory. The tradeoff, as usual, is between descriptive attractiveness and theoretical tractability.

Ill-posed and Computationally Intractable Problems

One important reason that researchers in the heuristics program seek to build a new comprehensive decision-making model from the bottom up stems from their belief that optimization models offer limited applicability to many real-world problems. Specifically, in two different manners, decision-making problems may be intractable in the sense that no optimal solution can be identified by

any presently available optimization model. First, many goals when specified mathematically take the form of "ill-posed" problems; that is, problems that cannot in principle be solved. In this category fall those problems with unknown, vague, or incalculable criteria, and those problems for which an adequate weighting function among criteria cannot be specified. Second, many of the remaining problems that are well-posed are nevertheless computationally intractable since their complexity exceeds the available computational capacity of not only humans but also machines. In this category fall those problems that are formally NP-hard, by which one means that they are intrinsically harder than those problems that can be solved in nondeterministic polynomial time, and those problems that are otherwise practically insoluble given the limits of currently available technology.

The fact that many problems cannot be solved with traditional optimization-based approaches has both descriptive and prescriptive implications. Descriptively, it raises a further challenge to the notion that individual behavior and decision making can best be predicted by a model of expected utility maximization. Indeed, the fact that humans face many problems that do not admit of optimal solutions has made it adaptively desirable over time that humans *not* replicate optimization-based systems in their cognition, at least not universally. (Similarly, in competitive environments, it is often desirable for human subjects to exhibit some degree of "irreducible uncertainty" in their behavior in order to avoid precise prediction by opponents [Glimcher 2003].) Thus, it is not surprising that rational choice theory has proven unable to accommodate a wide range of stable individual behaviors. To be sure, "as-if" optimization models provide strong predictive utility in many domains, particularly with respect to the identification of equilibrium outcomes that involve interactions among multiple actors and conditions. To admit these strengths of optimization models is not, however, to suggest that process models have no role to play. Process models may be particularly helpful for describing and predicting the way in which individuals respond to ill-posed or computationally intractable problems. Moreover, even in cases where some outer limit of optimal behavior can be identified, an "as-if" rational choice model typically will be consistent with numerous different processes by which people might approach that limit. In contrast, by providing more specific accounts of the cognitive processes that lead to observed behaviors, process models offer the prospect of predicting and explaining the gap between the optimal frontier of the rational choice model and the actual performance of observed behavior. Importantly, in many circumstances, it is precisely this gap between an accepted optimum and an observed behavior that will be of great interest, particularly to a prescriptive field such as law. Thus, psychology's effort to model heuristic decision making at the process level constitutes an important, complementary exercise to the optimization modeling that otherwise seems to dominate legal, economic, and political theory.

Prescriptively, the existence of ill-posed and computationally intractable problems also disrupts the claim of optimization-based regimes to

comprehensive application. In many cases the limit of the solution frontier for a decision- making problem will not be given by rational choice theory or any other available optimization systems. Thus, unless one arbitrarily excludes relevant variables or otherwise edits the problem to yield an optimum solution, assessing the usefulness of a heuristic for these types of problems will require specification of some other benchmark for comparison than conventional rational choice ideals. One commendable approach in such a situation is to proceed by systematically examining available decision-making techniques—heuristic or otherwise—and comparing the ease and effectiveness of their results, understanding that as technology and analytic systems evolve, the best practicably available solution may improve as well. Along these lines, researchers from the heuristics program argue that decision-making heuristics generally perform quite well if evaluated according to the criterion of "ecological rationality"; that is, fitness of the heuristics for the environment in which they are being deployed, as judged by their relative success at achieving intended aims compared to other realistically possible decision-making strategies (including, where appropriate, optimization models that are tailored to the specific problem at issue). Indeed, heuristics researchers argue that a variety of cognitive processes identified in the literature as biases or illusions appear well-adapted when viewed within the richer ecological context that shaped their development, rather than against a rational choice benchmark that is divorced from many of the constraints that characterize real- world decision making (Gigerenzer 2004, Table 4.1).

Heuristic and Optimization-based Cognition: The Dual-processing System Concept

Over the last several years, growing numbers of psychologists and other decision theorists have supported a dual-processing system conception of cognition that tracks, perhaps not accidentally, the distinction between heuristic-based and optimality-based theoretical models of decision making. In this dual-processing system conception, individuals are thought to employ both intuitive and analytical reasoning as more or less parallel mental apparatuses (Sloman 1996). The former, dubbed "System 1," provides quick, cognitively effortless, associational or holistic judgments, while the latter, "System 2," provides more deliberate, rule-based, or logical judgments. The processes associated with System 1 on this account are thought to include several "general-purpose heuristics," such as representativeness, availability, and anchoring and adjustment, that are not merely shorthand versions of the more calculative judgments associated with System 2, but rather are categorically different mental processes (Gilovich and Griffin 2002). Indeed, although the heuristics-and-biases research program was not originally devised with the System 1–2 dichotomy in mind, many have come to regard its methodology and findings as mapping nicely onto the two-system conception. From the heuristics-and-biases studies, therefore, has emerged the

somewhat caricatured view among legal academics and other secondary audiences that cognitive heuristics are automatic, persistent, and unreliable System 1 phenomena revealed through predictable instances in which they contradict the more sensible deliberations and conclusions that System 2 would prescribe.

This dual-system dichotomy accords well with everyday self-understanding and, for many purposes, may be conceptually helpful. On the other hand, it also may abstract at too general of a level for a host of theoretical and empirical tasks (Gigerenzer and Regier 1996), including legal policy making which must remain keenly attuned to specific features of decision-making environments that the System 1–2 dichotomy largely ignores. A more dynamic model would take the form of a single, continuous device, in which processes that now are associated with System 1 would not be viewed as fixed and immutable, but rather as subject to the same evolutionary forces that influence all of human cognition, including a range of environmental feedback mechanisms and, indeed, the cognitions of System 2. By rejecting the image of mental processes removed from context, such a conception might better remind legal theorists of the degree of environmental specificity needed to generate strong predictions about the operation of heuristics in novel or unfamiliar circumstances. This sensitivity to environmental context and cognitive adaptation has been a hallmark feature of the heuristics research program. Broadly speaking, where the heuristics-and-biases program utilizes failures of optimization in experimental settings to provide evidence of relatively general cognitive processes, the heuristics research program examines more narrowly delineated decision-making processes to inspect the degree of their adaptive fitness to the specific decision-making task for which the process is being utilized. The importance of this sensitivity is recognized now even by proponents of the dual-processing system view, who have begun to investigate the possibility that there may be "special-purpose heuristics" that are triggered only in certain environmental contexts (Gilovich and Griffin 2002; see also, Kahneman and Frederick 2002; Frederick 2002).

A second risk of the dual-system view is that it is often interpreted in a value-laden fashion, in which the "general-purpose heuristics" associated with System 1 are regarded as comparatively primitive and highly likely to lead to systematic error, while the more deliberative analytical and computational processes associated with System 2 are thought to perform the real heavy lifting in cognition. Taken to its extreme, this view of System 2 finds expression in neoclassical economics and other applied versions of rational choice theory, where the results of expected utility maximization equations acquire a prescriptive cast—not merely "optimal" in the statistical sense, but also in the sense of providing an individually or socially desirable outcome. For legal scholars, moreover, the System 1 and 2 typology invites an interpretation that there are two relevant sets of heuristics: those used by individual actors outside of the legal process that are likely to lead to biases and are resistant to learning or debiasing (System 1), and those that are deliberately and flawlessly constructed by legal

policy makers to correct for the biases of others (System 2). These are dangerous oversimplifications. There is no doubt that cognitions can be characterized as requiring more or less effort, in the sense presumed by the dual-system conception, but the direct association sometimes drawn between computational effort and efficacy is unwarranted. In this respect, results of the heuristics research program have somewhat unsettled conventional views by identifying heuristic decision-making processes that are remarkably well-adapted to their respective decision-making environments, despite the fact that they are "primitive" in the sense that they both ignore readily available information and eschew processes that deliberately seek to calculate and attain optimum results in the classical sense.

The Next Stage: Selection Models

The contrast between the heuristics-and-biases and heuristics research programs has sparked great debate in the psychological literature (Gigerenzer 1996; Kahneman and Tversky 1996; Gigerenzer 1991), yet some important common ground can be identified. In essence, two successful research paradigms have approached the task of studying cognitive processes from opposite ends of a spectrum: one uses novel, constructed decision-making environments to elicit evidence of heuristic reasoning through predictable errors, and the other uses real or more richly described decision-making environments to infer the heuristics actually being used to solve problems. It was entirely predictable that these different methodologies would uncover evidence of a different valence. What was perhaps not foreseeable was the extent to which secondary users of the psychological research would oversimplify and generalize from the findings of the heuristics-and-biases program. Those who characterize this research as uncovering widespread, systematic cognitive failures neglect the fact that Kahneman and Tversky's original intent in studying heuristic "errors" was to devise a methodology for studying cognition that was akin to the use of optical illusions, forgetfulness, or tongue twisters in order to understand sight, memory, and language. Reflecting on this overlooked aspect of their research, Kahneman and Tversky wrote as early as 1982: "Although errors of judgment are but a method by which some cognitive processes are studied, the method has become a significant part of the message" (Kahneman and Tversky 1982, p. 494). As will be explained below, for reasons having to do with the history of law and economics and rational choice theory in the law, legal scholars in particular seem to have over-learned this part of the message.

Rather than rehashing the "Great Rationality Debate" (Tetlock and Mellers 2002), we think that more fruitful lines of inquiry will lie in examining the questions of ecological fitness and heuristic selection that have been raised and highlighted by the findings of the respective programs. The next stage of research will require mapping the range of available heuristics, creating a set of useful

decision-making environment prototypes, and, finally, devising some model of how heuristics are selected or are triggered for use in the presence of given environmental characteristics. These research needs can be conceptualized as Figure 6.1, in which the class of known and possible cognitive heuristics (e.g., A, B, C) and environment prototypes (e.g., X, Y, Z) reveals a universe of potential matches between them. One may consider the heuristics research to have unearthed a series of heuristic–environment pairings that are well-suited for each other, producing an appearance of ecological rationality on the part of the heuristic (cells labeled "ER"). In other cells, one may consider the heuristics-and-biases research program to have discovered poorly matched heuristic–environment pairings, revealing the appearance of a heuristic process that leads to cognitive bias or illusion (cells labeled "bias").

As one can see, many heuristic–environment combinations remain unexplored and, thus, even as presently formulated the two research programs still offer great promise for future insight. Perhaps of even more importance now, though, is the generation of real understanding of the mechanisms that select among heuristics in the presence of given environmental features. In other words, when and why do individuals utilize a certain heuristic in a certain environment? Is there a selection process on the individual level that responds to identifiable environmental features in ways that afford predictions about heuristic selection? When is such a selection mechanism likely to produce desirable and undesirable results? How is it likely to interact with other forces, such as markets or government policies, that operate on the societal level to influence the use of certain heuristics? Understanding of that nature likely will require developing new research techniques that move beyond both the heuristics-and-biases paradigm, which seeks general mental principles to the detriment of environmental specificity, and the heuristics paradigm, which emphasizes the particularities of decision-making tasks and environments to the detriment of heuristic generalizability.

Figure 6.1   Conceptualization of the classes of known and possible cognitive heuristics (A, B, C) and environment prototypes (X, Y, Z).

An Illustrative Example

Research along these lines may be well-illustrated by Ayton and Fischer's recent investigation of the hot-hand fallacy in basketball and the gambler's fallacy, two well-known findings from the heuristics-and-biases literature (Ayton and Fischer 2004). Individuals exhibiting the hot-hand fallacy believe that basketball shooting performance is "streaky" in the sense of being sequentially correlated, yet extensive data analysis of actual shooting performance suggests instead that basketball shots are probabilistically independent events (Gilovich et al. 1985). Individuals exhibiting the gambler's fallacy, on the other hand, believe that probabilistic events such as coin tosses "self-correct" by showing a higher probability of landing heads after a series of tails, when, of course, fair coins possess no such powers of memory and adjustment. Both of these behaviors have been explained in the literature as manifestations of the same heuristic process of representativeness, in which judgments of the likelihood of an event are thought to be based on assessments of how well the event represents or matches particular prototypes (Kahneman and Tversky 1974). Indeed, one recent review introduces the hot-hand fallacy as the "flip side" of the gambler's fallacy (Camerer and Loewenstein 2004).

This conventional account of the two phenomena demonstrates the shortcomings of identifying a cognitive heuristic such as representativeness at too general of a level of abstraction. The representativeness heuristic simultaneously has been proposed to drive both the gambler's fallacy and the hot-hand fallacy, yet the heuristic is unable to predict or explain the fact that subjects' revealed expectations in the two different contexts are mutually contradictory. That is, the two behaviors being "explained" by the representativeness heuristic consist of predictions by individuals that a probabilistic streak will both continue unabated—in the case of the hot-hand fallacy—and reverse direction—in the case of the gambler's fallacy. Policy makers and others interested in extrapolating from the heuristics-and-biases research therefore face difficulty predicting the effect of the representativeness heuristic in other decision-making contexts that are not perfectly symmetric with either of the previously studied environments. Clearly, this is a case in which the type of next generation research called for in this chapter might be of great use.

Ayton and Fischer begin such a project by hypothesizing that the hot-hand fallacy and the gambler's fallacy are better explained as overgeneralizations of, on the one hand, a belief that skill performance is often sequentially correlated such that it demonstrates positive recency and, on the other hand, a belief that natural or inanimate processes such as weather patterns are often characterized by negative recency. Both of these beliefs may prove accurate and useful in a variety of contexts, but appear "fallacious" when applied in an inappropriate setting. For instance, given the nature of the basketball environment, individuals may not receive adequate feedback from their performance in order to learn that, unlike many other skill tasks such as golf putting and throwing darts, basketball

seems not to be characterized by performance streaks. In the casino, on the other hand, players do receive feedback, but they also must contend with the fact that casinos offer chance games that resemble very few life tasks for which humans have been selected. In such an environment, the use of ordinary heuristics associated with inanimate processes seems to generate a mismatch between the cognitive heuristic and the decision-making environment, thereby causing individuals to predict erroneously that chance games will demonstrate negative recency. Ayton and Fischer ingeniously support their hypotheses through an experiment in which subjects *simultaneously* exhibit negative recency in their predictions for the results of random binary outcomes from a roulette wheel (which the researchers hypothesized would be perceived as inanimate by subjects) and positive recency in their expectations about the accuracy of their predictions (which they hypothesized would be perceived as a skill performance).

   This experiment demonstrates the great care with which legal analysts must treat psychological evidence. Taking the message that representativeness is a "general-purpose heuristic" far too literally, legal scholars have invoked the concept in well over one hundred law review articles across an ambitious range of subject matter contexts. Yet this study suggests that the heuristic may be more profitably decomposed into constituent heuristics that are much more environmentally contingent. Specifically, in Ayton and Fischer's study, the hot-hand fallacy and the gambler's fallacy are revealed to be artifacts of certain underlying expectations about the likely patterns that will be demonstrated by processes that are perceived as inanimate or as involving human skill. This improved understanding has not eliminated the "fallacy" aspect of earlier observed behavior on the basketball court or in the casino, but it has provided a much richer understanding of the heuristics that might be at work in those examples and the environmental features that might be likely to trigger both their operation and their potential for mismatching with new environments. Importantly, Ayton and Fischer's results also form the basis of a more refined and testable pairing of decision-making heuristics: If a pattern appears to be of inanimate origin, expect negative recency; if a pattern appears to involve human skill, expect positive recency. By formulating heuristics with this level of specificity, a host of further research opportunities are created, including opportunities to confirm, deny, or amend the heuristic model, as well as to examine the important question of how individuals come to associate an observed pattern with a particular type of origin. It is precisely this level of sophistication and progress in the experimental research that will be necessary as disciplines like economics and law come to seek deeper inspiration from the psychological literature.

HEURISTICS IN LEGAL THEORY

Law is prescriptive in a way that psychology need not be. The question of whether heuristics provide a "problem" or a "solution" in a given context

therefore has different, more significant stakes for law. In a real sense, law must make a judgment on the question in any given policy-making context, even if the judgment is simply to await further evidence before acting. In making these judgments, law must depend on *some* prescriptive theory about the desirable aims toward which social, economic, and political institutions should strive. In addition, to craft responses to perceived problems, law also must depend on *some* implicit or explicit psychological assumptions about human behavior. Particularly for those who evaluate law consequentially, according to the influence that it has on human behavior and well-being, some descriptive model of choice and decision making is necessary to generate conclusions about the effect of legal rules. Thus, law can learn much from decision theory, both prescriptively in terms of identifying the best outcome that, given a set of constraints, society could hope in principle to achieve, and descriptively in terms of developing a predictive model of individual and group decision making that will help to estimate how a given legal response will influence human behavior.

Law and Economics

During the 1970s and 1980s, legal theory underwent a dramatic revolution as the law and economics movement provided compelling methodological assumptions for both of these tasks: in overly simplified terms, the law and economics movement offered rational choice theory as a descriptive account of human behavior and social or aggregate utility maximization as a prescriptive goal for the design of legal rules (Posner 1972). This simultaneous endorsement of utility maximization as both a predictive and prescriptive model did not render law irrelevant, because the law and economics paradigm carried with it important market failure concepts from welfare economics, in which even perfectly rational individual actors were thought to fail to maximize collective utility. Thus, legal theorists influenced by the law and economics movement came to focus on situations of incomplete or asymmetric information, negative externalities, public goods, collective action problems, monopolies, and other circumstances in which individually rational behavior was thought especially likely to lead to suboptimal outcomes, as measured against a standard of collective utility maximization. In those contexts, the prescribed goal for legal rules was to provide incentives or other policy mechanisms that would alter the decision-making environment of the operative individuals, such that overall utility would be improved.

Behavioral Law and Economics

Operating within the law and economics tradition, an exploding number of legal scholars in the late 1980s and throughout the 1990s began to turn to the empirical work of psychologists and experimental economists to enrich the behavioral

model of the neoclassical economic framework. To these scholars, a primary theoretical defect of conventional law and economics had been its "sliding scale" approach to defining utility, in which theorists seemed forced to choose between "thin" notions of utility (e.g., revealed preference) that risk tautology by essentially defining an "ought" as an "is," and "thick" notions of utility (e.g., wealth maximization) that provide more rigorous, testable behavioral predictions, but that mounting experimental evidence suggested were demonstrably inaccurate (Korobkin and Ulen 2000). Especially with respect to the models of individual wealth maximization that had tended to dominate law and economics, the heuristics-and-biases research offered a natural advance in that its experimental methodology was designed to identify deviations from the behavioral assumptions of classical rational choice models. Thus, from cognitive psychology and experimental economics, legal scholars hoped to assemble a model of individual behavior and decision making that was more descriptively accurate than rational choice theory, thereby increasing the confidence that one might place in the policy recommendations that emerged from legal economic analysis.

In addition, many scholars in the law and economics tradition were dissatisfied with the generally anemic role that "thin" notions of utility implied for law with respect to individual behaviors that seemed problematic, but that had no "spillover" effects or other collective welfare consequences sufficient to justify legal intervention. By providing a standard of individual utility maximization that sometimes ran dangerously close to being non-falsifiable, the neoclassical approach placed a heavy burden of proof on those who regarded law as a potential solution to perceived problems of individual choice. For instance, actually demonstrating that aggregate levels of smoking or obesity are undesirable can be surprisingly difficult within the confines of a theoretical framework that uses revealed preference as its value criterion. For that reason, the findings of researchers who attempted to uncover individual decision-making anomalies within the framework of rational choice theory became especially attractive to some legal scholars. By altering the behavioral model to become more descriptively accurate, one also might alter the burden of proof on important policy issues by showing that individuals sometimes behave systematically in a suboptimal fashion even in the absence of third party consequences.[2] This had particular salience in areas such as smoking or obesity, where large portions of the policy community simply refused to accept the idea that individual choices were *not* amounting to a problem, even for the individual choosers themselves.

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[2] This view was an oversimplification in that it tended both to overgeneralize from existing psychological research and to ignore the administrative burdens, unintended consequences, and other costs of legal intervention that exist even when heuristics are thought to lead to harmful error (Rachlinski 2003).

**The Next Stage: Incorporating the Heuristics Research
Program into Legal Theory**

Thus, into the descriptive void of neoclassical economic approaches to law stepped the new project of behavioral law and economics. To date, behavioral law and economics has been heavily influenced by the conceptual framework of the heuristics-and-biases program. This has been enormously fruitful research (for helpful overviews, see Langevoort 1998; Rachlinski 2003; Guthrie 2003). However, by neglecting the findings of the heuristics research, the behavioral law and economics program has tended to share the same glass-half-empty perspective displayed by the judgment and decision-making literature more generally. To some extent, legal theorists can be more forgiven for this overemphasis than psychologists. After all, law focuses on crimes, resource conflicts, social disputes, accidents, and other events which, although certainly not all driven by cognitive "mistakes," nevertheless are likely to contain circumstances in which overall utility has not been maximized. Thus, the tendency of legal scholars to fixate on moments of mismatch between heuristic and environment in the psychological literature was driven largely by the nature of their enterprise, particularly as it had been influenced by the expected utility maximization tradition of law and economics. In their haste to apply the findings of cognitive psychology to legal problems, however, behavioral law and economics scholars have tended to extrapolate from the heuristics-and-biases research without appreciating the way in which that research's aim of identifying "general-purpose heuristics" might not be well-suited for the purpose of making domain-specific policy recommendations.

   In addition, although the heuristics-and-biases research unsettled dramatically the descriptive consensus among legal academics on rational choice theory, it has, perhaps unwittingly, reinforced the primacy of expected utility maximization as the appropriate prescriptive benchmark. By accepting the overall theoretical framework of law and economics, the new movement has focused attention naturally on those instances in which heuristics lead to decision making that fails to comport with rationalist ideals. This focus risks creating a theoretical blind spot, in which legal scholars fail to attend to the variety of ways in which heuristics—whether in the form of evolved cognitive processes or heuristic procedures deliberately contrived for a given task—perform quite well in the context for which they were adapted or devised. Moreover, the focus of behavioral law and economics on cognitive biases has prevented scholars from challenging more fundamentally the prescriptive claims of economics regarding the ideal of expected utility maximization. Instead, behavioral law and economics has become somewhat of a "repair model" itself, in which law is marshaled to refashion the world in the image of the utility maximizing ideal. In so marshalling, scholars overlook the fact that many legal problems in the real world do not admit of an analytically best solution, either because the problem is not

well-posed, because the problem is computationally intractable, or because the problem cannot be solved optimally in light of time, resource, or other constraints imposed on the actual decision-making environment in which the problem must be confronted. One important lesson of the heuristics research is that, in such situations, encouraging the pursuit of an analytically derived optimum through the "repair model" of legal intervention may cause more problems than it solves.

In short, legal scholars have much to learn from the heuristics research program, both on the descriptive and prescriptive levels. To be sure, the heuristics research program does seek to create highly specific environmental models and, thus, it may be difficult for legal scholars to extrapolate from the results of particular experiments to different decision-making environments by force of logic alone. This is in contrast to the heuristics-and-biases research which expressly seeks to identify cognitive heuristics at a high level of abstraction and which, consequently, lends itself to ready (mis)application by legal scholars. Weaned on such "general purpose heuristics," legal scholars may be tempted to dismiss the findings of the heuristics research as too narrow and environmentally contingent for purposes of making policy prescriptions. This would be an unfortunate inversion of the earlier mistakes of the behavioral law and economics movement. In its most ambitious formulation, the heuristics research program offers the prospect of accumulating experimental results into a well-specified matrix of decision-making heuristics, environmental conditions, and ecological rationality assessments. Such a matrix would provide legal scholars and policy makers with the ability to create descriptive models of decision making tailored to particular law-relevant settings, ultimately enabling scholars to offer better defined, clearer, and more specific policy recommendations than they are able to generate from the less specific findings of the heuristics-and-biases program.

At present, neither the findings of the heuristics program nor the heuristics-and-biases program accumulate into a matrix of this sort. Thus, for present purposes, interdisciplinary collaboration between those scholars interested in legal policy and those scholars creating and testing process theories of how individuals use heuristics should focus on identifying the types of decision tasks in the types of environments that legal policy makers would benefit most from understanding in greater detail. In that manner, heuristics researchers can focus on investigating decision making in law-relevant environments, such that research results can inform legal policy recommendations directly. In the remainder of this chapter, we seek to further that type of collaborative research by identifying areas and environments in which we expect heuristic processes to be of special relevance to the design and implementation of law. We emphasize that our statements will be highly speculative in nature and should not be thought to make strong claims about what is happening or will happen or should happen in these various contexts. Instead, we seek to offer suggestions, based on theoretical models and informed by existing empirical work, for areas in which further research might be especially fruitful.

HEURISTICS IN THE BEHAVIOR OF LEGAL SUBJECTS

Determining whether the use of heuristics by legal subjects constitutes a "problem" or a "solution" can only be answered in relation to specified goals and realistically available alternatives. This is a complicated task for law because a heuristic must be assessed simultaneously on several different levels, including the adaptive suitability of the heuristic for the environment in question, the social desirability of the goal toward which it is oriented, and the degree to which it is subject to influence by legal rules and other social forces. Comprehending the numerous permutations presented by these variables is an important theoretical task for researchers interested in heuristics and the law. This section offers some preliminary thoughts in furtherance of that task.

Evaluating the Adaptive Suitability of Heuristics

Although legal scholars have tended to overemphasize the biases side of the heuristics-and-biases equation, it would be equally wrong to assume that ecologically evolved heuristics are invariably superior to alternative decision-making approaches. Such an assumption would embrace observed heuristic processes as both the best descriptive account of human decision making and the best prescriptive account, inviting in turn charges of tautology similar to those that have plagued rational choice theory. By process of selection, heuristic reasoning should be expected to move toward greater success at a given task, but it still should be possible to compare the performance of available decision-making techniques against each other and to identify ways in which existing behaviors can be improved upon. Gigerenzer, for instance, evaluates the diagnostic accuracy of three different decision-making techniques for assigning patients who present with chest pains to coronary care units (Gigerenzer, this volume). In this example, a deliberately constructed fast and frugal decision tree outperforms both a conventional holistic expert assessment and, when one considers the cost and time constraints of the actual decision-making environment, an elaborately crafted computational aid. Detailed and ecologically grounded comparison therefore suggests that decision-making strategy performance is highly contingent, and that the best results are provided sometimes by optimization-based models, sometimes by deliberately constructed heuristic devices, and sometimes by the heuristic processes that individuals already employ.

The question then becomes how law can support or encourage the use of heuristic decision making in appropriate circumstances and in an ecologically rational fashion. Scholars should begin by developing a typology of "heuristic failures" akin to the market failure concepts of welfare economics. Just as neoclassical economics depends on theoretical predictions of the circumstances in which markets can be expected to fail to achieve aggregate utility maximization, heuristics research needs some predictions regarding the circumstances in

which heuristic decision-making processes can be expected to be ill-adapted to their environments. Presently, one can point to certain general features of decision-making environments—such as abundant information and low uncertainty in the relevant criterion (Gigerenzer et al. 1999, Chaps. 5–6)—in which heuristics might be thought especially likely to provide unreliable or undesirable results. However, much more specific theoretical predictions are necessary to operationalize effectively heuristics research for law. Such a project will parallel, in many respects, the efforts of psychologists and other decision theory researchers to examine the cognitive mechanism that selects and deploys heuristics within particular environments.

Consider, for instance, a long-standing debate in products liability law over whether individual consumers possess adequate awareness and understanding of product injury risks to make utility maximizing purchases. Within the conventional law and economics framework, which assumes that consumers acquire, process, and act upon risk information in accordance with rational choice procedures, debate has focused on information costs, contracting costs, principal-agent problems, and other structural aspects of product markets that might be expected to lead to suboptimal decision making by consumers (e.g., Landes and Posner 1987). Within behavioral law and economics, on the other hand, scholars have assumed that individuals do not process risk information in the manner of rational choice models, but rather utilize heuristic processes to both discern and evaluate cues about product dangerousness. Debate within this framework has focused on whether cognitive heuristics are more likely to cause individuals to accurately estimate, over-estimate, or under-estimate the safety hazards posed by consumer products. As a theoretical matter, if consumers systematically under-estimate the risks of products, then safety levels given by unregulated market equilibriums cannot be trusted to reflect desired levels of investment in risk reduction.

The problem with the behavioral law and economics approach thus far has been its inability to determine through theoretical analysis alone whether and in what direction the psychological research suggests consumers will err when they perceive and evaluate product risks (Hanson and Kysar 1999a). Reflecting the dangers of extrapolating too readily from the heuristics-and-biases research, products liability theorists have offered sometimes sharply conflicting accounts of how the same cognitive heuristic might impact consumer decision making. Scholars have disagreed, for instance, over the implications of the representativeness heuristic for risk perceptions. Schwartz and Wilde (1983) have argued that the representativeness heuristic will lead consumers who experience a series of safe encounters with products to expect an unsafe encounter, just as the gambler's fallacy seems to prompt individuals to expect a heads coin toss after a long series of tosses that land on tails. Latin (1994, p. 1231), on the other hand, notes that most ordinary product risks are very low frequency events, such that "[p]eople who generalize from their own experiences may treat this limited

sample as 'representative' of overall product risks and therefore anticipate continued safety."

These contrary predictions parallel the two inconsistent senses of representativeness investigated by Ayton and Fischer. Recall that under the gambler's fallacy, individuals expect a local probability sample to "self-correct" to resemble better the individuals' expectations about the characteristics of the overall distribution. Under the hot-hand fallacy, on the other hand, individuals construct their expectations about the overall distribution from the pattern that is exhibited by the local sample. Ayton and Fischer's study suggests that predicting which of these procedures will be utilized by individuals to estimate a given sequence of events depends in large part on whether the events are perceived to be driven by inanimate processes or by processes involving human skill. For products liability law, therefore, the pertinent question for further empirical research is whether consumer product safety risks are perceived by individuals to be more like the former or the latter. The answer to that question in turn will help to determine whether consumers are more likely to over- or under-estimate products risks. In short, Ayton and Fischer's study points the way both toward a more refined, empirical understanding of an important question that long has plagued products liability law and, more generally, toward the type of next generation research that should be extended across a spectrum of law-relevant questions in order to develop a typology of "heuristic failures."

Evaluating the Social Desirability of Heuristic Goals

In circumstances where individuals have been shown to operate in a stable decision-making environment using heuristics with high ecological rationality, one might be tempted to advise the law to leave well enough alone. However, even well-adapted heuristics may become candidates for legal intervention if they are employed in service of a goal that society regards as illicit, wrongful, or otherwise undesirable. As noted in the section on HEURISTICS IN LEGAL THEORY, legal scholars, in particular those scholars influenced by economics, often take the aggregate maximization of utility to provide the goal of legal rules, coupled with some mechanism for tax and transfer of resources to satisfy any distributive justice concerns that remain after society has progressed toward greater efficiency (Kaplow and Shavell 2001). On this account, legal theorists reserve government policy interventions primarily for those cases in which the individual pursuit of utility maximization is likely to lead to undesirable results, either because the individual lacks sufficient information or ability to maximize her own utility, or because her individual behavior leads to adverse consequences when viewed from an aggregate or collective perspective. With respect to the former category of individual decision failures, the previous section has identified a number of ways in which the heuristics research can improve the ability to diagnose such cases. With respect to the latter category of social problems, the heuristics research again has much to contribute.

An important preliminary research task, for instance, will be to consider how traditional market failure concepts such as monopolies or public goods problems should be adjusted to account for the fact that legal subjects utilize cognitive heuristics in their decision making, rather than purely self-interested optimization procedures. Even the corporate firm, which often is taken to be the actor most likely to approach wealth-maximizing behavior in light of its structure and the competitive environment within which it operates, nevertheless depends on heuristic procedures for much of its decision making (Langevoort, this volume). A primary challenge that all firms face is coordinating the behavior of multiple employees such that those employees act in concert toward the same set of goals, rather than in conflict with each other. Given inherent limitations on the ability of employees to communicate simultaneously along all relevant dimensions of a firm's activities, employees must operate under some shared understanding of how decisions will be made so that the behavior of others easily can be anticipated. As Langevoort argues, only fast and frugal heuristics meet the test of simplicity and predictability necessary to serve this coordinating function well. We therefore should expect heuristics to flourish within the firm because the local ecology makes them not only rational, but essential.

Despite the ecological rationality of these organizational heuristics, however, they will not necessarily serve societal interests for two distinct reasons. First, as is common to many settings, the decision making by employees, officers, and other agents that is facilitated through the use of heuristics may reflect the self-interest of the agents, rather than the interests of the firm itself. When monitoring and incentive mechanisms are imperfect, the principals of the firm become vulnerable to exploitation at the hands of the firm's agents. One important goal for research in law and psychology is therefore to identify heuristics that generate positive returns for agents at the expense of principals, particularly when those heuristics operate in ways that might be either unexpected within the framework of rational choice theory or resistant to the conventional monitoring and incentive mechanisms prescribed as corrective devices by rational choice theory. Conflict of interest disclosure rules, for instance, are often proposed as legal responses to principal–agent problems, yet some experimental evidence suggests that disclosure of conflicts of interest actually can cause principals to become *more* vulnerable to exploitation, primarily because agents who have disclosed their conflicts feel greater "moral license" to engage in behavior at odds with the interests of the principal (Cain et al. 2003). Designing conflict of interest regulations to inform principals without at the same time licensing agents in this manner will require better understanding of the cognitive processes at work in the agents' decision to exploit.

Second, even if organizational decision-making heuristics are adaptive for principals as well as for agents, the price of such adaptation may be the exclusion of important societal interests from consideration. A good example of this exclusion may be found in the area of   employment discrimination. Many

common patterns of behavior (e.g., word of mouth communications, the adoption of norms and language that conform to the preferences of incumbent groups) are highly adaptive in simplifying hiring and promotion tasks for employers (Gigerenzer, this volume). Those behaviors, however, frequently have the effect of biasing hiring and promotion decisions against individual members of groups that were not well represented within the local ecology of the firm as its behavioral patterns evolved. The conventional legal approach to correcting such a situation, which largely depends on changing financial incentive structures so as to upset the comfortable equilibrium that has developed within the firm, can be both difficult and costly. Alternative approaches that are designed to minimize heuristic processes such as race encoding may offer "soft solutions" that are both less costly and less likely to be perceived as coercive by regulated actors (Cosmides and Tooby 2004). As discussed below, legal interventions in general should be offered with great sensitivity to the use of decision-making heuristics by those subjects that the law is intending to influence.

It also is important to note that we are not compelled to adopt the optimization standard of utility maximization in order to consider the implications of heuristics for law. Instead, in many cases, we simply can take the social appropriateness or inappropriateness of a heuristic's aim as exogenously given, and describe the implications that might follow for the use of heuristics by legal and nonlegal actors. Peering behind this curtain, one can imagine that the conventional welfare economic analysis of behavior might determine the desirability of ends and, thus, that socially inappropriate aims will be tied to conventional market failure concepts. However, one just as easily can imagine that social ends are prescribed according to deontological principles (Sagoff 1988), objective list criteria of welfare (Nussbaum 2000), well-formulated political procedures (Nozick 1974), happiness and reported well-being studies (Frey and Stutzer 2002b), or a range of other measures or approaches. In some cases, in fact, these other prescriptive criteria may be necessary given limitations of the conventional revealed preference approach to defining utility. How else, for instance, can one evaluate the fact that individuals are willing to pay more for a food item labeled 75% fat-free than one labeled 25% fat (Hanson and Kysar 1999b)? What is the appropriate policy response to the finding that individuals report overwhelming willingness to repeat a prostate surgery procedure that has impaired their urinary and sexual function (Stanford et al. 2000), when the procedure may, in some instances, be medically unadvisable (Gigerenzer 2002)? Or that individuals seem in retrospect to prefer colonoscopy procedures with a certain distribution of pain intensity, even if the aggregate amount of pain is higher than under alternative procedure profiles (Redelmeier and Kahneman 1996)? As one can see, in some contexts, the notion of utility maximization raises more questions than it answers. Heuristics research, which replaces the coherence criteria of formal systems such as utility maximization with more pragmatic correspondence criteria relating to real-world decision-making performance (Gigerenzer et al. 1999), may have much to offer in such situations.

Situating Heuristics within Dynamic, Overlapping Models

The two foregoing parameters—the adaptive suitability of the heuristic for the environment in question, and the social desirability of the goal toward which it is oriented—become multiplied into a host of theoretical and empirical questions when one considers the fact that heuristic users typically operate in environments of enormous social, economic, and political complexity, with multiple sources of feedback exerting parallel and potentially conflicting influences over behavior. Such dynamic, polycentric environments require careful analysis, to say the least. Ideally, theorists should contrive multiple models and identify points of mutual interaction between them, acknowledging not only that the ecological rationality of heuristics depends on the fit between mind and environment, but also that mind and environment both are subject to a variety of influences, some of which are manipulable by law and others of which lie beyond its purview. Instead, to date, behavioral law and economics scholars have tended to view heuristic cognitions as relatively fixed and immutable, perhaps reflecting the influence of the oversimplified System 1–2 dichotomy. By taking heuristics as exogenously given in this manner, scholars have felt comfortable proposing legally based alterations to the decision-making environment of heuristic users, such as information disclosure rules or incentive-based liability rules, that are designed to improve the fit between heuristic and environment in light of identified social goals. A more rigorous modeling exercise, however, would acknowledge that both mind and environment are in flux, and that legal institutions hardly exhaust the class of powerful influences over behavior and cognition.

As a thought experiment to illustrate these various complexities, consider the possibility that economically motivated actors might exploit the use of cognitive heuristics by individuals in ways that lead to undesirable decision making, a possibility that has been observed by many commentators in the literature (Korobkin, this volume; Gigerenzer, this volume; Gigerenzer et al. 1999; Hanson and Kysar 1999a, b; Langevoort 1996, 1997; Frey and Eichenberger 1994). The very notion of a heuristic device assumes that not all information is being utilized by the decision maker, an omission that potentially creates an opportunity for exploitation by actors with the incentive and means to profit from an individual's cognitive habits. Moreover, one lesson of the heuristics-and-biases research seems to be that heuristic users can be "led astray" by experimental researchers who are in a position to carefully control and manipulate the informational environment of research subjects. To the extent that market actors are in a similar position to alter important features of the individual's decision-making environment, the opportunity for exploitation of cognitive heuristics may be even greater. It is important to note in this regard that firms and other potential manipulators need not seek to exploit heuristic decision-making processes consciously or explicitly. Instead, the powerful feedback process of the market might discipline economic actors to behave "as-if" they are

exploiting cognitive heuristics of customers, whether or not they appreciate that they are doing so. Indeed, especially powerful market forces might lead economic actors to exploit certain vulnerable heuristics even if they only represent a small fraction of an otherwise highly ecologically rational class of heuristics (Hanson and Kysar 1999a).

To understand better the significance of market manipulation, theorists must evaluate multiple actors and multiple evolutionary processes, including: the firm, acting under the incentives of the market to exploit heuristics; the individual, receiving feedback information from unwise decisions or purchases; the firm's competitors and other informational intermediaries, witnessing the firm's exploitation of customers and recognizing a potential arbitrage opportunity; and the state, playing some more or less active role in trying to police the market. Despite important early theoretical work on the incentives that strengthen and deter psychological anomalies in economic settings (Frey and Eichenberger 1994), much remains unclear about the relative strength of these forces. For instance, what kind and quality of feedback do ordinary consumer purchases generate and how rapidly do consumers adjust heuristics in light of their experiences? Are informational intermediaries such as *Consumer Reports Magazine* serving an adequate educational function for consumers, or do some manipulative traits or practices elude even professional arbitragers? How do the incentives for firms to devise (or stumble upon) manipulative practices compare in strength to the incentives for government regulators to monitor and counteract such practices?[3]

Even assuming the existence of some residually significant amount of harmful deception after these various processes reach an equilibrium point, it remains unclear what the most appropriate policy response should be. Some have argued that with respect to product safety risks, the government should prescribe a uniform risk vocabulary and presentation format, such that consumers will be able to access full actuarial risk information and situate it within their decision making as a rational actor would (Viscusi 1991). Others contend that the bulk of manipulative conduct occurs through means more varied and slippery than could be counteracted by simple informational remedies of regulators. For these theorists, the only policy tool with a chance to keep pace with market manipulation is a market-based regulatory device, such as a strict torts products liability system, which forces manufacturers to bear the full costs of product-caused injuries (Hanson and Kysar 1999b). Such a system seeks to improve consumer product safety by forcing the internalization of product-caused accident costs to market actors who, in turn, obtain strong economic incentives to devise (or stumble

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[3]   A related empirical question that is worth investigating is whether heuristics might in some instances leave individuals less vulnerable to manipulation than decision-making strategies that seek to replicate expected utility maximization. There is evidence that certain types of decision-making tasks are performed worse by individuals who are asked to give and consider explicit reasons for their judgments (Arkes and Shaffer, this volume). Presumably, therefore, the use of heuristics in some instances might make individuals less vulnerable to exploitation than deliberate optimization strategies.

upon) safer products and more effective hazard warnings. Because a strict liability system attaches financial responsibility only to product-caused health or safety costs, such a system would not address those forms of consumer exploitation that do not involve personal injury. As an indirect dampening force for those kinds of harms, policy makers might consider Frank's proposal to reduce the dead weight loss of competitive arms race advertising through a revenue neutral advertising tax (Frank 1999).

We offer one final prescriptive caveat on this important, but empirically indeterminate issue. One risk of evaluating the danger and extent of market manipulation exclusively through a lens that takes individual utility maximization as its ideal is that policy makers might miss larger questions about the effect that legal and economic structures have on the development of citizens more systemically (Hirsch 1976; Bell 1976). For instance, in the 1970s, the U.S. Federal Trade Commission (FTC) abandoned the practice of regulating comparative price advertising (e.g., 10% off list price), reasoning that "as long as consumers are accurately informed of the [final] offering price," they still can engage in utility maximizing consumption choices (Pitofsky 1977). The heuristics research might be read by legal theorists to support the FTC's assessment, though it would offer a different descriptive account of how consumers adapt to new pricing practices than the rational choice account. A separate question remains, however, regarding the macro-level desirability of a market decision-making environment in which consumers are forced to exert a large amount of cognitive effort to avoid being swindled. By virtue of bearing the burden of scrutinizing illusory price claims, whether through heuristics or otherwise, consumers under the revised FTC rule become forced into a defensive, distrustful market role (Ramsay 1996). Ferreting out "bargains" from among a deluge of fictitious price claims may be cognitively *possible* for consumers, but whether it is desirable remains a separate question altogether.

Offering Legal Responses with Sensitivity to Heuristic Use

Assuming that a particular heuristic decision-making process has been identified as a candidate for legal intervention, the next important task for scholars is to prescribe an appropriate legal response. As an initial matter, the heuristics research calls into doubt some conventional forms of legal policy that seem to have been devised with rational choice actors in mind. For instance, as Guthrie has noted (this volume), the Anglo-American legal tradition frequently attempts to further individual autonomy through the mandatory provision of information to individual decision makers. Although disclosure rules are undoubtedly an important policy tool even in a world where actors are thought to utilize heuristics in order to make decisions, the implicit "more is more" presumption that underlies many modern disclosure regimes should be reexamined in light of the lessons of the heuristics research. In medical contexts, for instance, risk disclosure

in furtherance of patient autonomy has been the object of common-law tort liability, legislative directives, and agency rule-making for decades, to the point that individuals are now typically forced to confront a daunting seriatim list of adverse health risks before taking a prescription drug or undergoing a surgical procedure. The tort law doctrine of failure-to-warn liability similarly has encouraged consumer product manufacturers to provide hazard warnings that stretch across several pages of text in product user manuals, listing nearly every conceivable way in which a seemingly innocuous consumer product can become an instrument of death and dismemberment for the unwary user.

We do not intend to make light of the health and safety hazards presented by prescription drugs, surgical procedures, or consumer products, or to cast doubt on the motivation of policy makers who have advanced information disclosure rules as a means for improving individual autonomy and reducing risk. We do question, however, the wisdom of disclosure regimes that are insensitive to the manner in which individuals actually perceive and process risk information. When product safety warnings become ubiquitous across and within product categories, their efficacy may be undermined both because warning proliferation confounds the individual's ability to evaluate information in a consistent, contextual manner (Viscusi 1991), and because it encourages individuals to view warnings merely as tools of pettifoggery that are designed by manufacturers only to avoid liability, rather than to provide useful risk information to consumers (Hanson and Kysar 1999b). Similarly, when prescription drug manufacturers are required to list all clinically observed side effects above a certain minimal threshold, the resulting laundry list of observations may be interpreted by readers in a manner that is insensitive to the actual frequency with which particular side effects appear. A hallmark feature of many decision-making heuristics is their deliberate ignorance of frequency or weighting information in the evaluation of cues. Such a strategy is often ecologically rational in the sense that generally reliable estimates can be obtained at significantly reduced cognitive load. However, these heuristics might provide a poor fit for the evaluation of drug risk disclosure statements that have been designed with readers in mind who process risk identification and frequency data in a textbook Bayesian fashion. Ultimately, this mismatch between heuristics and information presentation may lead to significantly different levels of individuals taking prescription drugs than would be the case if risk information were offered using more ecologically appropriate presentation formats.

In the foregoing examples, the law seems to presume as a descriptive matter that individuals employ rational optimization processes in their decision making. In other contexts, the law may attempt to promote such decision making as a prescriptive matter by holding actors liable for failing to make decisions in a legally required manner. The law of medicine again provides an instructive example, as the standard of liability for medical decision making in the United States has undergone dramatic changes in the past century that might be said to reflect a

shift away from locally evolved physician practices to objectively specified "best" practices. Traditionally, the common-law liability rule in the U.S. avoided prescribing specific decision-making processes such as cost-benefit analysis or some other optimization technique, deferring instead to whatever customary standards of care prevailed among medical practitioners in the local community. Eventually, the law began a transition toward national standard requirements, in which medical decisions were evaluated in comparison to the practices prevailing on a national, rather than a local level. This shift created the risk of a mismatch between the incentives provided by the liability rule and the actual environmental conditions facing doctors. Clearly, the best diagnostic heuristic will differ depending on the equipment, facilities, cost structure, and other features that characterize the local environment. In sensitivity to this concern, most jurisdictions made an effort to tailor the national practice standard in light of major impediments or restrictions presented by the local situation.

According to Peters (2000), however, a dramatic development has occurred more recently in nearly half of U.S. jurisdictions, as courts have shifted away from customary medical standards altogether. The argument in favor of such a shift centers on the perceived "lock-in" effect caused by hinging liability on existing customs. In customary medical standard jurisdictions, with minor exceptions the *only* way that plaintiffs can challenge a medical decision as negligent is by arguing that the decision departed from prevailing practices. Importantly, defendants remain free in customary medical standard jurisdictions to argue that their departure from a conventional practice represented an improvement on the possibilities frontier. However, out of fear that this argument would not be understood or accepted, or out of fear simply of the costs of offering and defending such an argument, doctors might face strong disincentives to depart from existing customs, even when heuristics of higher ecological rationality have been identified. Thus, the incorporation of customary standards into tort law, which initially appears to support the ecological rationality of heuristics, may in fact impede the adoption of behavioral improvements over time that would otherwise result from improved technology or advances in knowledge. The extent to which heuristic adaptation is impaired by legal incentives in this manner is an important question for further investigation.

In place of custom, the shifting jurisdictions identified by Peters now typically offer a more general reasonableness standard as the determinative benchmark for liability in medical malpractice cases. The critical difference between these approaches and previous standards is that plaintiffs can now challenge the actual substance of the physician's decision, rather than simply the decision's conformity to an exogenously given custom or practice. Like the "reasonableness" standards of tort law more generally, however, the reasonable medical care standard lacks specific, process-level content. That is, jurors are not told *how* a reasonable medical professional decides and, thus, they are given wide latitude to provide their own understanding of "reasonableness" in the cases

before them. An additional area of investigation therefore might be to examine the reaction of mock jurors to various attempts to give specific content to the notion of "reasonableness" in the medical context. For instance, presented with Gigerenzer's analysis of the three available decision-making techniques for coronary care assignment, would subjects agree that the fast and frugal heuristic outperformed competing options, or would they fail to appreciate the beguiling power of the "less is more" thesis? Indeed, one of the potential areas of great interest in law and heuristics may be the extent to which the current legal vocabulary is appropriate for a world in which heuristics aptly describe, and often prescribe, effective human and group decision making. If, for instance, the reasonable medical standard is interpreted by jurors in a manner that requires doctors to demonstrate that they considered as many factors as were available, then the law in practice might discourage the adoption of heuristic processes that are more globally sensible than a comprehensive factor analysis when viewed within the full ecological context of the medical decision.

HEURISTICS AS A MODEL FOR THE DESIGN OF LEGAL RULES

Law typically deals with decision-making tasks involving multiple criteria, imperfect information, unclear additive weights, and a host of other problem features that strongly resemble the areas in which heuristics have been shown to offer great promise. Thus, in addition to examining the implications of heuristic decision making by legal subjects, one should also consider the possibility that heuristics research may help to inform the content and design of legal rules themselves. Like judgment and decision making more generally, legal decision making may benefit from a "less is more" strategy in the face of certain problems or certain environmental conditions. Such a possibility was not lost on Judge Learned Hand, the esteemed U.S. jurist who provided tort law's most famous formal expression of cost-benefit optimization,[4] but who also held the view that "all such attempts [to quantify the determinants of liability] are illusory; and, if serviceable at all, are so only to center attention upon which one of the factors may be determinative in any given situation" (*Moisan v. Loftus* 1949). In other words, Judge Hand, who is often proudly claimed by the law and economics movement as an early proponent of their optimizing prescriptions (Posner 1972), actually seems to have favored a one-reason decision-making heuristic (Gigerenzer et al. 1999). This section considers a variety of implications and questions that follow from Judge Hand's more considered judgment (for a more thorough discussion, see Haidt et al., this volume).

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[4] Hand opined that negligence may be determined by reference to the following formula: "[I]f the probability [of an accident occurring] be called P; the injury, L; and the burden [of avoiding the accident], B; liability depends upon whether B is less than L multiplied by P: i.e., whether B is less than PL" (*United States v. Carroll Towing* 1947).

Legal Heuristics in the Common Law

Epstein has argued that in many contexts, the traditional and functionally simpler rules of the Anglo-American common law provided superior outcomes to either the complex regulatory schemes devised by modern administrative experts or the multi-part balancing tests favored by more recent (and more ambitious) judicial actors (Epstein, this volume; Epstein 1995). His arguments highlight an important area of research that legal scholars interested in heuristics in the law should address. Specifically, if policy makers are to use heuristics as a model for legal decision making, then they should consider the possibility that, just as decision-making heuristics sometimes adapt poorly to changing environments, legal heuristics may sometimes lag social or economic changes that render previously acceptable maxims harmful to aggregate welfare.

Two widely cited examples from the common law are the fellow servant rule and interspousal immunity, both of which provided a simple (and perhaps well-adapted at the time of their development) on-off liability test by rendering employers and spouses immune from tort liability under specified conditions. With respect to the fellow servant rule, the doctrine's effects became socially undesirable when the process of industrialization dramatically changed the size, structure, and risk level of the workplace. In other words, a well-adapted rule no longer fit its changed environment. With respect to interspousal tort immunity, the doctrine—which had worked systematically to shield male spouses from liability for domestic physical or sexual violence—became socially undesirable when beliefs about family privacy, violence, and gender relations shifted. Thus, a well-adapted rule continued to serve value judgments that no longer reflected the sentiments and beliefs of the community. In both cases, the common law seemed to adapt clumsily (or not at all) to the changed environment.

A similar story can be told from the opposite extreme. Consider the modern development of products liability, in which common-law judges self-consciously set out to change legal rules that they believed were outmoded in light of observed changes in the environment. Offering confident assertions about the degree of information that consumers held regarding product risks, the amount of bargaining influence that manufacturers exerted over consumers, the likelihood that consumers would be positioned to avoid product harms, and the availability and desirability of mandatory product accident insurance, these American judges crafted the products liability revolution as a deliberate effort to update pertinent legal heuristics, such as the common-law privity barrier that previously had rendered product manufacturers relatively immune from tort suits (Hanson and Logue 1993). Although a handful of scholars have attempted to defend this revolution through theoretical and empirical argumentation, the consensus in legal economic scholarship generally has been that the early products liability judges were wrong on each observation that they had used to advance their dramatic changes (Stewart 1987).

What seems needed, plainly, is some analysis of how the law selects, monitors, and modifies its own heuristics, much the way that psychologists must begin to examine more closely the heuristic learning and selection process on the individual decision-making level. Common-law judges applying decision-making heuristics, such as the fellow servant rule or the privity barrier, might not be well positioned to learn from their decisions, given the limited and not necessarily representative selection of cases and facts that they are presented with in order to gain feedback from earlier decisions. In the case of the fellow servant rule, for instance, judges learned too late that conditions had changed dramatically and, as a result, legislatures ultimately encroached on the courts' conventional territory by instituting workers compensation schemes and other statutory displacements of the common-law rule. In the case of the privity barrier, many observers would argue that judges acted prematurely, cutting off adaptive efforts of the market that would have reached a superior solution to the judicially crafted response of modern products liability law. As can be gleaned from these examples, an important research task for scholars interested in heuristics and the law is to undertake comparative analyses of the barriers facing institutional learning for courts, legislatures, and administrative agencies (Rachlinski, this volume).

Legal Heuristics in the Administrative State

One may regard the common-law heuristics devised by judges as being analogous to the process-level cognitive heuristics that are observed in individual decision making and that researchers believe have evolved over time into quick, non-taxing mental procedures for resolving complex decisions. Like these individual heuristics, common-law legal heuristics conserve on deliberation costs by drawing from a storehouse of accumulated wisdom and experience. Also like individual heuristics, however, legal heuristics sometimes fail to adapt in a timely or appropriate fashion to changing conditions. Thus, we should be careful to avoid the mistake of holding up common-law heuristics as both our descriptive account of what legal actors are doing and our prescriptive account of what they should be doing. Such a conflation would risk the same "is/ought" fallacy that heuristics research more generally must seek to avoid. Instead, we should consider the possibility that in some contexts, legislatively or administratively devised legal rules will offer desirable improvements over the background or default rules that have been established by the common-law system. In contrast to the slowly evolving rules of the common law, legislatively or administratively devised legal rules may offer improvements similar to those of expert decision-making aids that are deliberately constructed and prescribed for use in particular contexts (Arkes and Shaffer, this volume).

Like decision-making procedures more generally, the forms that such legal rules might take range from full-blown optimality-based prescriptive models to

simple one-factor decision rules. The choice of form in any given context will depend on the type of problem faced and other relevant characteristics of the decision-making environment. Of particular interest to scholars working at the intersection of heuristics and the law will be legal problems that do not admit of optimal solutions, for those areas might be thought especially appropriate for the use of decision-making heuristics of the sort championed by heuristics researchers. Within the law and economics tradition, it has been accepted as commonplace that any particular legal goal, such as eliminating murder, can be addressed through the use of rational choice models that "solve" legal problems by identifying the level of societal resource commitment necessary to generate a desired reduction in the incidence of the targeted activity. However, strong conclusions can be obtained from such models only if they are premised on empirically valid models of behavior and, more fundamentally, only if they specify fully and accurately all possible costs and benefits of social action, as well as a weighting rule for combining those costs and benefits into a single solution or solution frontier. In practice, it is not always possible to specify these costs, benefits, and weighting functions in tractable forms. In such cases, heuristic procedures may provide the most ecologically rational model for the construction of legal rules.

As a concrete example from environmental law, consider the 1990 Clean Air Act Amendments in the U.S., which created a market for sulfur dioxide emissions by issuing a given number of pollution permits and allowing recipient firms to trade the permits after their issuance. In this case, the U.S. Congress devoted almost none of its attention to the question of how many tons of emissions to permit in the aggregate—the efficiency question that, from the societal standpoint, might be considered the most important aspect of designing a pollution market, given that it determines the desired tradeoff between economic costs and human health and the environment. Instead, as one observer has noted, Congress seemed much more preoccupied with the distributive aspect of designing the permit scheme—that is, the question of which favored industries would receive the newly created and economically valuable permits (Heinzerling 1995). In addition to the usual political preoccupation with graft, Congress's single-minded focus on this latter question also could have been caused by the daunting degree of intractability that characterized the former question. Congress was advised to engage in a cost-benefit optimization exercise by proponents of the tradable permit policy instrument, but such an effort in the sulfur dioxide context would have required the generation of enormous amounts of scientific and economic information, as well as the resolution of theoretically indeterminate judgments about such questions as the monetary value of human and nonhuman lives and the appropriate distribution of scarce natural resources between generations (Kysar 2003). Thus, although numerous scholars predicted that adoption of a tradable permit scheme would have the deliberative benefit of ensuring open, democratic discussion concerning the "right" amount

of pollution for society to endure (Ackerman and Stewart 1985; Sunstein 1991), in this instance, the U.S. Congress was unwilling to take the bait.

Experience from administrative law suggests that Congress may have been wise to avoid explicit cost-benefit calculation in devising the sulfur dioxide trading program. Within administrative agencies, where cost-benefit analysis of environmental, health, and safety standards is more routinely practiced, one observer has argued that the regulatory rule-making process has become afflicted with a form of "paralysis by analysis" (McGarity 1998). Assuming this diagnosis is accurate, one wonders whether heuristic approaches to such intractable problems as pollution regulation might, in the balance, be preferable. In many environmental contexts, for instance, the U.S. and other nations have followed a simple practice of requiring installation of the best available pollution abatement technology, with opt-out procedures available for firms that are able to demonstrate achievement of equal abatement levels using an alternative technology. This simple heuristic—in essence, "do the best you can"—implies great collective commitment to the preservation of human life and the environment without requiring satisfaction of Herculean informational demands by regulators. Moreover, in actual practice, the approach becomes similar to a "knee of the cost curve" decision-making heuristic, in which pollution abatement is required up to the point that marginal returns from further abatement begin to steeply decline (McGarity 1991). Thus, the legal heuristic approaches cost-benefit optimization without requiring a costly and potentially counterproductive exercise of computation and, importantly, without adopting a decision-making framework that may be politically unpalatable to citizens and other constituents. Indeed, even regulated industries might prefer such "command and control" standards, given the high degree of predictability that they afford.

Legal Heuristics and Process Values

Unlike methods of assessment that evaluate solely according to outcomes, extensive evidence suggests that individuals evaluate decisions according to both the content of the decision outcome itself and certain perceived characteristics of the process that led to the outcome (Frey and Benz 2002; Benz and Stutzer 2002; Frey and Stutzer 2002a, b; Lind and Tyler 1988; Thibault and Walker 1975). Thus, in addition to the instrumental interests that are assessed when we compare the accuracy of decision-making techniques, scholars interested in heuristics and the law must also consider the impact that use of particular legal heuristics might have for the "process values" that are served by law (Summers 1974). For instance, when extolling the virtues of simple common-law maxims, we should be careful not to overlook arguments that might weigh in favor of more elaborately specified legal rules for reasons that do not bear on outcome reliability. Courts must often project the appearance that certain interests have been considered before rendering a decision, irrespective of whether those

interests are given significant weight in the court's implicit additive function and, indeed, irrespective of whether a fast and frugal decision rule could achieve the same results with considerably less deliberative load. In that sense, the modern proliferation of balancing tests in the law may further important expressive values by requiring at least nominal consideration of a variety of interests that are of concern to parties and other audiences. Indeed, in light of such process values, we may be forced as a practical matter to keep legal tests that employ cumbersome amalgams of factors, while relying on the heuristics research methodology to "excavate" the real factors and weights that end up being used by judicial actors within the seemingly unpredictable balancing tests (Dhami 2002; Dhami and Ayton 2001).

It is important to note that this argument in favor of multi-factored judicial balancing tests may not extend to formulations of balancing tests that are analytically or computationally formalized. Indeed, in many sensitive areas of law, the specification of a weighted additive function for decision making might do violence to traditional notions of due process, separate and apart from consideration of the reliability of outcomes generated by the prescribed algorithm. In the U.S., for instance, a uniform system of federal criminal sentencing was established in 1988 to produce greater consistency in the punishments that similarly situated defendants would receive from different sentencing judges. The guidelines require an elaborate computational exercise in which a defendant's sentence is determined by various weighted factors relating to the seriousness of the basic offense, the manner in which the crime was committed, the circumstances of the victim, the defendant's degree of acceptance of responsibility for the crime, and the defendant's criminal history. In addition to raising doubts about the guidelines' actual success at bringing consistency to federal sentencing, numerous courts and commentators have also criticized the guidelines for constraining the ability of judicial actors to mete out *individualized* justice according to factors and nuances that inevitably escape the formalized system. To these critics, despite the laudable goal embraced by the drafters of the guidelines, too little attention was devoted to the various process values that would be disserved by a system in which a defendant's penal fate can be modeled and predicted by a computer software program.[5]

In a related fashion, proponents of cost-benefit optimization in the areas of environmental, health, and safety regulation may overlook the desire that individuals seem to have for certain factors *not* to be considered as part of an instrumentalist weighting and balancing of interests. Specifically, individuals have been shown to be especially reluctant to make explicit tradeoffs between

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[5] Analogously, the U.S. Supreme Court's requirement of individualized university admissions determinations that include race as a factor seems driven by a desire that university officers project the semblance of nuanced and particularized fairness judgments, even if such decisions ultimately differ little from the explicit weighted-factor systems that they replace (*Gratz v. Bollinger* 2003).

"sacred" categories, such as human life, and "secular" categories, such as monetary profit (Tetlock et al. 2000), an aversion that has also been demonstrated in areas of legal decision making. For instance, mock jurors appear to award higher punitive damages in fact settings in which corporate actors perform explicit, monetized cost-benefit balancing of human safety and products cost (Viscusi 2000). Indeed, as Hastie and Viscusi have concluded, experimental jurors seem to have an "ingrained hostility towards rational, mathematical analyses of benefits and costs in the domain of risk" (Hastie and Viscusi 1998, p. 913). More generally, mock jurors have been shown to impose punitive damages based on their sense of appropriate punishment rather than the level calculated to achieve "optimal deterrence" according to the economic model of punitive damages (Viscusi 2001). Such evidence has led prominent researchers to conclude that "the public will be skeptical of an effort" to adopt the economist's model of optimal deterrence for setting punitive damages because it "could be widely perceived as unfair and wrong" (Sunstein et al. 2000, p. 250).

These various findings suggest that there may be some domains of choice and decision making in which individuals would prefer the use of legal heuristics to avoid explicit calculation and trading off of the "sacred" and the "secular." Of course, such tradeoffs must and do occur at least implicitly on a daily basis; however, as Tetlock explains, nominal adherence to the proposition that life has infinite value serves important social purposes: "[O]ur commitments to other people require us to deny that we can compare certain things quantitatively. To transgress this normative boundary, to attach a monetary value to one's friendships or to one's children or to loyalty to one's country, is to disqualify oneself from certain social roles, to demonstrate that one does not have the faintest idea of what it means to be a true friend or parent or scholar" (Tetlock 2002, p. 596). In this regard, the choice by legal decision makers to adopt a heuristic device that refuses to calculate and compare life-saving interventions explicitly against economic cost may reflect a subtle kind of ecologically rationality—an awareness that, although it is nonsense to say that human life is priceless, it is socially "useful nonsense" (Will 1990). Judge Hand seems to have recognized as much, noting in one of his opinions that the effort to provide a cost-benefit formula for injury law must fail because the negligence determination "always involves some preference, or choice between incommensurables, and it is consigned to a jury because their decision is thought most likely to accord with commonly accepted standards, real or fancied" (*Conway v. O'Brien* 1940).

CONCLUSION

Antoni Gaudi's most famous work, *La Sagrada Familia* cathedral in Barcelona, was designed by the architect using his ingenious inverted rope-and-weights model. Following Gaudi's untimely death in 1926, however, the masterpiece lay dormant for several years and appeared destined to remain unfinished after a fire

destroyed most of the existing plans and models of the cathedral during the Spanish Civil War. Later, during the Franco era, fellow architect Francesc Quintana managed to reconstruct several plaster models of Gaudi's intended design for the structure, enabling some limited construction on the project to commence once again. Work has continued on and off for the past several decades, with carefully selected architectural masters standing in as stewards for the original creative vision of Gaudi. Presently, construction of the cathedral is supervised by New Zealand architect Mark Burry, who furthers the strange, intricate beauty of Gaudi's original design through an unlikely tool. Recognizing that Gaudi's complex geometric forms continued to surpass the capabilities of even modern computer-aided design techniques, Burry instead decided to adapt a type of software used in aeronautical engineering for the special purpose of transforming Quintana's plaster models into realizable architectural plans. The result has been a revolutionary advance in architectural modeling software, the influence of which is evident in *La Sagrada Familia* and in the work of Burry's frequent collaborator and world-renowned contemporary designer, Frank O. Gehry.

Gaudi's ingenious architectural design method, which was ecologically rational for its time and for several decades thereafter, finally now can be replicated through high-end digital modeling techniques that are both faster and less labor-intensive than Gaudi's physical exercise. In other words, the formal analytic system underlying Burry's modified computer software now outperforms Gaudi's modeling heuristic. Similarly, one might expect to find many cases in which optimization models outperform simple decision-making heuristics, whether as descriptive models to predict behavior, as prescriptive models to identify optimal solutions toward which individuals or legal policy makers should strive, or as analytical models to guide the design and content of legal rules. Much of law and policy has been premised on this very expectation, particularly as it has been influenced by the law and economics movement. Thus, several of the examples described in this chapter—including the movements toward *caveat emptor* models of consumer protection, toward cost-benefit optimization in medical malpractice and environmental law, and toward elaborately devised criminal sentencing schemes—reflect strong confidence in the suitability of optimality-based decision models for the social, economic, and political environments in which they are being advanced.

We do not object in principle to such efforts to obtain better, or even optimal, results. On the other hand, scholars would do well to recall the remarkable durability of Gaudi's simple gravitational insight and the heuristic solution that it provided. Technological advances such as the development of aeronautical engineering software may mean that previously ill-posed or computationally intractable problems eventually do become soluble in a mathematically optimal fashion. But beyond the newly traced optimal frontier will still remain other problems that demand heuristic solutions and that, characteristically, will often

be areas of intense interest to law. As a prescriptive matter, therefore, the heuristics research is of importance to legal scholars because it compels a certain degree of realism to their theoretical work, both by demonstrating ways in which individual decision making can be highly ecologically rational despite using heuristics that are distinct from analytical optimization procedures, and, more fundamentally, by identifying certain circumstances in which the benchmark of an analytically derived optimum is unlikely to provide achievable or even cognizable prescriptive advice. In addition, as a descriptive matter, heuristics research is of importance to legal scholars because it provides a detailed window into the black box of individual decision making, offering cognitive process models for particularized decision tasks that are capable of replication, analysis, and comparison across other domains. For these reasons, we believe that much exciting work lies ahead at the intersection of heuristics and the law.

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