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Articles

TIME-SHIFTED RATIONALITY AND THE LAW OF LAW'S LEVERAGE: BEHAVIORAL ECONOMICS MEETS BEHAVIORAL BIOLOGY

Owen D. Jones[*]

INTRODUCTION

People behave rationally. Except, apparently, when they don't. They get emotional, comply with costly social norms, and offer puzzlingly poor performances on any number of seemingly simple analytic tasks. This is, increasingly, a problem for both economists and legal thinkers.

It is increasingly a problem because the evidence of intriguingly patterned human irrationality has achieved critical mass and continues to grow. It is a problem for economists because the standard economic model assumes that humans will respond rationally to changes in incentives. And it is a problem for legal policymakers because they so often rely on economic analysis when recommending ways that incentives should be changed to achieve the goals of law with the tools of law. Where the economics is wrong, the law may be too.

As a result of the increasingly frequent mismatch between the popular theory of human behavior and the human behavior that is popular, a number of influential legal scholars have recently published articles arguing that something ought be done, and suggesting precisely what.[1] Generally, these

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[*] Visiting Professor, University of Texas School of Law; Professor of Law, Arizona State University College of Law; Faculty Fellow, Center for the Study of Law, Science, and Technology; Research Fellow, Gruter Institute for Law and Behavioral Research; B.A., Amherst College; J.D., Yale Law School.

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[1] *See, e.g.*, Christine Jolls, Cass R. Sunstein, & Richard Thaler, *A Behavioral Approach to Law and*

works of "behavioral law and economics" (here "BLE") reflect a new interdisciplinary approach that would incorporate into legal analysis important findings about irrationality from the field of cognitive psychology (and its cognates variously known as behavioral economics and behavioral decision theory).[2] Expanding on Herbert Simon's notion of "bounded rationality,"[3] and work conducted and popularized by Tversky, Kahneman, and Thaler on the cognitive "heuristics and biases" that may flow therefrom,[4] BLE scholarship identifies and explores possible implications for law of consistent and patterned deviations from rational choice predictions.

This bounded rationality approach, while promising, faces two hurdles. The first is methodological. Commentators argue that BLE is undertheorized. That is, it reasons from observations to implications without explanations. As explored further below, this criticism has some merit. The second hurdle, partly a consequence of the first, is practical. Many economists, as well as law and economics scholars, remain skeptical of behav-

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Economics, 50 STAN. L. REV. 1471 (1998); Russell Korobkin, *The Status Quo Bias and Contract Default Rules*, 83 CORNELL L. REV. 608 (1998); Russell B. Korobkin & Thomas S. Ulen, *Law and Behavioral Science: Removing the Rationality Assumption From Law and Economics*, 88 CAL. L. REV. 1051 (2000); Jeffrey J. Rachlinski, *Gains, Losses, and the Psychology of Litigation*, 70 S. CAL. L. REV. 113 (1996); Cass R. Sunstein, *Behavioral Analysis of Law*, 64 U. CHI. L. REV. 1175 (1997); Thomas S. Ulen, *The Growing Pains of Behavioral Law and Economics*, 51 VAND. L. REV. 1747 (1998).

Recent symposia on the legal implications of irrational behavior have appeared in 50 STAN. L. REV. 1471 (1998) and 51 VAND. L. REV. 1497 (1998). Note 40, *infra*, provides a more extensive sampling of the dozens of articles on this subject that have recently appeared.

[2] This outpouring of scholarship appears under various names. These include "behavioral law and economics," "law and behavioral science," "behavioral analysis of law," "behavioral economic analysis of law," "the behavioral approach to law and economics," "behavioral economics analysis," and "law and the 'new' psychology." *See, e.g.*, BEHAVIORAL LAW AND ECONOMICS (Cass R. Sunstein ed., 2000); Korobkin & Ulen, *supra* note 1; Sunstein, *supra* note 1; Jennifer Arlen, Comment, *The Future of Behavioral Economic Analysis of Law*, 51 VAND. L. REV. 1765 (1998); Jolls et al., *supra* note 1; Christine Jolls, *Behavioral Economics Analysis of Redistributive Legal Rules*, 51 VAND. L. REV. 1653 (1998) [hereinafter Jolls, *Behavioral Economics Analysis*]; Jeffrey J. Rachlinski, *The "New" Law and Psychology: A Reply to Critics, Skeptics, and Cautious Supporters*, 85 CORNELL L. REV. 739 (2000). For reasons that will become clear below, I prefer the title "law and behavioral science," though it is not yet in broad use.

For an historical perspective on the rise of behavioral economics, see Colin Camerer, *Behavioral Economics: Reunifying Psychology and Economics*, 96 PROC. NAT'L. ACAD. SCI. 10575 (1999); David Laibson & Richard Zeckhauser, *Amos Tversky and the Ascent of Behavioral Economics*, 16 J. RISK & UNCERTAINTY 7 (1998); Sendhil Mullainathan & Richard Thaler, *Behavioral Economics*, working paper entry in the International Encyclopedia of the Social and Behavioral Sciences, *available at* http://www.nber.org/papers/w7948 (Oct. 2000).

[3] Simon introduced the concept of bounded rationality in Herbert Simon, *A Behavioral Model of Rational Choice*, 69 Q.J. ECON. 99 (1955). Subpart I.A, *infra*, briefly traces its influence.

[4] *See, e.g.*, RICHARD H. THALER, QUASI-RATIONAL ECONOMICS (1991); Amos Tversky & Daniel Kahneman, *Rational Choice and the Framing of Decisions*, *in* RATIONAL CHOICE: THE CONTRAST BETWEEN PSYCHOLOGY AND ECONOMICS 67 (Robin Hogarth & Melvin Reder eds., 1987). "Heuristics" is the term describing the supposed rules of thumb by which people commit these cognitive errors, and "biases" are the errors themselves, when systematic across a study population. *See* John Conlisk, *Why Bounded Rationality?*, 34 J. ECON. LIT. 669, 670 (1996).

ioral economic findings and claims, and are evidently loathe to relax the traditional rationality assumption.[5] For them, existing data on alleged irrationalities are—without more—unpersuasive and insufficient to warrant complicating existing models that so often work well. In either case, any successful integration into law of behavioral economics insights depends on both developing its theoretical foundation and demonstrating that behavioral law and economics can be merged with existing law and economics analysis without either visiting undue violence on cherished assumptions of proven value or sacrificing inconvenient facts on the alter of pet theories.

As we attempt to develop a theoretical foundation that can adequately encompass both rational and irrational behavior, in a model useful for law, it is worth remembering that all theories of behavior are ultimately theories about the human brain. As any concerted study of biology makes clear, this seemingly banal observation is in fact far from trivial. For our actions inevitably reflect the brain's information processing patterns, which in turn reflect its form and function. And we now know that the form and function of the human brain, like the form and function of all other organs of the body, have been significantly influenced by powerful, omnipresent, evolutionary processes, including natural and sexual selection, whose important roles in influencing human behavior remain underappreciated. Since careful study of these evolutionary processes has long been the province of the field of behavioral biology, and since a great deal is now known about the influence of evolutionary processes on species-typical brain function, it seems not only probable but inevitable that behavioral biology can offer something constructive to the interdisciplinary effort to understand and predict human irrationality in ways useful to law.[6]

In prior work, I have argued that the extraordinary growth of behavioral biology renders obsolete any law-relevant model of human behavior that fails to integrate life science perspectives with social science ones, and that this deficiency can be remedied, in part, through what I have referred to as *evolutionary analysis in law*.[7] Here I argue that advances in behavioral

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[5] For a useful examination of why economists are so attached to their assumptions about human rationality, see Thomas S. Ulen, *Rational Choice and the Economic Analysis of Law*, 19 L. & SOC. INQUIRY 487, 487-91 (1994).

[6] The term behavioral biology is susceptible of several meanings. By its use I mean to refer to the study of biological influences on behavior, as presently advanced by scholars in numerous fields, including but not limited to evolutionary biology, behavioral ecology, ethology, evolutionary psychology, primatology, and evolutionary anthropology. The cross-disciplinary nature of the subject matter defies easy efforts to name it. But a principal, shared, and core idea is simply this: evolutionary processes (such as natural selection and sexual selection)—together with environmental and physical inputs—built brains equipped with information-processing predispositions that consequently yield nonrandom behaviors.

[7] *See, e.g.*, Owen D. Jones, *Evolutionary Analysis in Law: An Introduction and Application to Child Abuse*, 75 N.C. L. REV. 1117 (1997) [hereinafter Jones, *Evolutionary Analysis in Law*]; Owen D. Jones, *Law and Biology: Toward an Integrated Model of Human Behavior*, 8 J. CONTEMP. L. ISSUES 167 (1997); Owen D. Jones, *Sex, Culture, and the Biology of Rape: Toward Explanation and Prevention*, 87

biology have largely overtaken existing notions of bounded rationality, revealing them to be misleadingly imprecise—and rooted in outdated assumptions that are not only demonstrably wrong, but also wrong in ways that have material implications for subsequent legal conclusions. This can be remedied. Specifically, behavioral biology offers three things of immediate use.

First, the measured deployment of easily accessible principles of behavioral biology can lay a foundation for both revising bounded rationality and fashioning a solid theoretical basis for understanding and predicting many human irrationalities. Behavioral biology can not only help to expose precisely what critics suspect is missing from the existing approaches to irrationality—it can also help to supply it.

Second, a principle we may derive from the fundamentals of behavioral biology, which I term *time-shifted rationality* (or "TSR"), can help us

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CAL. L. REV. 827 (1999) [hereinafter Jones, *Sex, Culture, and the Biology of Rape*]; Owen D. Jones, *Proprioception, Non-Law, and Biolegal History*, 53 U. FLA. L. REV. (forthcoming 2001) [hereinafter Jones, *Proprioception, Non-Law, and Biolegal History*].

The general idea that legal thinkers should take account of the influence of human biological heritage on human behavior relevant to law has been raised on numerous occasions, in a variety of contexts. And such work provides important background for all that I attempt here. See, for example, various programs of both the Gruter Institute for Law and Behavioral Research, http://www.gruterinstitute.org, and the Society for Evolutionary Analysis in Law (SEAL), http://www.sealsite.org. *See* RICHARD ALEXANDER, DARWINISM AND HUMAN AFFAIRS (1979) (containing chapter on "Evolution, Law, and Justice"); JOHN H. BECKSTROM, EVOLUTIONARY JURISPRUDENCE: PROSPECTS AND LIMITATIONS ON THE USE OF MODERN DARWINISM THROUGHOUT THE LEGAL PROCESS (1989) (discussing advantages and limits of using evolutionary theory in legal thinking); THE SENSE OF JUSTICE: BIOLOGICAL FOUNDATIONS OF LAW (Roger Masters & Margaret Gruter eds., 1992); RICHARD A. POSNER, SEX AND REASON (1992); Amicus Brief of the Gruter Institute, *In re* Baby M., 537 A.2d 1227 (N.J. 1988); Kingsley R. Browne, *Sex and Temperament in Modern Society: A Darwinian View of the Glass Ceiling and the Gender Gap*, 37 AZ. L. J. 972 (1995); E. Donald Elliott, *Law and Biology: The New Synthesis?*, 41 ST. LOUIS L. J. 595 (1997); Robin Fox, *In the Matter of "Baby M": Report from the Gruter Institute for Law and Behavioral Research*, 7 POL. & LIFE SCI. 77 (1988); Lawrence Frolik, THE BIOLOGICAL ROOTS OF THE UNDUE INFLUENCE DOCTRINE: WHAT'S LOVE GOT TO DO WITH IT?, 57 U. PITT. L. REV. 841 (1996); Oliver Goodenough, *Biology, Behavior, and Criminal Law: Seeking a Responsible Approach to an Inevitable Interchange*, 22 VT. L. REV. 263 (1998); Mark Grady & Michael McGuire, *A Theory of the Origin of Natural Law*, 8 J. CONTEMP. L. ISSUES 87 (1997); Cheryl Hanna, *Can A Biological Inquiry Help Reduce Male Violence Against Women?*, 22 VT. L. REV. 333 (1998); John O. McGinnis, *The Original Constitution and Our Origins*, 19 HARV. J. L. & PUB. POL'Y 251 (1996); William Rodgers, *Bringing People Back: Toward a Comprehensive Theory of Takings in Natural Resources Law*, 10 ECOLOGY L. Q. 205 (1982); Paul Rubin & Chris Paul, *An Evolutionary Model of Taste for Risk*, 17 ECONOMIC INQUIRY 585 (1979); Jeffrey E. Stake, *Darwin, Donations, and the Illusion of Dead Hand Control*, 64 TUL. L. REV. 705 (1990); Margo Wilson, *Impact of the Uncertainty of Paternity on Family Law*, 45 U. TORONTO FAC. L. REV. 217, 223 (1987); Margo Wilson & Martin Daly, *The Man Who Mistook His Wife for a Chattel*, in THE ADAPTED MIND: EVOLUTIONARY PSYCHOLOGY AND THE GENERATION OF CULTURE 289, 310-13 (Barkow et al. eds., 1992); "Ethology of Law: Biological Bases of Legal Behavior" (seminar offered at Yale Law School by E. Donald Elliott and Roger Masters in 1988); numerous other sources cited in Owen D. Jones, *Evolutionary Analysis in Law: An Introduction and Application to Child Abuse*, 75 N.C. L. REV. 1117, 1121-23 n.3 (1997), as well as in an on-line bibliography I maintain at the "Readings" page of the SEAL website at http://www.sealsite.org.

to usefully disentangle phenomena currently lumped together under the label bounded rationality. Doing so suggests that some seeming irrationalities are not, in fact, the product of conventional bounded rationality, as that concept is generally understood, but are instead the product of a very different phenomenon. As a consequence and by-product of this analysis, it is possible to reconcile some of the supposed irrationalities with an existing rationality framework in a new, more satisfying, and more useful way.

Third, behavioral biology affords the raw material for deriving a new principle, which I term *the law of law's leverage*, that can help us to better understand and predict the effects of law on human behavior.[8] Specifically, it can help us anticipate the comparative sensitivities of various human behaviors to legal changes in incentives. That is (to put it more explicitly in economic terms) it enables us to anticipate differences in the slopes of demand curves for various law-relevant behaviors.[9] This law of law's leverage can therefore afford us new, coherent, and systematic power in predicting the comparative costs to society of attempting to change behaviors through legal means. And the principle also provides a new and powerful tool for explaining and predicting many of the existing and future architectures of legal systems.

Each step in this argument bears its own Part. The first step is preceded, however, by some additional context, immediately below, to frame the issues more fully and to highlight precisely what is at stake. The last step is followed by discussion of several possible objections to this line of reasoning.

I. CONTEXT

This Part provides brief overviews of bounded rationality, the issues at stake in behavioral law and economics, and critical reactions to behavioral law and economics scholarship.

A. Rationality, Irrationality, Bounded Rationality

As is commonly known, economists modeling choice under conditions of scarcity assume that people are rational maximizers.[10] Though definitions of rationality vary,[11] for present purposes we can consider rational be-

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[8] *See* Owen D. Jones, *On the Nature of Norms: Biology, Morality, and the Disruption of Order*, 98 MICH. L. REV. 2072, 2100-01 (2000) (conjecturing on the possibility of deriving this relationship from the principles of behavioral biology).

[9] Even more technically, I am referring to differences in the elasticities. *See infra* note 140.

[10] *See generally* DAVID W. BARNES & LYNN A. STOUT, CASES AND MATERIALS ON LAW AND ECONOMICS (1992); HENRY N. BUTLER, ECONOMIC ANALYSIS FOR LAWYERS (1998); ROBERT COOTER & THOMAS ULEN, LAW AND ECONOMICS (3d ed. 2000); RICHARD A. POSNER, ECONOMIC ANALYSIS OF LAW (5th ed. 1998).

[11] For useful distinctions between different kinds of rationality, see ROBERT H. FRANK, MICROECONOMICS AND BEHAVIOR (3d ed. 1997); Korobkin & Ulen, *supra* note 1.

havior to come in two kinds. Behavior is *substantively rational* when it is appropriate to the achievement of given goals, within the limits imposed by given conditions and constraints. Behavior is *procedurally rational* when it is the outcome of appropriate deliberation.[12]

Dividing labor, economists tend to focus on the former kind of rationality, while psychologists tend to focus on the latter.[13] That is, economists assume that individuals pursue consistent ends using efficient means, regardless of whether their choices reflect conscious deliberation and calculation.[14] Of course, that assumption reflects a simplification, rather than a belief. (As, in similar fashion, we might assume for purposes of analyzing forces in a collision that each car is a sphere—without actually believing it to be so.) Yet despite that unrealistic simplification (and in many ways because of it) this general economic approach to rationality has proved famously useful.[15]

Rationality, of course, has a carefully prescribed meaning that does not necessarily imply conscious deliberation. Richard Posner notes, for example, that rational behavior is not limited to humans. RICHARD A. POSNER, SEX AND REASON 85 (1992).

[12] *See generally* HERBERT A. SIMON, 1 MODELS OF BOUNDED RATIONALITY: ECONOMIC ANALYSIS AND PUBLIC POLICY (1982) [hereinafter SIMON, 1 MODELS OF BOUNDED RATIONALITY]; Herbert Simon, *From Substantive to Procedural Rationality*, *in* METHOD AND APPRAISAL IN ECONOMICS 424 (S.J. Latss ed., 1976) [hereinafter Simon, *From Substantive to Procedural Rationality*].

[13] As Herbert Simon puts it:

> The rational person of neoclassical economics always reaches the decision that is objectively, or substantively, best in terms of the given utility function. The rational person of cognitive psychology goes about making his or her decisions in a way that is procedurally reasonable in the light of the available knowledge and means of computation.

Herbert Simon, *Rationality in Psychology and Economics*, 59 J. BUS. S209 (1986).

[14] Individuals are assumed to make choices that will "pursue consistent ends using efficient means [as a function of] preferences which are complete, reflexive, transitive, and continuous." NICHOLAS MERCURO & STEVEN G. MEDEMA, ECONOMICS AND THE LAW: FROM POSNER TO POST-MODERNISM 57 (1997); *see also* Nicholas Mercuro & Steven G. Medema, *Schools of Thought in Law and Economics: A Kuhnian Competition*, *in* LAW AND ECONOMICS: NEW AND CRITICAL PERSPECTIVES 65, 67 (Robin Paul Malloy & Christopher K. Braun eds., 1995).

[15] *See, e.g.*, GARY S. BECKER, THE ECONOMIC APPROACH TO HUMAN BEHAVIOR (1976); POSNER, *supra* note 10.

Of course, we need not necessarily care whether the behavioral model law employs is perfectly accurate or complete. Newtonian physics fails to describe accurately the interaction of particles at the quantum level, and yet it nonetheless serves quite well when launching rockets. The pragmatic test, therefore, for whether the often serviceable rational actor model should continue to serve, is simply whether it accomplishes the tasks we assign it more efficiently than would a model that squarely addressed irrationality—when both the benefits and costs of changing from or supplementing the existing neoclassical model are taken into account. Sacrificing accuracy for simplicity can be rational when the marginal increase in accuracy is outweighed by the increased costs of learning and using a more complex model. *See* Gregory S. Crespi, *Does the Chicago School Need to Expand Its Curriculum?*, 22 L. & SOC. INQUIRY 149, 154 (1997) (making similar point); *see also* Douglas G. Baird, *Introduction to Symposium: The Future of Law and Economics: Looking Forward*, 64 U. CHI. L. REV. 1129, 1131 (1997) ("The use of assumptions in economics is perhaps the aspect of the field that lawyers understand the least. Economists aim to capture as much of the dynamics of behavior as they can with the fewest possible assumptions. The question is not whether economists' assumptions are unrealistic, but whether

Even setting aside, as inapposite, those critiques of economic approaches that reflect definitional and methodological misunderstandings of the economic approach to behavior, it remains clear that the history of economics includes a history of criticism.[16] Moreover, the rapidly accumulating evidence that people quite frequently behave irrationally—and do so in consistent, widespread, and patterned ways—has afforded some rational choice critics present and tangible momentum.[17] Several typical contexts, which are widely considered to represent significant challenges to the edifice of traditional economic theory, have garnered much attention and will briefly illustrate several of the basic phenomena upon which BLE scholars build.[18]

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they capture enough of what is at work to allow us to see basic forces operating in an otherwise impenetrable maze.").

The possible benefits of a more accurate but more complicated model will approach materiality as a function, in part, of the number of different contexts in which people behave irrationally, the legal significance of those contexts, the proportion of the population that so behaves, the costs of their doing so, and the marginal increase in predictive power that a modified behavioral model would afford. The costs of a more accurate model will obviously depend, in part, on how accessible its theoretical foundations are, how easily we can apply it to legal concepts, and with what results.

[16] For a critique of allegedly conservative ideological bias, see RATIONAL CHOICE: THE CONTRAST BETWEEN PSYCHOLOGY AND ECONOMICS (Robin Hogarth & Melvin Reder eds., 1987); Amartya K. Sen, *Rational Fools: A Critique of the Behavioural Foundations of Economic Theory*, *in* PHILOSOPHY AND ECONOMIC THEORY 87 (Frank Hahn & Martin Hollis eds., 1979). For concern that traditional law and economics analysis underestimates the influence of social norms, see ERIC A. POSNER, LAW AND SOCIAL NORMS (2000); Richard H. McAdams, *The Origin, Development, and Regulation of Norms*, 96 MICH. L. REV. 338 (1997); Robert C. Ellickson, *Law and Economics Discovers Social Norms*, 27 J. LEGAL STUD. 537 (1998).

[17] *See, e.g.*, THALER, *supra* note 4, at xxi ("In some well-defined situations, people make decisions that are systematically and substantively different from those predicted by the standard economic model.").

Technically, the point that humans are not always rational is neither new nor surprising. *See, e.g.*, Arthur Allen Leff, *Economic Analysis of Law: Some Realism About Nominalism*, 60 VA. L. REV. 451 (1974). But only in recent years has the evidence of and interest in substantively irrational behavior reached unignorable proportions. This is underscored by the admissions, in microeconomic textbooks, that "even with transparently simple problems, people often violate the most fundamental axioms of rational choice." FRANK, *supra* note 11, at 247. For a useful overview, see *id.* at 245-70.

[18] For useful introductions to behavioral economics and cognitive psychology relevant to human irrationality, see HAL ARKES & KENNETH HAMMOND, JUDGMENT AND DECISION MAKING: AN INTERDISCIPLINARY READER (1986); JONATHAN ST. B.T. EVANS, BIASES IN HUMAN REASONING: CAUSES AND CONSEQUENCES (1989); ROBIN HOGARTH, JUDGMENT AND CHOICE: THE PSYCHOLOGY OF DECISION (2d ed. 1987); JUDGMENT UNDER UNCERTAINTY: HEURISTICS AND BIASES (Daniel Kahneman et al. eds., 1982); RICHARD NISBETT & LEE ROSS, HUMAN INFERENCE: STRATEGIES AND SHORTCOMINGS OF SOCIAL JUDGMENT (1980); MASSIMO PIATTELLI-PALMARINI, INEVITABLE ILLUSIONS: HOW MISTAKES OF REASON RULE OUR MINDS (1994); RATIONALITY: PSYCHOLOGICAL AND PHILOSOPHICAL PERSPECTIVES (K.I. Manktelaw & D.E. Over eds., 1993); SCOTT PLOUS, THE PSYCHOLOGY OF JUDGMENT AND DECISION MAKING (1993); THALER, *supra* note 4; RICHARD THALER, THE WINNER'S CURSE: PARADOXES AND ANOMALIES OF ECONOMIC LIFE (1992); THE LIMITS OF RATIONALITY (Karen Schweers Cook & Margaret Levi eds., 1990); Richard H. Thaler, *Toward a Positive Theory of Consumer Choice*, 1 J. ECON. BEHAV. & ORG. 39 (1980); Ulen, *supra* note 5. *See also* sources cited in Conlisk, *supra* note 4, at 670.

Real people have inconsistent preferences. For example, they will place a high value on losing weight, but eat ice cream.[19] They cooperate too much. For example, they leave a tip in a restaurant far from home, that they will never visit again, for a waiter they will never again see, for service already and irrevocably rendered.[20] They miscalculate calendars and clocks, over-weighting the present compared to the future. For example, they often prefer to receive $100 today than $110 in a week but, in odd reverse, opt for $110 in eleven weeks over $100 in ten weeks.[21] They employ absurdly high discount rates. For example, they regularly prefer a slightly less expensive but energy-guzzling appliance to a slightly more expensive appliance that is far less costly to run.[22]

People routinely give answers that are highly sensitive to logically irrelevant changes in questions. Research suggests, for example, that people will strongly prefer to support a hypothetical policy in which sixty percent of the people in a population live to one in which forty percent of them die.[23] They display seemingly irrational tastes for both fairness and spite, often preferring to forgo receiving a benefit in order to impose a cost on someone they consider to be unfair.[24] And, perhaps most famously, among

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[19] For discussion of such self-control problems, see Richard H. Thaler & H.M. Shefrin, *An Economic Theory of Self-Control*, 89 J. POL. ECON. 392 (1981).

[20] For discussion, see Ulen, *supra* note 5, at 491.

[21] Camerer, *supra* note 2, at 10576; *see also* George Ainslie, *Derivation of "Rational" Economic Behavior from Hyperbolic Discount Curves*, 81 INTERTEMPORAL CHOICE 334 (1991); George Loewenstein & Drazen Prelec, *Anomalies in Intertemporal Choice: Evidence and an Interpretation*, 107 Q.J. ECON. 573, 574-75 (1992); George Loewenstein & Richard H. Thaler, *Anomalies: Intertemporal Choice*, 3 J. ECON. PERSP. 181 (Fall 1989); Ted O'Donoghue & Matthew Rabin, *Doing It Now or Later*, 89 AM. ECON. REV. 103, 103 (1999) ("When considering trade-offs between two future moments, present-biased preferences give stronger relative weight to the earlier moment as it gets closer."); Ulen, *supra* note 1, at 1758.

[22] *See, e.g.*, Melvin Aron Eisenberg, *The Limits of Cognition and the Limits of Contract*, 47 STAN. L. REV. 211 (1995); Daniel Kahneman & Amos Tversky, *Choices, Values, and Frames*, AM. PSYCHOLOGIST, April 1984, at 341. As Thomas Ulen notes:

> [P]eople routinely ignore the warnings of dermatologists that overexposure to the sun can cause skin cancer later in life but may pay attention if the dermatologist tells them that the sun may cause large pores or blackheads in the near future. Most homeowners do not have nearly enough insulation in their attics and walls, even though the cost of installing more would lead to significant savings on energy use within one year. . . .
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> . . . [D]iscount rates decline sharply with the length of time that the subject must wait for her reward and with the size of the reward. These experimental results are not consistent with received economic theory, which holds that discount rates should equal the market rate of interest and that the discount rates should be constant (i.e., invariant to the period of time considered) and certainly invariant with respect to the amount of money involved.

Ulen, supra note 5, at 513-14.

[23] An early article on such "framing" effects is Amos Tversky & Daniel Kahneman, *Rational Choice and the Framing of Decisions*, 59 J. BUS. S251 (1986).

[24] For an overview, see Sunstein, *supra* note 1, at 1186. The phenomenon is often studied in so-called "ultimatum games." The ultimatum game is straightforward: "A is given an amount of money. He can offer as little or as much of it as he pleases to B. If B accepts the offer, A gets to keep the rest; if B refuses, neither gets anything." Richard A. Posner, *Rational Choice, Behavioral Economics, and the*

the many other oddities,[25] people value something they have just received at a higher amount than they would have been willing to pay for it.[26] For example, people often demand a far larger sum to sell an object they have just come to own than they would be willing to pay to acquire that object from someone else, even when the transaction costs of acquisition are very low.[27]

In each of these cases, considered in sequence in subpart III.B. below, people behave in ways not predicted by standard economic assumptions. For instance (taking up the last example) standard economic assumptions imply that, after controlling for wealth effects, differences between an individual's maximum willingness to pay for a good and the minimum compensation demanded for the same good should be negligible. Yet they are not.[28]

Law, 50 STAN. L. REV. 1551, 1564 n. 27 (1998). As discussed in section III.B.5, *infra*, B refuses the offer far more often than traditional analysis predicts.

[25] Scratching more of this expansive surface of human irrationality, John Conlisk has noted that people also, among other things, make false inferences about causality, ignore relevant information, exaggerate the importance of vivid over pallid evidence, exaggerate the importance of fallible predictors, display overconfidence in judgment relative to evidence, exaggerate confirming over disconfirming evidence relative to initial beliefs, do redundant and ambiguous tests to confirm an hypothesis at the expense of decisive tests to disconfirm, display intransitivity, and make frequent errors in deductive reasoning tasks such as syllogisms. In addition, they misunderstand statistical independence, mistake random data for pattern data and vice versa, fail to appreciate the law of large number effects, fail to recognize statistical dominance, make errors in updating probabilities on the basis of new information, understate the significance of given sample sizes, fail to understand covariation, and exaggerate the ex ante probability of a random event that has already occurred. Conlisk, *supra* note 4, at 670.

[26] For overviews, see Jack L. Knetsch, *The Endowment Effect and Evidence of Nonreversible Indifference Curves*, 79 AM. ECON. REV. 1277 (1989); Jack L. Knetsch & J.A. Sinden, *Willingness to Pay and Compensation Demanded: Experimental Evidence of an Unexpected Disparity in Measures of Value*, 99 Q.J. ECON. 507 (1984); George Loewenstein & Daniel Adler, *A Bias in Predicting Tastes*, 105 ECON. J. 929 (1995).

[27] *See* Elizabeth Hoffman & Matthew L. Spitzer, *Willingness to Pay vs. Willingness to Accept: Legal and Economic Implications*, 71 WASH. U. L.Q. 59 (1993) (reviewing literature on endowment effect and discussing alternative explanations); Daniel Kahneman et al., *Anomalies: The Endowment Effect, Loss Aversion, and Status Quo Bias*, 5 J. ECON. PERSP. 193 (1991); Jeffrey Evans Stake, *Loss Aversion and Involuntary Transfers of Title*, *in* LAW AND ECONOMICS: NEW AND CRITICAL PERSPECTIVES 331, 339 (Robin Paul Malloy & Christopher K. Braun eds., 1995); Arlen, *supra* note 2, at 1771-72.

The conundrum has been explained this way:

> One should value a coffee mug at $5, whether one owns it or not: certainly, there should not be a large gap between what one would pay to acquire it and the price at which one would sell it. So much for standard microeconomic theory: the well documented endowment effect refers to the fact that people indeed must be paid more to give up a good than they would pay to get the very same good in the first instance. The effect has been tested in a variety of thought and actual experiments, where it has been robustly found that people insist on being paid about twice as much for a good as they would pay to acquire it: about $10, for a mug that they could readily buy for $5.

Edward J. McCaffery et al., *Framing the Jury: Cognitive Perspectives on Pain and Suffering Awards*, 81 VA. L. REV. 1341, 1352 (1995).

[28] Daniel Kahneman et al., *Experimental Tests of the Endowment Effect and the Coase Theorem*, 98 J. POL. ECON. 1325 (1990). It should be noted, however, that the magnitudes of this endowment effect sometimes vary. *See* Robert Franciosi et al., *Experimental Tests of the Endowment Effect*, 30 J. ECON. BEHAV. & ORG. 213 (1996); Jeffrey J. Rachlinski & Forest Jourden, *Remedies and the Psychology of*

Over the years, economists have proposed various ways of reconciling these supposed irrationalities with rational choice theory. As one example, apparent inconsistencies in the ordering of preferences can result either from multiple "selves," each with different tastes, or from preferences that simply lacked sufficiently precise articulation to make the supposed inconsistency disappear.[29] For another example, seemingly over-cooperative behavior can result from individual effort to maximize "psychic income" (provided we assume that being altruistic brings happiness). Although, to be fair, such explanations are not quite as glib as they at first sound, neither are they particularly satisfying.

Over time, the concept of "bounded rationality" has emerged as one of the most popular ways to explain seemingly irrational behavior without straying too far from traditional economic assumptions.[30] Although its meaning has varied,[31] bounded rationality draws attention to the discrepancy between the perfect human rationality that economic theory often assumes and actual human behavior as it is observed in economic life. Bounded rationality essentially captures the idea that there are very real, very important constraints on the actual human capacity to gather and process information.[32]

Ownership, 51 VAND. L. REV. 1541 (1998).

[29] As Ulen notes, "whenever there are seeming deviations from the predictions of price theory, economists can usually explain those deviations without having to assume that the decision makers involved are irrational." Ulen, *supra* note 5, at 489. Ulen explains that even when there seems to be a real anomaly, it is considered insufficient to have falsified rational choice theory. Economists may invent "effects," that by labeling the phenomenon appear to reconcile it with rational choice assumptions, or simply posit that there are important "nonmonetary elements in their utility functions." *Id.* at 490, 498.

[30] Important works in bounded rationality include Simon, *supra* note 3; Simon, *From Substantive to Procedural Rationality*, *supra* note 12; Sen, *supra* note 16; and OLIVER E. WILLIAMSON, THE ECONOMIC INSTITUTIONS OF CAPITALISM (1985); JOHN ELSTER, SOUR GRAPES: STUDIES IN THE SUBVERSION OF RATIONALITY (1983); ARIEL RUBINSTEIN, MODELING BOUNDED RATIONALITY (1998); Conlisk, *supra* note 4; Jon Elster, *Emotions and Economic Theory*, 36 J. ECON. LIT. 47 (1998); John Elster, *When Rationality Fails*, *in* THE LIMITS OF RATIONALITY 19 (Karen Schweers Cook & Margaret Levi eds., 1990); Barton L. Lipman, *Information Processing and Bounded Rationality: A Survey*, CANADIAN J. ECON., Feb. 1995, at 42 (and sources cited therein); Herbert A. Simon, *Invariants of Human Behavior*, 41 ANN. REV. PSYCH. 1 (1990) [hereinafter Simon, *Invariants of Human Behavior*].

[31] As one commentator observes:

> Despite the fact that many economists view bounded rationality as a more realistic and more appropriate assumption than perfect rationality at least for many situations, there are very few papers that explore the implications of bounded rationality. The reason for this is very simple: there is no clear agreement on how one models this phenomenon.

Lipman, *supra* note 30, at 43; *see also* Avery W. Katz, *Introduction to Chapter 7*, *in* FOUNDATIONS OF THE ECONOMIC APPROACH TO LAW 267, at 267-68 (Avery W. Katz ed., 1998) (noting same); Gregory Lilly, *Bounded Rationality: A Simon-like Explication*, 18 J. ECON. DYNAMICS IN CONTROL 205 (1994) (noting same). One commentator goes so far as to say that there has been a steady "subsumption, extension, elaboration, and transformation" of Simon's bounded rationality. James G. March, *Bounded Rationality, Ambiguity, and Engineering of Choice*, *in* RATIONAL CHOICE 147 (John Elster ed., 1986).

[32] Useful overviews appear in Conlisk, *supra* note 4; Lipman, *supra* note 30; Herbert A. Simon, *Theories of Bounded Rationality*, *in* DECISION AND ORGANIZATION (1972) [hereinafter Simon, *Theories of Bounded Rationality*]; *see also* HERBERT A. SIMON ET AL., ECONOMICS, BOUNDED RATIONALITY

Some constraints—such as how much information the finite brain can hold, and how quickly it can calculate—are internal. Other constraints—such as the amount of time and energy required to gather all relevant information, and to process it—are external. Together, these constraints limit human information-gathering and information-processing capacities in ways that can yield deviations from perfectly rational, optimal outcomes. That is, the notion of bounded rationality enables us to conclude that what we observe as *substantive irrationality*—the failure to choose the optimal outcome under the circumstances—may often be the product of *procedural rationality* operating within realistic constraints. Positing bounded rationality thus temporarily alleviates the irrationality problem, because the high costs of acquiring complete information and the fixed limits on human computation, viewed together, make it clear that in some cases, paradoxically, it would be irrational to become fully informed.[33]

For example, it can be procedurally rational to spend less time on a problem than an optimal solution would require, once a minimally acceptable solution becomes apparent. The practical impossibility of calculating the best of all possible moves in chess is often cited as an illustration.[34] People are "satisficers," in Simon's terms,[35] rather than "optimizers," because the constraints of bounded rationality require them to rely upon habits, educated guesses, and rules of thumb that tend to yield satisfactory—if not necessarily optimal—outcomes.[36]

AND THE COGNITIVE REVOLUTION (1992) [hereinafter SIMON, THE COGNITIVE REVOLUTION]; SIMON, 1 MODELS OF BOUNDED RATIONALITY, *supra* note 12; HERBERT A. SIMON, 2 MODELS OF BOUNDED RATIONALITY: BEHAVIORAL ECONOMICS AND BUSINESS ORGANIZATION (1982); HERBERT A. SIMON, 3 MODELS OF BOUNDED RATIONALITY: EMPIRICALLY GROUNDED ECONOMIC REASON (1997); WILLIAMSON, *supra* note 30; Simon, *Invariants of Human Behavior*, *supra* note 30; Herbert A. Simon, *Rationality in Psychology and Economics*, *in* RATIONAL CHOICE: THE CONTRAST BETWEEN PSYCHOLOGY AND ECONOMICS 25 (Robin Hogarth & Melvin Reder eds., 1987).

In Simon's view:

> "[B]ounded rationality" is used to designate rational choice that takes into account the cognitive limitations of the decision maker—limitations of both knowledge and computational capacity. Bounded rationality is a central theme in the behavioral approach to economics, which is deeply concerned with the ways in which the actual decision-making process influences the decisions that are reached.

Herbert Simon, *Bounded Rationality*, *in* 1 THE NEW PALGRAVE: A DICTIONARY OF ECONOMICS 266, 266 (J. Eatwell et al. eds., 1987) [hereinafter Simon, *Bounded Rationality*].

[33] *See* FRANK, *supra* note 11, at 247.

[34] *See, e.g.*, SIMON, THE COGNITIVE REVOLUTION, *supra* note 32, at 29; Simon, *Theories of Bounded Rationality*, *supra* note 32.

[35] On the early history of the concepts of satisficing, see Herbert Simon, *A Behavioral Model of Rational Choice*, 69 Q.J. ECON. 99 (1955); Herbert Simon, *Rational Choice and the Structure of the Environment*, 63 PSYCHOL. REV. 129 (1956); Herbert Simon, *Theories of Decision-Making in Economics and Behavioral Sciences*, 49 AM. ECON. REV. 77 (1957). On Simon's later formation of the concept, see Herbert Simon, *A New Theory of Satisficing*, 19 J. BEHAV. ECON. 35 (1990).

[36] A useful discussion appears in Katz, *supra* note 31, at 267-68. Katz distinguishes bounded rationality from the traditional notion of constrained maximization this way: "Under the model of bounded rationality, uncertainty and imperfect information are modeled not as constraints within which rational

B. The Issues at Stake

The bounded rationality explanation for substantively irrational behavior is central to behavioral law and economics scholarship.[37] For by constraining rational choice *theory* with actual choice *facts*, behavioral law and economics scholars hope to inject more realism into behavioral models, to improve the ability to predict human behavioral choices, and to pursue the legal implications of this.[38] (After all, notes Sunstein, "the legal system is pervasively in the business of constructing procedures, descriptions, and contexts for choice."[39])

At stake in this pragmatic effort are no less than some of the most cherished notions of law and economics.[40] Behavioral anomalies are quite trou-

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individuals maximize, but as limits on the reasoning process itself." *Id.*

There is some recent movement to recharacterize the process of "satisficing" as the deployment of "fast and frugal heuristics." *See, e.g.*, Gerd Gigerenzer et al., *How Good Are Fast and Frugal Heuristics?*, *in* DECISION SCIENCE AND TECHNOLOGY: REFLECTIONS ON THE CONTRIBUTIONS OF WARD EDWARDS (James Shanteau et al. eds., 1999).

[37] Simon, defining "behavioral economics," notes:

> Behavioral economics is concerned with the empirical validity of these neoclassical assumptions about human behavior and, where they prove invalid, with discovering the empirical laws that describe behaviour correctly and as accurately as possible. As a second item on its agenda, behavioral economics is concerned with drawing out the implications, for the operation of the economic system and its institutions and for public policy, of departures of actual behavior from the neoclassical assumptions. A third item on its agenda is to supply empirical evidence about the shape and content of the utility function (or of whatever construct will replace it in an empirically valid behavioral theory) so as to strengthen the predictions that can be made about human economic behavior.

Herbert Simon, *Behavioral Economics*, *in* 1 THE NEW PALGRAVE: A DICTIONARY OF ECONOMICS 221, 221 (J. Eatwell et al. eds., 1987).

In comparison, Simon also notes:

> "[B]ounded rationality" is used to designate rational choice that takes into account the cognitive limitations of the decision maker—limitations of both knowledge and computational capacity. Bounded rationality is a central theme in the behavioral approach to economics, which is deeply concerned with the ways in which the actual decision-making process influences the decisions that are reached."

Simon, *Bounded Rationality*, *supra* note 32, at 291.

[38] *See, e.g.*, Jolls, *Behavioral Economics Analysis*, *supra* note 2.

[39] Cass R. Sunstein, *Introduction* to BEHAVIORAL LAW AND ECONOMICS 1 (Cass R. Sunstein ed., 2000).

[40] A sampling of only comparatively recent BLE scholarship includes dozens of sources. *See, e.g.*, BEHAVIORAL LAW AND ECONOMICS (Cass R. Sunstein ed., 2000); Stephen M. Bainbridge, *Mandatory Disclosure: A Behavioral Analysis*, 68 U. CIN. L. REV. 1023 (2000); Melvin A. Eisenberg, *The Limits of Cognition and the Limits of Contract*, 47 STAN. L. REV. 211 (1995); Larry T. Garvin, *Disproportionality and the Law of Consequential Damages: Default Theory and Cognitive Reality*, 59 OHIO ST. L.J. 339 (1998); Chris Guthrie et al., *Inside the Judicial Mind*, 86 CORNELL L. REV. 777 (2001); Jon D. Hanson & Douglas A. Kysar, *Taking Behavioralism Seriously: The Problem of Market Manipulation*, 74 N.Y.U. L. REV. 630 (1999); Jon D. Hanson & Douglas A. Kysar, *Taking Behavioralism Seriously: A Response to Market Manipulation*, 6 ROGER WILLIAMS U. L. REV. 259 (2000); Jon D. Hanson & Douglas A. Kysar, *Taking Behavioralism Seriously: Some Evidence of Market Manipulation*, 112 HARV. L. REV. 1420 (1999); Robert A. Hillman, *The Limits of Behavioral Decision Theory in Legal Analysis: The Case of Liquidated Damages*, 85 CORNELL L. REV. 717 (2000); Samuel Issacharoff, *Can There Be a Behavioral Law and Economics?*, 51 VAND. L. REV. 1729 (1998); Christine Jolls, *Behavioral Economics Analysis*

bling for legal thinkers, Ulen has explained, for if we premise legal policy on the assumption that people behave rationally, and if their behavior too systematically proves otherwise, then the desired results of our legal rules may not follow.[41] If individuals make many more errors in their attempts to maximize their utility or profit than the rational choice model assumes, and those errors are due not to the standard sorts of market imperfections but

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of Redistributive Legal Rules, 51 VAND. L. REV. 1653 (1998); Christine Jolls et al., *Theories and Tropes: A Reply to Posner and Kelman*, 50 STAN. L. REV. 1593 (1998); Jolls et al., *supra* note 1; Kim A. Kamin & Jeffrey J. Rachlinski, *Ex Post Does Not Equal Ex Ante: Determining Liability in Hindsight*, 19 LAW & HUM. BEHAV. 89 (1995); Mark Kelman, *Behavioral Economics as Part of a Rhetorical Duet: A Response to Jolls, Sunstein, and Thaler*, 50 STAN. L. REV. 1577 (1998); Mark Kelman et al., *Context-Dependence in Legal Decision Making*, 25 J. LEGAL STUD. 287 (1996); Russell Korobkin, *The Efficiency of Managed Care "Patient Protection" Laws: Incomplete Contracts, Bounded Rationality, and Market Failure*, 85 CORNELL L. REV. 1 (1999); Russell Korobkin, *Inertia and Preference in Contract Negotiation: The Psychological Power of Default Rules and Form Terms*, 51 VAND. L. REV. 1583 (1998); Russell B. Korobkin & Thomas S. Ulen, *Law and Behavioral Science: Removing the Rationality Assumption from Law and Economics*, 88 CAL. L. REV. 1051 (2000); Russell Korobkin, *Policymaking and the Offer/Asking Price Gap: Toward a Theory of Efficient Entitlement Allocation*, 46 STAN. L. REV. 663 (1994); Russell Korobkin & Chris Guthrie, *Psychological Barriers to Litigation Settlement: An Experimental Approach*, 93 MICH. L. REV. 107 (1994); Alon Harel & Uzi Segal, *Criminal Law and Behavioral Law and Economics: Observations on the Neglected Role of Uncertainty in Deterring Crime*, 1 AM. L. & ECON. REV. 276 (1999); Russell Korobkin & Chris Guthrie, *Psychology, Economics, and Settlement: A New Look at the Role of the Lawyer*, 76 TEX. L. REV. 77 (1997); Russell Korobkin, *The Status Quo Bias and Contract's Default Rules*, 83 CORNELL L. REV. 608 (1998); Timur Kuran & Cass R. Sunstein, *Availability Cascades and Risk Regulation*, 51 STAN. L. REV. 683 (1999); Donald C. Langevoort, *Behavioral Theories of Judgment and Decision Making in Legal Scholarship: A Literature Review*, 51 VAND. L. REV. 1499 (1998) (containing useful bibliography of other behavioral law and economics scholarship); Donald C. Langevoort, *Selling Hope, Selling Risk: Some Lessons for Law from Behavioral Economics About Stockbrokers and Sophisticated Customers*, 84 CAL. L. REV. 627 (1996); Edward J. McCaffery, *Cognitive Theory and Tax*, 41 UCLA L. REV. 1861 (1994); Edward J. McCaffery et al., *Framing the Jury: Cognitive Perspectives on Pain and Suffering Awards*, 81 VA. L. REV. 1341 (1995); Richard A. Posner, *Rational Choice, Behavioral Economics, and the Law*, 50 STAN. L. REV. 1551 (1998); Matthew Rabin, *Psychology and Economics*, 36 J. ECON. LITERATURE 11 (1998); Jeffrey J. Rachlinski, *Gains, Losses, and the Psychology of Litigation*, 70 S. CAL. L. REV. 113 (1996); Jeffrey J. Rachlinski, *Heuristics and Biases in the Courts: Ignorance or Adaptation?*, 79 OR. L. REV. 61 (2000); Jeffrey J. Rachlinski, *The "New" Law and Psychology: A Reply to Critics, Skeptics, and Cautious Supporters*, 85 CORNELL L. REV. 739 (2000); Jeffrey J. Rachlinski, *A Positive Psychological Theory of Judging in Hindsight*, 65 U. CHI. L. REV. 571 (1998); Jeffrey J. Rachlinski & Forest Jourden, *Remedies and the Psychology of Ownership*, 51 VAND. L. REV. 1541 (1998); Robert K. Rasmussen, *Behavioral Economics, the Economic Analysis of Bankruptcy Law and the Pricing of Credit*, 51 VAND. L. REV. 1679 (1998); Stake, *supra* note 27; Cass R. Sunstein, *Behavioral Analysis of Law*, 64 U. CHI. L. REV. 1175 (1997); Cass R. Sunstein, *Behavioral Law and Economics: A Progress Report*, 1 AM. L. & ECON. REV. 115 (1999); Cass R. Sunstein, *Preferences and Politics*, 20 PHIL. & PUB. AFF. 3 (1991); Thomas S. Ulen, *Cognitive Imperfections and the Economic Analysis of Law*, 12 HAMLINE L. REV. 385 (1989); Thomas S. Ulen, *The Growing Pains of Behavioral Law and Economics*, 51 VAND. L. REV. 1747 (1998); Thomas S. Ulen, *Rational Victims—Rational Injurers: Cognition and the Economic Analysis of Tort Law*, *in* LAW AND ECONOMICS: NEW AND CRITICAL PERSPECTIVES 387 (Robin Paul Malloy & Christopher K. Braun eds., 1995); Deborah M. Weiss, *Paternalistic Pension Policy: Psychological Evidence and Economic Theory*, 58 U. CHI. L. REV. 1275 (1991); Arlen, *supra* note 2; Jennifer Arlen et al., *Endowment Effects, Other-Regarding Preferences and Corporate Law*, Olin Working Paper No. 00-2 USC Law School (April 21, 2000) (manuscript on file with author).

[41] Ulen, *supra* note 5, at 492.

rather to a widespread repertoire of cognitive imperfections, and those errors are systematic (rather than randomly distributed with mean zero), then our analysis of the efficiency properties of legal rules is in error to the extent that it ignores these cognitive imperfections.[42]

Even a partial list of contexts in which BLE scholars have recently attempted to incorporate (rather than ignore) cognitive imperfections gives a clear sense of potentially sweeping implications. These contexts include contracts, torts, property, criminal law, bankruptcy, health care, social security, risk regulation, tax, and corporate securities, as well as topics ranging from judging to market manipulation.[43] Four concrete examples—derived from property law, general litigation, environmental law, and criminal law—will illustrate the breadth and significance of what behavioral law and economics proponents believe to be at stake.

Consider property rights. As is well-known, the venerable Coase Theorem predicts that, so long as transaction costs are low, the initial distribution of entitlements (through either property rights or liability rules) is irrelevant to the final allocation of resources.[44] The market will correct distributional inefficiencies by moving resources to those who value them most highly. Nevertheless, numerous experiments, argued to have revealed a pervasive "endowment effect," suggest that the initial allocation—whatever it may be—will be vested (or "endowed") with certain psychological inertia. This will affect the final allocation, *irrespective* of transaction costs.

As mentioned earlier, standard economic theory predicts that (after correcting for wealth effects) the value a person ascribes to an object should be completely independent of its ownership, reflecting a stable constancy of preferences. But it is not.[45] Cognitive psychology research suggests that failure of the Coase Theorem to predict reality is not just attributable to the high costs of information and negotiation. Rather, people tend to value an object more highly as soon as they possess it—often twice as highly—compared to how they value the same object if they had to purchase it.[46] Put another way, their indifference curves shift in a systematic manner as soon as they acquire a good, increasing the ascribed value of the endowed good relative to all other goods.[47]

If this is true, then end distributions of entitlements are quite sensitive to initial distributions of entitlements, quite independent of information

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[42] Thomas S. Ulen, *Cognitive Imperfections and the Economic Analysis of Law*, 12 HAMLINE L. REV. 385, 388 (1989).

[43] *See generally* sources cited *supra* note 40.

[44] A useful discussion appears in Stake, *supra* note 27, at 346-47.

[45] *See generally* Kahneman et al., *supra* note 28; McCaffery et al., *supra* note 27; Rachlinski & Jourden, *supra* note 28.

[46] Loewenstein & Adler, *supra* note 26, at 929.

[47] *Id.* at 929-30 (noting that the endowment effect can be viewed as a type of endogenous taste change).

costs and transaction costs. The initial allocation of entitlements matters, it seems—much more than we used to think.[48] As Ulen puts it, the fact that content and strengths of preferences seem predictably to vary as a function of the initial distribution of property or rights is troubling "because it suggests that it may be impossible to discuss the assignment of rights meaningfully in terms of efficiency."[49] It is difficult to divide up property or wealth, so as to maximize things, when the things being maximized shift in the wind.

Consider litigation. Traditional economic theory predicts that people will pursue litigation so long as the potential recovery, discounted by the probability of success, exceeds foreseeable litigation costs.[50] This sounds reasonable, because we expect people not to spend a dollar to buy a ten percent chance of winning two dollars. Nevertheless, experimental evidence from "ultimatum" games reveals a rather widespread, though seemingly irrational, taste for spite.[51] Participants regularly choose to forgo a small gain in order to impose a larger loss on someone they consider to have unfairly overreached. That is, they sometimes pay happily just to see someone else pay more. One legal implication of this is that we can expect that, at least when a sense of having been treated unfairly is at issue, real world litigants may continue to litigate longer than expected, indeed long after they have concluded that the monetary costs will exceed likely monetary gains.

Consider environmental regulation. Rational choice theorists predict that people will purchase a slightly more expensive, less polluting item, if the difference in cost between that item and a less expensive but more polluting one can be recouped in, say, a year. In fact, people routinely do the opposite, due apparently to irrational, hyperbolic discounting.[52] Consider, too, the effect of framing effects on choosing between logically equivalent, environment-relevant alternatives.[53] Experiments suggest that when con-

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[48] As Stake puts it: "Thus assets are sticky; after their initial allocation, they tend to stay put. . . . This psychological attachment to belongings should be added to transaction costs and wealth limitations on our list of commonly occurring barriers to market correction." Stake, *supra* note 27, at 347.

[49] Ulen, *supra* note 5, at 517.

[50] *See, e.g.*, BARNES & STOUT, *supra* note 10, at 288 ("Rational individuals will not pursue even meritorious legal claims if their expected recovery is less than the attorney's fees, costs, and other expenses involved.").

[51] *See, e.g.*, C.F. Camerer & R.H. Thaler, *Ultimatums, Dictators, and Manners*, 9 J. ECON. PERSP. 209 (1995); Werner Guth et al., *An Experimental Analysis of Ultimatum Bargaining*, 3 J. ECON. BEHAV. & ORG. 367 (1982); W. Guth & R. Tietz, *Ultimatum Bargaining Behavior: A Survey in Comparison Experimental Results*, 11 J. ECON. PSYCHOL. 417 (1990). *See also* FRANK, *supra* note 11, at 237 (discussing ultimatum game); Sheryl Ball & Catherine C. Eckel, *Economic Value of Status*, 27 J. SOCIO-ECONOMICS 495, 497 (1998) (discussing ultimatum game and citing much of the recent literature).

[52] *See generally* Ainslie, *supra* note 21; Kris N. Kirby & R.J. Herrnstein, *Preference Reversals Due to Myopic Discounting of Delayed Reward*, 6 PSYCHOL. SCI. 83 (1995); Loewenstein & Prelec, *supra* note 21.

[53] *See, e.g.*, McCaffery et al., *supra* note 27; Amos Tversky & Daniel Kahneman, *Rational Choice and the Framing of Decisions*, 59 J. BUS. S251 (1986); Amos Tversky & Daniel Kahneman, *The Fram-*

sumers are told that they can use energy conservation methods to *save* X dollars per year they behave differently than if told that, if they do *not* use energy conservation methods, they will *lose* the same amount each year.[54]

Consider criminal law. Rational choice theory predicts that people will evaluate the desirability of an option presented, in the jury context, independent of variations in other options presented. Cognitive psychologists have demonstrated a seemingly disproportionate influence of context on choice: the same option can appear more or less attractive as a function of how it is contextualized with other options.[55] Preferences are termed "context-dependent" if a choice between two options is affected by the presence of a third option that provides no new information about the relative merits of the other options. Context dependence includes both compromise effects and contrast effects. The compromise effect is at work when the same option is evaluated more favorably when it is seen as intermediate in the set of options under consideration than when it is extreme. The contrast effect is evident when an option is evaluated more favorably in the presence of similar options clearly inferior to it than in the absence of such options. The contrast effect suggests, for example, that merely including instructions on "lesser included offenses" in criminal trial jury charges can powerfully affect verdicts.[56] This is patently inconsistent with our preferences for how juries should reach decisions.

C. Reactions to BLE Scholarship

Despite the seemingly unassailable logic that faulty premises can lead to faulty legal policies, reactions to BLE scholarship have been mixed.[57] To be fair, behavioral law and economics has several strengths that should be (and often are) freely acknowledged. For example, BLE relies on large accumulations of empirical cognitive science. Proponents in both cognitive science and law are, by and large, well-known scholars respected for their creativity, insight, and intellectual rigor. There are also, as noted above, important legal implications, if all the phenomena described are robust. And the phenomena are inherently interesting, with intuitive resonance for readers who can observe these supposed irrationalities, inconsistencies, and emotional by-products blossoming daily in the rich, colorful, human world around them.

Yet, even after making due allowance for the relative youth of behav-

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ing of Decisions and the Psychology of Choice, 30 SCIENCE 453 (1981).

[54] This phenomenon is discussed in Sunstein, *supra* note 1, at 1177.

[55] *See generally* Kelman et al., *supra* note 40, at 301.

[56] *Id.*

[57] *See, e.g.*, Robert A. Hillman, *The Limits of Behavioral Decision Theory in Legal Analysis: The Case of Liquidated Damages*, 85 CORNELL L. REV. 717 (2000); Kyron Huigens, *Law, Economics, and the Skeleton of Value Fallacy*, 89 CAL. L. REV. 537 (2001); Kelman, *supra* note 40; Posner, *supra* note 24; Ulen, *supra* note 1; Arlen, *supra* note 2.

ioral law and economics, scholars evaluating both existing BLE work and its prospects for the future are not unqualifiedly enthusiastic. For example, some have argued that BLE proponents overstate the supposed passionlessness of *Homo economicus*.[58] Some express concern that certain named psychological effects seem to emerge, rather inexplicably, far more strongly in some experiments than in others.[59] And at least several critics maintain that some of the much-heralded cognitive effects on which behavioral law and economics relies are misleading artifacts of experimental conditions, leading to incorrect conclusions.[60]

The most important and ultimately constructive criticism, however, is that BLE simply lacks any theoretical foundation.[61] BLE scholars stand accused, for example, of merely organizing anecdotes, and of confusing counterstories for theories. This should not, of course, be construed as automatically damning. After all, unexpected empirical facts can, in sufficient number, warrant changes in legal strategies for pursuing existing goals, even absent convincing explanations for their patterned occurrence.

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[58] *See, e.g.*, Posner, *supra* note 24.

[59] *See, e.g.*, Arlen, *supra* note 2.

[60] *See* Gerd Gigerenzer, *Ecological Intelligence: An Adaptation for Frequencies*, *in* THE EVOLUTION OF MIND 9 (Denise Dellarosa Cummins & Colin Allen eds., 1998); *see also* Leda Cosmides & John Tooby, *Are Humans Good Intuitive Statisticians After All? Rethinking Some Conclusions from the Literature on Judgment Under Uncertainty*, 58 COGNITION 1 (1996); Gerd Gigerenzer, *How to Make Cognitive Illusions Disappear: Beyond Heuristics and Biases*, *in* 2 EUROPEAN REVIEW OF SOCIAL PSYCHOLOGY 83 (Wolfgang Strobe & Miles Hewstone eds., 1991).

[61] This was the principal point of contention in a colloquy involving Richard Posner and Mark Kelman, on one hand, and Christine Jolls, Cass Sunstein, and Richard Thaler ("JST"), on the other, in a recent issue of the *Stanford Law Review*.

For example, Kelman argued:

> What is ultimately perhaps more bothersome about JST's piece is that they are so unself-critical about the degree to which behavioral economics can better be seen as a series of particular counterstories, formed largely in parasitic reaction to the unduly self-confident predictions of rational choice theorists, than as an alternative general theory of human behavior. Again and again, the authors seem to confuse discordant observations for a countertheory and evade questions about the gaps in the behavioral picture, seemingly believing, quite wrongly in my view, that acknowledging these gaps would fatally wound their enterprise.

Kelman, *supra* note 40, at 1586. Kelman then goes on to comment on the "manifest incompleteness as theories" of behavioral law and economics offerings. *Id.* And he claims that much of the JST article consists of organizing "anecdotes." *Id.* at 1580.

Richard Posner argued:

> [BLE] is undertheorized because of its residual, and in consequence purely empirical, character. Behavior economics is defined by its subject rather than by its method and its subject is merely the set of phenomena that rational-choice models (or at least the simplest of them) do not explain. . . . Describing, specifying, and classifying the empirical failures of a theory is a valid and important scholarly activity. But it is not an alternative theory.

Posner, *supra* note 24, at 1559-60.

Other commentators, though perhaps ultimately more optimistic than Kelman and Posner, also voice strong reservations about the existing state of supposed theoretical underpinnings of BLE scholarship. *See, e.g.*, Ulen, *supra* note 5, at 521 ("[W]e are a long way from having a coherent theory of these individual imperfections in choice and the exercise of judgment."); Arlen, *supra* note 2.

And a number of BLE scholars have succeeded in making convincing cases for legal reform, based on empirical data about irrationalities alone, irrespective of causes.

Nevertheless, in the absence of buttressing theory such efforts represent isolated successes, rather than promisingly synergistic ones that would signal a broad, systematic approach. For it is quite clear in the end that BLE shows neither a present and satisfactory account of the origins and patterns of identified irrationalities, nor signs of making quick progress toward developing one. Constructing the theoretical foundation of these phenomena will ultimately be necessary if BLE is to achieve its potential and be as useful, persuasive, and important to law as its proponents now hope.

There are two reasons. First, a good theory is essential for the long-term success of any otherwise fact-driven argument. For instance, a theory that can make coherent sense of unusual, unfamiliar, or inconveniently aberrational data eases acceptance that the data are accurate and meaningful—a typical prerequisite for supporting legal changes. Second, a good theory, combined with good data, affords greater predictive power than data alone, pointing the way toward useful but otherwise unnoticed facts. After all, data neither self-collect nor self-organize. They are a function either of stumbled-upon luck, or of presuppositions that, if wrong, may unintendedly obscure otherwise useful law-relevant data.[62]

At present, both behavioral law and economics scholarship, and the underlying cognitive psychology literature on which it relies, are simply far better at explaining *that* people often behave in ways inconsistent with traditional economic theory than they are at explaining *why* they do so.[63] To critics both friendly and less friendly, BLE is at base a movement founded on scattered discovered anomalies that, no matter how robust, are as yet wholly unconnected by theoretical foundation or adequate explanatory support. This impedes the persuasiveness of BLE, hinders its growth, and highlights its predictive shortcomings. For without a theory of where these anomalies come from, why they appear, and how they may be connected, it is difficult to anticipate in whom they will appear, in what contexts, and with what vigor.[64] Conspicuously absent is a "meta-explanation" to weave

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[62] *See* Owen D. Jones, *Evolutionary Analysis in Law: Some Objections Considered*, 67 BROOK. L. REV. (forthcoming 2001).

[63] Arlen notes, "Behavioral analysis of law does not have a coherent model of human behavior in part because the existing behavioral scholarship has not focused on developing such a model. Behavioral economists and cognitive psychologists generally have focused on demonstrating *that* people do not necessarily exhibit rational choice." Arlen, *supra* note 2, at 1768 (emphasis added); *see also* RUBINSTEIN, *supra* note 30, at 3-4 ("We have clear, causal, and experimental observations that indicate systematic deviations from the rational man paradigm. We look for models that will capture this evidence.").

[64] Ulen observes that "[w]e do not know, for example, whether these cognitive imperfections affect all of us in the same sorts of situations . . . or only an identifiable subset of individuals in limited circumstances . . . ." Thomas S. Ulen, *Cognitive Imperfections in the Economic Analysis of Law*, 12 HAMLINE L. REV. 385, 408 (1989). "We need to know if in some circumstances cognitive limitations affect all

the various anomalies together into some larger pattern, and provide coherence to the whole.

While some BLE scholars are content, for the time being, to base legal analysis on empirical facts unexplained at the theoretical level, other BLE scholars dispute the claim that BLE lacks theory.[65] They offer two arguments deemed separately sufficient, but quite dispositive when conjoined.

The first argument for why behavioral law and economics is not undertheorized follows this syllogistic form. A theory generates accurate predictions; BLE generates accurate predictions; therefore BLE has a theory.[66] This cannot work. A theory, in the scientific sense, requires far more than the ability to make accurate predictions. And an empirical regularity is not a theory. For example, predicting that since rocks and leaves fall toward the earth raindrops will too provides no theory of falling, even if raindrops do in fact fall as predicted. In both the technical and lay senses, we know that no number of accurate predictions can alone offer explanations.[67]

The second, stronger, argument for why BLE is not undertheorized is from counter-example. The status quo bias evident in endowment effects, BLE scholars argue to illustrate, has been explained by "prospect theory"[68] (also appearing as "loss aversion" or "regret avoidance").[69] This argument

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actors, and if in others they only affect certain people." Ulen, *supra* note 1, at 1757.

Arlen notes:

> It is difficult to predict how, when, or whether many of these biases will manifest themselves in the real world because scholars do not yet fully understand why many of them exist—they are empirical results awaiting a full theoretical explanation. Yet we cannot be confident an observed bias really does affect actual decisions—as opposed to being simply an artifact of experimental design—until we can explain why the bias exists. Even when we are confident a bias exists, we must know why people exhibit the bias in order to determine when they will do so and also the extent to which a particular bias may be susceptible to manipulation. . . .
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> . . . .
>
> . . . [I]t will be difficult to construct a more realistic model of human behavior based on cognitive biases whose origins, scope, and magnitude are not well understood.

Arlen, *supra* note 2, at 1768-69, 1778.

Posner claims, "it is profoundly unclear what 'behavioral man' would do in any given situation. He is a compound of rational and nonrational capacities and impulses. He might do anything. [Leading BLE scholars] have neither a causal account of behavioral man nor a model of his decisional structure." Posner, *supra* note 24, at 1559.

[65] *See, e.g.*, Jolls et al., *Theories and Tropes: A Reply to Posner and Kelman*, 50 STAN. L. REV. 1593, 1597 (1998).

[66] *Id.* at 1597-99.

[67] For an argument that BLE scholars often confuse description for theory because they confuse prediction for explanation, see Posner, *supra* note 24, at 1560.

[68] For an explanation of prospect theory, see Richard H. Thaler, *Toward a Positive Theory of Consumer Choice*, 1 J. ECON. BEHAV. & ORGAN. 39 (1980). Prospect theory was first proposed in Daniel Kahneman & Amos Tversky, *Prospect Theory: An Analysis of Decision Under Risk*, 47 ECONOMETRICA 263 (1979).

[69] *See, e.g*, Jolls et al., *supra* note 65, at 1597 (defending); *see also* Stephen M. Bainbridge, *Mandatory Disclosure: A Behavioral Analysis*, 68 U. CIN. L. REV. 1023 (2000) (describing how "loss aversion" and "regret avoidance" have been advanced as explanations for the "status quo bias").

essentially consists of two separate claims: a) the reason that the lowest price for which a person will sell an item often materially exceeds the highest price they would be willing to pay to buy the very same item is because the prospect of losing something one has looms larger, psychologically, than the prospect of failing to gain the same item;[70] and b) this account provides sufficient theoretical substructure for understanding endowment effects.

This also cannot work. Explaining one phenomenon as the product of another, closely related phenomenon is intuitively appealing, but never satisfying, *even when the phenomena are in fact causally linked.* Arlen, Spitzer, and Talley, in a recent paper, explain one reason why this approach fails to satisfy:

> Attributing the [endowment] effect to loss aversion only begs the questions of when loss aversion occurs, and what factors influence the magnitude of the effect. In other words, stating that a person 'endowed' with a good exhibits loss aversion does not help us predict under what circumstances a person will 'endow' a good. . . . [W]ithout a thorough explanation for the psychology of endowment it is difficult to predict ex ante whether, and to what extent, the effect will operate in any given circumstance.[71]

Put somewhat differently by Edward McCaffery (a BLE proponent), explaining endowment effects with prospect theory is like trying to explain the phenomenon of rain by pointing out that it is caused by a storm.[72]

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[70] "The loss aversion proposition is that losses have greater subjective impact than objectively commensurate gains." Stake, *supra* note 27, at 339; *see also* Edward J. McCaffery et al., *Experimental Tests of the Endowment Effect and the Coase Theorem, in* RICHARD H. THALER, QUASI-RATIONAL ECONOMICS 167, 169 (1991) (explaining that loss aversion is "the generalization that losses are weighted substantially more than objectively commensurate gains in the evaluation of prospects and trades"); Edward J. McCaffery et al., *Framing the Jury: Cognitive Perspectives on Pain and Suffering Awards*, 81 VA. L. REV. 1341, 1353 (1995) ("Loss aversion refers to the phenomenon that gains are less valued, in absolute terms, than losses are disvalued. The subjective utility of losing a good exceeds that of gaining it, even controlling for wealth effects.").

[71] Jennifer Arlen, Mathew Spitzer & Eric Talley, Endowment Effects, Other-Regarding Preferences and Corporate Law, Olin Working Paper No. 00-2 USC Law School 20 (April 21, 2000) (unpublished manuscript, on file with author). For example, "experimental evidence reveals that people do not invariably 'endow' all entitlements: 'endowment' depends on the nature of the commodity, the subject's psychological sense of entitlement to it, and the legal rights protecting it." *Id.*; *see also* Rachlinski & Jourden, *supra* note 28, at 1556-59.

[72] Edward J. McCaffery, *Cognitive Theory in Tax*, 41 UCLA L. Rev. 1861, 1866-67 (1994). Russell Korobkin, another leading BLE scholar, takes an intermediate view, finding "regret avoidance" somewhat more satisfactory, as an explanation for endowment effects, than "loss aversion." Russell Korobkin, *The Status Quo Bias and Contract's Default Rules*, 83 CORNELL L. REV. 608, 657 (1998). He notes: "The concept of loss aversion provides a convincing descriptive account of the status quo bias, but it is neither completely satisfying nor helpful because it provides no motivational theory: why are individuals often loss-averse?" *Id.* The same question might be posed of regret avoidance: why do individuals experience greater regret when undesirable consequences follow from action than from inaction?

Any attempt to solve these problems with recourse to norms would only abstract the problem up one

These are significant criticisms. Strictly speaking, however, they are not entirely new. The debate over whether or not BLE can or does satisfactorily explain the puzzling behaviors of the human animal precisely duplicates early debates in biology over what constitutes adequate explanations for the often puzzling behaviors of *other* animals.

It is obvious that explanations require an understanding of causes. It was less obvious, as biologists eventually clarified, that causes of behavior in living organisms are categorically different than causes of, say, the meandering of rivers or allegedly tortious accidents. Investigating such causes requires different methods. It is this unique nature of causation in the context of behavioral phenomena that ultimately makes the well-established methods of behavioral biology so useful for present purposes, in thinking about puzzling human behaviors. Those methods help not only to clarify what the debate between BLE scholars and critics is all about, but also to show how that debate can be resolved in ways that open up new avenues of research, with new prospects for legal relevance.

The next Part, which will substantiate the claims just made, provides a (necessarily quite condensed) overview of behavioral biology.

II. BEHAVIORAL BIOLOGY AND EVOLUTIONARY ANALYSIS

A. Proximate and Ultimate Causes

For most contexts in which inanimate phenomena are at issue, it makes little difference whether we ask "how?" questions or "why?" questions in seeking explanation. This is as true in law as it is in other contexts. For example, note that the answer to the question "Why did the scale fall on Mrs. Palsgraf?"—a question certainly relevant for determining if liability for injury might attach, and to whom—elicits precisely the same legal inquiry and answer as the question "How did the scale come to fall on Mrs. Palsgraf?" As is well known from the famous *Palsgraf* opinion,[73] Judge Cardozo recounts that an entire series of precursor events, each independently scrutable, led to an ignition . . . which caused an explosion . . . which caused a reverberation . . . which caused a falling upon . . . which caused Mrs. Palsgraf's injury. Whether or not Cardozo was accurate in his description of the facts,[74] the important point is that we in law, as illustrated by *Palsgraf*, usually come to understand a phenomenon in its component parts adequately for our purposes of assessing rights, duties, and appropriate liability *regardless of whether our inquiry is shaped by* how *or* why *questions*. Those questions are—here and so often—functionally equivalent.

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level. One would still have to explain why some norms, rather than others, are so much more likely than random to arise independently in human populations all over the globe.

[73] *See* Palsgraf v. Long Island R.R., 248 N.Y. 339 (1928).

[74] There is much to suggest that he was not. *See* RICHARD A. POSNER, CARDOZO: A STUDY IN REPUTATION 33-48 (1990).

How explains why.

Not so with the behavior of living organisms.[75] A moment's reflection on a simple analogy will clarify. Suppose one were to observe a male robin singing in the spring, and were to wonder why he does so. There are two very different kinds of causal analysis required to satisfactorily explain the phenomenon. One kind of causal analysis attends to the physical pathways by which singing occurs. From this perspective, the "cause" of singing is the predicate sequence by which hormonal changes, triggered by the lengthening of successive days, causes neural actions in the brain, that in turn cause the lungs to pass air forcefully over appropriately shaped vocal chords. Sound ensues.

But it is immediately apparent that this causal analysis—this partial component of an explanation—leaves important questions unanswered. It does not explain why it came to pass that lengthening days rather than shortening ones spark the hormonal changes. Nor does it explain why the hormonal changes lead to singing behavior rather than to, say, one legged hopping up and down. Such answers—which can make sense of *why* behavioral phenomena are linked in specific ways to environmental phenomena—are categorically beyond mechanistic methods, no matter how far back we trace the chain of necessary, causal events.

Only a second kind of causal analysis, attending to the historical processes by which organisms come to exhibit particular traits and not others, can provide the missing answers. From this perspective, the "cause" of

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[75] Space limitations obviously preclude summarizing behavioral biology in any detail. Moreover, existing summaries in law reviews of basic and well-accepted principles are already available. *See, e.g.*, Jones, *Evolutionary Analysis in Law*, *supra* note 7, (Part I of which provides "A Primer in Law-Relevant Evolutionary Biology."); *see also* Timothy H. Goldsmith & Owen D. Jones, *Evolutionary Biology and Behavior: A Brief Overview and Some Important Concepts*, 39 JURIMETRICS J. 131 (1999); William H. Rodgers, Jr., *Where Environmental Law and Biology Meet: Of Pandas' Thumbs, Statutory Sleepers, and Effective Law*, 65 U. COLO. L. REV. 25 (1993). For recent discussion of the relationship between biology and the social sciences, see Todd J. Zywicki, *Evolutionary Psychology and the Social Sciences*, 13 HUMANE STUD. REV. 1 (2000), *available at* http://www.humanestudiesreview.org/fall2000/secondframeset.html.

Treatments of modern behavioral biology for the general audience include: TIMOTHY H. GOLDSMITH, THE BIOLOGICAL ROOTS OF HUMAN NATURE: FORGING LINKS BETWEEN EVOLUTION AND BEHAVIOR (1991); STEVEN PINKER, HOW THE MIND WORKS (1997); MATT RIDLEY, THE RED QUEEN: SEX AND THE EVOLUTION OF HUMAN NATURE (1993); ROBERT WRIGHT, THE MORAL ANIMAL: EVOLUTIONARY PSYCHOLOGY AND EVERYDAY LIFE (1994).

Accessible textbooks, for gaining more technical familiarity with the issues here discussed include: JOHN ALCOCK, ANIMAL BEHAVIOR: AN EVOLUTIONARY APPROACH (6th ed. 1998); DAVID BUSS, EVOLUTIONARY PSYCHOLOGY: THE NEW SCIENCE OF THE MIND (2000); MARTIN DALY & MARGO WILSON, SEX, EVOLUTION, AND BEHAVIOR (2d ed. 1983); SCOTT FREEMAN & JON C. HERRON, EVOLUTIONARY ANALYSIS (2d ed. 2001); DOUGLAS J. FUTUYMA, EVOLUTIONARY BIOLOGY (2d ed. 1986); TIMOTHY H. GOLDSMITH & WILLIAM F. ZIMMERMAN, BIOLOGY, EVOLUTION, AND HUMAN NATURE (2001); JAMES L. GOULD & CAROL GRANT GOULD, SEXUAL SELECTION (1997); J.R. KREBS & N.B. DAVIES, AN INTRODUCTION TO BEHAVIOURAL ECOLOGY (3d ed. 1993); MARK RIDLEY, EVOLUTION (1993); ROBERT TRIVERS, SOCIAL EVOLUTION (1985).

singing is the process by which remote ancestors of today's singing males announced territory, advertised health and availability, attracted mates, and left more offspring than did contemporaries not predisposed to sing, or predisposed (for example) to sing and mate in the harsh winter, rather than the spring. To the extent that the ability to sing and the urge to sing in response to certain environmental cues were influenced by heritable predispositions, the proportion of male robins in successive generations that sang inevitably increased over time until the trait became typical of males of the species.

Behavioral biologists consequently understand that both kinds of causes—mechanistic pathways and evolutionary processes—provide two very different but equally necessary components of a full explanation of behavior. By biologists' convention, the former kinds of causes are termed "proximate causes." The latter are termed "ultimate causes."[76]

Proximate causes in biology (similar to, but definitely not to be confused with, proximate causes in law) are essentially "how" causes or immediate causes, relating to the internal mechanisms, physical processes, and organismic development that are predicates to behavior. *Ultimate causes* are more properly "why" causes, describing evolutionary processes by which a behavior came to be commonly observable in a species, and helping to explain the underlying reasons why given environmental stimuli (lengthening and warming days rather than shortening and cooling ones) tend to yield certain kinds of behaviors (such as singing) rather than certain alternative or random behaviors (such as hopping). Proximate causes are often defined in terms of physiology and biochemistry, for example, as well as an organism's unique developmental/environmental life history. Ultimate causes are often defined in terms of the history and reproductive consequences of behavior.[77]

The significance of recognizing the distinction between the biological terms of art *proximate causation* and *ultimate causation* cannot be overstated. Proximate and ultimate causes always operate together, with all behavior depending on ultimately shaped proximate mechanisms. Because evolutionary processes operate as inexorably on brain function as they do on the function of every other part of the body, proximate and ultimate causes are an integral part of comprehensive explanations for law-relevant

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[76] The venerable proximate/ultimate distinction traces to Ernst Mayr, *Cause and Effect in Biology*, 134 SCIENCE 1501 (1961), and Gordon H. Orians, *Natural Selection and Ecological Theory*, 96 AM. NAT. 257 (1962). On proximate and ultimate causation, see generally ALCOCK, *supra* note 75, at 2-6; GOLDSMITH, *supra* note 75, at 3-11, 46-69; John Alcock & Paul Sherman, *The Utility of the Proximate-Ultimate Dichotomy in Ethology*, 96 ETHOLOGY 58 (1994); Goldsmith & Jones, *supra* note 75; and Jones, *Sex, Culture, and the Biology of Rape*, *supra* note 7, at 874-77.

[77] Another example: "Why do polar bears have white furs? The proximate explanation is that the polar bears' body doesn't make pigment for the fur. The evolutionary explanation is that white polar bears catch more seals than brown ones." *Interview with Randy Nesse*, 14 HUM. ETHOLOGY BULL., Dec. 1999, at 3. Care should be taken not to confuse the term of art "ultimate," meaning "evolutionary," with its lay meaning of "superior" or "more important."

behaviors.[78]

Obviously, ultimate causation analysis will be more useful in some contexts than in others. In many cases, we may feel that our existing understanding of a phenomenon, even if that understanding extends only to proximate causes, is sufficient for our purposes. But often, when we are puzzled about human behavior, an inquiry into ultimate causation will prove a useful complement to existing efforts to understand and predict the behavior.

Such is the case with human irrationality. What is currently missing from, and acutely needed by, efforts to find satisfactory explanations for why the irrational behaviors arise is analysis of seemingly irrational behaviors from the level of ultimate causation. In many cases, ultimate causation analysis can help to explain why such behaviors are so widespread, and why they exist in the very specific patterns that they do, instead of in other patterns, or in no patterns at all.

Because so many of the contexts we commonly encounter in law do not require disentangling "how" questions from "why" questions, "how" answers are often misadvanced as "why" answers. And current efforts to explain human irrationalities (by the theory of loss aversion, for example) are, while essential, nonetheless attending only to the proximate half of the full causation equation. They are thus really providing "how" answers, not "why" answers, and it is for this reason that those answers appear insufficient and undertheorized to critics.

The balance of this Article explores how accessible methods and findings from behavioral biology can address the other half of the causation equation, and how behavioral biology insights can be partnered with current efforts in order to develop a more complete and useful explanation for human irrationalities.

B. From Brain to Behavior and Back

From the perspective of ultimate causation, nervous systems exist because they enable organisms to perceive important environmental information (objects, other organisms, dangers, and the like), to process that information (stimuli may, for instance, represent food, mates, threats, or offspring), and to respond appropriately to the environment (thus: eat food, copulate with mates, avoid threats, nourish offspring). Because only some of the many possible reactions to different environmental stimuli lead to continued existence and reproductive success (contrast: copulating with food, fleeing potential mates, ignoring predators, and eating offspring), nervous systems that more successfully bias the bodies that bear them toward behaviors that tended to be reproductively advantageous in ancestral

[78] For an introduction to studying law-relevant behaviors and legal processes from a perspective that explicitly integrates proximate and ultimate causation, see Jones, *Evolutionary Analysis in Law*, *supra* note 7.

environments tend to appear in larger and larger percentages of successive populations.

Here is the basic logic. Behavior requires both perception and information processing. Perception and information processing are thoroughly dependent on brain function. Brain function reflects the evolutionary processes that built the brain's intricate functionality. Therefore, behavior—the principal output of the brain—reflects evolutionary processes.[79]

What are the implications? There are several of immediate use to understanding irrationality. As a result of what we know about the evolutionary processes of natural selection and sexual selection,[80] operating over evolutionary time,[81] we may have some confidence in the following conclusions (widely-accepted in relevant scientific communities, and simplified here for brevity).

First, the brain was not designed to maximize *individual* utility. Nothing is. Individuals do not replicate, nor do brains. Only genes do.[82] Evolu-

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[79] Again, detailed description of behavioral biology would be unwieldy and duplicative. An extended primer on the subject of this section appears in Jones, *Evolutionary Analysis in Law*, *supra* note 7. A shorter overview appears in Goldsmith & Jones, *supra* note 75.

[80] "Natural selection" is the inevitable result of any system that combines heredity, variation, and differential reproduction. Those heritable traits (including, for example, behavior-biasing neural algorithms) that tend to increase reproductive success more than do heritable traits contemporaneously borne by others tend to appear in larger and larger proportions of subsequent generations. The compounding effect is so dramatic that even a heritable trait providing its possessor with a mere 1% reproductive advantage over its contemporaries will swell (all else being equal) from 1% representation in a population to 99% in merely 265 generations. TRIVERS, *supra* note 75, at 28-29.

Technically, natural selection is one of four factors influencing gene frequencies. The other three are: (1) mutation, involving replication errors in genetic codes; (2) gene flow, referring to migration of genes between populations due to the movement of organisms carrying them; and (3) random drift, which describes the effects of chance events, such as accident or disease, on reproductive success. *See* GOLDSMITH, *supra* note 75, at 29-31.

"Sexual selection," occurring in all species in which males and females differ in their hypothetical reproductive maxima and parental investment minima, drives differences in mate choice, which in some circumstances can yield different heritable physical and behavioral features between the sexes. On natural and sexual selection, see generally ALCOCK, *supra* note 75; GOLDSMITH, *supra* note 75; GOLDSMITH & ZIMMERMAN, *supra* note 75; GOULD & GOULD, *supra* note 75; MATT RIDLEY, *supra* note 75; and TRIVERS, *supra* note 75.

[81] Our primate ancestry alone (not even to mention our mammalian and pre-mammalian ancestry) extends back fully 70 million years. This makes our primate history more than thirty-five thousand times as long as the (trifling) two-millennium period we recently celebrated. *See* Jones, *Evolutionary Analysis in Law*, *supra* note 7, at 1129-32.

[82] There is far more to this proposition than can be covered here. But the important point is that we err if we believe that natural selection operates primarily at the level of the individual or of the group. It has been demonstrated beyond peradventure that it does not. With extremely rare exceptions (not relevant here) natural selection operates primarily at the level of the gene, since genes, not individuals or groups, are replicating entities. In other words, every organism is a parliament of genes, and its morphology and behavior are in an important sense epiphenomenal to the interaction of genes that were selected to reproduce themselves by cooperating with one another. It follows, technically, that the brain has been designed more to maximize the replication of an individual's constituent genes than to maximize an individual's interests, per se—notwithstanding the fact that this design generally leads to behav-

tionary processes therefore favor replication of genetically heritable traits, some of which appear (in frequencies discounted by degrees of consanguinity) in relatives.[83] To the extent that people and other animals often behave as if they were rational maximizers of individual utility, it is partly because their information processing pathways have been honed by natural selection, the most relentlessly economizing force in the history of life; and partly because maximizing individual utility is often epiphenomenal to maximizing genetic utility. As a result, evolutionary processes inevitably and importantly contribute to the common origins and ordering of some preferences that constitute every individual's utility curve.

Second, the brain is not a general, all-purpose, information processor.[84] We know of no path by which natural selection could design such a thing. There is no reason whatsoever to believe that evolution has designed the human brain to yield either substantively or procedurally rational outcomes in each and every circumstance in which the body may happen to find it-

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ior that can be characterized as also maximizing the individual's interests. *See generally* ALCOCK, *supra* note 75; GOLDSMITH & ZIMMERMAN, *supra* note 75; GEORGE C. WILLIAMS, ADAPTATION AND NATURAL SELECTION (1966).

This distinction concerning the level of selection will only rarely be of practical significance, since in the vast majority of contexts the "interests" of the individual and of the genes align. But there are some circumstances in which they do not (in the same way that the interests of a labor union and a single one of its members may occasionally diverge). And it will be in precisely those circumstances in which the interests do diverge that behavior will appear to be most puzzling when viewed from the perspective of rational individuals. For example, tendencies toward self-sacrificing behavior can spread through a population through (among other pathways) the effects of self-sacrifice on the reproduction of kin, as measured through standard inclusive fitness calculations (on which, see *infra* note 83). For a controversial argument that, in some limited circumstances, natural selection can operate at the level of the group, as well as at the level of the gene, see David Sloan Wilson & Elliott Sober, *Reintroducing Group Selection to the Human Behavioral Sciences*, 17 BEHAV. & BRAIN SCI. 585 (1994) (followed by extensive peer commentary).

[83] It is important to note that genetic success, or "fitness," is not measured in offspring alone, because offspring are not the only genetic relatives an individual has. Since relatives other than offspring, such as siblings and parents, also share genes with an individual (because of recent shared ancestors), their own reproductive success can in some circumstances contribute to an individual's fitness. When calculating fitness, one therefore needs to take account of the extent to which an individual has increased the reproductive success of its relatives (discounted by their degrees of relatedness), beyond the reproductive success those relatives would have had in the absence of the individual's contributions. This cumulative, additive calculation of fitness, which takes account of both direct and indirect replication of genes, is known as "inclusive fitness." ALCOCK, *supra* note 75, at 561-69. Consequently, an organism can increase its overall genetic success by increasing its inclusive fitness, even if it does not itself have offspring.

[84] While some still dispute this, the evidence is overwhelming, and growing. *See, e.g.*, ROBERTO CABEZA & ALAN KINGSTONE, HANDBOOK OF FUNCTIONAL NEUROIMAGING OF COGNITION (2001); THE COGNITIVE NEUROSCIENCE OF FACE PROCESSING (Nancy Kanwisher & Morris Moscovitch eds., 2000); THE COGNITIVE NEUROSCIENCES (Michael S. Gazzaniga ed., 1995); Truett Allison et al., *Social Perception from Visual Cues: Role of the STS Region*, 4 TRENDS IN COGNITIVE SCI. 267 (2000); Michael S. Gazzaniga, *Organization of the Human Brain*, 245 SCIENCE 947 (1989); Nancy Kanwisher, *Domain Specificity in Face Perception*, 3 NATURE NEUROSCIENCE 759 (2000).

self.[85] This renders importantly misleading any analogy of the brain to a computer. Computers are general-purpose machinery into which software is installed, whereas the brain comes prepackaged with a wide variety of information-processing predispositions.[86]

Third, the brain is a functionally specialized, context-specific information processor, better at some tasks than at others. Like other aspects of basic anatomy, the basic internal psychological mechanisms leading to many behavioral predispositions evolved under the challenges and selection pressures posed by particular environmental conditions. Since natural selection results in increasing frequencies of heritable traits that solve environmental challenges in ways offering comparative gains in reproductive success, both anatomical and behavioral traits tend to reflect incrementally, and historically-contingent, specialized solutions rather than optimal or universal ones. Consequently, the brain is a path-dependent adaptation implementer, not a general-purpose cost-benefit maximizer.[87]

Fourth, the brain is better, on average, at confronting environmental challenges that were frequently encountered during long periods of its adaptation than it is at confronting entirely novel challenges. Natural selection is incapable of either looking forward, anticipating changes in environmental conditions, or preplanning for change.

Fifth, evolutionary processes have left the brain designed, de facto, to predispose its bearers toward behaviors that were adaptive (that is, they contributed to reproductive success), on average, in the *environment of evolutionary adaptation* (abbreviated, by convention, as "EEA").[88] Because

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[85] In this respect, it may also be worth considering that some of the brain's obvious limitations are themselves the products of tradeoffs between the costs of running it and the benefits of having it. The human brain's unique capacities are, in part, a function of its size. Yet its size requires that human babies be born less physically developed and therefore more vulnerable than other primate babies—lest larger cranial size pose even greater birthing problems than it already does. In addition, the brain requires remarkable quantities of energy to run: roughly 20% of all calories consumed, despite being only 2% of body mass. PATRICIA SMITH CHURCHLAND, NEUROPHILOSOPHY 36-37 (1986). This is roughly 22 times as much energy as that required to nourish an equivalent weight of muscle, at rest. STEVEN MITHEN, THE PREHISTORY OF MIND 11 (1996); *see also* Adam Gifford, Jr., *Being and Time: On the Nature and the Evolution of Institutions*, 1 J. BIOECONOMICS 127, 136-37 (1999).

[86] Very useful introductions to the subjects of these paragraphs appear in Leda Cosmides et al., *Introduction: Evolutionary Psychology and Conceptual Integration*, *in* THE ADAPTED MIND: EVOLUTIONARY PSYCHOLOGY AND THE GENERATION OF CULTURE 3 (Jerome H. Barkow et al. eds., 1992) [hereinafter Cosmides, *Introduction*]; and John Tooby & Leda Cosmides, *The Psychological Foundations of Culture*, *in* THE ADAPTED MIND 19 (Jerome H. Barkow et al. eds., 1992).

[87] *See* Cosmides, *Introduction*, *supra* note 86, at 7-9.

[88] For discussion, see Leda Cosmides, *The Logic of Social Exchange: Has Natural Selection Shaped How Humans Reason?*, 31 COGNITION 187 (1989). As Cosmides puts it:

> The realization that the human mind evolved to accomplish adaptive ends indicates that natural selection would have produced special-purpose, domain specific, mental algorithms—including rules of inference—for solving important and recurrent adaptive problems . . . it is advantageous to reason adaptively, instead of logically, when this allows one to draw conclusions that are likely to be true, but cannot be inferred by strict adherence to the propositional calculus. Adaptive algorithms would be selected to contain expectations about specific domains that have proven reliable

natural selection cannot anticipate environmental changes, or generate new mutations in response to changes, there is generally a significant time lag between change and adaptation. This lag is sharply increased by the rapid pace of human cultural and technological development.[89]

Three brief clarifications. First, none of this should be understood, in any way, to be genetically deterministic. Evolved predispositions are context-specific, operating probabilistically, in species-typical, environment-sensitive patterns.[90] Because probability is not inevitability, predispositions do not guarantee any behavior from any individual. Second, none of this implies any normative conclusion about brain design or current function. Description is not prescription—nor is explanation justification. Third, none of this exalts nature *over* nurture, or genes *over* culture. Arguing about whether or not a given behavior is the product of genes or culture is (as is often noted) like arguing about whether the area of a rectangle is the product of its length or its width.[91] Nature and nurture are inseparably intertwined, neither making sense without the other.[92] All biological processes, including normal brain development, ultimately depend upon rich environmental inputs. Similarly, all environmental influences can only be perceived, sorted, analyzed, and understood through biological—and therefore evolutionary—processes. Sociality, culture, and learning are all reflections of the human brain and its evolved capacities. While it is true that evolutionary processes have designed a human brain that both generates and reciprocally responds to cultural influences, it is essential to recognize that a number of important patterns in culture generation and perception reflect deep cognitive structures of the brain, and the mindless handiwork of evolutionary processes that enabled those structures to become widely shared by members of the species.

The five propositions above, which address how evolutionary processes create information-processing, behavior-biasing features of the brain, raise the following hypothesis: some behaviors currently ascribed to cogni-

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over a species' evolutionary history. These expectations would differ from domain to domain. Consequently, if natural selection had shaped how humans reason, reasoning about different domains would be governed by different, content-dependent cognitive processes.

Id. at 193.

[89] I am grateful to Professor John Robertson for pointing out that Wilson makes this point particularly well in E.O. WILSON, CONSILIENCE: THE UNITY OF KNOWLEDGE 181-82 (1998).

[90] *See generally* sources cited *supra* note 75.

[91] Since at least the 1950s, many have labored to expose the absurdity of the genes/culture dichotomy. *See, e.g.*, DONALD OLDING HEBB, A TEXTBOOK OF PSYCHOLOGY 195-96 (2d ed. 1966); Anne Anastasi, *Heredity, Environment, and the Question "How?"*, 65 PSYCHOL. REV. 197, 197 (1958); D.O. Hebb, *Heredity and Environment in Mammalian Behaviour*, 1 BRIT. J. ANIMAL BEHAV. 43, (1953). Unfortunately, it persists. For cogent attacks on its oversimplicity, see MATT RIDLEY, *supra* note 75, at 175, 316-20, and Paul R. Abramson & Steven D. Pinkerton, *Introduction: Nature, Nurture, and In-Between*, *in* SEXUAL NATURE, SEXUAL CULTURE 1 (Paul R. Abramson & Steven D. Pinkerton eds., 1995).

[92] Owen D. Jones, *Law, Emotions, and Behavioral Biology*, 39 JURIMETRICS J. 283, 285 (1999).

tive limitations reflect not defect, but rather finely tuned features of brain design. If so, we may gain important insights into the patterns of human irrationality by combining our proximate causation analysis with our ultimate causation analysis to yield a comprehensive evolutionary analysis.

The next two Parts explain why.

III. TIME-SHIFTED RATIONALITY

This Article develops, in this Part and the next, two tools of the evolutionary analysis approach just described. In this Part, I explain why it makes sense to reconceptualize some cognitive processes that lead to seeming irrationalities as design features instead of defects, and provide several brief examples.

A. From Defects to Design

The current approach to bounded rationality, which BLE scholarship reflects, is to assume that when people are substantively irrational it is because of (and in these oft-employed terms) cognitive fallibilities, frailties, flaws, errors, defects, quirks, limitations, and imperfections.[93] These cognitive errors and defects are, in turn, assumed to be (and by the vocabulary used, are reciprocally reinforced as) the exclusive result of the internal and external limits mentioned earlier (such as brain size and computing speed), with net behavioral outcomes that are, while defective, at least understandable under the circumstances.

Over the years, a small group of scholars has attempted to bring economics and biology closer together, generally.[94] A few of them have even

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[93] So characterizing our cognitive faculties are, for example: BECKER, *supra* note 15; HOGARTH, *supra* note 18, at 63, 204-06; RICHARD H. THALER, THE WINNER'S CURSE: PARADOXES AND ANOMALIES OF ECONOMIC LIFE 2-3 (1992); OLIVER E. WILLIAMSON, MARKETS AND HIERARCHIES: ANALYSIS AND ANTITRUST IMPLICATIONS: A STUDY OF ECONOMICS OF INTERNAL ORGANIZATION 21, 22 (1975); Robert C. Ellickson, *Bringing Culture and Human Frailty to Rational Actors: A Critique of Classical Law and Economics*, 65 CHI.-KENT L. REV. 23 (1989); Melvin Aron Eisenberg, *The Limits of Cognition and the Limits of Contract*, 47 STAN. L. REV. 211, 213 (1995); Jolls et al., *supra* note 1, at 1477; Barton L. Lipman, *Information Processing and Bounded Rationality: A Survey*, CANADIAN J. OF ECON. 42, 42-43 (February 1995); Posner, *supra* note 24, at 1553; Herbert A. Simon, *From Substantive to Procedural Rationality*, *in* METHOD AND APPRAISAL IN ECONOMICS 129, 135 (Spiro J. Latsis ed., 1976); Simon, *Bounded Rationality*, *supra* note 32, at 266-67; Cass R. Sunstein, *Behavioral Analysis of Law*, 64 U. CHI. L. REV. 1175, 1175 (1997); Thomas S. Ulen, *Cognitive Imperfections and the Economic Analysis of Law*, 12 HAMLINE L. REV. 385, 387-388, 390-400 (1989).

[94] Among these, Gary Becker, Jack Hirshleifer, Paul Rubin, Richard Posner, and Robert Frank are particularly significant. Becker observed in 1976 that some tastes were likely selected through biological pathways. Gary S. Becker, *Altruism, Egoism, and Genetic Fitness: Economics and Sociobiology*, 14 J. ECON. LITERATURE 817 (1976). Hirshleifer, roughly contemporaneously, explored this idea at greater length, and was the first economist to point out the deep connectivity between, and parallel enterprises of, economics and biology. Jack Hirshleifer, *Economics from a Biological Viewpoint*, 20 J.L. & ECON. 1, 37 (1977) ("Even emotional supports for exchange, like the sense of justice ('moralistic aggression') may represent genetically evolved characters."). Hirshleifer notes that the fundamental economic con-

speculated on the value of such conjunction in some irrationality contexts, specifically.[95] For example, in his recent comments on the BLE enterprise,

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cepts of scarcity, competition, equilibrium, and specialization are as central to the study of evolved behavior as they are to the study of economics generally. Hirshleifer cites economist Alfred Marshall as calling economics "a branch of biology, broadly interpreted," and Hirshleifer describes it as the study of "Nature's economy." *Id.* at 1 n.2 (citing ALFRED MARSHALL, PRINCIPLES OF ECONOMICS 772 (9th ed. 1920)). And Hirshleifer has continued, over the years, to offer bioeconomic perspectives on important phenomena. *See, e.g.*, Jack Hirshleifer, *Evolutionary Models in Economics and Law*, 4 RES. L. & ECON. 1 (1982); Jack Hirshleifer, *The Bioeconomic Causes of War*, 19 MANAGERIAL & DECISION ECON. 457 (1998).

Rubin noted that behavioral biology may materially undermine the standard economic assumption that tastes are arbitrary, and explored an evolutionary explanation for tastes in such things as risk and moralistic aggression. Paul Rubin & Chris Paul, *An Evolutionary Model of Taste for Risk*, 17 ECON. INQUIRY 585 (1979); Paul Rubin, *Evolved Ethics and Efficient Ethics*, 3 J. ECON. BEHAV. & ORG. 161 (June/Sept 1982); PAUL RUBIN, DARWINIAN POLITICS: THE EVOLUTION OF POLITICAL PREFERENCES (unpublished manuscript on file with author). Posner offered a sustained effort to link sexual behavior with economic behavior. RICHARD POSNER, SEX AND REASON (1992). And Frank has compellingly argued (as has Hirshleifer) that in many contexts being predisposed to be "irrational" can prove advantageous, even adaptive. ROBERT FRANK, PASSIONS WITHIN REASON (1988); Robert Frank, *If Homo Economicus Could Choose His Own Utility Function, Would He Want One with a Conscience?*, 77 AM. ECON. REV. 595 (1987); Jack Hirshleifer, *On the Emotions as Guarantors of Threats and Promises*, *in* THE LATEST ON THE BEST: ESSAYS IN EVOLUTION AND OPTIMALITY (John Dupre ed., 1987).

Works by other authors have also contributed in various ways to this disciplinary interchange. *See* Leda Cosmides & John Tooby, *Better Than Rational: Evolutionary Psychology and the Invisible Hand*, 84 AM. ECON. ASS'N PAPERS & PROC. 327 (May 1994); Michael P. Ghiselin, *Economy of Body*, 68 AM. ECON. REV. 233 (1978); Arthur J. Robson, *A Biological Basis for Expected and Non-Expected Utility*, 68 J. ECON. THEORY 397 (1996); Paul A. Samuelson, *Modes of Thought in Economics and Biology*, 75 AM. ECON. REV. 166 (1985); Thorstein Veblen, *Why Is Economics Not an Evolutionary Science?*, Q.J. ECON. 373 (July 1898); Ulrich Witt, *Bioeconomics as Economics from a Darwinian Perspective*, 1 J. BIOECONOMICS 19 (1999); Ulrich Witt, *Economics, Sociobiology, and Behavioral Psychology on Preferences*, 12 J. ECON. PSYCHOL. 557 (1991); *see also id.* at 557 (noting several other sources); Paul J. Zak & Arthur Denzau, *Economics Is an Evolutionary Science*, *in* EVOLUTIONARY APPROACHES IN THE BEHAVIORAL SCIENCES: TOWARD A BETTER UNDERSTANDING OF HUMAN NATURE (Albert Somit & Stephen Peterson eds., forthcoming 2001). SOCIOBIOLOGY AND BIOECONOMICS: THE THEORY OF EVOLUTION IN BIOLOGICAL AND ECONOMIC THEORY (Peter Koslowski ed., 1999) collects several quite recent chapters on this subject, including Michael T. Ghiselin, *Darwinian Monism: The Economy of Nature*, *id.* at 7; Peter T. Saunders, *Darwinism and Economic Theory*, *id.* at 259; and Ulrich Witt, *Evolutionary Economics and Evolutionary Biology*, *id.* at 279.

For a description of the historical ebbing and flowing of interchange between biology and economics, see GEOFFREY M. HODGSON, ECONOMICS AND EVOLUTION: BRINGING LIFE BACK INTO ECONOMICS (1993).

[95] Speculation on the possible relationship between biology and irrationality varies considerably. *See, e.g.*, HOGARTH, *supra* note 18, at 227, 232; Donald T. Campbell, *Rationality and Utility from the Standpoint of Evolutionary Biology*, *in* RATIONAL CHOICE: THE CONTRAST BETWEEN PSYCHOLOGY AND ECONOMICS 171 (Robin Hogarth & Melvin Reder eds., 1987); Cosmides & Tooby, *supra* note 94, at 330-31; Gigerenzer, *Ecological Intelligence*, *supra* note 60; Paul Gilbert, *The Evolved Basis and Adaptive Functions of Cognitive Distortions*, 71 BRIT. J. MED. PSYCHOL. 447 (1998) (discussing evolutionary explanations for psychopathologies); Elizabeth Hoffman & Matthew L. Spitzer, *Willingness to Pay Vs. Willingness to Accept: Legal and Economic Implications*, 71 WASH. U. L.Q. 59, 89-90 (1993) (discussing prospect theory and the endowment effect); Posner, *supra* note 24; Alan R. Rogers, *Evolution of Time Preference by Natural Selection*, AM. ECON. REV., June 1994, at 460; Ulen, *supra* note 1, at 1760 (noting the implications of "hard-wired" cognitive limitations); Michael Waldman, *Systematic Er-*

Judge Richard Posner has suggested that BLE could benefit from viewing irrationality from an evolutionary biology perspective.[96] And psychologist Gerd Gigerenzer has forcefully argued that some supposed irrationalities are experimental artifacts of providing information in forms that humans did not typically encounter in ancestral environments.[97] Nevertheless, one can hardly avoid concluding that biology remains widely ignored in existing BLE scholarship, and that the argument for partnering behavioral biology with behavioral economics needs a great deal of further development.

A biologically informed view of the brain makes clear that substantive irrationalities are probably not just about physical, temporal, and informational limits. They are also, in some circumstances, likely to be about specific, narrowly tailored, efficiently operating features of brain design. My argument here is that the traditional approach to bounded rationality and decision-making is, in many cases, both descriptively wrong and materially misleading.[98] It is descriptively wrong in the same way that it would be wrong to say that a Porsche Boxster is "defective" when it fails to climb logs and ford streams off road, or that a moth's brain is "defective" when the moth flies into an artificial light source. It is materially misleading because to the extent that irrationalities are considered to be the result of defects, rather than design features, their specific content is assumed to be, though patterned ex post, unpredictable, unsystematized, and random ex ante—rather than predictable, interrelated, and content-specific.[99] Put another way, turning old cognitive tools to entirely new uses introduces changed circumstances, not defects. And the inappropriateness of old tools to new uses does not mean those tools lack specialized design and function. Understanding what the tools were designed to do provides significant pur-

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rors and the Theory of Natural Selection, AM. ECON. REV., June 1994, at 482; Owen D. Jones, Law, Behavioral Economics, and Evolution (April 16, 1999) (unpublished paper presented at The Olin Conference on Evolution and Legal Theory at Georgetown University Law Center, on file with author).

[96] *See* Posner, *supra* note 24 and *infra* notes 108, 128, and 136.

[97] *See* Gigerenzer, *Ecological Intelligence*, *supra* note 60; Gerd Gigerenzer, *How to Make Cognitive Illusions Disappear: Beyond Heuristics and Biases*, *in* 2 EUROPEAN REVIEW OF SOCIAL PSYCHOLOGY 83 (Wolfgang Strobe & Miles Hewstone eds., 1991) [hereinafter Gigerenzer, *Cognitive Illusions*]; Gerd Gigerenzer, *Rationality: Why Social Context Matters*, *in* INTERACTIVE MINDS: LIFE-SPAN PERSPECTIVES ON THE SOCIAL FOUNDATION OF COGNITION 319 (Paul B. Baltes & Ursula M. Staudinger eds., 1996); Gerd Gigerenzer & Peter M. Todd, *Fast and Frugal Heuristics: The Adaptive Toolbox*, *in* SIMPLE HEURISTICS THAT MAKE US SMART (Gerd Gigerenzer et al. eds., 2000).

[98] Indeed, the very term human "decision-making" is obfuscating. What is at issue is not how people make decisions, but how people behave. Many of their behaviors do not reflect decisions in the typical sense of that word.

[99] For any given choice, many different irrational outcomes are possible. I am not suggesting that the final distribution of outcomes is, or has been considered to be, random. For people tend to reach the same kind of irrational outcome, when presented with similar choices. What I am suggesting, instead, is that traditional approaches, while noting the patterned outcomes, have no systematic way of predicting that human behavior will cluster around one irrational result rather than another. That is, the content of the irrationality can appear to be random, even while the accumulated human behavior is patterned. This will be illustrated in section III.B.1, *infra*.

chase on explaining and predicting how they will function when applied in novel contexts.

We know that brains are highly specialized organs, which natural selection has left designed to perform very specific tasks.[100] And we know that, because of the way evolutionary processes work, the information processing tasks for which the brain is best adapted are those relating to information, challenges, and environments of deep ancestral time, rather than the present time. (Except in those cases in which present conditions are the same as those in the past).

The consequence of this, it follows, is that we not only should allow for, but should indeed expect, that there will be times when a perfectly functioning brain—functioning precisely as it was designed to function—will incline us toward behavior that, viewed only in the present tense and measured only by outcomes in current environments, will appear to be substantively irrational. This is simply because the brain was designed to process information in ways tending to yield behaviors that were substantively rational in different environments than the ones in which we now find ourselves.

This calls the assumptions of the traditional approach to bounded rationality into serious question. For instance, the traditional approach assumes that rationality should be measured solely in the present tense—evaluating current behavior, in current environments, for current outcomes. The temporal, historical dimension to information-processing that evolutionary analysis affords suggests something quite different. It suggests, in essence, that a great deal of what is currently lumped under the over-inclusive and somewhat dismissive heading "bounded rationality" is a function of discrete contexts in which there is a temporal mismatch between design features appropriate for ancestral environments, on one hand, and quite different current environments, on the other. In what follows, and in order to bridge the gap separating behavioral biology scholarship from behavioral law and economics scholarship, I will refer to the results of this temporal mismatch of historically adaptive behavior and modern environments as *time-shifted rationality* or TSR. Specifically, time-shifted rationality describes any trait resulting from the operation of evolutionary processes on brains that, while increasing the probability of behavior that was adaptive in the relevant environment of evolutionary adaptation in the ancestral past, leads to substantively irrational or maladaptive behavior in the present environment. In other words, poor behavior choices sometimes derive not from brain defects, per se, by rather from the brain's deployment of old, once-successful techniques in the face of new problems. So before judging the brain's abilities, we need to consider the effects of its choices in the environments for which the brain is principally adapted.

Time-shifted rationality—a kind of evolutionary lag, or novel envi-

[100] *See, e.g.*, PINKER, *supra* note 75.

ronment effect, that leads to maladaptation—can describe physical as well as mental phenomena. The physical ones, because they are more obvious, can provide preliminary illustration. For example, current scholarship on a variety of physical ailments examines the consequences of mismatch between body design and changed conditions.[101] The research reveals that stress automatically reduces your immediate ability to digest, to grow, and to have sex. This was good in the EEA, the environment of evolutionary adaptation. During periods of extreme stress it was adaptive to temporarily shut down all systems not immediately dedicated to addressing a crisis at hand, such as running away from a predator. Historically, most extreme stresses were of rather limited duration: either you got away, or you didn't. And most severe but survivable stresses passed more quickly than multidistrict litigations, lengthy divorce proceedings, or corporate takeovers. That does not make the modern body's stress response defective when it interferes with digestion, growth, and reproduction. It renders the body's stress response substantively rational but temporally mismatched—a time-shifted rationality.

My argument here is that just as many modern physical ailments reflect the body's well-honed approach to ancestral problem solving, many supposed cognitive errors reflect the brain's well-honed approach to ancestral problem solving. We will do no better to understand and combat irrationalities without evolutionary analysis than we will do in understanding and combating stress responses without evolutionary analysis.[102] The main point is that we err when we attempt to understand supposed irrationalities without the temporal, historical dimension that behavioral biology affords. The next section provides examples.

B. Examples

This section briefly explores a variety of contexts in which an evolutionary analysis, applying the tool of time-shifted rationality, may help to illuminate seemingly irrational behaviors. In some cases, this suggests that they may be substantively rational behavior, temporally mismatched to the

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[101] *See, e.g.*, RANDOLPH M. NESSE & GEORGE C. WILLIAMS, WHY WE GET SICK: THE NEW SCIENCE OF DARWINIAN MEDICINE (1994); ROBERT M. SAPOLSKY, WHY ZEBRAS DON'T GET ULCERS: AN UPDATED GUIDE TO STRESS, STRESS-RELATED DISEASES, AND COPING (1998).

[102] Similarly, an evolutionary perspective on other physical ailments has provided new and useful insights. *See generally* NESSE & WILLIAMS, *supra* note 101. For example, while fever was long considered to be an adverse byproduct of bacterial infection—something to be suppressed—it is now known to be part of a suite of evolved anti-bacterial counter-measures that help to inhibit rapid bacterial growth. In cases of life-threatening infections, of course, life-threatening fevers may result. In ordinary cases, however, suppressing fever actually weakens the body's ability to fight infection. Similar thinking has led to breakthroughs in understanding the connections between evolved nausea and ingested substances that, while harmless to a developed body, interfere with proper development of a fetus. *See, e.g.*, Samuel M. Flaxman & Paul W. Sherman, *Morning Sickness: A Mechanism for Protecting Mother and Embryo*, 75 Q. REV. BIOLOGY 113 (2000).

current environment. The examples begin with comparatively straightforward contexts, involving inconsistent preferences, and later conclude with the more challenging applications of TSR, such as in the context of endowment effects. In each case, the purpose of the example is to demonstrate how the hypothesis of TSR yields a novel and promising perspective.

1. Inconsistent Preferences.—The rational actor model, at the heart of economic analysis of law, depends on people having consistent preferences.[103] The existence (and persistence) of inconsistent preferences therefore poses a significant problem. A seemingly trivial example—poor dieting behavior—has large implications if it is as representative of inconsistent preferences as many fear it to be.

The problem of poor dieting is simply this: dieting individuals often appear to behave irrationally, given their self-expressed ordering of preferences. They may value losing weight more highly than eating ice cream, but later make for the fridge. Such inconsistent preferences pose important legal implications when, for example, government regulators attempt to encourage retirement savings.[104] The overweight dieter who eats sweets is not materially different from someone who refuses to take a personal loan at ten percent interest, while carrying substantial credit card debt at eighteen percent interest.

A neoclassical economist can solve this inconsistent preferences problem in one of four equally unsatisfactory ways. She can suppose that the seemingly inconsistent dieter a) acted rationally, having lied about his preferences; b) acted rationally, having earlier misjudged his own preferences; c) acted rationally, having simply changed his preferences later; or d) acted irrationally, and thus inconsequentially.

The first two explanations (lying and misjudging) are inconsistent with most people's personal experiences with dieting, and seem both facile and implausible. The third explanation, if allowed, would reduce economics to nothing more than descriptions of what people actually do. And the fourth explanation, most often invoked, seems suspiciously convenient. Even more telling (and reminiscent of the singing bird example, earlier), it provides no explanation for why people are so much more likely to *overeat,* when acting irrationally, than they are to undereat. And it provides no explanation for why people are so much more likely to overeat *sweets,* when acting irrationally, than they are to overeat sours or rotting foods.

Evolutionary analysis, with this tool of time-shifted rationality and its

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[103] MERCURO & MEDEMA, *supra* note 14, at 57.

[104] For information on self-control generally, see Thaler & Shefrin, *supra* note 19. Regarding savings, specifically, the *New York Times* reports that 40% of American families would run out of cash within three days of a layoff or medical crisis. Brendan I. Koerner, *Where to Go When You're Broke,* NEW YORK TIMES MAG., Oct. 15, 2000, at 104. While there is obviously far more to low savings than simply inconsistent preferences, it appears likely that inconsistent preferences are an important part of the picture.

emphasis on the ultimate causation half of the full causation equation, provides a fifth alternative: that the behavior occurs because a powerful predisposition to pursue sweets was once "rational" (or "adaptive") and simply is so no longer.[105] It is, in essence, a substantively rational predisposition that has been obsolesced by events.

The analysis begins with the obvious: it is no accident that humans, all across the planet, have a strong preference for sweets over sours or bitters. In ancestral environments, natural selection favored heritable traits that biased nervous systems toward associating pleasure with the perception of chemical stimuli that happened to be present in foods of high caloric value. A taste for sweets was highly adaptive, and differentially reproduced in successive generations, simply because it tended to lead organisms that had it toward foods of high caloric value, which enhanced their survival and reproduction.

In ancestral environments, sweet foods (such as ripe fruit) never contained caloric concentrations high enough, and in sufficient quantity, to yield maladaptive obesity. Consequently the selection pressure favoring a strong desire for sweets was never countered by any selection pressure against *over*-eating sweets. Our modern environment presents an evolutionarily novel environmental feature: refined sugar. Eating too much can be unhealthy, and we can recognize this at the conscious level. Nevertheless, we are left with a brain—essentially a living fossil—that natural selection shaped to crave sweets. Doing so was "rational" in the environment in which our brain's behavior-biasing functions were formed. Although we may break diets in a way that appears irrational, our behavior is both highly patterned rather than random (none gorge on sour or rotting food, for instance) and also explicable as the product of rational, economic forces.

If explaining this particular irrationality as a product of time-shifted rationality looks easy, that's because it is. The *proximate cause* of overeating is that sweets taste good. The *ultimate cause* of overeating is that natural selection strongly favors the consumption of high calorie foods, and the ultra-high calorie foods available today, that make over-consumption possible, were never present in the environment of evolutionary adaptation. This is why people tend to overeat rather than undereat, and why, when they do so, they tend to overeat sweets rather than sours or spoiled cabbage.

Of course, not every example of inconsistent preferences can be so easily addressed. But this straightforward example illustrates why evolutionary analysis provides such a useful starting point any time we are concerned about behaviors that are odd, in their nature, but quite common, in their fre-

[105] This particular illustration, though not yet widely known outside biology circles, is often used to illustrate the ways in which once-adaptive behavior can become maladaptive. The argument I am attempting to extend is that a similar phenomenon can occur with respect to more abstract mental processes, and that this phenomenon can be understood to explain many of the seeming lapses from rationality that seem to so trouble economists.

quency of occurrence. And the first two steps of such analysis are often illuminating in themselves. First, assume that behavior-biasing information processing has been quite systematically shaped by evolutionary forces. Second, examine the supposed irrationality at issue through a temporal lens that puts it in the time and in the situational context of the environment during which relevant human brain functions likely evolved.

2. Over-Cooperativeness.—Although the rational actor model does not predict anything as simplistic as unbrokenly selfish behavior, it does predict that costly acts without any visible possibility of benefit will be rare. This is why the commonplace practice of leaving tips when dining "on the road," for example, is so puzzling to economists—and so seemingly irrational. We already know that in repeat-player contexts even seemingly altruistic acts can yield important payoffs through later cooperation and reciprocal altruism.[106] But why do even people dining alone (and out of view of acquaintances) regularly leave tips for service already rendered in a restaurant far from home or overseas?

In an attempt to solve this and other puzzles of greater-than-predicted cooperativeness, economists often resort to the notion of "psychic income." That is, they simply posit a taste for tipping, in which tipping on the road gives one a sense of pleasure, and thus confers some benefit larger than the cost. This is, of course, an explanation in terms of proximate causation—in the same way that "because it tastes good" explains eating sweets, or "because it feels good" explains sex. But this psychic income, proximate cause answer—like those for sweets or sex—provides no very satisfactory explanation. It simply begs the question: *why* do so many people perceive this particular behavior to be sufficiently pleasurable to pay for it? Why, that is, is tipping more pleasurable than stiffing?

Time-shifted rationality offers a plausible hypothesis, grounded in ultimate causation analysis, for why it will never be coin-flipping odds whether tipping or stiffing will be more pleasurable to humans. The TSR analysis suggests that seemingly irrational tipping exists because of the adaptive value of reciprocal altruism (and reputation effects) operative in small communities, *notwithstanding* the fact that technology has quite recently made such communities rare. We know that in small communities greater codependence and interaction of members makes reputation important. It is therefore adaptive to be known as generous, honest, and cooperative (though not indiscriminately so) in a small society. We know that tendencies toward reciprocal altruism are both adaptive and heritable in many other social species.[107] And we have good reason to believe that for

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[106] *See, e.g.*, HERBERT GINTIS, GAME THEORY EVOLVING: A PROBLEM-CENTERED INTRODUCTION TO MODELING STRATEGIC BEHAVIOR (2000).

[107] Reciprocal altruism is the dominant explanation for unselfish acts between non-kin in animal populations. The concept traces to Robert L. Trivers, *The Evolution of Reciprocal Altruism*, 46 Q. REV. BIOLOGY 35 (1971).

the overwhelming bulk of their evolutionary history our hominid ancestors lived in small groups. Moreover, we see cross-cultural evidence of reciprocally altruistic behavior in human populations. It is therefore not only possible but probable that humans bear evolved predispositions toward reciprocal altruism.

If so, it is easy to see how some novel environmental features, when bumping up against such predispositions, could create puzzling phenomena such as tipping on the road and other seeming overcooperativeness. That tipping on the road appears irrational in an explosively burgeoned society—in which one travels by methods previously unavailable, to distances previously untraveled, to meet strangers in numbers never before encountered, whom one is unlikely ever to encounter again—does not automatically mean that such tipping is the product of a malfunctioning brain, or one that has simply internalized a random norm.[108] Instead, it probably reflects time-shifted rationality, in which a generally adaptive predisposition is temporally mismatched to today's evolutionarily unique conditions.

This is not, of course, to say that tipping is itself an adaptation. But tipping and similarly altruistic behavior may often be a by-product of evolved psychological mechanisms that both preferentially generate and reciprocally internalize local norms that encourage cooperative behavior in contexts that would have had important consequences for reputation and reproductive success in deep ancestral environments.[109]

3. Intertemporal Choice Anomalies and Irrationally Discounted Futures.—Rational choice theorists generally assume that people evaluate the future sensibly. For example, people should discount to present value any right to receive a sum certain, on a specified future date, according to expected interest rates on investments across the intervening time. Nonetheless, people regularly discount the future at extraordinary (or "hyperbolic") rates, which are themselves inconstant.[110] Researchers have noted

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[108] Posner notes the following, in the context of a discussion about altruism in ancestral environments:

> [I]t would not have been essential to have an innate capacity to discriminate between relatives and other intimates, on the one hand, and, on the other hand, those people—call them "strangers"—with whom one did not have repeated face-to-face interactions. Nowadays we interact a great deal with strangers. But our instincts are easily fooled when confronted with conditions to which human beings never had a chance to adapt biologically.

Posner, *supra* note 24, at 1561.

[109] I provide a discussion of how evolutionary processes influence norms in Jones, *supra* note 8.

[110] *See generally* Kris N. Kirby & R. J. Herrnstein, *Preference Reversals Due To Myopic Discounting of Delayed Reward*, 6 PSYCHOL. SCI. 83 (March 1995); George Loewenstein & Drazen Prelec, *Anomalies in Intertemporal Choice: Evidence and an Interpretation*, 107 Q.J. ECON. 573 (1992).

As Kirby and Herrnstein explain:

> [R]esults are consistent with models of impulsiveness that assume that deferred outcomes are discounted hyperbolically, and such results are a direct challenge to standard economic theory. The constancy of discount rates assumed by economic theory predicts that subjects should never consistently reverse their preference from an SER [smaller, earlier reward] to an LLR [larger, later

not only that people often prefer to receive a smaller good now over a disproportionately greater good later, but also that people reverse this preference as the delay for receiving either good increases in equal amounts.[111] This seems irrational. For example, the fact that a majority of adults would rather receive $50 now than $100 in two years—at the same time that virtually no one prefers $50 in four years to $100 in six years—is seen as clear evidence of "anomalies in the utilitarian reasoning of the normal human adult."[112] And this both hyperbolic and anomalous discounting has important implications for whether paternalistic policies, such as the forced savings of social security, can be justified at both theoretical and empirical levels. Rational people are delayed gratification people, who plan for the future. But hyperbolic discounters will not save enough for retirement.[113]

It is likely a mistake to conclude that seemingly irrationally discounted futures are necessarily the function of calculating errors. Evolutionary analysis suggests an ultimate cause explanation.[114] Hyperbolic discounting may reflect another time-shifted rationality. How might modern environmental features differ from features of the environment of evolutionary adaptation in ways that render once-adaptive predispositions maladaptive?

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reward] as the delays to both rewards are changed by constant amounts of time . . . . These experiments are the first with humans, using real rewards, to document individual intertemporal preference reversals and to locate the delays at which those reversals occur . . . .

Kirby & Herrnstein, *supra*, at 88. Kirby and Herrnstein found that "[i]n all three experiments, an overwhelming majority of subjects reversed their preferences systematically as a function of delay." *Id.* at 85.

[111] *See, e.g.*, George Ainslie, *Derivation of "Rational" Economic Behavior from Hyperbolic Discount Curves*, 81 AM. ECON. ASSOC. PAPERS AND PROC. 334 (1991). Similar evidence comes from the frustrating frequency with which people will persist in purchasing less expensive but energy-hungry appliances when the difference between the price of that appliance and a more expensive but less energy-hungry appliance would be earned back in energy savings within a year. *See, e.g.*, George Loewenstein & Richard H. Thaler, *Anomalies: Intertemporal Choice*, J. ECON. PERSP., Fall 1989, at 181, 182-83.

[112] *Id.* at 334.

[113] For discussion of the legal implications of this phenomenon, see Deborah M. Weiss, *Paternalistic Pension Policy: Psychological Evidence and Economic Theory*, 58 U. CHI. L. REV. 1275 (1991). "Left to their own devices, many people will not save enough for their old age. This hard truth about human behavior has led American government to make a long and expensive commitment to retirement security programs." *Id.* at 1275; *see also* Stephen M. Bainbridge, *supra* note 40, at 1023, 1027 ("[I]t seems probable that behavior economics increasingly will be invoked by those who favor government intervention precisely because behavioral economics offers a new line of argument in favor of regulating private conduct.")

[114] There is, reportedly, some evidence for hyperbolic discounting in other animals. *See* Kirby & Herrnstein, *supra* note 110, at 83. Only two authors, to my knowledge, have specifically explored the possibility that human time preferences may have evolved. Rogers, *supra* note 95, provides an elegant argument for why human time preferences may be in evolutionary equilibrium. Gifford, while agreeing that time preferences are likely to reflect the operation of evolutionary processes, argues that "the rate of time preference that resulted from cultural coevolution of large brains, language and consciousness diverged from . . . the rate of time preference in biological fitness." Gifford, *supra* 85, at 139-40.

First, average life expectancy has skyrocketed.[115] And high discount rates make sense when life expectancy is short. Second, for nearly all of the roughly seventy million years of primate evolution, there was no such thing as a reliable future, let alone a reliable future payoff. Even under the most generous definition of investment, investment horizons were short. Third, a "right" to receive something in the future is a trivially recent invention of modern humanity.

Since long lives, reliable futures, and reliable rights to future payoffs were not part of the environment in which the modern brain was slowly built, it is not particularly surprising that the modern brain tends to steeply discount the value of a future benefit compared to an immediate one, and is not particularly well equipped to reach the outcome currently deemed most rational. Rather than assume that people will be rational discounters, we should, logically, *expect and assume* the opposite: most often people will be hyperbolic discounters. In the EEA, the environment of evolutionary adaptation, the kind of hyperbolic discounting that humans now so regularly exhibit often would have led to more substantively rational results than the alternative.

Put another way, at almost no time in human evolutionary history could there have been a selection pressure that regularly favored the kind of coolly calculated and deferred gratification now deemed to be so reasonable. Selection pressures can only result from the differential reproduction of contemporaneously existing alternatives in light of regularly encountered environmental features. So, absent a regular environmental feature that offered a "guarantee" of future payoff, future payoffs would be quite speculative. Consequently, foregoing immediate payoffs would often be irrational, and thus subject to selection pressure against such delayed satisfaction.

4. Framing Problems and Mistaken Assessments of Probability.— The rational actor model assumes that most of the time people will neither be misled by meaningless differences between options, nor make gross errors in calculating the probabilities of events. The facts indicate otherwise.[116] People often make different choices, between functionally equivalent options, depending on how the options are posed, or "framed." And people routinely misunderstand probabilities. This has obvious and far-reaching implications for legal decision making, risk assessment, and

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[115] For a summary of a Center for Disease Control report on the increase in life expectancy in the United States (from 47.3 years to 76.1 years), see Patricia J. Mays, *Life Expectancy Climbs Nearly 30 Years Since 1900*, DAYTON (OH.) DAILY NEWS, July 29, 1999, at 8A. For a treatment by the National Academy of Sciences of modern, international, and ancestral life expectancy, see BETWEEN ZEUS AND THE SALMON: THE BIODEMOGRAPHY OF LONGEVITY (Kenneth W. Wachter & Caleb E. Finch eds., 1997), *at* http://www.nap.edu/books/0309057876/html/ index.html.

[116] *See, e.g.*, Edward J. McCaffery et al., *Framing the Jury: Cognitive Perspectives on Pain and Suffering Awards*, 81 VA. L. REV. 1341 (1995); Tversky & Kahneman, *supra* note 23; Amos Tversky & Daniel Kahneman, *The Framing of Decisions and the Psychology of Choice*, 211 SCIENCE 453 (1981).

sensible reactions to changing incentives.

In view of what we know about how evolutionary processes shape information-processing organs, we should expect that people's preferences for different outcomes will often vary as a function of the ways, and the formats, in which questions are posed. This will be particularly likely whenever one option is presented in a form that is more consonant than the other with the form in which options were regularly encountered in the EEA. This is because the brain is functionally specialized in a context- and content-specific way. Thus the more closely a problem resembles, in operative part, a problem faced by our ancestors, the more likely it is to invoke evolved, context-specific mechanisms. These may or may not yield the same behavioral inclination that dispassionate cost-benefit analysis would.[117] The brain may therefore reflect time-shifted rationality, because it is better adapted to bias behavior appropriately in the face of an historically common problem than it is in the face of a novel one.

For example, psychologists Leda Cosmides and John Tooby, in studies informed by evolutionary analysis, discovered that when two logically equivalent problems were posed to test subjects, one involving comparatively abstract rules (*e.g.*, "if a person has a 'D' rating, then his documents must be marked code '3'"), and the other involving the possibility of detecting someone else's cheating on a social bargain (*e.g.*, if Betty used the company car on Sunday, then it was not on business) far fewer people reached the "rational" result in the former context than in the latter (roughly forty percent, compared to eighty-eight percent).[118] The Cosmides and Tooby studies provide strong evidence for an evolved, functionally specialized psychological "cheater-detection" mechanism, which was (and still is) obviously adaptive. That is, the human brain appears to be specifically alert "to detect violations of conditional rules when these can be interpreted as cheating on a social contract."[119] The consequence of this line of reasoning is that, by considering the environmental features common to the time during which the brain evolved, we may not only explain but also predict patterns of variation in modern human ability to solve problems.

Linking errors in probability assessment to errors consequent to framing effects, Gerd Gigerenzer and colleagues have recently argued that supposedly robust errors in statistical, probabilistic reasoning disappear entirely when probabilistic information is reframed in terms of frequency distribu-

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[117] For example, this explains why people are more afraid of snakes than cars, although the latter are far more dangerous.

[118] Leda Cosmides & John Tooby, *Cognitive Adaptations for Social Exchange*, *in* THE ADAPTED MIND: EVOLUTIONARY PSYCHOLOGY AND THE GENERATION OF CULTURE 163, 182, 205 (Jerome H. Barkow et al. eds., 1992). The problems were, of course, more sophisticated than the examples used here (for the sole purpose of distinguishing the *kinds* of problems) otherwise indicate. See *id.* for a full description.

[119] *Id.* at 205.

tions.[120] The argument, in essence, is that it was never coin-flipping odds whether humans would be equally good at handling decimals and percentages (the vocabulary of probability) or at handling integers (the vocabulary of frequency distributions). Because the overwhelming abundance of data observable in the EEA appeared in the natural sampling form of event frequencies, the brain is likely to be better adapted to making substantively rational choices on the basis of frequency distributions than on the basis of more abstract, and only recently invented, statistical probability representations. Gigerenzer's evolutionarily informed analysis explains why, and predicts that, for example, people will typically have a far more realistic assessment of risk when told that eight people out of ten died after eating a plant, than they will when told that eating a plant carries a ".8" risk of death.[121]

Gigerenzer's approach makes use of the image of an "adaptive toolbox" into which the brain reaches for "fast and frugal heuristics."[122] When problems come in unfamiliar forms, the tool—which was "ecologically rational" in ancestral times—may be confounded. Gigerenzer's model emphasizes the extent to which, by changing the current format of information to be compatible with what the brain evolved to expect, irrationalities and other failures will "disappear" and a rational result can follow.[123] That approach is extremely useful, and not incompatible with the time-shifted rationality approach I describe here. But it does not appear to connect an evolutionary explanation for framing effects with the other effects explored here, such as endowment effects, hyperbolic discounting, and the like. TSR can provide such connection. Additionally, the TSR approach predicts that, even when the information *is* in a format encountered during ancestral times, brain mechanisms will often lead to outcomes that are irrational in the present tense. That is, TSR underscores that there will be many times when the brain's predisposition toward a seemingly irrational result is not just a function of its inability to process environmental information with which it is unfamiliar, but is instead a function of being designed to yield a substantively different outcome than one that would now be appropriate—even if the format of the information it processes is identical to that to which the brain is adapted.

5. Ultimatum Games and The Irrational Taste for Spite.—Rational actors prefer some benefit to no benefit. Now famous experiments, however, reveal many contexts in which the people choose no benefit over

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[120] *See, e.g.*, Gigerenzer, *Ecological Intelligence*, *supra* note 60, at 11-15; Gigerenzer, *Cognitive Illusions*, *supra* note 97; Gerd Gigerenzer, *The Bounded Rationality of Probabilistic Mental Models*, *in* RATIONALITY: PSYCHOLOGICAL AND PHILOSOPHICAL PERSPECTIVES 284 (K.I. Manktelaw & D.E. Over eds., 1993).

[121] Gigerenzer & Todd, *supra* note 97.

[122] *Id.*

[123] *See, e.g.*, Gigerenzer, *Cognitive Illusions*, *supra* note 97.

benefit. In the so-called "ultimatum game," for example, two subjects face the following scenario.[124] The first subject is given a sum of money. She must then propose, to the second subject, how to divide the money between them. If the second subject agrees to the proposed split, each keeps the money according to that split. If, instead, he rejects the proposed split, neither subject keeps any money.

A moment's thought reveals that the second subject, acting rationally, should accept any split by which he receives anything at all. Because anything is better than nothing. The first subject, seeing the wisdom of this, should propose to give the second subject one penny and keep the balance of the sum for herself.

In reality, however, the second subject rejects many proposed splits, rather than none. He is particularly likely to do so when he would share less than about twenty percent of the total. This appears to be evidence of a widespread but seemingly irrational taste for spite. It takes this form: for the benefit of inflicting a greater cost on another, one inflicts a cost on himself. This finding has legal relevance because rational individuals would not be expected, for example, "to pursue even meritorious legal claims if their expected recovery is less than the attorney's fees, costs, and other expenses involved."[125] And yet people regularly do.

Evolutionary analysis suggests an explanation. We know from game theory that condition-dependent (in this case, retaliatory) spitefulness can be a feature of an evolutionarily stable strategy for reaping gains from cooperators, punishing defectors, and encouraging cooperative outcomes.[126] And research suggests there are biological underpinnings to a sense of fairness.[127] It is adaptive to identify cheaters, and to be identified as a non-

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[124] *See* ROBERT H. FRANK, MICROECONOMICS AND BEHAVIOR 237-39 (3d ed. 1997) (discussing ultimatum game); Sheryl Ball & Catherine C. Eckel, *The Economic Value of Status*, 27 J. SOCIO-ECONOMICS 495, 497 (1998) (discussing ultimatum game, and citing much of the recent literature). *See generally* Colin Camerer & Richard H. Thaler, *Ultimatums, Dictators and Manners*, J. ECON. PERSP., Spring 1995, at 209; Werner Guth et al., *An Experimental Analysis of Ultimatum Bargaining*, 3 J. ECON. BEHAV. & ORG. 367 (1982); W. Guth & R. Tietz, *Ultimatum Bargaining Behavior: A Survey and Comparison of Experimental Results*, 11 J. ECON. PSYCHOL. 417 (1990).

[125] DAVID W. BARNES & LYNN A. STOUT, CASES AND MATERIALS ON LAW AND ECONOMICS 288 (1992).

[126] An early model appears in W.D. Hamilton, *Selfish and Spiteful Behaviour in an Evolutionary Model*, 228 NATURE 1218 (1970). *See also* ROBERT AXELROD, THE EVOLUTION OF COOPERATION (1984); GAME THEORY AND ANIMAL BEHAVIOUR (L.A. Dugatkin & Hudson Kern Reeve eds., 1998); JOHN MAYNARD SMITH, EVOLUTION AND THE THEORY OF GAMES (1982). A recent book demonstrating the general value of game theoretic approaches to behavior is POSNER, *supra* note 16.

[127] This theme is explored in, among other places, MATT RIDLEY, THE ORIGINS OF VIRTUE: HUMAN INSTINCTS AND THE EVOLUTION OF COOPERATION (1996). *See also* RICHARD D. ALEXANDER, THE BIOLOGY OF MORAL SYSTEMS (1987); LARRY ARNHART, DARWINIAN NATURAL RIGHT: THE BIOLOGICAL ETHICS OF HUMAN NATURE (1998); FRANS DE WAAL, GOOD NATURED: THE ORIGINS OF RIGHT AND WRONG IN HUMANS AND OTHER ANIMALS (1996); INVESTIGATING THE BIOLOGICAL FOUNDATIONS OF HUMAN MORALITY (James P. Hurd ed., 1996) [hereinafter INVESTIGATING BIOLOGICAL FOUNDATIONS]; THE SENSE OF JUSTICE: BIOLOGICAL FOUNDATIONS OF LAW (Roger D.

sucker—someone not easily exploited.[128] Consequently, the predisposition to act spitefully when being unfairly exploited by a stingy cooperator may be a time-shifted rationality, underpinning seemingly irrational behavior in modern contexts.

6. Endowment Effects and The Irrational Pricing of Property.—As mentioned earlier, the rational actor model, as reflected in the Coase Theorem, predicts that the value one ascribes to a good (or to a right) will be stable, and unaffected by whether one already happens to own it. Much empirical evidence suggests the contrary.[129] The strength of the preference to own is seemingly irrationally contingent on whether or not one already does own. And the legal implications for the initial distribution of rights and resources are potentially profound.[130]

BLE scholarship presently lacks satisfactory explanations for this phenomenon.[131] The effort to model the behavior is complicated, scholars note, by seemingly peculiar variations, by context, in the size of the endowment effect. For example, in a famous series of experiments researchers discovered that the effect is present for drinking mugs, but absent for tokens representing the right to a mug.[132] While it is clear that, psychologically, losses loom larger than gains, BLE lacks any meta-explanation for *why* this is so. Was it just coin-flipping odds, for example, whether people would exhibit loss aversion instead of gain aversion—or whether recently acquired goods would be endowed rather than un-endowed (or "anti-endowed")?

Not likely. If we approach the endowment effect with a TSR lens, we can see that certain evolutionarily novel features make the endowment pre-

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Masters & Margaret Gruter eds., 1992) [hereinafter SENSE OF JUSTICE]; JAMES Q. WILSON, THE MORAL SENSE (1993); Dennis L. Krebs, *The Evolution of Moral Behaviors, in* HANDBOOK OF EVOLUTIONARY PSYCHOLOGY: IDEAS, ISSUES, AND APPLICATIONS 337 (Charles Crawford ed., 1998).

For recent discussion, see Jones, *supra* note 8; RUBIN, DARWINIAN POLITICS, *supra* note 94.

[128] Posner briefly aired an alternative, but still evolutionary, hypothesis in Posner, *supra* note 24. He suggested that rejection of unfair bargains may be a result of the adaptive value of pride. *Id.* at 1564.

[129] *See, e.g.*, Hoffman & Spitzer, *supra* note 95, at 89-90; Daniel Kahneman et al., *Experimental Tests of the Endowment Effect and the Coase Theorem, reprinted in* RICHARD H. THALER, QUASI-RATIONAL ECONOMICS 167 (1991); Jack L. Knetsch, *The Endowment Effect and Evidence of Nonreversible Indifference Curves*, 79 AM. ECON. REV. 1277 (1989); Jack L. Knetsch & J.A. Sinden, *Willingness to Pay and Compensation Demanded: Experimental Evidence of an Unexpected Disparity in Measures of Value*, 99 Q.J. ECON. 507 (1984); George Loewenstein & Daniel Adler, *A Bias in the Prediction of Tastes*, 105 ECON. J. 929 (1995).

[130] *See, e.g.*, Herbert Hovenkamp, *Legal Policy and the Endowment Effect*, 20 J. LEGAL STUD. 225 (1991); Rachlinski & Jourden, *supra* note 28; *see also* discussion *supra* subpart I.B.

[131] *See* discussion *supra* subpart I.C.

[132] *See* Daniel Kahneman et al., *Anomalies: The Endowment Effect, Loss Aversion, and Status Quo Bias*, J. ECON. PERSP., Winter 1991, at 193, 195-197; *see also* Jennifer Arlen et al., Endowment Effects, Other-Regarding Preferences and Corporate Law, Olin Working Paper No. 00-2 USC Law School at 45 (April 21, 2000) (unpublished manuscript, on file with author) ("As noted above, however, numerous studies have suggested that subjects tend not to endow goods that are predominantly stores of value for future trade or production.").

disposition seem irrational in present environments. Principally, the abstract notion of tradable "rights" to things, which we now take for granted, is a wholly modern invention in the history of mammals. Never before, in the history of natural selection, could a selection pressure have favored the ability to process information about a thing itself in precisely the same way as information about a *right* to a thing—even if such a trait were to have arisen.

This perspective may help explain some oft-noted but unexplained aberrations in observed endowment effects. For example, it helps explain experimental findings that a mug in hand is endowed, while a token representing a right to a mug is not.[133] The TSR perspective also suggests that while researchers have attempted to control for wealth effects,[134] the brain may still reflect a time-shifted rationality appropriate for ancestral environments that generally lacked any sequestrable overabundance of resources.

TSR also suggests another hypothesis: that the reason losses loom larger than gains, in humans, shares a common origin with the reason losses loom larger than gains in so many other species. There is much written in

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[133] I am not implying that people will be incapable, as a function of evolutionary history, of valuing tokens or money. I am suggesting that, as a product of TSR, the psychological mechanisms by which money is valued are hardly likely to be identical to the psychological mechanisms by which goods are valued—notwithstanding the fact that in today's environment it would be rational that they should be.

Moreover, it may be incorrect to conclude, as some have, from experiments matching goods with goods, goods with money, and money with tokens (a form of money), that goods are endowed while money is not. It would be interesting to know whether the endowment effect for a given good will be larger when that good is to be bought with or sold for money than when that good is to be bought with or sold for other goods. Although I have not researched the matter thoroughly, I have not yet come across any experiment that compares the size of the endowment effects, for a single good, in these two different contexts. Such an experiment might involve, for example, first establishing (through both selling and purchasing scenarios) the endowment effect for some number of mugs exchanged for cash, and then comparing that result to the endowment effect, similarly exposed, when some number of mugs are exchanged (again in both purchasing and selling scenarios) for some number of other valued goods, such as houseplants.

Note that this hypothesis is consistent with the otherwise unexplained experimental finding that the endowment effect for mugs is much smaller when transactions involved the sale for cash of vouchers for mugs, rather than the mugs themselves. One implication of this line of reasoning is that people will tend not to value the "right" to a thing as much as they will value the thing itself, since it is only trivially recently in human evolutionary history that a "right" to something could be traded (and thus only recently that selection pressures could begin to operate systematically on psychological mechanisms that value such intangibles). There is recent evidence consistent with this hypothesis. *See* Rachlinski & Jourden, *supra* note 28.

Note that there is some evidence, however, for the endowment of some kinds of rights, notwithstanding the apparent fact that many rights are wholly unendowed. *See* Russell Korobkin, *The Status Quo Bias and Contract Default Rules*, 83 CORNELL L. REV. 608 (1998). This clearly requires further study, both empirical work to identify distinctions between endowed and unendowed rights, and theoretical work to explain distinctions that may emerge.

[134] The wealth effect, simplified, is what makes a single sandwich more valuable to someone living in poverty than it would be to someone living in luxury.

behavioral biology documenting the widespread phenomenon in territorial systems that residents of a territory almost invariably defeat challengers.[135] Although the literature does not refer to it in terms of "endowment effects," observational and experimental evidence suggests that defenders of territory routinely ascribe a higher value to what they have than they ascribe to the same territory if they have to procure it from another. That is, they fight harder to defend a territory than they do to reacquire it, once it has been transferred to another. A leading hypothesis for this well-known and well-studied phenomenon is that there are payoff asymmetries favoring residents (as in, for example, the different future costs to challenger and resident of having to negotiate boundaries with neighbors). The adaptive value of a predisposition to hang on to what you have, once you have managed to get it, may provide both an empirical and a theoretical foundation for understanding and predicting the endowment effect in humans.[136]

C. Out of Bounds: A Summary

A principal insight of economics was to redescribe legal sanctions as prices. A principal insight of behavioral biology is to redescribe emotions, preferences, and other behavior-biasing, information-processing mechanisms as, in many cases, evolved adaptations (or in some cases by-products of adaptations) that increase the probability of behaviors that were useful in solving problems faced by our human and non-human ancestors. My argument is that these evolved adaptations underlie some of the seemingly irrational behavior that appears inconsistent with rational choice theory.

None of the examples just ventured above was intended to provide irrefutable proof that the phenomenon at issue is, in fact, a neurological artifact of our evolved brain. Rather, the examples were intended first to suggest the general contours of how a time-shifted rationality analysis might proceed and, second, to provide a sufficient sense of plausibility to warrant further future exploration. The purpose here is not to conclusively demonstrate a superior analysis of, for example, inter-temporal choice anomalies, but rather to suggest why it will generally be sensible to consider the TSR hypothesis, and to open the way for an entirely different approach to solving these puzzles than is currently employed in BLE

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[135] *See, e.g.*, GOULD & GOULD, *supra* note 75, at 132-35; L.D. Beletsky & G.H. Orians, *Territoriality Among Male Red-Winged Blackbirds*, 24 BEHAV. ECOLOGY AND SOCIOBIOLOGY 333 (1989); John R. Krebs, *Territorial Defence in the Great Tit (Parus major): Do Residents Always Win?*, 11 BEHAV. ECOLOGY AND SOCIOBIOLOGY 185 (1982); Joe Tobias, *Asymmetric Territorial Contests in the European Robin: The Role of Settlement Costs*, 54 ANIMAL BEHAV. 9 (1997).

[136] Posner apparently anticipated this argument, suggesting: "The only 'rights' in prehistoric society would have been possessory rights, and so people who didn't cling to what they had would have been at a disadvantage." Posner, *supra* note 24, at 1565. However, he favors the approach of traditional rationality, which he subsequently offers. *Id.* at 1565-67. Paul Rubin raises a similar possibility in DARWINIAN POLITICS, *supra* note 94, suggesting that individuals living at subsistence who did not overweigh losses would have left fewer offspring than those who did.

scholarship.

Presently, remember, we have *no* models that adequately explain and connect many instances of seemingly irrational behavior. This is, in part, because researchers have concentrated their efforts on discovering proximate causes for those behaviors to the exclusion of seeking the complement necessary for any complete explanation: the ultimate causes for those behaviors. Ultimate causation is the domain of behavioral biology. Behavioral biology is the principle tool of evolutionary analysis, which attempts to integrate proximate and ultimate explanations (from the social sciences and life sciences, respectively) into a coherent whole.

In sum, evolutionary analysis, through what we might usefully call time-shifted rationality, raises the hypothesis, soundly grounded in behavioral biology, that at least a significant subset of puzzlingly irrational behavior is not simply the result of cognitive defects, mechanistic constraint, or other procedural limitations that suggest we are uninformed, imperfect, mistaken, malfunctioning, misled, or otherwise uneducated in the wiley ways of proper decision making. In many cases, such irrational behaviors are probably the result of substantively rational behavior that simply surfaces in the wrong era, facing novel environmental conditions that render once-adaptive behavior maladaptive—and once rational behavior irrational. TSR analysis not only provides plausible explanations for a wide variety of existing puzzles, briefly surveyed above, but the single principle of TSR also links them all together, suggesting they are all manifestations of the same fundamental phenomenon.

TSR analysis, drawing upon existing research in behavioral biology, begins from the proposition that natural selection, a mindless process incapable of looking forward, inevitably leaves bodies and brains designed to overcome challenges posed in past, rather than present or future environments. TSR analysis then considers whether the environmental features that make a given irrationality manifest were likely to be encountered in the EEA—the deep, ancestral, environment of evolutionary adaptation. The less likely these features were to be encountered, the less likely it is that selection pressures unique to them could possibly have preferred brains that deal with them well—and therefore the more likely it is that well-honed, evolved cognitive processes are stumbling over newly changed circumstances.

The analysis then considers whether the content of the irrationality, that is, its substantive, patterned result, was likely to yield behavior that would have been adaptive, on average, when confronting situations commonly encountered during the EEA. The more likely such behavior was adaptive, the more likely it is, again, that evolved cognitive processes are now stumbling over novel conditions. Thus, sharp differences between modern environments and ancestral ones may yield a variety of seemingly irrational behaviors, including inconsistent preferences, overcooperativeness, intertemporal choice anomalies, hyperbolically discounted

futures, framing effects, a taste for spite, and the endowment effects that result in the seemingly irrational pricing of property.

In light of TSR, as explored above, it seems probable that we overeat because our evolved predisposition toward sweets encounters unprecedentedly concentrated foodstuffs. We cooperate with strangers, in part, because we evolved in small groups, with frequent opportunities for future reciprocities and powerful reputational effects, now substantially diminished due to increases in population size and individual mobility. We discount the future heavily because in the EEA there rarely was any reliable future. We think in frequency distributions, rather than statistical probabilities, because the latter is a recent and less concrete form of information. And we become attached to what we have because ancestral environments lacked "rights" to things not actually possessed, and because ancestral subsistence was never far from the margin.

The benefits of employing TSR are several. In appropriate cases, the hypothesis that a given irrationality may be the function of time-shifted rationality, rather than procedurally bounded rationality, helps us understand why the irrationalities are widespread. It helps us see how a number of supposed irrationalities can still be reconciled with a rationality framework. It helps us understand why the content of the irrationalities leads to errors in one direction rather than another. It shows us how the irrationalities can be linked together, at the theoretical level, into a coherent whole. It offers a tool for beginning to predict some of the contexts in which other seeming irrationalities are likely to emerge, and will help us to expect behavior that is currently thought to be so surprising.

We might end here. It may be useful to speculate briefly, however, about other implications of TSR that might be explored, in greater depth, in the future. The next Part provides some preliminary thinking about one line of research that may hold promise.

IV. LOOKING FORWARD: THE LAW OF LAW'S LEVERAGE

We can usefully consider law to be a lever for moving human behavior in directions it would not go on its own.[137] Law's fulcrum in this effort is

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[137] *See* Jones, *Proprioception, Non-Law, and Biolegal History*, *supra* note 7. Like other images from physics (momentum, inertia, flexibility, slippery slopes, and the like) the lever metaphor has been invoked, for many different purposes, in a wide variety of legal contexts. Sometimes, for example, it is used to emphasize the way a lever multiplies force, effecting large changes with small efforts. *See, e.g.*, E. Donald Elliott, *Environmental Law at a Crossroad*, 20 N. KY. L. REV. 1, 2 (1992) (using the concept of regulatory leverage to describe a ratio of government agency expenditures to consequently—and disproportionately large—redeployed behavior). Sometimes it is used to describe a force applied by threat of criminal conviction. *See, e.g.*, Seth F. Kreimer, *Releases, Redress, and Police Misconduct: Reflections on Agreements to Waive Civil Rights Actions in Exchange for Dismissal of Criminal Charges*, 136 U. PA. L. REV. 851, 929 (1988) ("Both the tradition of legal ethics and the common law definition of extortion suggest that the use of possible criminal prosecution as leverage to obtain advantage in a civil lawsuit is inappropriate."); Rachel Ratliff, *Third-Party Money Laundering: Problems of Proof and*

the behavioral model it employs. Ideally, the model should integrate the best information available on why people behave the ways they do. For just as a lever's efficiency depends on the solidity of its fulcrum, law's efficiency in moving behavior depends on the accuracy of its behavioral model. As demonstrated earlier, it is often the case that one needs to integrate both *proximate* and *ultimate* causes of behavior to generate a truly robust explanation, on which law's lever may lean.[138]

Because the social sciences were artificially divided from the life sciences in some distant past, social sciences traditionally investigate and discover only proximate causes for behavior. This works serviceably in many contexts, but is inadequate to the task of meeting some important challenges of actual human behavior, such as those posed by seemingly irrational behavior. Considering irrational phenomena from an ultimate causation or evolutionary history perspective reveals the probability that much bounded rationality is really time-shifted rationality, as we have seen.

While this is useful in itself, the implications of TSR extend far beyond irrationality alone. The TSR approach described above also contributes directly to improving the model of human behavior on which law relies in other contexts. As this Part will briefly explore, the power of TSR to uncover causes and patterns of previously disconnected behavior may eventually offer two additional advantages.

First, an evolutionary analysis, deploying the TSR tool, could provide broad insights into the differing ways law and behavior interact, depending on the behavior at issue. Because we are alert to the fact that the brain tends to process information in ways that tended to yield adaptive solutions to problems encountered in the environment of evolutionary adaptation, we may expect that behavioral inclinations will generally vary in their susceptibility to the influence of different legal tools. More specifically, evolutionary analysis may offer useful explanations and predictions about the

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Prosecutorial Discretion, 7 STAN. L. & POL'Y REV. 173, 181 (1996) ("To counter these incentives to keep quiet, prosecutors often use the leverage of a potential criminal charge."). It is often used to describe the economic effects of market power. *See, e.g.*, Louis Kaplow, *Extension of Monopoly Power Through Leverage*, 85 COLUM. L. REV. 515, 515 (1985) (discussing the "ability of firms to use restrictive practices to leverage their monopoly power from one market to another"). And it has been used in the context of civil disputes as well. *See, e.g.*, Ira Mark Ellman, *The Theory of Alimony*, 77 CALIF. L. REV. 1, 7 (1989) ("The fault rules gave great bargaining leverage to the spouse who felt no urgency to end the marriage....").

My own use of the lever metaphor has been for highlighting the necessary existence of a "fulcrum," which I suggest best represents the point of transfer between the energy vested in law and the behavior we hope to achieve with the tools of law, and also best focuses attention on the utter dependence of law on solid knowledge about human behavior. *See, e.g.*, Owen D. Jones, *Law, Value-Clarification, and Legal Policy*, address at the *Human Behavior and Evolution Society* Annual Meeting (June 1995); Owen D. Jones, *Law and Biology: Toward an Integrated Model of Human Behavior*, 8 J. CONTEMP. L. ISSUES 167, 167 (1997); Jones, *Proprioception, Non-Law, and Biolegal History*, *supra* note 7.

[138] As a reminder, "proximate cause" and "ultimate cause" are biological terms of art, explained earlier in subpart II.A.

comparative difficulties law will encounter, and the comparative regulatory costs society will therefore pay, in attempting to move particular behaviors with particular tools (such as prison time).[139] This is because, using evolutionary analysis, we can systematically derive useful predictions about the *relative* slopes of demand curves for different behaviors.[140] We have, of course, empirical information that helps us to describe these, after the fact. But at present we have very little *theoretical* foundation that systematically explains and predicts relative variations in demand curves.[141] A collateral benefit of this approach is that such evolutionary analysis will also suggest contexts in which some *kinds* of legal tools may be more effective in moving behaviors than other kinds.

Second, evolutionary analysis, deploying the TSR tool, can provide a new lens to view previously hidden features in the architecture of legal systems.[142] In much the same way that the lens of efficiency offered by economic analysis helped us see how current law reflects the selective pressure of efficiencies, the ultimate causation lens that evolutionary analysis provides can help us see how current law reflects the effects of evolutionary processes on the human brain. And as twinned lenses enable three-dimensional sight, greater than the sum of its two parts, so might joining ultimate causation and proximate causation enable a broader, richer, more detailed, more accurate, and more penetrating view of law.

These are bold claims, not idly made. Although a full exploration and defense of them would require separate publication, in what follows I provide short overviews and examples to explain how this line of reasoning might proceed, to draw some new connections, and to illustrate the potential promise of this approach.

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[139] Professor Wax adverts to a similar point in Amy L. Wax, *Against Nature—On Robert Wright's* The Moral Animal, 63 U. CHI. L. REV. 307, 330-335 (1996) (book review). Although my emphasis here is on costs incurred by society in regulating behavior, it is worth noting that regulated individuals may also incur costs. The Amicus Brief of the Gruter Institute, *In re* Baby M., 537 A.2d 1227 (N.J. 1988), argued, for instance, that "To avoid needless human suffering, rules of law should be framed in harmony with the rules that nature has built into the biology of our species, except where some clear ground of public policy dictates otherwise." I am grateful to Donald Elliott for pointing out this passage.

[140] I will adopt the common but imprecise convention of using variations in slope to capture the idea of variations in elasticity by, for example, describing inelastic demand with a steeply sloped demand curve. Technically, the elasticity of a demand curve, and the curve's slope, are not the same. Slope depends on the rate of change in price and quantity, while elasticity depends on percentage changes. On every straight-line demand curve, elasticity varies from infinity, at the vertical axis intercept when quantity demanded is zero, to zero, at the horizontal axis when price per unit is zero. The curve below the midpoint (at which elasticity is precisely one) is therefore inelastic while the curve above the midpoint is elastic. However, it is common to refer to flatter or steeper slopes as reflecting elasticity or inelasticity, respectively, because in the former case we tend to focus on the upper half of the curve, and in the latter case on the lower half.

[141] This may be one reason why some economists are so fond of the convenient assertion that "there is no accounting for tastes."

[142] Note that a number of the sources cited *supra* note 7 have also attempted to explore the effects of human behavioral biology on modern legal features.

This Part consists of two subparts, which track the two advantages described above: 1) estimating relative costs for moving different behaviors; and 2) revealing underlying legal structures. The subsequent (and final) Part of the Article anticipates and evaluates objections.

A. Comparative Responsiveness to Sanctions

Traditional economic analysis predicts that if we increase the cost of a good, the demand for that good will generally decrease—along a curve that describes how much people want the good at any given price (given available resources and substitute goods). Because this principle operates for behaviors, as well as for goods, we often consider legal sanctions as prices, when attempting to calculate the effect on behavior that an increase in the legal sanction (a fine or a jail term, for example) will yield.

Because sanctions are often costly in themselves, it would be useful to have some sense, ahead of time, of the probable return on investment in sanctions. Nonetheless, we lack theoretical models to predict systematically whether the retreat along the demand curve, as penalties rise, will be fast or slow, reflecting price sensitivity or insensitivity.[143] The principle introduced in the next section, though it cannot predict such curves with *precision,* may eventually afford us some intellectual traction on the effort and at least allow predictions about the *comparative* slopes of demand curves for law-relevant behaviors. It may thus afford some basis for estimating relative costs, to society, of attempting to move different kinds of behavior.

1. The Law of Law's Leverage.—Combining the principles of behavioral biology summarized in Part II, with the principle of time-shifted rationality, articulated in Part III, would appear logically to yield a broad and useful description of the relationship between law and behavior. We might refer to this as *the law of law's leverage,* which I suggest may be formulated as follows:

> The magnitude of legal intervention necessary to reduce or to increase the incidence of any human behavior will correlate positively or negatively, respectively, with the extent to which a predisposition contributing to that behavior was adaptive for its bearers, on average, in past environments.

That is, the law of law's leverage describes the phenomenon in which the aggregate difficulty of using law to reduce the incidence of any behavior

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[143] Indeed, it is likely the case that some of the behaviors we label as irrational seem irrational only because the demand for them seems so much more inelastic (with the relevant part of the demand curve steeper) than traditional economic or social science thinking can systematically explain. A large increase in legally imposed sanctions for behavior results in disproportionately small reductions in the incidence of the behavior at issue. For example, studies indicate that the most common variety of homicides results from seemingly trivial altercations, the swift and violent resolution of which cannot plausibly be thought to stack up against the penalty (even discounted by the probability of apprehension and conviction). *See generally* MARTIN DALY & MARGO WILSON, HOMICIDE 125 (1988).

depends on the extent to which that behavior, or the psychological mechanism influencing it, was adaptive for its bearers, on average, in the relevant environment of evolutionary adaptation. Resistance to change will vary in patterns reflecting evolutionary influences on behavior. Similarly, the aggregate difficulty of using law to increase the incidence of any behavior will decrease with the extent to which that behavior, or the psychological mechanism influencing it, was adaptive for its bearers, on average, in the relevant environment of evolutionary adaptation. Several aspects of this formulation require separate explanation.

The law of law's leverage predicts that less legal intervention will be necessary to shift a behavior in ways that tended to increase reproductive success in ancestral environments than will be necessary to shift behavior in ways that tended to decrease reproductive success in ancestral environments. Put another way, the slope of the demand curve for historically adaptive behavior that is now deemed to be socially (in some cases even individually) undesirable will be far steeper than the slope of the demand curve for behavior that was comparatively less adaptive in ancestral environments.[144] Importantly, this relationship between the slopes will hold, even when the costs that an individual actually and foreseeably incurs in behaving in an historically adaptive way will exceed presently foreseeable benefits of such behavior.

By use of the language "magnitude of legal intervention" I refer in most instances to costliness. Greater resistance to change will increase the cost of effecting change. However, it is important to note, as a caveat, that assessing the magnitude of legal intervention may in some cases require separate attention to the severity of an intervention (e.g., the harshness of a penalty). This is because, although in the typical case increased severity will simply yield increased costs, there may be unusual cases in which severe interventions are less administratively cumbersome, and therefore less costly, than are less severe interventions, which may at times be preferred because other values are in some tension with the value of changing the behavior at issue.

By use of the language "the extent to which" a predisposition contributing to the behavior was adaptive to its bearers, I mean to underscore the fact that while members of a species share a variety of different adaptations, some are comparatively more essential than others. In a primate species, for example, hunger is more essential to survival than a capacity for empathy. And the abilities to distinguish kin from non-kin, and male from female, are more essential than are many other psychological adaptations. Admittedly, not all comparisons are easily made. The utility of some adaptations depends on the existence of others, and both physical and behavioral adaptations are necessarily intertwined (as in the context of sexual coupling, for example). But there is value in even the rough sorting of adaptations

[144] *See supra* note 140.

along a continuum of importance, for even the rough theoretical structure this affords is better than none.

By use of the language "a predisposition" I refer to a psychological trait that is a heritable and behavior-biasing algorithm manifested in the brain's neural architecture.

For a behavioral predisposition to be "adaptive," it must have conferred greater fitness benefits on individuals that bore it than did any other contemporaneously existing alternatives exhibited by other individuals within the population—and thus have been maintained by natural selection.[145] As always, genetic fitness is measured in terms of inclusive fitness (rather than in offspring only, for example). Thus, an individual's overall fitness calculation takes into account the extent to which an individual has increased the reproductive success of its relatives, discounted by their degrees of consanguinity.[146]

The use of the language "on average" in the law of law's leverage refers to whether the cumulated effects of the adaptation, across all the organisms that bore it, yielded increases in inclusive fitness that outweighed any decreases. That is, "on average" the trait increased the reproductive success of organisms that bore it. Thus, the occurrence of maladaptive outcomes for some individuals, even in the environment of evolutionary adaptation, is not dispositive of the adaptation analysis, since it is only the average effect that matters.[147] "On average" does not refer to the average fitness consequences within a single individual, throughout its lifetime. Nor does it refer to any net of fitness effects of all behavioral traits an organism simultaneously manifests.

"Past environments" refers to the environment of evolutionary adaptation (EEA). The relevant environment of evolutionary adaptation varies from feature to feature.[148] For example, the EEA from which the opposable thumb emerged doubtless antedated the EEA in which language acquisition predispositions emerged. And there is some debate over how to best describe the EEA for various adaptations. Nonetheless, there are a number of things we can know with confidence about features that our ancestors' envi-

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[145] *See* ALCOCK, *supra* note 75, at G-1 (defining "Adaptation").

[146] On reproductive success and inclusive fitness, see *supra* note 83.

[147] *See* ALCOCK, *supra* note 75, at G-1 (defining "Adaptation"); FUTUYMA, *supra* note 75, at 149-83. Robert Wright illustrates this with the image of a ground squirrel sentry.

> If the warning call saves the lives of four full siblings that would otherwise die, two of which carry the gene responsible for it, then the gene has done well for itself, even if the sentry containing it pays the ultimate sacrifice. This superficially selfless gene will do much better over the ages than a superficially selfish gene that induced its carrier to scurry to safety while four siblings—and two copies of the gene, on average—perished.

WRIGHT, *supra* note 75, at 158.

[148] Useful discussion of the variety of views on this point appears in Martin Daly & Margo I. Wilson, *Human Evolutionary Psychology and Animal Behaviour*, 57 ANIMAL BEHAV. 509, 512-14 (1998); Robert Foley, *The Adaptive Legacy of Human Evolution: A Search for the Environment of Evolutionary Adaptedness*, 4 EVOLUTIONARY ANTHROPOLOGY 194 (1995-1996).

ronments did and did not contain. (For example, they contained internal fertilization, giving rise to sex asymmetries in minimum parental investment and maximum number of offspring; they did not contain automobiles). And it is to these features that analysis must refer.

The full-fledged phrasing, to put it more accurately, if much more cumbersomely, is this: the law of law's leverage states that the magnitude of legal intervention necessary to reduce or to increase the incidence of any human behavior will correlate positively or negatively, respectively, with the extent to which a behavior-biasing, information-processing predisposition underlying that behavior (a) increased the inclusive fitness of those bearing the predisposition, on average, more than it decreased it, across all those bearing the predisposition, in the environment in which it evolved and (b) increased the inclusive fitness of those bearing the predisposition more, on average, than did any other alternative predisposition that happened to appear in the environment during the same period.

This law of law's leverage I have proposed offers one possible explanation for why some of what we refer to as non-market behavior *is* non-market behavior. Non-market behavior is essentially behavior that is relatively insensitive to price changes. What I am arguing is that non-market behavior is precisely that behavior that will be predicted to be comparatively insensitive to prices as a result of the law of law's leverage. That is, non-market behavior arises because of the effects of evolutionary processes on our brain's information-processing patterns. Ironically, it is precisely the economizing force of natural selection that gave rise to the behavioral predispositions we now deem to be beyond simple economic analysis, because the origins and strengths of preferences seemed so mysterious.

Because of the way natural selection builds brains, legal contexts in which the law of law's leverage may be particularly relevant include those aspects of, for example, constitutional law, criminal law, family law, torts, property, and contracts, that involve such things as the following:

mating;
fairness;
homicide;
child-rearing;
status-seeking;
property and territory;
resource accumulation;
sexuality (including infidelity and jealousy);
speech;
privacy;
empathy;
crimes of passion;
moralistic aggression;
risk-valuation and risk-taking;
cooperative/altruistic behavior;
male mate-guarding and related violence.

Behavioral biology suggests there are evolutionary underpinnings to the essential elements of each of these activities. This list of contexts in which the law of law's leverage predicts costly challenges for law circumscribes a great deal of human behavior. By doing so, it begins to highlight the essential connection between behavior, on one hand, and emotions, tastes, norms, and preferences, on the other. That connection is not as in-

scrutable to the methods of scientists and legal thinkers as often supposed, because the content of emotions, norms, and the like will tend, like every other domain of human behavior, to reflect the evolutionary forces that have inclined human brains to the form and function they now exhibit.[149]

2. Examples.—While explanation is not justification, explanation surely provides information useful to any efforts to change human behavior through the mechanisms of law. Here are several examples of contexts in which the combination of existing biobehavioral research and the law of law's leverage may operate to make sense of behaviors that historically have been comparatively insensitive to legal interventions.

The cornerstone of an economic approach to crime is that increasing the price of engaging in an illegal activity will tend to decrease the incidence of that activity. While this may be true as a general matter, we know there are many contexts in which illegal behavior is likely to be relatively insensitive to the magnitude of legal sanctions, in ways that traditional economic theory cannot predict. Examples include what we have come (as a function of tautology, rather than theory) to call crimes of "passion," such as killing the lover of a spouse caught in flagrante delicto, or killing a daughter's rapist.[150]

It is intuitively obvious to us that laws prohibiting such behavior are unlikely to be effective deterrents. This is a remarkable admission. The question is: why? Why is this intuitively obvious, and by what theoretical mechanisms could we predict the pattern in which behaviors will be less sensitive to cost? Evolutionary analysis provides an important window into the kinds of contexts in which increasing criminal penalties is simply unlikely to materially affect behavior. It may eventually help to delineate more clearly and to explain more satisfactorily the boundaries beyond which the rational actor model ceases to operate in the usual straightforward way.

A short survey of several examples illustrates the potential of this approach. Evolutionary analysis predicts that, and explains why, the slope of the demand curve for adulterous behavior is likely to be comparatively

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[149] Among sources to consider the relationship between biology, morality, and norms are the following: ALEXANDER, *supra* note 127; RICHARD D. ALEXANDER, DARWINISM AND HUMAN AFFAIRS (1979); ARNHART, *supra* note 127; DE WAAL, *supra* note 127; DANIEL C. DENNETT, DARWIN'S DANGEROUS IDEA: EVOLUTION AND THE MEANINGS OF LIFE (1995); INVESTIGATING BIOLOGICAL FOUNDATIONS, *supra* note 127; RICHARD A. POSNER, THE PROBLEMATICS OF MORAL AND LEGAL THEORY (1999); RIDLEY, *supra* note 127; SENSE OF JUSTICE, *supra* note 127; WILSON, *supra* note 127, WRIGHT, *supra* note 75; Jones, *supra* note 8; Krebs, *supra* note 127.

[150] For analysis of how evolutionary processes affect attitudes toward rape, see Jones, *Sex, Culture, and the Biology of Rape*, *supra* note 7. Incidentally, I do not mean to suggest that there is a predisposition toward killing in such contexts, rather than aggressing generally. It is possible that such predispositions exist. *See* David M. Buss & T. K. Shackelford, *Human Aggression in Evolutionary Psychological Perspective*, 17 CLINICAL PSYCHOL. 605 (1997). But even a predisposition to aggress that only sometimes leads to killing as a by-product is sufficient to have the implications mentioned here.

steep[151] (as is the slope for most sexual behavior) and thus comparatively insensitive to the imposition of legal prohibitions (or other costs, such as effect on career). Evolutionary analysis also predicts that, and may help explain why, marriage, separation, divorce, and remarriage behavior will be less sensitive to legal changes than will be many other forms of behavior.[152] Because, as we know, natural selection disfavors inbreeding among close relatives, evolutionary analysis also and separately predicts that it will be far less costly to discourage incest among parents and their natural children, and between siblings reared together, than among stepparents and stepchildren, and among stepchildren.[153] Because we know that natural selection favors discriminative parental solicitude rather than indiscriminate parental solicitude (that is, it generally favors psychological mechanisms that bias resources toward offspring over non-offspring), we can explain and anticipate that the cost of reducing child abuse will be greater, per capita, for stepparent households than for non-stepparent households.[154] Similarly, we can predict that men under court-order to provide child support payments for a child they know or suspect they did not father will be less likely to comply than will biological fathers.[155]

One of the principal implications of natural and sexual selection is that the sexes will be somewhat differently inclined in domains related to mating. And both the theoretical and empirical foundations for expecting males to be more sexually jealous than females (only on average, of course) are very well established.[156] (The asymmetries for males and females of in-

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[151] *See generally* BUSS, *supra* note 75.

[152] *See generally* HELEN E. FISHER, ANATOMY OF LOVE: THE NATURAL HISTORY OF MONOGAMY, ADULTERY, AND DIVORCE (1992). For a recent study on the relative insensitivity of divorce rates to divorce laws, see Ira Mark Ellman & Sharon L. Lohr, *Dissolving the Relationship Between Divorce Laws and Divorce Rates*, 18 INT'L REV. L. & ECON. 341 (1998).

[153] Some studies suggest that a girl is much more likely to be incestuously abused by a stepfather than by a biological father. *See, e.g.*, Diana E. H. Russell, *The Prevalence and Seriousness of Incestuous Abuse: Stepfathers vs. Biological Fathers*, 8 CHILD ABUSE & NEGLECT 15 (1984) (noting that it is eight times more likely). Moreover, the severity of incestuous abuse appears to be greater with stepfathers. *Id.* Existing data are mixed, however, with some studies suggesting little distinction. *See generally* JUDITH LEWIS HERMAN & LISA HIRSCHMAN, FATHER-DAUGHER INCEST (1981). On the human tendency to avoid brother-sister incest where siblings are reared together, see GOLDSMITH, *supra* note 75, at 9-10.

[154] The risk of an infant being killed by a parent is more than 100 times greater if there is a stepparent in the house than if there is not. *See, e.g.*, DALY & WILSON, *supra* note 143, at 89; Jones, *Evolutionary Analysis in Law*, *supra* note 7, at 1207.

[155] *See* Margo Wilson, *Impact of the Uncertainty of Paternity on Family Law*, 45 U. TORONTO FACULTY L. REV. 217, 223 (1987) (citing S.H. Fritschner, The *Nature of Paternity Actions*, 19 J. FAMILY L. 475, 492 (1980-81)). I am grateful to David Buss for first alerting me to this possibility. For an account of a man paying child support for 3 children that DNA analysis proved not to be his, see Tamar Lewin, *In Genetic Testing for Paternity, Law Often Lags Behind Science*, NEW YORK TIMES, March 11, 2001, at A1.

[156] *See, e.g.*, DAVID M. BUSS, THE DANGEROUS PASSION: WHY JEALOUSY IS AS NECESSARY AS LOVE AND SEX (2000); FISHER, *supra* note 152; David M. Buss et al., *Sex Differences in Jealousy: Evo-*

ternally fertilizing species in the consequences of a partner having extra-pair copulation favored sexual territorialness in males even more strongly than it did in females, since only males can be uncertain of their genetic relationship to their putative children.) Evolutionary analysis therefore predicts that the slope of the demand curve for jealous violence (against rivals, and potentially straying partners) is likely to be steeper, on average, for males than for females.

One of the most significant findings of modern criminology is that most homicides arise from seemingly trivial altercations. One boy gives the finger to another boy, in public. The latter shoots him. We can be reasonably confident, of course, that the shooter is generally motivated more by emotion than by deliberate calculus. But evolutionary analysis offers a robust theory for why males, in particular (and young males, more specifically) are so emotionally aroused by perceived threats to status, one of the most valuable of resources.[157] It suggests that threats to status are of greatest cost when there are observers whose opinions are valued (as if as assets) by the threatened individual. It therefore predicts that the slope of the demand curve for violence consequent to status threats will be steeper than that for most other proscribable behavior, and will be particularly steep in public fora.

And, beyond aiding us in evaluating the inertia law must overcome, when attempting to shift different behaviors, evolutionary analysis may provide a useful window into the relative effectiveness of different legal techniques used to shift behavior. For example, scholars and judges have recently rejuvenated punishments that impose reputational costs rather than monetary costs.[158] The idea is that locally publicizing the name of tax cheats, for example, may be a more effective deterrent than stiff but private monetary penalties. Those not informed of evolutionary theory may underestimate the value people place on local status, value that is readily susceptible to evolutionary analysis.

B. The Architecture of Law

As we look across our culture and others, at the various architectures of law, we see a variety of patterns. Certainly, there are many differences in the details. But that cannot obscure the fact that the main themes are generally the same.[159] Great bodies of law address the disposition, control, use,

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lution, Physiology, and Psychology, 3 PSYCHOL. SCI. 251 (1992); Martin Daly et al., *Male Sexual Jealousy*, 3 ETHOLOGY & SOCIOBIOLOGY 11 (1982).

[157] *See, e.g.*, DALY & WILSON, *supra* note 143; David M. Buss & T.K. Shackelford, *Human Aggression in Evolutionary Psychological Perspective*, 17 CLINICAL PSYCHOL. 605 (1997); Daly & Wilson, *supra* note 148.

[158] *See, e.g.*, Stephen P. Garvey, *Can Shaming Punishments Educate?*, 65 U. CHI. L. REV. 733 (1998); James Q. Whitman, *What Is Wrong with Inflicting Shame Sanctions?*, 107 YALE L.J. 1055 (1998).

[159] *See, e.g.*, DONALD E. BROWN, HUMAN UNIVERSALS (1991).

and exchange of resources, separate permissible from impermissible sexual behavior, define privileges and obligations of child rearing, and the like. We see allowances made for the sometimes-undesirable behaviors of "reasonable" people. We see forced sexual intercourse as a uniquely unconscionable affront to body and psychology. We see armed conflicts over territory and attempted constraints on the exercise of aggression. And, even in our own federal Constitution, we see basic assumptions about human nature: ambition exists, and unrestrained it yields disproportionate concentrations of power and resources.[160]

To our perennial question "Why is the law the way it is?" have been offered a variety of answers, having recourse to, for example, God, the politics of power, and the principles of efficiency. To these and like others, evolutionary analysis may eventually submit another.

Viewed from the perspective of the law of law's leverage, the configuration of all legal systems will tend to reflect their encounters with human brains shaped by natural selection. The law of law's leverage can therefore reveal previously underappreciated forces at work in shaping law, the evidence of which is manifest in legal and social institutions. And it will be as evident in what we attempt to regulate by legal means as it is in what we do not.

Take, for example, a hypothetical legal rule that required an adult, in a crisis situation involving both her children and the children of others, to save children in order of their ranked intelligence (or any other desirable characteristic), irrespective of her own relatedness to each. We know that such a legal rule would be absurd. But why? It is not because the rule would lead to inefficient outcomes. To the contrary, the outcome might increase social wealth compared to the alternative.

It is not enough to say that powerful social norms would generate irresistible emotions in the woman to save her own children, because it so happens that we would expect the same behavior from parents all over the world, regardless of the many vicissitudes of culture. We know the rule would be absurd because we intuitively sense that the preference to save one's own child would be insensitive to variations in legal costs we might impose in an effort to shift the behavior—all over the planet, in every human culture. The theoretical basis for that sense of relative inelasticity of the demand for certain behaviors, in certain contexts, is not simply acculturation alone, but the law of law's leverage, as derived from the effects of evolution on human behavior-biasing psychological predispositions.

This may help to explain a variety of common features in the architecture of law. For example, why do people find the right to marry to be so

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[160] *See, e.g.*, John O. McGinnis, *The Human Constitution and Constitutive Law: A Prolegomenon*, 8 J. CONTEMP. LEGAL ISSUES 211, 229-239 (1997); John McGinnis, *The Primacy of Nature: A Prolegomenon to Evolutionary Political Science*, HARVARD REVIEW OF PHILOSOPHY STUDIES IN HUMAN NATURE, Occasional Paper No. 2 (2000).

important? Why is adultery almost never prosecuted? Why does reproductive decision-making pose such contentious issues? Why is rape so uniquely offensive, compared to other physical assaults? Why is it not possible to write a prenuptial marriage contract that legally binds a new couple to a detailed program of behavior through the course of their marriage?[161] What provides the theoretical basis for employing a reasonable person standard? Why are crimes of passion routinely afforded less punishment than other crimes, and how have we decided what they are?

It is commonly noted that economics "laid bare the architecture of the common law by showing how much of it could be derived from the axioms of economics."[162] Much of it can be. But an evolutionary analysis may eventually supply an even broader perspective on the legal institutions of the human animal.[163] That perspective is not only often consistent with the axioms of economics, it also demonstrates that much of those areas that economic theory has not successfully penetrated can be understood to be a product of the relentlessly economic influences of natural selection.

The law of law's leverage, for example, can be described as an intensely powerful winnowing force that explains a great deal of the laws we have, as well as the laws we don't have. One of the limits on law-making has been not only the fact that inefficient legal rules tend to disappear faster than efficient ones, but also that legal rules that would be extremely difficult to enforce tend not to be enacted, even if they would otherwise lead to highly desirable outcomes. In this way, light from the law of law's leverage tends to silhouette the small proportion of all possible legal rules that are not far too costly, because of evolved human psychology, to even consider.

C. Summary

None of the examples speculatively ventured in Subparts A and B of this Part was intended to provide irrefutable proof that either the varying responsiveness of human behavior to changes in incentives or the underlying features of legal systems can only be explained as neurological artifacts of our evolved brain. Rather (and as in the case of TSR, earlier), the examples are intended to first suggest the general contours of how analysis using the law of law's leverage might proceed, and to subsequently provide a sufficient sense of plausibility to warrant further exploration. The purpose of this Part is not to conclusively demonstrate a superior analysis of, for example, why sexual behavior is less pliable to legal tools than is jaywalking behavior, but rather to open the way for an entirely different approach to

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[161] Theodore C. Bergstrom poses this question in *Economics in a Family Way*, 34 J. ECON. LITERATURE 1903, 1929-30 (1996).

[162] Baird, *supra* note 15, at 1132. For overviews, see, for example, BARNES & STOUT, *supra* note 125; POSNER, *supra* note 10.

[163] I further explore this possibility in Jones, *Proprioception, Non-Law, and Biolegal History*, *supra* note 7.

solving the mysteries of patterned variation in human responsiveness to changes in legal incentives.

Presently, remember, we have no satisfactory models to explain and connect existing data on differing slopes of demand curves for different law-relevant behavior. This is probably because we have neglected the problem, dismissing variation as borne of causes that are either categorically inscrutable or randomly generated by the *deus ex machina* of culture.

Evolutionary analysis of behavior, focusing on brain design and function, is today providing a far richer understanding of these behaviors than has been previously obtained. Integrating this perspective with law can provide a systematic way of organizing, explaining, and predicting the contexts in which demand for behavior will be least sensitive to prices imposed by law. This, in turn, is important for the legal system, because it enables a systematic comparative assessment of the costs to society of attempting to change these behaviors, and variations in these costs may help to explain why some of the main features of law are as they are.

V. OBJECTIONS CONSIDERED

This Part considers several likely objections to employing time-shifted rationality and the law of law's leverage in legal analysis.[164]

A. Ad Hocery

Critics sometimes fault evolutionists for seeking to explain everything in evolutionary terms, on the premise that a principle explaining everything explains nothing. That criticism might extend with equal force to time-shifted rationality as a partial explanation for some seemingly irrational behavior.[165] This general criticism of evolutionary reasoning has intuitive appeal and in some instances has undoubtedly helped chasten theorists against too-facile hypotheses, which sometimes seem to be ad hoc. The challenge, of course, is to distinguish between more and less legitimate hypotheses. And in our efforts to do so, three things bear noting.

First, it is quite clear that an effort to reconcile every observable behavior with evolutionary history is insufficient, by itself, to render all resultant explanations ad hoc. By comparison, we observe that rocks fall, birds fly, and hot air balloons rise. But we would never fault a physicist for claiming that each of these phenomena—no matter how disparate—must either rec-

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[164] I consider several additional objections to evolutionary analysis in Owen D. Jones, *Evolutionary Analysis in Law: Some Objections Considered*, 67 BROOK. L. REV. (forthcoming 2001). As this is no venue for a broad rebuttal to criticisms of evolutionary theory generally, readers interested in challenging the value or robustness of evolutionary theory may find numerous other places in which such rebuttals are undertaken. *See, e.g.*, DOUGLAS J. FUTUYMA, SCIENCE ON TRIAL: THE CASE FOR EVOLUTION (1983). A number of the sources cited *supra* note 75 are also useful.

[165] Coincidentally, it might also be extended to commonly encountered assertions that all human behavior can be explained by socialization or culture and similar environmental determinism.

oncile with the theory of gravity or overthrow it. We make this strong claim because the theory of gravity, while not perfect, is backed by such overwhelming evidence that we consider it very robust. The first time we see a balloon rise as a rock falls we may be puzzled, but we would neither abandon the theory of gravity nor denounce its practitioners for attempting to sweep too much under its auspices. Attraction of object to object by gravitational forces is foundational, and while it may take time to puzzle out how things may rise or fall, we are confident that the mechanisms by which they do so reflect the relentless effects of gravity.

Similarly, it is not only acceptable but presently required as a matter of modern science and logic that we start from the presumption that all human behavior, whether rational or irrational, cooperative or competitive, must in the end reconcile with known evolutionary processes—or overthrow them. While there are still debates about details of evolution on the margin (just as there continue to be debates among those studying gravity), the process of evolution by natural selection is no less robust than the gravitational attraction of mass to mass. We may not know by what precise pathways evolutionary processes (such as natural and sexual selection) leave a big-brained species capable of widespread, species-typical errors in judgment. But that they have remains undisputed. We may not yet discern the cognitive processes by which we reach specific decisions, develop our various preferences, or give content to emotional realities. But that the cognitive processes must inevitably reflect both the guiding and scarring of evolutionary processes has not been significantly challenged by any comprehensive, alternative, nonsupernatural theory.

Second, it would be error to conclude that, simply because every behavior must square with evolutionary history or overthrow it, each causal hypothesis is as easy as another, affording no basis for preference or rejection. One occasionally hears the view that evolutionary theories may be disregarded, because their explanations necessarily cut equally in opposite directions. This criticism seems to be based on the mistaken belief that one can often, perhaps always, construct two equally plausible evolutionary accounts that could explain both what is observed and the opposite of what is observed.[166]

For example, a critic might think that evolutionary processes are just as likely to have favored perfect rationality as irrationality, and conclude on that basis that evolutionary theorizing can offer nothing reliable at present to the study of irrationality. After all, would it not be adaptive to be able to reason without logical flaws? But such thinking would reflect a serious misapprehension of the very basics of evolutionary processes. Specifically, the fact that natural selection would have favored a trait, *if it arose*, says precisely nothing about the likelihood that the trait exists. Evolution is path-dependent (you must always get here from there), with natural selec-

[166] *See, e.g.*, Jolls et al., *supra* note 65, at 1600.

tion inexorably sifting among contemporaneously existing heritable traits (varying by genetic mutation). Such sifting favors reproductively useful traits, but it does not create them. For, as zoologist Richard Dawkins once put it, no one would expect pigs to have wings, even if they would come in handy from time to time. And, similarly, natural selection cannot build an all-purpose optimizing machine, even if it would be beneficial to have one.[167]

Natural selection cannot look forward. Problems do not generate mutational solutions. And natural selection never guarantees perfection. Whatever heritable abilities exist exist only because they were left over after alternative traits, somewhat less likely to contribute to reproductive success, were gradually swept away in the relentless process that affords compounded gains over time to even small reproductive advantages. We have absolutely no reason to believe that evolutionary processes have afforded us an optimal brain, or one capable of choosing and inclined to choose the most appropriate behavior for achieving any end—even reproductive success. It just doesn't work that way. Consequently, evolutionary hypotheses are always seriously constrained by the empirical facts of our own evolutionary history, by the limits of what evolution can achieve, and the significantly channeled processes by which it achieves anything.

B. Parsimony

A thoughtful critic of the evolutionary analysis that undergirds time-shifted rationality and the law of law's leverage may object that it is unparsimonious, and therefore to be disfavored. Existing economic or behavioral economic approaches (this logic might go) are simple, and they ignore behavioral biology wholesale. The approach I recommend would seem to require additional, seemingly over-complicating assumptions about the influence of evolutionary processes on behavior.

Parsimony is a useful and principled reason to prefer one theory—a simpler one—to another one that is more complex, requiring more assumptions. We should, as a general rule, prefer more parsimonious explanations to less parsimonious ones, at least as a starting point. It is an underappreciated fact, however, that simplicity has never been the sole prerequisite of parsimony. The principle of parsimony requires a rebuttably presumptive preference for the simplest theory *that is consistent with known (or at least accepted) facts*. Such facts include the evolution of the human brain by natural selection. And thus no theory that posits the existence of a brain natural selection could not have designed can be more parsimonious than one grounded in knowledge of evolutionary processes. To think otherwise is to think that it would be more parsimonious to construct a twenty story building beginning with the nineteenth floor than to begin at the ground

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[167] *See generally supra* note 84.

level.

Science knows of no process by which the human brain could not be materially influenced by its own evolutionary history. We know of no process by which our emotions, norms, tastes, preferences, and behaviors could be categorically unaffected (or only trivially affected) by the process that built the brain in the first place. Consequently, until the theory of evolution by natural selection is displaced by some other non-supernatural theory, a theory of cognition must be consistent with evolutionary history to qualify as parsimonious. In some cases, this makes evolutionary explanations more parsimonious than alternative ones.

C. Adaptationism

Biologists prefer not to assume, unreflectively, that every feature of every organism is an adaptation.[168] Many features are by-products, sometimes even disadvantageous ones, of other, compensatingly advantageous features. Does the approach advanced here make the mistake of assuming adaptation too quickly? It does not.

My argument is not that we should assume that all human irrationality is really time-shifted rationality. Rather, we should immediately cease our practice of assuming that *none* of it is. Once open to the hypothesis that a supposed irrationality may be the product of a temporal mismatch between adaptation and modern environment, we favor or disfavor the hypothesis by first triangulating from what else we think we know—about brain design, evolutionary processes, the archaeological record, ancestral species, the environmental features they likely encountered, the behavior of modern humans, the behavior of other species, results of experimentation with other species, and the like—and then assessing plausibility. What we look for here, as in all other scientific endeavors, is a sense of "fit" with the many implications and historical antecedents of facts in which we have confidence, behavioral observations, commonalities with other species, and overall theoretical coherence.[169] While we should not be quick to assume adaptation, nor should we be quick to assume brain defect or limitation. Our misdiagnosis may drive incorrect conclusions, and inefficient laws.

D. Mechanisms

It is considered highly unlikely that any cognitive process or behavior is mediated by a single gene. And yet the notion that biology influences behavior depends on gene-environment interactions. The complexity of these interactions leaves them as yet unknown, and perhaps never truly knowable. A thoughtful critic of the evolutionary analysis advanced here might argue that until we can identify the precise mechanisms by which

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[168] For useful discussion, *see* ALCOCK, *supra* note 75, at 266-68; WILLIAMS, *supra* note 82.

[169] I discussed this process in Jones, *Evolutionary Analysis in Law*, *supra* note 7.

specific neural pathways are constructed, we should hesitate.

Were we to aspire (unwisely) to engineer an endowment-effect-free brain (for instance), surely we would need to know more about mechanisms and pathways. But at the level at which law operates—regulating behavior on the basis of behavioral models—specification of mechanisms and pathways is wholly unnecessary. What matters is that we understand major forces at work in brain design. Just as it would be possible to know important things about any operational sailboat, small or large, as a function of inescapable physical features and forces of water, gravity, and wind, without recourse to the boat's blueprints, it is possible to know important things about the design and function of brains, human or non-human, as a function of inescapable physical and evolutionary forces, without recourse to neuroanatomy or microbiology.

E. Quantification

While the law of law's leverage has clear utility at the gross-cut level, its utility is clearly imprecise. How troublesome should this be? For example, the metric of the law of law's leverage is not clear, and it does not quantify in detail. It does not predict the exact steepness of any demand curve's slope. Nor does it predict the precise shape of the curve itself. Moreover, it will be difficult to measure or describe the requisite reproductive nexus in the EEA with precision.

Though these features may somewhat limit the power of the law of law's leverage as a tool, they do not negate it. The concept of bounded rationality, by comparison, is no more precise (arguably less so), and is far less explanatory and predictive. It is nonetheless widely, and often usefully, employed. Also by comparison, it is often difficult to specify with precision the line between the presence and absence of consideration in contract. And yet even that imprecise concept has found acceptance and widespread utility in law. The value of the evolutionary tools developed here does not depend on whether they can quantify. The value depends on whether they can improve our explanatory and predictive power beyond that of models we currently employ.

F. Hubris

Finally, is it not simply hubris to articulate principles purporting to describe mindless influences on the human mind? I don't think so. As an initial matter, these principles are not dramatic, speculative jumps from what is now known. They represent conclusions derivable from a series of small steps, each grounded in the empirically reliable evidence and sound theory underlying modern behavioral biology. In a very important sense, it would probably be more hubristic to think that humans, alone among all living organisms, have categorically escaped the reach of the evolutionary process that built our brains, and that therefore, in conducting our important job of

regulating human behavior, we may ignore behavioral biology without consequence.

CONCLUSION

Law deals in human behavior. The power of its models limits the power of law. The rational actor model often works. But it also tends to fail us in the face of real people—with their puzzlingly patterned assortments of emotions, foibles, and fears.

It is increasingly clear that law must respond. It is less clear how. Behavioral law and economics scholars, ably integrating cognitive psychology insights, have established an empirical basis for modifying our behavioral models and for beginning to explore the implications for law. But theoretical structure necessary for greater explanatory and predictive power is missing.

What I have argued is as follows. First, as we attempt to develop a theoretical foundation that can adequately encompass both rational and irrational behavior, we can usefully partner both economics and behavioral economics with behavioral biology. Although behavioral biology provides no normative guidance as to what our specific goals should be, it does provide important methodological tools, robust theories, and mountains of data, all useful in gaining deeper insights into the evolutionary forces that shape and influence all behavior—human and non-human.

Second, the evolutionary analysis that such a partnership furthers strongly suggests that a substantial and important subset of the irrationalities we have long ascribed to cognitive defect should be ascribed, instead, to cognitive design. Those irrationalities are likely to be products of what I have here referred to as *time-shifted rationality*—the temporal mismatch between the environment in which natural selection shaped the brain to function and different, modern environments that technology has only recently enabled. Such a view makes coherent sense of the nonrandom content of some seemingly irrational behavior, reveals previously hidden connections among a wide variety of seemingly separate irrationalities, and affords far greater predictive power to our efforts both to anticipate the circumstances in which seemingly irrational behavior will appear and to explain and predict the content and directionality of the seemingly irrational results. Further, by adding a deeper temporal dimension, encompassing evolutionary time, the analysis often reconciles those results with traditional measures of rationality, rendering time-shifted rationalities a new and important subset of substantive rationality. While it would undoubtedly be a mistake to conclude that all seeming irrationalities were once adaptive, it is surely no less a mistake to assume that none of them were. There can be no serious assault on the paradoxes of human behavior without the tools of behavioral biology.

Third, time-shifted rationality logically implies a principle, which I

have termed *the law of law's leverage*, that may be useful in two ways. It can help us to better explain and predict the comparative difficulties law may encounter in attempting to shift different behaviors, by affording us a framework for estimating the relative steepness of demand curves for various behaviors regulated by law. And it affords an entirely new, modern, and biologically informed perspective on the underlying architecture of law, helping to explain why some of the larger features have developed as they have, and helping to differentiate between more probable and less probable features of future legal systems.