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The Evolution of Irrationality

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SYMPOSIUM

THE EVOLUTION OF IRRATIONALITY

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ABSTRACT: The place of the rational actor model in the analysis of individual and social behavior relevant to law remains unresolved. In recent years, scholars have sought frameworks to explain: (a) disjunctions between seemingly rational behavior and seemingly irrational behavior, (b) the origins of and influences on law-relevant preferences, and (c) the nonrandom development of norms. This essay explains two components of an evolutionary framework that can encompass all three. They are, respectively, *time-shifted rationality* and the *law of law's leverage*.

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The success of the neoclassical model of human behavior in the legal domain is largely attributable both to the model's relative simplicity and to the large proportion of law-relevant contexts in which it accurately predicts how people's behaviors will change.[1] Of course, that model, like all behavioral models, employs simplifying assumptions. One of these is that people generally behave as if they were rational maximizers of personal satisfaction (utility), given whatever it is that makes them happy. From this core assumption have spun many derivative predictions, important for law and empirically confirmed.

Despite its many successes, however, this law and economics model of human behavior has been targeted for increasingly insistent criticism. The model is inaccurate, critics first noted, because people do not always behave "rationally."[2] People get emotional, they comply with costly norms, and they make logic errors in their decision-making.

Without more, this criticism would be irrelevant, for law does not necessarily care if the behavioral model it 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.[3]

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

1. *See generally* ROBERT COOTER & THOMAS ULEN, LAW AND ECONOMICS (3d ed. 2000); RICHARD A. POSNER, ECONOMIC ANALYSIS OF LAW (5th ed. 1998).

2. 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. *See* RICHARD A. POSNER, SEX AND REASON 85 (1992). 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). For useful distinctions between different kinds of rationality, see ROBERT H. FRANK, MICROECONOMICS AND BEHAVIOR (3d ed. 1997); Russell B. Korobkin & Thomas S. Ulen, *Law and Behavioral Science: Removing the Rationality Assumption from Law and Economics*, 88 CAL. L. REV. 1051, 1060 (2000).

3. Sacrificing accuracy for simplicity can be rational when the increase in accuracy is outweighed by the increased costs of learning and using a more complex model. *See* Douglas G. Baird, *The Future of Law and Economics: Looking Forward*, 64 U. CHIC. L. REV. 1129, 1146–48 (1997); Gregory S. Crespi, *Does the Chicago School Need to Expand Its Curriculum?*, 22 LAW & SOC. INQUIRY 149, 154 (1997).

afford. The costs of a more accurate model obviously will depend, in part, on how accessible its theoretical foundations are, how easily we can apply it to legal concepts, and with what results.

These are all subjects of current debate. Those contending that irrationality is sufficiently serious to warrant material modification of the rational actor model will have the stronger argument, if they succeed not only in proving the existence of allegedly irrational behavior, but also in both identifying and explaining patterns in which it arises. Otherwise, the irrational among us are vulnerable to being dismissed as random outliers and mere behavioral noise.

In building this argument for the legal significance of irrationality, a number of scholars have ably begun the important work of identifying, grouping, analyzing, and exploring the legal implications of a number of distinct patterns in seemingly irrational behavior.[4] Much of this work, variously known as "behavioral economics,"[5] "behavioral law and economics,"[6] "behavioral economic

4. *See, e.g.*, BEHAVIORAL LAW AND ECONOMICS (Cass R. Sunstein ed., 2000); Jennifer Arlen, *Comment: The Future of Behavioral Economic Analysis of Law*, 51 VAND. L. REV. 1765 (1998); Melvin Aron Eisenberg, *The Limits of Cognition and the Limits of Contract*, 47 STAN. L. REV. 211 (1995) [hereinafter Eisenberg, *The Limits of Cognition*]; Christine Jolls et al., *A Behavioral Approach to Law and Economics*, 50 STAN. L. REV. 1471 (1998) [hereinafter Jolls, *A Behavioral Approach*]; Russell B. Korobkin, *The Status Quo Bias and Contract Default Rules*, 83 CORNELL L. REV. 608 (1998); Korobkin & Ulen, *Law and Behavioral Science*, *supra* note 2; 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) (compiling bibliography of behavioral law and economics scholarship); Richard A. Posner, *Rational Choice, Behavioral Economics, and the Law*, 50 STAN. L. REV. 1551 (1998) [hereinafter Posner, *Rational Choice*]; Matthew Rabin, *Psychology and Economics*, 36 J. ECON. LITERATURE 11 (1998); Jeffrey J. Rachlinski, *The "New" Law and Psychology: A Reply to Critics, Skeptics, and Cautious Supporters*, 85 CORNELL L. REV. 739 (2000) [hereinafter Rachlinski, *The "New" Law and Psychology*]; Jeffrey Evans Stake, *Loss Aversion and Involuntary Transfers of Title*, *in* LAW AND ECONOMICS: NEW AND CRITICAL PERSPECTIVES 331 (Robin Paul Malloy & Christopher K. Braun eds., 1995); Cass R. Sunstein, *Behavioral Analysis of Law*, 64 U. CHI. L. REV. 1175 (1997) [hereinafter Sunstein, *Behavioral Analysis of Law*]; Cass R. Sunstein, *Preferences and Politics*, 20 PHIL. & PUB. AFF. 3 (1991) [hereinafter Sunstein, *Preferences and Politics*]; Thomas S. Ulen, *Cognitive Imperfections in the Economic Analysis of Law*, 12 HAMLINE L. REV. 385 (1989) [hereinafter Ulen, *Cognitive Imperfections*]; Thomas S. Ulen, *The Growing Pains of Behavioral Law and Economics*, 51 VAND. L. REV. 1747 (1998) [hereinafter Ulen, *Growing Pains*]; and authorities cited in Owen D. Jones, *Time-Shifted Rationality and the Law of Law's Leverage: Behavioral Economics Meets Behavioral Biology*, 95 NW. U. L. REV. (forthcoming 2001) [hereinafter Jones, *Time-Shifted Rationality*].

5. *See, e.g.*, Ulen, *Growing Pains*, *supra* note 4. For an historical perspective on the rise of behavioral economics, see David Laibson & Richard Zeckhauser, *Amos Tversky and the Ascent of Behavioral Economics*, 16 J. RISK & UNCERTAINTY 7 (1998).

6. *See, e.g.*, BEHAVIORAL LAW AND ECONOMICS, *supra* note 4.

analysis of law,"[7] "behavioral analysis of law,"[8] "law and behavioral science,"[9] "law and the 'new' psychology"[10] and the "behavioral approach to law and economics,"[11] is pioneering.

These studies are significantly interdisciplinary (invoking, for example, cognitive psychology, sociology, and the like), and they highlight truly important behavioral phenomena. And scholars have identified a number of contexts in which knowledge of patterns in irrationality can or should have implications for law. This represents an essential advance over prior work. Nevertheless, these studies are far better at *describing* irrationality than *explaining* it.[12] To date, the studies have proven far better at discovering and documenting cases and patterns of irrational behavior, and making the point *that* people behave irrationally, than they are at explaining why people do so, and why, when they do so, they do so in the same ways that other people do.

As more than one critic has noted,[13] the existing lack of a coherent explanatory framework for irrationality impedes the incorporation of behavioral economics insights into existing behavioral models. Proponents need to explain why certain contexts more than others tend to elicit cognitive blips—and why these blips tend to manifest one specific and consistent pattern rather than another pattern, or none at all.[14]

My hypothesis for why our descriptions of irrationality lack adequate explanatory power is quite simple. Studies of bounded rationality tend to suffer from bounded analysis, as a function, in part, of the ways in which the world has been artificially divided among the departments in the universities that trained us. That is, the studies of human behavior are importantly interdisciplinary without yet being adequately interdisciplinary. In the effort to understand human behavior, our own patterns of education lead us to err, so long as we suppose that the universities' common division between the social science and life science perspectives on behavior represents any meaningful distinction in knowledge.[15]

7. *See, e.g.*, Arlen, *supra* note 4.

8. *See, e.g.*, Cass R. Sunstein, *Behavioral Analysis of Law*, *supra* note 4.

9. *See, e.g.*, Korobkin & Ulen, *supra* note 2.

10. *See, e.g.*, Rachlinski, *The "New" Law and Psychology*, *supra* note 4, at 741–42.

11. *See, e.g.*, Jolls et al., *A Behavioral Approach*, *supra* note 4, at 1473–74.

12. *See, e.g.*, ARIEL RUBINSTEIN, MODELING BOUNDED RATIONALITY 3–4 (1998) ("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."); Posner, *Rational Choice*, *supra* note 4, at 1554.

13. *See, e.g.*, Arlen, *supra* note 4, at 1768–75; Posner, *Rational Choice*, *supra* note 4, at 1551, 1555–57.

14. Attempts to solve these problems with recourse to norms only abstracts the problem up one level. One still must explain why some norms, rather than others, are so likely to arise independently in human populations all over the globe.

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

In prior work, I have argued that knowledge of human behavior must in the end be seamless between disciplines, 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.[16] In this essay, I join with those seeking to highlight the legal significance of irrationality, and attempt to outline components of a theoretical foundation for a behavioral model that can explain many already observed patterns of irrationality and predict new ones.

Specifically, I argue that two principles we can derive from evolutionary theory, "time-shifted rationality" and "the law of law's leverage," provide useful tools to legal scholars.[17] The former can help to explain and predict when, where, how, and why the rational actor assumption will be incorrect. The latter can help to explain and predict those aspects of human behavior that will be most sensitive and least sensitive to changes in legal rules. Together, these two principles reveal deep commonalities between, and systematically interrelate, the often independent lines of legal and economic scholarship that explore irrationality, cognitive decision theory, emotions,[18] norms,[19] and endogenous preferences.[20]

16. *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, *Sex, Culture, and the Biology of Rape: Toward Explanation and Prevention*, 87 CAL. L. REV. 827 (1999) [hereinafter Jones, *Sex, Culture, and the Biology of Rape*]; Owen D. Jones, *Law and Biology: Toward an Integrated Model of Human Behavior*, 8 J. CONTEMP. LEGAL ISSUES 167 (1997); *see also* Owen D. Jones, *Genes, Behavior, and Law*, 15 POL. & LIFE SCI. 101 (1996); Timothy H. Goldsmith & Owen D. Jones, *Evolutionary Biology and Behavior: A Brief Overview and Some Important Concepts*, 39 JURIMETRICS J. 131 (1999) [hereinafter Goldsmith & Jones, *Evolutionary Biology and Behavior*].

17. *See* Jones, *Time-Shifted Rationality*, *supra* note 4.

18. *See, e.g.*, Jon Elster, *Emotions and Economic Theory*, 36 J. ECON. LITERATURE 47 (1998); Peter H. Huang & Ho-Mou Wu, *Emotional Responses in Litigation*, 12 INT'L REV. L. & ECON. 31 (1992).

19. *See, e.g.*, ERIC A. POSNER, LAW AND SOCIAL NORMS (2000); Richard H. McAdams, *The Origin, Development and Regulation of Norms*, 96 MICH. L. REV. 338 (1997); Richard H. McAdams, *Cooperation and Conflict: The Economics of Group Status Production and Race Discrimination*, 108 HARV. L. REV. 1003 (1995); Robert Cooter, *Normative Failure Theory of Law*, 82 CORNELL L. REV. 947 (1997); Robert Ellickson, *Law and Economics Discovers Social Norms*, 27 J. LEGAL STUD. 537 (1998); Eric A. Posner, *Law, Economics and Inefficient Norms*, 144 U. PENN. L. REV. 1697 (1996) [hereinafter Posner, *Law, Economics, and Inefficient Norms*]; Symposium, *Social Norms, Social Meaning, and the Economic Analysis of Law*, 27 J. LEGAL STUD. 537 (1998); Symposium, *Law, Economics & Norms*, 144 U. PENN. L. REV. 1643 (No. 5, 1996).

20. *See, e.g.*, Kuran & Sunstein, *supra* note 4; Sunstein, *Preferences and Politics*, *supra* note 4; Sunstein, *Behavioral Analysis of Law*, *supra* note 4; Kenneth Dau-Schmidt, *Economics and Sociology: The Prospects for an Interdisciplinary Discourse in Law*, 1997 WIS. L. REV. 389 (1997).

I hope to demonstrate below that beneath the wellspring of social science literature on irrationality lies an entire aquifer of useful biological knowledge about the ways in which brains process information and influence behavior. That knowledge is well developed, accessible to nonbiologists, and essential to improving law's models of human behavior.

I. FROM FLAWS TO FUNCTIONS: CHANGING NOTIONS OF BEHAVIOR AND BRAIN

A. From Whence Anomalies?

Into the drawing-room comfort of the rationality assumption crept recurringly anomalous behavior: people behave inconsistently with their own expressed preferences and often pursue those preferences inefficiently. Pondering this in the 1950s, Herbert Simon observed that people often voluntarily stop short of acquiring full information about a decision, make guesstimates about what would be a serviceable outcome, and are then done with the matter. This led him to conclude that we often behave as if we were "satisficers," rather than true maximizers. Simon coined the term "bounded rationality"[21] to describe and explain the phenomenon, which he believed was the product of internal physiological limits, such as fixed computing speed and power, on human rational behavior. He considered these physiological limits to be distinct from, but symmetrically paired with, the external costs of rational decision-making, such as information costs, that typically concerned economists. Positing bounded rationality thus temporarily alleviated the irrationality problem, because the high costs of acquiring complete information and the fixed limits on human computation, viewed together, made it clear that in some cases, paradoxically, it would be irrational to become fully informed.[22]

Simon's work, though internationally recognized, has only recently begun to affect mainstream economic theory.[23] The study of bounded rationality has been

21. Herbert Simon, *A Behavioral Model of Rational Choice*, 69 Q.J. ECON. 99 (1955).

22. *See* FRANK, *supra* note 2, at 247 (noting same).

23. RUBINSTEIN, *supra* note 12, at 3. Important works in bounded rationality include JON ELSTER, SOUR GRAPES: STUDIES IN THE SUBVERSION OF RATIONALITY (1983); THE LIMITS OF RATIONALITY (Karen Schweers Cook & Margaret Levi eds., 1990); OLIVER E. WILLIAMSON, THE ECONOMIC INSTITUTIONS OF CAPITALISM: FIRMS, MARKETS, RELATIONAL CONTRACTING (1985); John Conlisk, *Why Bounded Rationality?*, 34 J. ECON. LITERATURE 669 (1996); Jon Elster, *Emotions and Economic Theory*, 36 J. ECON. LITERATURE 47 (1998); Jon 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*, 28 CAN. J. ECON. 42 (1995) (and sources cited therein) [hereinafter Lipman, *Information Processing*]; Amartya Sen, *Rational Fools: Critique of the Behavioral Foundations of Economic Theory*, *in* PHILOSOPHY AND ECONOMIC THEORY (Frank Hahn & Martin Hollis eds., 1979); Herbert A. Simon, *Invariants of Human Behavior*, 41 ANN. REV. PSYCHOL. 1 (1990).

revitalized by cognitive psychology research that suggests that computational limits exist, but that people tend to commit the same sorts of computational errors in the same sorts of ways.[24] For example, people consistently use irrelevant information, such as sunk costs, give answers that are highly sensitive to logically irrelevant changes in questions, and make errors in updating probabilities on the basis of new information.[25]

This work has sparked a burgeoning literature in law on the importance of what has been variously termed irrationality, bounded rationality, fallibilities, frailties, cognitive errors, cognitive limitations, and cognitive imperfections.[26] The significance of this work for economic theory and for legal scholars is underscored by admissions in microeconomic textbooks that "even with transparently simple problems, people often violate the most fundamental axioms of rational choice."[27]

Almost without exception, however, the scholars most intent on expanding our understanding of human behavior and irrationality and most vociferous in

24. Important works that explore these topics include HAL R. ARKES & KENNETH R. HAMMOND, JUDGMENT AND DECISION MAKING: AN INTERDISCIPLINARY READER (1986); ROBIN HOGARTH, JUDGMENT AND CHOICE: THE PSYCHOLOGY OF DECISION (1980); 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); Conlisk, *supra* note 23, at 670 (sources cited therein).

25. *See* Conlisk, *supra* note 23, at 670. "Heuristics" is the term describing the supposed rules of thumb by which people make these errors, and "biases" are the errors themselves, when systematic across a study population. *Id.*

26. So characterizing our cognitive faculties are, for example, GARY S. BECKER, THE ECONOMIC APPROACH TO HUMAN BEHAVIOR 151 (1976); HOGARTH, *supra* note 24, at 63; HERBERT A SIMON, 1 MODELS OF BOUNDED RATIONALITY: ECONOMIC ANALYSIS AND PUBLIC POLICY 430 (1982); RICHARD THALER, THE WINNER'S CURSE: PARADOXES AND ANOMALIES OF ECONOMIC LIFE 3 (1992); OLIVER E. WILLIAMSON, MARKETS AND HIERARCHIES: ANALYSIS AND ANTITRUST IMPLICATIONS: A STUDY IN THE ECONOMICS OF INTERNAL ORGANIZATION 21–22 (1975); Eisenberg, *The Limits of Cognition*, *supra* note 4, at 211, 213; Robert C. Ellickson, *Bringing Culture and Human Frailty to Rational Actors: A Critique of Classical Law and Economics*, 65 CHI.-KENT L. REV. 23, 35 (1989); Jolls, *A Behavioral Approach*, *supra* note 4, at 1477; Lipman, *Information Processing*, *supra* note 23, at 42–43; Posner, *Rational Choice*, *supra* note 4, at 1553–54; Herbert Simon, *Bounded Rationality*, *in* THE NEW PALGRAVE: A DICTIONARY OF ECONOMICS 277, 279 (J. Eatwell et al. eds., 1987); Herbert Simon, *From Substantive to Procedural Rationality*, *in* METHOD AND APPRAISAL IN ECONOMICS 424 (Spiro J. Latsis ed., 1976); Sunstein, *Behavioral Analysis of Law*, *supra* note 4, at 1175–76; Ulen, *Cognitive Imperfections*, *supra* note 4, at 387–88, 390, 401.

27. FRANK, *supra* note 2, at 247. A scholar of bounded rationality recently argued that, despite several decades of periodic concern, modeling bounded rationality "remains one of the most important lacunae in economic theory." J.R. Krebs & N.B. Davies, *An Introduction to Behavioural Ecology* 168 (3d ed. 1993); *see also* Gregory Lilly, *Bounded Rationality: A Simon-Like Explication*, 18 J. ECON. DYNAMICS & CONTROL 205, 205 (1994); Lipman, *Information Processing*, *supra* note 23, at 43–44.

their call for interdisciplinary sleuthing suggest that we need only fertilize law and economics with other *social science* perspectives.[28] Why commence such an important and ambitious enterprise with such a restriction? In my view, the results of exclusively social science inquiries are severely limited. Just as no number of different kinds of hammers can substitute for the right size wrench, no number of aggregated social science disciplines can alone provide adequate explanation of human behavior.

To be clear, the social sciences have generated and continue to generate critical knowledge. Were they unconsulted, I would argue alongside others for their inclusion. But enthusiasm for exclusively human-focused social sciences is rather blinkered. To move forward in understanding seemingly irrational behavior, we must aggressively combine social sciences with the natural sciences generally, and with the life science studies of evolution and behavioral biology, specifically.[29]

B. Bringing Back Brain

The most interesting thing to me about the observation just made is that I am 100 years too late to make it first. In 1898, economist Thorstein Veblen queried: "Why is Economics Not an Evolutionary Science?"[30] Veblen wondered, having read Darwin, why economists had not yet seen the implications of evolution by natural selection for their own discipline. Surely, if species evolve, so does behavior. Over time, natural selection affects the distributional patterns of behavioral traits, as well as physical ones.[31] And there has been ample time to do so in ways that affect present human behavior. Our primate ancestry alone

28. *See, e.g.*, Jolls et al., *A Behavioral Approach*, *supra* note 4, at 1547 ("We hope that economists and economically oriented lawyers will simply incorporate the useful findings of other social sciences . . . ."); Elster, *When Rationality Fails*, *supra* note 23, at 19; Dau-Schmidt, *supra* note 20, at 390; Sunstein, *Behavioral Analysis of Law*, *supra* note 4, at 1175–76; Rabin, *supra* note 4, at 11.

29. There are a number of important disciplinary trends moving in this direction, including evolutionary anthropology, behavioral ecology, evolutionary psychology, and Darwinian psychiatry. However, few legal scholars have incorporated much from these emerging disciplines into their scholarship. For a partial listing of those who have incorporated the work into their scholarship, see sources compiled on the "Readings" page of the website for the *Society for Evolutionary Analysis in Law* (SEAL) at www.sealsite.org.

30. Thorstein Veblen, *Why Is Economics Not an Evolutionary Science?*, 12 Q.J. ECON. 373 (July 1898).

31. Natural selection is the inevitable result of any system that combines heredity, variation, and differential reproduction. Heritable traits that increase reproductive success tend to appear in larger and larger proportions of subsequent generations. The compounding effect is so dramatic that even a heritable trait providing a mere 1% reproductive advantage will swell, all else being equal, from 1% representation in a population to 99% in merely 265 generations. ROBERT TRIVERS, SOCIAL EVOLUTION 28–29 (1985).

extends back roughly 70 million years, making it 35,000 times as long as the two-millennium period recently celebrated.[32]

Economists and others have occasionally attempted to consider or resuscitate Veblen's intuition about biology's utility to economics.[33] Gary Becker observed in 1976 that some tastes were likely selected through biological pathways.[34] Jack Hirshleifer explored this idea at greater length and was the first economist to point out the deep connections between economics and biology.[35] Paul Rubin noted that behavioral biology may materially undermine the standard economic assumption that tastes are arbitrary, while exploring an evolutionary explanation for tastes in such things as risk and moralistic aggression.[36] And Robert Frank and Jack Hirshleifer have argued that in many contexts being predisposed to be "irrational" can prove advantageous and even adaptive.[37]

32. Jones, *Evolutionary Analysis in Law*, *supra* note 16, at 1129–32.

33. *See, e.g.*, Werner Guth, *An Evolutionary Approach to Explaining Cooperative Behavior by Reciprocal Incentives*, 24 INT'L J. GAME THEORY 323 (1995); Steffen Huck, *Trust, Treason, and Trials: An Example of How the Evolution of Preferences Can Be Driven by Legal Institutions*, 14 J.L. ECON. & ORG. 44 (1998); Eskander Alvi, *Fairness and Self-Interest: An Assessment*, 27 J. SOCIO-ECONOMICS 245 (1998); Alan R. Rogers, *Evolution of Time Preference by Natural Selection*, 84 AM. ECON. REV. 460 (1994); Arthur J. Robson, *A Biological Basis for Expected and Non-Expected Utility*, 68 J. ECON. THEORY 397 (1996); Posner, *Law, Economics and Inefficient Norms*, *supra* note 19; *see also* POSNER, *supra* note 2 (allowing for biobehavioral influences on peoples preferences for different sexual activities); HOWARD MARGOLIS, SELFISHNESS, ALTRUISM, AND RATIONALITY: A THEORY OF SOCIAL CHOICE (1982).

34. Gary S. Becker, *Altruism, Egoism, and Genetic Fitness: Economics and Sociobiology*, 14 J. ECON. LIT. 817 (1976).

35. 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 concepts of scarcity, competition, equilibrium, and specialization are as central to the study of evolved behavior as to the study of economics. Hirshleifer cites economist Alfred Marshall as calling economics "a branch of biology, broadly interpreted," and Michael Ghiselin as describing it as the study of "Nature's economy." *Id.* at 1 n.2 (citing ALFRED MARSHALL, PRINCIPLES OF ECONOMICS 772 (9th ed. 1920), and MICHAEL T. GHISELIN, THE ECONOMY OF NATURE AND THE EVOLUTION OF SEX (1974)). Hirshleifer has continued to offer bioeconomic perspectives on important phenomena. *See, e.g.*, *Evolutionary Models in Economics and Law*, 4 RES. L. & ECON. 1 (1982); *The Bioeconomic Causes of War*, 19 MANAGERIAL DECISION ECONOMICS 457 (1998).

36. *See generally* Paul H. Rubin & Chris W. Paul II, *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 (1982).

37. ROBERT FRANK, PASSIONS WITHIN REASON: THE STRATEGIC ROLE OF THE EMOTIONS (1988); Robert Frank, *If Homo Economicus Could Choose His Own Utility Function, Would He Want One with a Conscience?*, 77 AM. ECON. REV. 593 (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).

Partly through the inspiration of these and other scholars interested in the power of evolutionary processes, "evolutionary economics" has become a popular and important tool within economics generally and in legal analysis specifically.[38]

Insights generated by evolutionary economics are clearly quite significant and useful. Yet, with very rare exceptions, evolutionary economics has fulfilled neither the full promise of its name nor the full vision of Veblen. Current evolutionary economics scholarship focuses almost exclusively on the study of nonbiological replicating entities, such as institutions or legal rules.[39] Like most evolutionary game theory,[40] evolutionary economics is only "evolutionary," therefore, by metaphor.[41] To incorporate all that is clearly useful from evolution into economics, scholars would need to take the full stride into the world of evolved brains and behavior that evolutionists have uncovered. Specifically, a truly evolutionary economics would integrate knowledge about the effects of evolutionary processes on the brain's information processing operations into the study of the very process by which people's brains arrive at decisions that affect behavior.

Biology is essential to any robust model of human behavior for one simple reason: all theories of human behavior are theories about the human brain. A more than superficial understanding of evolutionary processes is necessary for even

38. For its use in the legal context, see, for example, Randal C. Picker, *Simple Games in a Complex World: A Generative Approach to the Adoption of Norms*, 64 U. CHI. L. REV. 1225 (1997).

39. That is, it borrows the meaning of evolution from the truly biological context and deploys it to describe processes by which given circumstances may change over time as a function of how variants reproduce differentially. In this sense, ideas, the common law, institutions, and even chain letters "evolve."

Even Gary Becker, who has aggressively explored the frontiers of the origins of tastes, has tended to disaggregate biology from all but the most basic biological needs. *See, e.g.*, GARY BECKER, ACCOUNTING FOR TASTES 3 (1996). But disaggregating biology from emotions, emotions from behavior, and biology from culture, all of which are routinely done in much current scholarship, is scientifically incorrect and imposes opportunity costs in foregone predictive power that an integrated behavioral model would afford.

40. *See, e.g.*, Karl Warneryd, *An Economist's Perspective on the Evolution of Norms: Comment*, 150 J. INSTITUTIONAL & THEORETICAL ECON. 68 (1994). Evolutionary game theory, which merges game theory with such concepts as the evolutionarily stable strategy, borrowed from biology, "focuses on the survival properties of strategies themselves in environments in which they have to compete with each other." *Id.* at 68. But this is a far cry from incorporating the more fundamental biological insight that the human brain is designed to make choices that reflect the same processes of adaptation (as a function of heredity, variation, and differential reproduction) as those that govern the distribution of behavioral strategies economists may be studying.

41. Articles on evolutionary economics commonly develop sophisticated theories, to which evolutionary processes are central, that nonetheless have no distinctly biological foundation. *See, e.g*, Eddie Deckel & Suzanne Scotchmer, *On the Evolution of Optimizing Behavior*, 57 J. ECON. THEORY 392 (1992) (and sources cited therein).

rudimentary understanding of the operation of the human brain because the brain's form and function are the products of evolutionary processes operating across 3.5 billion years.[42] The relevant insight of this last observation can be stated simply: the brain's basic behavior-biasing, information-processing patterns are the result of evolutionary processes.

Juxtapose the obviousness of the latter proposition with the passionate interest legal thinkers evince in the processes by which people make decisions, and one wonders why it is taking so long to pull law, economics, and evolutionary biology together. Evolutionary processes have honed the human brain to be functionally specialized, like other organs of the body. Behavioral outcomes are now known to be the product of contingent and highly flexible associations between perceived environmental conditions and motivation. Why then has there been, to date, so little attention in law, economics, or behavioral economics to the mountains of recent literature on the functioning of the human brain—the one organ of the body most important in generating precisely the behaviors law seeks to regulate and economics seeks to model?

There are many reasons. Veblen attributed the economists' persistent lack of attention to behavioral biology to the intellectual and physical comforts of clustering behavior, noting that "well-worn paths are easy to follow and lead into good company."[43] Other reasons may include the raw physical hurdles to studying the brain's effects on behavior,[44] as well as the numerous conceptual hurdles, given widespread and mistaken assumptions of how evolutionary processes affect behavior.[45]

42. This does not mean that every feature is itself a specific adaptation. For more on this distinction, see, for example, JOHN ALCOCK, ANIMAL BEHAVIOR: AN EVOLUTIONARY APPROACH 266–68 (6th ed. 1998).

43. Veblen, *supra* note 30, at 395.

44. There are at least two. First, out-of-sight is out-of-mind. The brain, unlike the foot, is visually removed, delicate, and relatively inaccessible. We know the brain by its revealed effects, but not (until quite recently) by direct observation. Unlike most parts of the body (including the heart, for example) the brain's operation and functions are not susceptible to reasonable speculation on the basis of inspection alone. Second, the brain deals in immovables and intangibles. Unlike most parts of the body, which chew food, throw rocks, or are more obviously involved in supporting these kinds of activities, the brain deals in electricity. It is in the business of information processing and storage, and its methods are more mysterious than the methods of other body parts.

45. I have elsewhere described a number of practical impediments to incorporating knowledge of evolution into behavioral contexts. *See* Jones, *Sex, Culture, and the Biology of Rape*, *supra* note 16. These include, for example, the errors consequent to false dichotomies (between nature and nurture, for example) and errors consequent both to misattributed genetic determinism and to the frequent failure to distinguish between behavioral genetics (tracing different behaviors to different alleles of genes) and evolved psychology (tracing different behaviors to different environmental conditions encountered by neurologically similar brains sporting evolved contingent algorithms).

C. The Evolution of Behavior

Suppose, however, we cleared these hurdles to integrating economic analysis with evolutionary analysis. What promise lies on the other side? The main insight of economics was to redescribe legal sanctions as prices. The main insight of behavioral biology is to redescribe emotions, preferences, and other behavior-biasing, information-processing mechanisms as 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 nonhuman ancestors.[46]

The evolutionary perspective on the human information-processing organ affords us the theoretical and empirical foundation for a variety of propositions useful in constructing the explanatory framework that behavioral economics currently lacks. I think the following are likely to be representative:

1. All human behaviors reflect patterns of information processing that are the product of evolutionary forces.

2. The human brain did not evolve to maximize individual utility.[47]

3. What we label as human emotions and tastes are, in large measure, the manifestations of value-ascribing and preference-forming algorithms—context-specific states of the nervous system caused by evolved information-processing pathways—that increase the likelihood of behavior that was adaptive, on average, during ancestral environments.

4. A great deal of seemingly irrational behavior is attributable to once-adaptive information-processing predispositions that are mismatched to novel environmental circumstances.

Space limitations preclude exploring at any length the rich theoretical and empirical bases in biology for each of these propositions. A large number of popular and technical works now provide ready access to the basic principles of behavioral biology and to its subtleties.[48] Instead, I move in this next Part to offer several observations on the utility of these propositions to several current issues in behavioral economics.

II. TIME-SHIFTED RATIONALITY

This Part surveys very briefly, in sequence, the following problems: (a) inconsistent preferences; (b) over-cooperativeness; (c) intertemporal choice anomalies and irrationality discounted futures; (d) framing problems and mistaken assessments of probabilities; (e) ultimatum games and the irrational taste for spite; and (f) endowment effects and the irrational pricing of property.[49]

46. Again, not every behavior is itself adaptive. See *supra* note 42. But the vast majority of species-typical behavior flows directly or indirectly as by-products of morphological and behavioral adaptations of the human animal. Note that I am not arguing that experiences and social forces have no influence on tastes. Quite the opposite, I am arguing that experiences and social forces affect tastes precisely because they are processed in a brain evolved to preferentially perceive, record, and respond to different patterns of experiences and social forces in different ways, which reflect evolutionary pressures on brain design. "Learned" is not an antonym to "biologically influenced." The very capacity of the human brain to learn is itself an evolved adapation. *See, e.g.*, STEVEN PINKER, THE LANGUAGE INSTINCT 242–43 (1994). On the relationship between biology, emotions, and law, see Owen D. Jones, *Law, Emotions, and Behavioral Biology*, 39 JURIMETRICS J. 283 (1999).

47. There is far more to this proposition than can be covered here, but the important point is that natural selection does not operate primarily at the level of the individual or of the group. With extremely rare exceptions (not relevant here), natural selection operates primarily at the level of the gene, because genes, not individuals or groups, are replicating entities. In other words, every organism is a parliament of genes, and its morphology and behavior are 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—notwithstanding the fact that this design *generally* leads to behavior that can be characterized as *also* maximizing the individual's interests.

This distinction concerning the level of selection only rarely will be of practical significance, because 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 those circumstances, 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.

48. Useful introductions to modern behavioral biology include TIMOTHY H. GOLDSMITH, THE BIOLOGICAL ROOTS OF HUMAN NATURE: FORGING LINKS BETWEEN EVOLUTION AND BEHAVIOR (1991); MATT RIDLEY, THE RED QUEEN: SEX AND THE EVOLUTION OF HUMAN NATURE (1994); ROBERT WRIGHT, THE MORAL ANIMAL: EVOLUTIONARY PSYCHOLOGY AND EVERYDAY LIFE (1994). Accessible textbooks include JOHN ALCOCK, ANIMAL BEHAVIOR: AN EVOLUTIONARY APPROACH (6th ed. 1998); DAVID M. BUSS, EVOLUTIONARY PSYCHOLOGY: THE NEW SCIENCE OF THE MIND (1999); MARTIN DALY & MARGO WILSON, SEX, EVOLUTION, AND BEHAVIOR: ADAPTATIONS FOR REPRODUCTION (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 (2000); JAMES L. GOULD & CAROL GRANT GOULD, SEXUAL SELECTION (1989); J.R. KREBS & N.B. DAVIES, AN INTRODUCTION TO BEHAVIOURAL ECOLOGY (3d ed. 1993); MARK RIDLEY, EVOLUTION (1993); ROBERT TRIVERS, SOCIAL EVOLUTION (1985).

An introduction to law-relevant principles of behavioral biology, written specifically for legal thinkers without biology backgrounds, appears in Part I: A Primer in Law-Relevant Evolutionary Biology, of Jones, *Evolutionary Analysis in Law*, *supra* note 16, at 1126–57, and in Goldsmith & Jones, *Evolutionary Biology and Behavior*, *supra* note 16. 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. (Fall 2000), *available at* http://www.humanestudiesreview.org/Fall2000/secondframeset.html.

49. Again, fuller discussions appear in Jones, *Time-Shifted Rationality*, *supra* note 4.

A. Inconsistent Preferences

I begin with a seemingly mundane phenomenon that proves surprisingly problematic for economists: poor dieting. 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. Legal implications of such inconsistency abound, including, for example, the probability that people may wish to save for their retirement and simultaneously spend beyond their means.

A neoclassical economist can solve the importantly representative dieting problem in one of four unsatisfactory ways. He can suppose that the individual: (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. 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.

Evolutionary analysis solves this problem by presenting 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.[50] 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 in turn enhanced their survival and reproduction.

In ancestral environments, sweet foods (such as ripe fruit) never contained calorie concentrations so high as to yield maladaptive obesity. Consequently, there was no selection pressure *against* overeating sweets. Notwithstanding the facts that our modern environment presents refined sugar, that eating too much can *now* be unhealthy, and that we can recognize this at the conscious level, we are left with a brain that natural selection shaped to crave sweets—because 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 to be irrational, our behavior is both highly patterned (none gorge on sour or rotting food) and explicable as the product of rational, economic forces.

50. This particular illustration of once-adaptive behavior that is adaptive no longer is common in the biological literature.

I have suggested that we might usefully call this temporal mismatch of historically adaptive behavior and modern environments "time-shifted rationality" (TSR).[51] 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, leads to substantively irrational or maladaptive behavior in the present environment.

If explaining human irrationality with evolutionary analysis looks easy, in this case, that's because it is. A great number of circumstances require far more complex evolutionary explanations, but the first two steps of evolutionary analysis are often illuminating in themselves. First, consider behavior-biasing information processing to be quite systematically shaped by evolutionary forces. Second, examine the behavior at issue through a temporal lens that puts it in the context of the environment during which relevant human brain functions likely evolved.

B. Over-Cooperativeness

In like fashion, TSR offers one possible solution to the tipping problem. Economists wonder why people consistently tip on the road, when the service has already been rendered and the restaurant is unlikely to be encountered again. Is this rational or irrational behavior, and what does it portend about law's ability to predict behavior?

To wedge this and other equally puzzling behavior into the rationality box, some economists resort to a surprisingly convenient abstraction known as "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. But this of course begs the question why so many people perceive this behavior to be sufficiently pleasurable to pay for it.

From the evolutionary perspective, TSR raises the possibility that tipping on the road is simply an epiphenomenon of psychological predispositions toward behavior that was often adaptive in ancestral times. The smaller the community, the greater the co-dependence of its members and thus the greater the importance of reputation. In a small society, with repeat interaction over sustained periods, a strategy of cooperative behavior is often superior to an overtly exploitative one. It is therefore adaptive to be known as a generous, honest, cooperative, and grateful individual in a small society. And indeed the logic of this is accessible through research on repeat player games, which yield similar results in the context of heritable tendencies to the same behaviors.

That tipping on the road appears to be 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,

51. Jones, *Time-Shifted Rationality*, *supra* note 4.

whom one is unlikely ever to encounter again—does not mean that such tipping is the product of a malfunctioning brain, or one that has simply internalized a random norm. 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 historically have had important consequences for reputation and reproductive success. The development of the norms, the existence of the behavior, and the evolution of the brain are all intimately correlated.[52] And none can be understood to exist independently of the others.

C. Intertemporal Choice Anomalies and Irrationally Discounted Futures

Researchers have noted not only that people 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.[53] This seems irrational. For example, the fact that a majority of adults would rather have $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."[54] This has, for example, obvious implications in the context of legal policies designed to encourage the purchase of expensive but energy-saving machines, or appropriate savings for retirement.[55]

It is likely a mistake to conclude that seemingly irrationally discounted futures are necessarily the function of calculating errors. An evolutionary TSR hypothesis would begin by examining the contexts in which such problems might have arisen in the environment of evolutionary adaptation. From this perspective, one can see that only in the most trivially recent period of our roughly 70 million years of primate evolution has there even been such a thing as a guaranteed future payoff (or even a guaranteed future). Since reliable future payoffs were not part of the environment in which the brain was slowly built, it is not terribly surprising that the brain tends to discount steeply 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.

52. For further discussion of the relationship between evolution and norm origins, see Owen D. Jones, *On the Nature of Norms: Biology, Morality, and the Disruption of Order*, 98 MICH. L. REV. 2072 (2000).

53. *See, e.g.*, George Ainslie, *Derivation of "Rational" Economic Behavior from Hyperbolic Discount Curves*, 81 AM. ECON. ASSOC. PAPERS & PROC. 334 (1991).

54. *Id.* at 334.

55. People frequently persist in purchasing less expensive, energy-hungry appliances when reduced energy costs would cover the difference between the price of that appliance and a more energy-efficient appliance within a year.

Put another way, at almost no time in human evolutionary history could there have been a selection pressure that clearly favored the cooly 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. Absent a regular environmental feature that offered a "guarantee" of future payoff, future payoffs would be quite speculative, and foregoing immediate payoffs would generally be irrational, and thus subject to selection pressure against such delayed satisfaction of personal utility.

D. Framing Problems and Mistaken Assessments of Probability

Evidence suggests that people's preferences for different outcomes in the face of uncertainty often vary as a function of the way questions are framed. This is troubling for any system that relies on rational choice between, for example, conflicting legal goals.

Evolutionary analysis suggests that the significance of framing may follow from the brain's being functionally specialized. 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 not yield the same behavioral inclination that dispassionate cost-benefit analysis would.

For example, psychologists Cosmides and 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, far fewer people reached the "rational" result in the former context than in the latter (roughly 40%, compared to 88%).[56] The Cosmides and Tooby studies provide powerful evidence for an evolved psychological "cheater-detection" mechanism, which was (and still is) adaptive. That is, the human brain appears to be specifically adept at "detecting violations of conditional rules when these can be interpreted as cheating on a social contract."[57] The possibilities this raises for explaining otherwise seemingly anomalous results as a function of question-framing are obvious.

56. 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).

57. *Id.*

E. Ultimatum Games and the Irrational Taste for Spite

In the so-called "ultimatum game," two subjects face the following scenario.[58] One subject is given a sum of money. He then proposes, to the other subject, how to divide the money between them. If the other subject agrees, each keeps the money according to the proposed split. If he disagrees, 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. Recognizing this, the first subject should propose to give the second subject one penny and keep the balance of the sum for himself. In reality, however, the second subject frequently rejects the proposed split (typically when the other proposes to share less than about 20% of the total). Researchers have thus discovered a seemingly irrational taste for spite. To inflict 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."[59] And yet people do.

Evolutionary analysis suggests that a predisposition toward context-specific spiteful behavior not only can evolve, as demonstrated by game theory, but probably did evolve. This, in turn, suggests that people's heightened attention to proportional fairness, and consequent tastes for spitefully rejecting even beneficial deals with stingy cooperators, are probably a function of species-typical evolved psychology. Natural selection could, through pathways now familiar to evolutionary game theory, select for a psychological predisposition that results in this time-shifted rationality.[60]

F. Endowment Effects and the Irrational Pricing of Property

Social scientists have observed, in a variety of experiments, that people tend to place a higher value on what they own (a mug, in the most famous experiment)

58. Werner Guth et al., *An Experimental Analysis of Ultimatum Bargaining*, 3 J. ECON. BEHAV. & ORG. 367, 367 (1982); Werner Guth & Reinhard Tietz, *Ultimatum Bargaining Behavior: A Survey in Comparison of Experimental Results*, 11 J. ECON. PSYCHOL. 417, 417–18 (1990); Colin F. Camerer & Richard H. Thaler, *Anomalies: Ultimatums, Dictators, and Manners*, 9 J. ECON. PERSP. 209, 210 (1995); *see also* Sheryl Ball & Catherine C. Eckel, *The Economic Value of Status*, 27 J. SOCIO-ECON. 495, 497 (1998) (discussing ultimatum game and citing much of recent literature); FRANK, *supra* note 2, at 237 (discussing ultimatum game).

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

60. Of course, there is a strong argument that a predisposition toward irrationally spiteful behavior can still be adaptive. *See* FRANK, *supra* note 37.

than they would be willing to pay to purchase the same.[61] This "endowment effect" is a frequently noted challenge to the rational actor model. Its potential significance to the laws of property and torts has been amply noted, because—inconsistent with assumptions underlying the Coase Theorem—the strength of the preference to own something is seemingly irrationally contingent on whether one already owns it.[62] Yet, there is currently no viable theory to explain why the endowment effect exists, or why so many people manifest it in the same way.[63] 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, researchers report that the effect is absent when tokens (instead of mugs) can be traded for cash.[64]

With a TSR lens, we can see that certain evolutionarily novel features make the endowment predisposition 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. Never before 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 helps explain some oft-noted but unexplained aberrations in endowment effects. For example, it explains the experimental finding that a mug in hand is endowed, while a token representing a right to a mug is not.[65] The TSR

61. *See, e.g.*, Elizabeth Hoffman & Matthew L. Spitzer, *Willingness to Pay vs. Willingness to Accept: Legal and Economic Implications*, 71 WASH. U. L.Q. 59, 69–84 (1993); Daniel Kahneman et al., *Experimental Tests of the Endowment Effect and the Coase Theorem*, 98 J. POL. ECON. 1325 (1990), *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).

62. *See, e.g.*, Herbert Hovenkamp, *Legal Policy and the Endowment Effect*, 20 J. LEGAL STUD. 225 (1991); Jeffrey J. Rachlinski & Forest Jourden, *Remedies and the Psychology of Ownership*, 51 VAND. L. REV. 1541, 1551–59 (1998); Stake, *supra* note 4.

63. The theory that the endowment effect is a function of "loss aversion"—the tendency to attach more importance to losses than to gains—begs for a theory of why people would systematically manifest such an aversion.

64. Rachlinski & Jourden, *supra* note 62, at 1558 (citing Kahneman, *supra* note 61, at 1329–31).

65. I am not implying that people are incapable 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

perspective also suggests that while researchers have attempted to control for wealth effects,[66] the brain may still reflect a time-shifted rationality appropriate for ancestral environments that generally lacked any sequesterable 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 why losses loom larger than gains in so many other species. There is a large literature in behavioral biology documenting the widespread feature of behavior in territorial systems that residents on territory almost invariably defeat challengers.[67] 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 territory than they do to reacquire it, once it has been transferred to another. The phenomenon is well-known and well-studied, and a leading hypothesis for why this may occur 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 empirical and theoretical foundation for understanding and predicting the endowment effect in humans.

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are endowed while money is not. My hypothesis is this: 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.

There is some evidence, however, for the endowment of some kinds of rights, notwithstanding the apparent fact that many rights are wholly unendowed. *See generally* Korobkin, *The Status Quo Bias and Contract Default Rules*, *supra* note 4. This clearly requires further study through both empirical work to identify distinctions between endowed and unendowed rights and theoretical work to explain distinctions that may emerge.

66. 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.

67. *E.g.*, L.D. Beletsky & G.H. Orians, *Territoriality Among Male Red-Winged Blackbirds: Testing Hypotheses of Territorial Dominance*, 24 BEHAV. ECOLOGY & SOCIOBIO. 333 (1989); John R. Krebs, *Territorial Defence in the Great Tit (Parus major): Do Residents Always Win?*, 11 BEHAV. ECOLOGY & SOCIOBIO. 185 (1982); Joe Tobias, *Asymmetric Territorial Contests in the European Robin: The Role of Settlement Costs*, 54 ANIMAL BEHAV. 9 (1997).

G. Summary

This sharply abbreviated evolutionary analysis of several common problems of supposed irrational behavior illustrates a larger point. A great deal of behavior currently thought to reveal cognitive limitations or imperfections is not necessarily the product of cognitive imperfections per se, as if the brain is malfunctioning or making computational mistakes. We do not say that a barometer is malfunctioning when it fails to record temperature. It is important to recognize that the problems of manifestly sub-optimal human behavior, under current conditions, should necessarily invoke the much neglected question of design. We must more frequently ask for what functions, and in what environment, was the brain designed? This is a question one cannot adequately answer without evolutionary analysis.

Consequently, I believe it is essential, in considering behavior that strikes us as sub-optimal, to recognize how finely tuned, how high performance, and how intensely specialized natural selection has left the brain to be. Much seemingly irrational behavior is likely the by-product of a highly specialized, well-adapted, and perfectly functional species-typical brain operating precisely as natural selection left it designed to operate. This is why so many people tend to exhibit the same patterns of supposedly irrational behavior. This is why they are far more likely to exhibit these patterns than other patterns. And this, incidentally, is why historically isolated human populations frequently share similar preferences, emotions, norms, and legal predicates in the contexts of activities central to reproductive success, such as family, sexuality, kin relationships, resource acquisition, status-seeking, and the like.[68]

My point is this: the existence of time-shifted rationality introduces a temporal dimension to the study of behavior. When economists label a behavior as rational or irrational, they need to be conscious of the temporal dimension to rationality. What we describe as "irrational" is often the product of a mismatch between the environment in which the brain evolved and the environment in which the brain now must operate. These behavioral outcomes, though odd by today's measure, do not reveal a brain that has simply bumped up against its fixed capacities, or one that sports some genetic or socialized defect, or one that is tired, uninformed, imperfect, uncertain, misfiring, mistaken, malfunctioning, misled, or uneducated in the wily ways of proper decisionmaking. Often, these behaviors reflect beautifully intricate and highly subtle adaptations, reflecting millions of years of fine tuning by evolutionary processes.

To describe the brain as operating imperfectly because it fails to motivate its owner toward behaving in the most efficient manner currently available is akin to condemning a high-performance sports car as imperfect or malfunctioning because it fails to climb logs when we take it off road. First, natural selection is path-dependent and opportunistic. It winnows, without itself creating, and

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68. *See, e.g.*, DONALD E. BROWN, HUMAN UNIVERSALS (1991).

therefore is economizing, not optimizing. Second, natural selection cannot build brains that operate equally well in any future environment they happen to encounter. It cannot design a one-size-fits-all, general-purpose brain. For natural selection cannot anticipate and cannot look forward.

Because natural selection is an economizing force, but can only work with contemporaneously existing alternative traits that happen to arise, it leaves brains with information-processing algorithms that tend to increase the probability of behaviors that were adaptive in most of the environments that brains had long encountered. The brain is therefore, in essence, a living fossil, always best designed for what came before. It biases our emotions and preferences in ways that were adaptive, on average, for the organisms bearing them in environments of evolutionary adaptation. When the environmental circumstances rapidly change, as they have, once-adaptive behavior can lead to distinctly maladaptive outcomes. This renders otherwise rational behavior irrational as a product not of design flaw, but of changed circumstances.

III. THE LAW OF LAW'S LEVERAGE

The rational actor model of human behavior works perfectly well—in those contexts in which people act rationally. But the utility of the model famously attenuates in those contexts in which people act differently. Behavioral economics is the promising field of study intended to supplement, counter-balance, or enrich (depending on how you look at it) the rational actor model. In recent years, behavioral economics has built an impressive empirical foundation for the study of irrational behavior. But its empirical foundations are as yet far stronger than its theoretical ones.

Evolutionary analysis supplies necessary theoretical structure, because it helps to explain and predict patterns of human cognition and decision making. It opens a view on human behavior as the product of a brain that evolutionary processes have functionally specialized to perceive and process information in ways that tended to yield adaptive solutions to problems encountered in ancestral environments of evolutionary adaptation. Time-shifted rationality is one product of those processes.

But this is only the beginning. While the rational actor model predicts that people will engage in activities in ways corresponding to the amounts they value those activities, economics has no useful theory to predict how common human values and tastes arise or the content of those values. Evolutionary analysis can be used to build such a theory. In doing so, it can demonstrate that a great deal of seemingly irrational, emotional, and nonmarket behavior is more intimately connected to rational behavior than previously supposed. Specifically, many of these behaviors are categorized as they are (i.e., as something categorically distinct from rational behavior) because the demand for them seems so much more

inelastic than traditional economic or social science thinking can systematically explain.[69]

Evolutionary analysis of behavior, focusing on brain design and function, is providing a richer understanding of these behaviors. 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.

A. Evolutionary Analysis of Comparative Legal Effectiveness

The sum of the various principles of evolutionary analysis relevant to law, including time-shifted rationality, will lead, I believe, to a richer description of the relationship between law and behavior. I have suggested that we might refer to this as "the law of law's leverage."[70]

> 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 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.[71] Similarly, the aggregate difficulty of using

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69. 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.

70. See Jones, *Time-Shifted Rationality*, *supra* note 4, at Part IV.

71. 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 (1996). A related idea appeared in the Amicus Brief of the Gruter Institute, In the Matter of Baby M., 537 A.2d

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.[72] 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

1227 (N.J. 1988) ("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.").

72. *See supra* note 69. The demand curve, in this context, traces the changing amounts of a given behavior that we will observe, in society, as the costs of engaging in that activity vary. Legal interventions can raise or lower the costs. In the context of criminal law, for example, sanctions such as fines or prison terms operate like prices to deter undesirable behavior, by making them more expensive. How much an increase in sanctions (prices) will reduce the incidence of a given behavior depends on the quantity of that behavior that people "demand"—that is, will choose to engage in—at different levels of sanctions.

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 along a continuum of importance, for even a rough theoretical structure 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.[73] 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.[74]

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 bearing it, yielded increases in inclusive fitness that outweighed any decreases. That is, "on average" the trait increased the reproductive success of organisms that bear 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.[75] "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 manifests.

"Past environments" refers to the environment of evolutionary adaptation (EEA). The relevant environment of evolutionary adaptation varies from feature to feature.[76] 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' environments 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.

73. *See* ALCOCK, *supra* note 42, at G-1.

74. On reproductive success and inclusive fitness, see *id.* at 561–69.

75. *See id.* at G-1.

76. *See, e.g.*, Robert Foley, *The Adaptive Legacy of Human Evolution: A Search for the Environment of Evolutionary Adaptedness*, 4 EVOLUTIONARY ANTHROPOLOGY 194 (1995-1996).

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 offers one possible explanation for why some nonmarket behavior *is* nonmarket behavior. Nonmarket behavior is essentially behavior that is relatively insensitive to price changes (compared to sensitivity to changes in the prices of other goods and behaviors). Nonmarket 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, nonmarket 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 behavioral predispositions we now term beyond simple economic analysis, because the origins and strengths of preferences seemed so mysterious.

Legal contexts in which the law of law's leverage will be particularly relevant will be those aspects of, for example, constitutional law, criminal law, family law, torts, property, and contracts, that involve such things as: 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.

B. Brief Examples

It is important to recognize that evolutionary analysis is a positive, not a normative, undertaking.[77] Explanation is not justification. But surely explanation provides useful information when we seek 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 volume of that activity.

77. *See, e.g.*, Jones, *Evolutionary Analysis in Law*, *supra* note 16; Jones, *Sex, Culture, and the Biology of Rape*, *supra* note 16.

While this may be true as a general matter, we are all aware of 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.[78] It seems obvious that laws prohibiting such behavior are likely to be relatively ineffective deterrents. But why? What theory predicts the pattern in which behaviors will be less sensitive to cost? Evolutionary theory provides a powerful window into the contexts in which increasing criminal penalties is unlikely to affect behavior materially. It therefore helps 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.

Other contexts in which similar analysis is useful include:

- *Adultery.* Evolutionary analysis predicts that the demand for adulterous behavior is likely to be comparatively inelastic (like the demand for most sexual behavior) and thus comparatively insensitive to the imposition of legal prohibitions (or other costs, such as effect on career).[79]
- *Marriage and Divorce.* Evolutionary analysis predicts that marriage, separation, divorce, and remarriage behavior will be less sensitive to legal changes than will be many other forms of behavior.[80]
- *Incest.* Evolutionary analysis predicts that it will be far less costly to discourage incest among parents and their natural children, and between siblings reared together, than between step-parents and step-children, and among step-children.[81]

78. For lengthier discussion of the effects of evolutionary processes on attitudes toward rapists, see Jones, *Sex, Culture, and the Biology of Rape*, *supra* note 16, and bibliographic sources cited in Appendix A. 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.

79. *See, e.g.*, BUSS, *supra* note 48.

80. *See* Ira Mark Ellman & Sharon L. Lohr, *Dissolving the Relationship Between Divorce Laws and Divorce Rates*, 18 INT'L REV. L. & ECON. 341 (1998) (arguing divorce rates are insensitive to divorce laws); *see generally* HELEN E. FISHER, ANATOMY OF LOVE: THE NATURAL HISTORY OF MONOGAMY, ADULTERY, AND DIVORCE (1992).

81. 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) (8 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,

• *Sexual Jealousy.* One of the great powers of evolutionary psychology is that it gives us a demographic basis for expecting, as well as a sound theoretical foundation for understanding, why sexually jealous behavior may be more extreme among men (on average) than among women.[82] The asymmetries for males and females in the consequences of a partner having extra-pair copulation favored sexual territorialness in males even more strongly than it did in females (as only males can be uncertain of their genetic relationship to their putative children). Evolutionary analysis predicts that the taste for jealous upset, and consequent violence (against rivals, and potentially straying partners) will be stronger, on average, across males than across females.

• *Crimes of Threats to Status.* One of the most significant findings of modern criminology is that most homicides arise from seemingly trivial altercations. One boy insults another in front of his friends; the latter shoots him. We can be reasonably confident that the shooter is generally motivated more by emotion than by deliberate calculus. Evolutionary analysis offers a robust theory for why males in particular (especially young males) are so emotionally aroused by perceived threats to status.[83] It suggests that threats to status are of greatest cost when there are observers whose opinions are valued (as if they are assets) by the threatened individual.

• *Shaming Sanctions v. Fines.* Beyond aiding us in evaluating the inertia law must overcome when attempting to shift different behaviors, evolutionary analysis provides occasional windows into the relative effectiveness of different legal techniques of shifting behavior. For example, scholars and judges have recently rejuvenated punishments that impose reputational rather than monetary costs.[84] 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.[85]

FATHER-DAUGHTER INCEST (1981). On the human tendency to avoid brother-sister incest where siblings are reared together, see GOLDSMITH, *supra* note 48, at 9–10.

82. *See, e.g.*, David M. Buss et al., *Sex Differences in Jealousy: Evolution, Physiology, and Psychology*, 3 PSYCHOL. SCI. 251 (1992); FISHER, *supra* note 80; Martin Daly et al., *Male Sexual Jealousy*, 3 ETHOL. & SOCIOBIO. 11 (1982).

83. *See, e.g.*, MARTIN DALY & MARGO WILSON, HOMICIDE 126–33 (1988); DALY & WILSON, *supra* note 48; Buss & Shackelford, *supra* note 78.

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

85. This value is readily susceptible to evolutionary analysis. *See, e.g.*, sources cited, *supra* note 48.

C. On Legal History

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."[86] Much of it can. But an evolutionary analysis can supply an even broader perspective on the legal institutions of the human animal that is not only often consistent with the axioms of economics, but also reveals that much of even those areas in which economics has not successfully penetrated can be understood to be a product of the relentlessly economic forces of natural selection.[87]

The law of law's leverage, for example, can be described as an intensely powerful winnowing force that explains which laws we have and which we do not. 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 portion of all possible legal rules that are not far too costly even to consider.

Take, for example, a 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. The outcome might increase social wealth compared to the alternative. The rule would be absurd because the own-child-saving preference 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, but the law of law's leverage, as derived from the effects of evolution on human behavior-biasing psychological predispositions.

Law's effectiveness depends on its behavioral model—the thing that suggests that if law moves this way, behavior will correspondingly move that way, and not some other way.[88] Behavioral models are necessarily models of how the human brain functions. Any modern understanding of how the brain functions requires the combined and integrated knowledge of both social and life sciences. Life science perspectives are necessarily evolutionary. And evolution-

86. Baird, *supra* note 3, at 1132; *see generally* POSNER, *supra* note 2; DAVID W. BARNES & LYNN A. STOUT, CASES AND MATERIALS ON LAW AND ECONOMICS (1992); HENRY N. BUTLER, ECONOMIC ANALYSIS FOR LAWYERS (1998).

87. *See generally* Owen D. Jones, *The Dunwody Distinguished Lecture in Law: Proprioception, Non-Law, and Biolegal History*, 53 U. FLA. L. REV. (forthcoming 2001).

88. *Id.*

ary analysis reveals several things important to any robust behavioral model, and thus important to law.

This importance to law flows from the same source as that providing the impetus to behavioral economics: the rational actor model is at once useful, important, and incomplete. Despite its many successes, the rationality assumption often fails us in the face of real people, with seemingly odd assortments of irrationality, emotions, norms, and preferences. To a more interconnected and comprehensive understanding of these, evolutionary analysis offers five things.

First, it reconceptualizes behavior to be a product not of a general-purpose information processor, as commonly presumed, but of a functionally specialized information processor. Second, it enables us to understand the brain's functionally specialized and context-specific behavior-biasing algorithms to be patterned products, in part, of a knowable, systematic, and evolutionary force: natural selection. These algorithms, and their patterned effects on preferences, emotions, and the like, are often adaptations to problems encountered in ancestral environments. To the extent that people often behave as if they were rational maximizers of personal utility, it is because their information processing pathways have been honed by the most relentlessly economizing process in the history of life. As a result, evolutionary processes inevitably contribute to the common origins and ordering of some preferences.

Third, evolutionary analysis provides us with an important new lens for examining seemingly irrational and aberrational human behavior. It reveals that such behavior often exists and is patterned into species-typical ways, not because of computational flaws, but because of time-shifted rationality—a temporal mismatch between the environment in which natural selection shaped the brain to function and the modern environment we have only recently created. Fourth, it provides us with a powerful tool for explaining patterns in which people will deviate from so-called rational behavior, predicting new ones, and then linking all of these patterns together into one conceptual framework.

Finally, this evolutionary analysis has revealed a principle, the law of law's leverage, that combines legal, economic, and biological insights. It predicts that the cost of using law to shift any behavior will be proportional to the average effect that the information-processing predisposition tending to yield that behavior had on the reproductive success of human and nonhuman ancestors in relevant environments of evolutionary adaptation. It offers a systematic way to explain and predict the comparative costs to society of shifting different kinds of human behavior. This not only has utility for estimating the costs of future legal regimes, but also provides a powerful tool for explaining a number of large patterns in legal history, both within a society and across human cultures.

If both economics and behavioral economics aspire to the status of a science of choice, neither can ignore the processes by which the evolutionary history of the human brain affects the tastes people have, the perceptions they form, and the choices they make.