INTERGENERATIONAL DECISION MAKING: AN EVOLUTIONARY PERSPECTIVE

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This Article consists of two parts. The first poses a challenge, which I call "The Pleistocene Dilemma," to all who write on the normative problems of intergenerational decision making. In analyzing such problems, it is common either to write abstractly or to focus on relatively short spans of time—at most a few generations. But many of the most important practical issues we currently face—resource depletion, for example—have much longer-term consequences. The hypothetical I pose spans some 12,500 years; at stake are the rise and fall of civilizations. Any credible normative theory of intergenerational decision making, I contend, must be able to address concrete challenges of this scope. Discounted cost-benefit analysis, the dominant intergenerational decision-making model in use today, fails this challenge miserably, as does one of the most politically correct approaches to its implementation, reliance on free markets.

The second Part of this article introduces the perspective of evolutionary theory. I am in the process of developing an evolutionary theory of motivation and normative obligation, to be laid out more fully in a longer article that, unfortunately, will not appear until after this Symposium issue has been published.[1] One of its premises is that all normative claims are motivational: When we say "you should do x" or "we should do y," we are attempting to motivate our audience

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1. *See* Theodore P. Seto, *An Evolutionary Theory of Motivation and Normative Obligation* (forthcoming).

to do x or y or to assure our audience that we ourselves are so motivated. Any theory of normative obligation, I assert, must adopt or include a theory of motivation; conversely, any comprehensive theory of motivation must include a theory of normative obligation.[2] The second Part of this Article will outline, in summary form, the parts of my theory that relate to normative obligation and explore some of their implications for intergenerational decision making. One of my conclusions is epistemological—that sometimes the only way to determine whether a behavior is optimal is by trial and error. Behavioral ecosystems are at least as complex as biological ecosystems, and we know that small changes in the latter often produce unexpected results. Nevertheless, the model permits identification of a long-term normative objective consistent with both evolutionary theory and our intuitions about ethics—to wit, the survival, evolution and integrative expansion of something I call our "We," that is, the set of actors to whom our system of ethics applies. Were the decision-maker in the Pleistocene Dilemma to adopt this long-term objective, the Article concludes, she would resolve that dilemma correctly.

I. A CHALLENGE: THE PLEISTOCENE DILEMMA

In his book *Guns, Germs, and Steel*,[3] Jared Diamond offers an evolutionary account of the gross features of human history. In particular, he explores why remarkably small numbers of Europeans were able to defeat and destroy large, well-established Native American civilizations in short order after Columbus's voyage in 1492.[4] We know mechanically how it was done: The Europeans used the horse and the gun to obtain an immediate military advantage; the diseases they brought then decimated American

2. Philosophy currently does not make such a link. Indeed, discussions of motivation are commonly labeled "folk psychology" in mainstream Western philosophy, with presumably intended derogatory overtones. *See* THE CAMBRIDGE DICTIONARY OF PHILOSOPHY 268-69, 514-15 (Robert Audi ed., 1995). In this regard, philosophy suffers from a failure to incorporate insights from other fields. I discuss some of the epistemological problems that may lead to current philosophical distrust of motivational claims in Part II.B.3 below.

3. JARED DIAMOND, GUNS, GERMS, AND STEEL (1997).

4. *See id.* at 67-68.

populations.[5] But why, Diamond asks, did the Europeans have guns, horses and disease, and not the Americans?[6]

His answer makes compelling reading and is not easily summarized. The development of settled human civilization, he suggests, depended initially on the domestication of edible plants and useful large mammals.[7] Wheat, barley, sheep, goats, cows, horses, and donkeys were all fortuitously available in or near southwestern Asia;[8] for this reason, humans first developed fixed settlements there some 7000 to 10,000 years ago.[9] The domestication of large herbivores—and of the horse in particular—made possible rapid advances in agriculture, mobility, and technology generally.[10] It also resulted in the transmission of disease from animals to humans,[11] leading to repeated plagues in Eurasia and relative immunity to such diseases on the part of the Eurasian population.[12] The Americas, by contrast, offered only corn as an edible starch, and the alpaca and llama (two breeds of a single species) as domesticable large herbivores.[13] Corn required substantial modification to become useful as a food crop;[14] the alpaca and llama were and are of limited utility.[15] The Americas

5. *See id.* at 69-81.
6. *See id.* at 81.
7. *See id.* at 86-91.
8. Diamond includes northern Africa in Eurasia for this purpose. *See id.* at 160-61.
9. *See id.* at 131-75.
10. *See id.*
11. Among the human diseases that evolved from diseases of animals are smallpox (cows and related species), flu (pigs and ducks), tuberculosis (cows), malaria (birds), measles (cows), and cholera and AIDS (monkeys), all of which have had devastating effects on human populations. *See id.* at 196-97, 207.
12. *See id.* at 205-14.
13. *See id.* at 354-57.
14. *See id.* at 137.
15. *See id.* at 355. The alpaca and llama are used for meat, wool, hides, and the transport of goods. They are not useful, however, for the production of milk, riding, or pulling vehicles or plows. *See id.* Diamond argues that, in facilitating the development of civilization, the five most important herbivorous domestic mammals were the sheep, goat, cow, pig, and horse. *See id.* at 160-61. The next nine were the Arabian camel, Bactrian camel, alpaca/llama, donkey, reindeer, water buffalo, yak, Bali cow, and mithan. Of these, none were indigenous to North America, and only the alpaca and llama were indigenous to South America. *See id.* The alpaca and llama were not domesticated in South America until about 3500 B.C. *See id.* at 167. Their use remained limited to a "small area of the Andes and the adjacent Peruvian coast." *Id.* at 355.

thus provided a relatively meager biological base. It was for this reason, Diamond argues, that American civilizations developed much later and more slowly[16] and posed no substantial biological threat to the invading Europeans.[17]

But why were there no other domesticable large herbivores in the Americas? After all, at the end of the Pleistocene Era, some 13,000 years ago, the Americas hosted an abundance of large mammalian species, including the horse, several species of camel, and many other possibly domesticable large herbivorous mammals.[18] The answer is not clear.[19] We do know that humans began arriving in large numbers at about that time—traversing the frozen waters of the Bering Strait.[20] Coincident with this human invasion, about eighty percent of the Americas' large mammalian species, including the horse and camel, became extinct.[21] These so-called "Pleistocene extinctions" may have been caused by human hunting, climatic change, or a combination of the two.[22] My hypothetical asks the reader to

16. *See id.* at 362-63. Thus, domestication of plants occured in the Fertile Crescent around 8500 B.C., South and Central America around 3000 B.C., and North America around 2500 B.C.; domestication of large herbivores occurred in the Fertile Crescent around 8000 B.C., South America around 3500 B.C., Central America around 500 B.C., and North America post-Columbus; use of copper or bronze tools occurred in the Fertile Crescent around 4000 B.C., South America around 1000 A.D., and Central and North America post-Columbus; and widespread use of iron tools occurred in the Fertile Crescent around 900 B.C., and the Americas only post-Columbus. *See id.*

17. *See id.* at 357-58.

18. *See id.* at 162. I use here the calibrated radiocarbon datings given by Diamond. *See id.* at 96-97.

19. A review of the literature on this issue appears in Anthony J. Stuart, *Mammalian Extinctions in the Late Pleistocene of Northern Eurasia and North America*, 66 BIOLOGICAL REVIEWS 453 (1991).

20. *See* DIAMOND, *supra* note 3, at 44-45.

21. *See id.* at 213. The larger the species, the more likely it was to become extinct; for this reason, the percentage of species eliminated depends on the weight cutoff used. *See* Stuart, *supra* note 19, at 455. Many of these North American species had no exact counterparts in Eurasia. *See* DIAMOND, *supra* note 3, at 167, 213. We therefore do not know whether they would have been domesticable or whether they would have carried diseases that might have evolved into human diseases.

22. *See* DIAMOND, *supra* note 3, at 46-48; Stuart, *supra* note 19, at 456. Diamond argues that similar extinctions occurred at the time of the first human invasion of Australia as well, leading to similar biological impoverishment. *See* DIAMOND, *supra* note 3, at 42-44.

assume that human hunting contributed significantly to the extinctions and, therefore, ultimately to the Native American holocaust. By posing this hypothetical, I do not mean to accuse Native Americans of having been responsible for their own near annihilation.[23] Solely for purposes of creating a useful thought experiment, however, I do ask the reader to consider the possibility of a causal link between Pleistocene hunting and the European victory 12,500 years later. Here, then, is the Pleistocene Dilemma:

> You are a decision-maker for the first Americans. Assume that you have only two choices—to limit your people's hunting or not. If you limit their hunting, some significant number will starve to death. In the long run, however, their descendants will domesticate the horse and other large mammals and develop civilizations better able to resist or absorb the coming European invasion. If, on the other hand, you impose no hunting limits, your people will be substantially better off in the short run—perhaps for many generations—but their culture will develop more slowly. As a result they will suffer cultural and physical near-annihilation some 12,500 years hence.

The Dilemma presents a relatively straightforward problem of resource use. Should we deplete a particular resource—in this case, the horse—today, or save it for possible future use? Any credible normative theory of intergenerational decision making must either (1) lead to a decision to limit hunting or (2) justify the deliberate choice of long-term catastrophe. The only questionable assumption the Dilemma makes is informational. Critics may assert that we can never know the long-term consequences of our actions. I address this issue in Part II.B.3 below. Apart from objections on informational grounds, however, the Dilemma poses a fair and concrete question that credible theories of intergenerational decision making

23. Indeed, preconquest Amerindian culture expressed far more concern for consequences to future generations than most. The Great Law of the Six Nations Confederacy (Iroquois) stated, in part: "In all our deliberations, we must be mindful of the impact of our decisions on the seven generations to follow ours." John Rohe, *Conservation in Northern Michigan*, 78 MICH. B.J. 424 (1999); *see* Paul Boudreaux, *Environmental Costs, Benefits, and Values: A Review of Daniel A. Farber's Eco-Pragmatism*, 13 TUL. ENVTL. L.J. 125, 159 n.211 (1999).

ought to be able to answer.

Cost-benefit analysis, the formal intergenerational decision-making approach most commonly used today, fails this challenge.[24] Implicitly utilitarian, it converts all costs and benefits (including lives lost) into dollar amounts, discounts future costs and benefits to present value using an appropriate discount rate, and selects the course of action with the highest resulting net benefit or lowest resulting net cost.[25] A positive discount rate always results in less weight being given to future consequences than to present costs and benefits—the higher the discount rate, the lower the weight given to the future.[26] U.S. courts and administrative bodies typically use rates of between five percent and fifteen percent; lower rates are used only by specific congressional mandate and negative rates are never used.[27]

Even at a discount rate of just one percent, however, cost-benefit analysis asserts that a decision that would have saved a single life 12,500 years ago would have been normatively required even if it results in wiping out 10^{54} (one followed by fifty-four zeros) lives to-

24. A valuable collection of perspectives on cost-benefit analysis appears in the June 2000 issue of the *Journal of Legal Studies*. *See generally* Symposium, *Cost-Benefit Analysis: Legal, Economic, and Philosophical Perspectives*, 29 J. LEGAL STUD. 837 (2000) (presenting various perspectives on cost-benefit analysis) [hereinafter "Cost-Benefit Symposium"].

25. *See generally* Amartya Sen, *The Discipline of Cost-Benefit Analysis*, 29 J. LEGAL STUD. 931 (2000) (providing an in-depth discussion of cost-benefit analysis as a general discipline).

26. *See* Daniel A. Farber & Paul A. Hemmersbaugh, *The Shadow of the Future: Discount Rates, Later Generations, and the Environment*, 46 VAND. L. REV. 267, 279 (1993).

27. In *Johnston v. Davis*, for example, the Tenth Circuit held that a 3.25% rate mandated by statute for specified purposes was unrealistically low and therefore required recalculation of other important long-term costs and benefits using a rate of 7.125%. Johnston v. Davis, 698 F.2d 1088 (10th Cir. 1983); s*ee also* N. Cal. Power Agency v. Fed. Energy Regulatory Comm'n, 37 F.3d 1517, 1523 (D.C. Cir. 1994) (upholding the use of a 15% discount rate); Trevino v. United States, 804 F.2d 1512, 1517 (9th Cir. 1986) (finding that the trial court's use of a negative discount rate was abuse of discretion). For general discussions of the problem of discount rates see Farber & Hemmersbaugh, *supra* note 26; Lisa Heinzerling, *Discounting Our Future*, 34 LAND & WATER L. REV. 39 (1999); Edward R. Morrison, *Judicial Review of Discount Rates Used in Regulatory Cost-Benefit Analysis*, 65 U. CHI. L. REV. 1333 (1998); Richard L. Revesz, *Environmental Regulation, Cost-Benefit Analysis, and the Discounting of Human Lives*, 99 COLUM. L. REV. 941 (1999).

day.[28] Most of us have no intuitive grasp of numbers of this magnitude. The following may place this assertion in perspective. Astronomers believe that the universe contains over 10^{22} (one followed by twenty-two zeros) stars.[29] Assume that every star in the universe supports a population of intelligent beings equal to that of Earth (roughly six billion).[30] On this assumption, cost-benefit analysis using a one percent discount rate concludes that the saving of one life 12,500 years ago would justify the wiping out of all intelligent life in the universe today not just once, but more than one billion trillion times. In the Pleistocene Dilemma, of course, the immediate benefit from unlimited hunting is much greater and the future harm much smaller; clearly, therefore, cost-benefit analysis would require continued unlimited hunting. Apart from saying "But we sure had fun in the meantime," utilitarianism does little to justify the resulting holocaust.

Reliance on free markets to make the decision is equally problematic. The philosophy that free markets produce normatively optimal results—which I will call "normative market theory"—is a product of the same branch of utilitarianism that underlies cost-benefit analysis. Descriptively, market theory asserts that in an efficiently functioning market with fully internalized costs and benefits, individual decision makers will rationally apply cost-benefit analysis to all of their decisions using the marginal real rate of return on capital, currently estimated to be about twelve percent,[31] as their discount rate. The normative branch of this theory further asserts that the outcomes of such decisions are normatively optimal because they maximize aggregate welfare as expressed through preferences satisfied in the market.[32] Although it would be next to impossible to

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28. *See* Farber & Hemmersbaugh, *supra* note 26, at 277-79.

29. *See* Paul J. Green, *Star*, *in* 18 THE WORLD BOOK ENCYCLOPEDIA 840, 840 (2000).

30. The human population of the planet Earth was estimated to be 6.1 billion in 2000 and is projected to be about 9.1 billion in 2050. *See* THE WORLD ALMANAC AND BOOK OF FACTS 860, 860 (2001).

31. *See* Tyler Cowen & Derek Parfit, *Against the Social Discount Rate*, *in* PHILOSOPHY, POLITICS, AND SOCIETY, SIXTH SERIES: JUSTICE BETWEEN AGE GROUPS AND GENERATIONS 144, 144 (Peter Laslett & James S. Fishkin eds., 1992).

32. Richard Epstein, for example, asserts that in general, so long as regulation prevents aggression and coordinates use of common pools, all other out-

determine the marginal real rate of return on capital in the Americas for each of the past thirteen millennia, there is no reason to believe that the actual decision made by Native Americans (by hypothesis, not to limit hunting) was other than rational and unconstrained. Under normative market theory, it follows that that decision must have been utility maximizing and therefore normatively correct.[33] Thus, reliance on free markets to resolve the Pleistocene Dilemma would also have resulted in continued unlimited hunting with the same absence of justification for the outcome.

II. EVOLUTIONARY PERSPECTIVES

A. An Evolutionary Theory of Motivation and Normative Obligation

Evolution is often misunderstood. At its core, it has nothing to do with biology, even though it is essential to modern biology. It is simply a process—a process that can apply to all sorts of things, genes among them.[34] In order to be subject to evolution, a set of

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comes are inferior to that which will be produced by unconstrained markets. *See* Richard A. Epstein, *Justice Across the Generations*, *in* PHILOSOPHY, POLITICS, AND SOCIETY, *supra* note 31, at 84, 85.

33. In effect, normative market theory claims that unless (1) costs and benefits were not fully internalized, (2) markets were not efficient, or (3) government was involved, then whatever actually happens is the best of all possible worlds. *See id.*

34. For example, mathematicians use evolution deliberately to solve problems not amenable to conventional solutions; they call this process the "genetic algorithm." *See, e.g.*, Mitchell A. Potter & Kenneth A. De Jong, *A Cooperative Coevolutionary Approach to Function Optimization*, *in* PARALLEL PROBLEM SOLVING FROM NATURE–PPSN III: INTERNATIONAL CONFERENCE ON EVOLUTIONARY COMPUTATION, THE THIRD CONFERENCE ON PARALLEL PROBLEM SOLVING FROM NATURE JERUSALEM, ISRAEL, OCTOBER 9-14, 1994 PROCEEDINGS 249 (Yuval Davidor et al. eds., 1994); R. Chandrasekharam et al., *Genetic Algorithm for Node Partitioning Problem and Applications in VLSI Design*, 140 COMPUTERS & DIGITAL TECHNIQUES 255, 255 (1993); David Goldberg, *Genetic and Evolutionary Algorithms Come of Age*, 37 COMM. ACM 113, 113-14 (1994); Kenneth V. Price, *Genetic Annealing*, 19 DR. DOBBS J.: SOFTWARE TOOLS FOR THE PROFESSIONAL PROGRAMMER 127, 127 (1994). *See generally* JOHN HOLLAND, ADAPTATION IN NATURAL AND ARTIFICIAL SYSTEMS (MIT Press ed. 1992) (1971) (discussing theoretical foundations and exploring applications of genetic algorithms in the study of complex adaptive systems). Drug companies now use an analogous process, called computer-aided molecular design (CAMD), to design new drugs. *See* Michael J. Felton, *Survival of the Fittest in Drug Design*, 3 MODERN DRUG

phenomena need only meet three criteria. (1) First, the phenomena must reproduce, and they must survive and reproduce differentially in response to a common set of environmental conditions. All this means is that some members of the population must do better than others in dealing with those conditions. The more successful ones will produce more offspring in the next generation. As a result, the character of the population as a whole will change over time. (2) Second, the phenomena must reproduce imperfectly. Otherwise, evolution will be limited to characteristics that were present in the first generation and no new characteristics will ever develop. (3) Third, such imperfect reproduction must not systematically disfavor adaptive changes; if it did, it might offset the effects of the first two. If these three criteria are met and environmental conditions are relatively stable, the law of evolution states that the population of such phenomena will, with a probability approaching infinity, become better adapted to those conditions.[35]

DISCOVERY 49, 49 (2000). Companies of all sorts are using a similar process, called directed molecular evolution, to develop detergents, crops, and other products. *See* Andrew Pollack, *Selling Evolution in Ways Darwin Never Imagined; If You Can Build a Better Gene, Investors May Come*, N.Y. TIMES, Oct. 28, 2000, at C1. Indeed, three corporations specializing in this process have gone public this past year. *See id.* Some of the most dangerous computer viruses use evolution to avoid detection and eradication. *See* Peter E. Sakkas, *Espionage and Sabotage in the Computer World*, 5 INT'L J. OF INTELLIGENCE & COUNTERINTELLIGENCE 155, 158 (1990). Gerald Edelman has even proposed that human learning results from selection among neuronal groups. *See* GERALD M. EDELMAN, NEURAL DARWINISM: THE THEORY OF NEURONAL GROUP SELECTION, 303-08 (1987).

35. More precisely, evolution is a process of directional change that operates on any phenomena that meet three criteria: (1) such phenomena survive or reproduce differentially in response to a common set of environmental conditions, (2) they reproduce imperfectly, and (3) adaptive imperfections in their reproduction are not systematically disfavored. If these three criteria are met and environmental conditions are relatively stable, the law of evolution states that the population of such phenomena will, over time, become better adapted to the environmental conditions it faces. For purposes of this definition, an environmental condition is a condition external to the phenomena in question that affects their survival or reproduction; it is relatively stable if it does not change as fast as evolution operates; a characteristic is adaptive if such phenomena are more likely to survive and reproduce successfully with that characteristic than without it; and phenomena are said to become better adapted to the environmental conditions they face if an increasing portion of the population of such phenomena have adaptive characteristics. The foregoing is merely a generalized restatement of *Fischer's Fundamental Law of Natural Selection*. *See*

Genetic evolution operates primarily at the level of the gene, not the level of the individual or group.[36] What this means is that over time, *genes* are favored if they survive and reproduce more successfully; their human or other carriers need not survive.[37] While the interests of genes can thus diverge from those of their individual carriers, this is more commonly the exception than the rule.[38] All else being equal, a gene that systematically kills its carrier is less likely to be successful than one that keeps its carrier alive and reproducing.[39] In the context of intergenerational decision making, such possible divergences in interest do not appear to be important. This Article will therefore, for the most part, treat the interests of the gene and its individual carrier as identical. Genes cause their carriers to develop specific attributes; those attributes are known as "phenotypes."[40] Bi-

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DANIEL L. HARTL, A PRIMER OF POPULATION GENETICS (3d ed. 1999).

Unfortunately, no generally accepted nomenclature exists for this process in all of its manifestations. Using it to explain the development of living species, Darwin called the process "natural selection," analogizing it to the "artificial" process used by animal breeders. CHARLES DARWIN, THE ORIGIN OF SPECIES 67-107 (Gillian Beer ed., Oxford World's Classics 1988) (1859). Biologists sometimes further distinguish between "natural" and "sexual" selection, using the former to refer to selection in favor of survival characteristics, and the latter to refer to selection in favor of characteristics that give advantages in mating. *See, e.g.*, GEOFFREY MILLER, THE MATING MIND: HOW SEXUAL CHOICE SHAPED THE EVOLUTION OF HUMAN NATURE (2000); Helena Cronin, *Sexual Selection: Historical Perspectives*, *in* KEYWORDS IN EVOLUTIONARY BIOLOGY 286 (Evelyn Fox Keller & Elisabeth A. Lloyd eds., 1992); Hamish G. Spencer & Judith C. Masters, *Sexual Selection: Contemporary Debates*, *in* KEYWORDS IN EVOLUTIONARY BIOLOGY, *supra* at 294. Mathematicians, who use the process deliberately, call it the "genetic algorithm." *See* Lawrence Davis & Martha Steenstrup, *Genetic Algorithims and Simulated Annealing: An Overview*, *in* GENETIC ALGORITHMS AND SIMULATED ANNEALING 1, 1-2 (Lawrence Davis ed., 1987); Chandraskharam et al., *supra* note 34, at 255. Yet other disciplines use other names. The lay world, oblivious to these distinctions, continues to call the process "evolution." Because no current technical term is sufficiently inclusive and because I believe the lay term to be less confusing to this article's intended audience, I call the process "evolution."

36. *See* Arthur Robinson, *Genetics and Heredity*, *in* 19 NEW ENCYCLOPAEDIA BRITANNICA 700, 700 (Philip W. Goetz et al. eds., 15th ed. 1988).

37. *See id.* at 721-22.

38. *See id.* at 720-21.

39. *See id.*

40. HARTL, *supra* note 35, at 2.

ologists often speak of phenotypes evolving; this article will too.

My theory of motivation begins with genetically-triggered behaviors. Consider, for example, the behavior of drinking water in response to thirst. Some gene produces the biochemical mechanism that makes us feel thirsty. We may not be able to identify that gene, nor may we understand the mechanism. We can, however, speak intelligently about why that mechanism evolved. Humans need water to survive. We therefore need some mechanism to motivate us to drink. Individuals who have such a mechanism are better adapted to their circumstances than those who do not. They are therefore more likely to survive and reproduce, reproducing in the process the relevant gene. In the long run evolutionary theory predicts that the human population should become dominated by individuals who feel thirst when their bodies need water.

Evolution applies to learned behaviors as well.[41] Like genes, learned behaviors are transmitted from individual to individual, although the mechanism may not always be clear. We know that behaviors are transmitted through imitation, instruction and evangelism; other mechanisms may also exist. Regardless of how transmission occurs, however, learned behaviors clearly do pass from one human carrier to another.[42] In other words, they reproduce. Their survival and reproduction, moreover, meet all three criteria for

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41. This is not a new claim, although my phrasing may be unconventional. In his 1976 book, *The Selfish Gene*, Dawkins suggested that "memes," which he defined alternatively as units of cultural transmission or units of imitation, might be subject to evolution just like genes. *See* RICHARD DAWKINS, THE SELFISH GENE 206-07 (1976). Others have since explored this suggestion at greater length. *See, e.g.*, SUSAN BLACKMORE, THE MEME MACHINE (1991); RICHARD BRODIE, VIRUS OF THE MIND: THE NEW SCIENCE OF THE MEME (1996); DANIEL C. DENNETT, CONSCIOUSNESS EXPLAINED (1991); DANIEL C. DENNETT, DARWIN'S DANGEROUS IDEA (1995); AARON LYNCH, THOUGHT CONTAGION: HOW BELIEF SPREADS THROUGH SOCIETY (1996). Unfortunately, there is as yet no consensus as to what a "meme" is. Most commonly, the term refers to an undefined set of which "idea" is one of the principal subsets. Some imply that virtually everything we know is a meme. Blackmore disagrees, asserting, for example, that the learned behavior of riding a bicycle is generally the result of operant conditioning, not the operation of memes. *See* BLACKMORE, *supra* note 41, at 45. I use the term to mean simply any non-genetic mechanism that produces learned behavior—in effect, the genotype of which the learned behavior is the phenotype.

42. *See, e.g.*, DAWKINS, *supra* note 41, at 205-06.

application of the law of evolution.[43] (1) Like genes, learned behaviors survive or reproduce differentially in response to environmental conditions.[44] Indeed, one of the avowed purposes of law is to influence the survival and reproduction of learned behaviors by shaping the environmental conditions their human carriers face; law often seeks to extinguish some learned behaviors and encourage others. (2) The reproduction of learned behaviors is imperfect, as any parent or teacher will attest. And (3) there is no evidence that adaptive imperfections are systematically disfavored. It follows that learned behaviors, like genes, evolve.

The motivation of learned behaviors is somewhat more complex than that of genetically programmed behaviors. It is not true, as economists sometimes assume, that we behave as we do because it is in our self-interest to do so.[45] We are not consciously "fitness maximizers"—that is, we do not decide how to behave by explicit reference to whether behaviors help us survive and reproduce. Our sense of self—that is, our preference for our own survival—often motivates us directly to attempt to survive. But other genetic motivators are less direct. For example, we are genetically motivated to seek pleasure and avoid pain. Not coincidentally, our bodies are hard-wired to give us pleasure when we engage in sexual intercourse. Intercourse, of course, helps us reproduce. But intercourse is not our only path to pleasure. We may also gain pleasure through entertainment, achievement, power, or other means. Learned behaviors take advantage of the indirect nature of genetic motivations, redirecting their emotional energy away from their original functions, a process that psychologists call "sublimation."[46] By their very nature, therefore, learned behaviors involve at least some diversion from the immediate tasks of individual survival and reproduction. Nevertheless, evolutionary theory posits that, like individuals with adaptive genes, individuals who carry adaptive learned behaviors are likely to come to dominate the population as a whole. (Again, this article will

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43. *See* BLACKMORE, *supra* note 41, at 14-16; *see also* HARTL, *supra* note 35, at 59-98 (explaining the causes of evolution).

44. *See* DAWKINS, *supra* note 41, at 213-14.

45. *See, e.g.*, THE CAMBRIDGE DICTIONARY OF PHILOSPHY, *supra* note 2, at 292 (discussing how individual choice can create deficient outcomes in the context of game theory).

46. *See, e.g.*, J. TREVOR DAVIES, SUBLIMATION (1947).

ignore problems created by any possible divergence between the evolutionary interests of the behavior and those of its individual carrier.)[47]

Indeed, regardless of whether behavior is learned or genetically programmed, under evolutionary theory, the simplest explanation is always that we are motivated to behave as we do because such behaviors are or have been adaptive.[48] If a particular behavior is in our objective self-interest, evolutionary pressure will exist for a mechanism motivating that behavior to evolve.[49] If it is in our objective self-interest to drink water, evolutionary pressure will exist for us to evolve thirst, which motivates us to drink. Similarly, if it is in our objective self-interest to cooperate, evolutionary pressure will exist for us to evolve cultural motivating mechanisms that make us feel we *should* cooperate. Conversely, the existence of a motivating mechanism creates a presumption that the relevant behavior is in our objective self-interest. The fact that we feel thirst creates a presumption that the consumption of water is in our objective self-interest. Not all animals need supplemental water; those that have no such need do not drink and presumably do not feel thirst.

As I have noted, this link between self-interest and motivation is not absolute. I therefore characterize it as a presumption, not a rule. For reasons founded in evolutionary theory but beyond the scope of this Article, there are many situations in which genetically programmed motivations lead to self-destructive behaviors—suicide, overeating, alcoholism, drug addiction, to name a few.[50] The fact that learned behaviors inherently involve some redirection away from the core tasks of survival and reproduction makes the link even looser where learning is involved. The presumption that we are motivated to behave as we do because such behaviors are, or have been, adaptive is therefore rebuttable. Nevertheless, the presumption remains. Where a motivation has persisted for a long time, contrary to apparent self-interest—for example, the desire to be good—

47. I explore this problem in depth elsewhere. *See* Seto, *supra* note 1.

48. *See id.*

49. *See* Egbert Giles Leigh, Jr., *Levels of Selection, Potential Conflicts, and Their Resolution: The Role of the "Common Good," in* LEVELS OF SELECTION IN EVOLUTION 15 (Laurent Keller ed., 1999).

50. *See* Jeanne L. Schroeder, *Rationality in Law and Economics Scholarship*, 79 OR. L. REV. 147, 175-76 (2000).

evolutionary theory demands that we either explain that persistence in evolutionary terms or reexamine our understanding of self-interest.[51]

Why are we motivated to be good? Under evolutionary theory, the simplest explanation is that we are motivated to be good because being good is adaptive.[52] But why is it adaptive to be good? The answer is given by iterated game theory. This tells us that in games like the repeated Prisoner's Dilemma, which model non-zero-sum conflicts of interest with repeated interactions (which is to say, much of life), cooperative behavior is often optimal.[53]

In its simplest form, the Prisoner's Dilemma is almost trivial. Two players each choose between two courses of action, known conventionally as cooperation ("C") and defection ("D"). Neither player knows in advance what the other will do. The payoffs for each player are as follows:

FIGURE 1

		player 2 C	player 2 D
player 1	C	x,x	z,y
player 1	D	y,z	w,w

where $y > x > w > z$.[54] In each pair of outcomes, the first payoff belongs to player 1, the second to player 2.

To make this simpler for the mathematically challenged, Figure 2 illustrates the same game, but substitutes numbers for letter variables:

51. *See* CHRISTOPHER BOEHM, HIERARCHY IN THE FOREST: THE EVOLUTION OF EGALITARIAN BEHAVIOR 197-224 (1999).

52. *See* Robert Axelrod, *The Evolution of Strategies in the Iterated Prisoner's Dilemma*, *in* GENETIC ALGORITHMS AND SIMULATED ANNEALING 32, 38 (Lawrence Davis ed., 1987).

53. *See* MICHAEL TAYLOR, THE POSSIBILITY OF COOPERATION 64-66 (1987).

54. *See id.*

FIGURE 2

		player 2	
		C	D
player 1	C	3,3	1,4
	D	4,1	2,2

Thus, if both players cooperate, each receives 3 points; if they both defect, each receives 2 points; if player 1 defects and player 2 cooperates, player 1 wins 4 points, while player 2 receives only 1.

Note player 1's motivations. If player 2 chooses to cooperate, player 1 is better off defecting (4 > 3). If player 2 chooses to defect, player 1 is still better off defecting (2 > 1). Indeed, no matter what player 2 chooses to do, player 1 should defect. And since the players' situations are symmetrical, an identical calculus applies to player 2. But, if both defect, each will have a payoff of 2; whereas if both cooperate, they will both be better off—they will each have a payoff of 3. Of course, if one chooses to cooperate, hoping the other will as well, then the other may choose to defect, thereby winning 4 rather than 3; and the cooperator will be worse off. Hence the dilemma.

A different calculus, however, operates if the game is played not once, but repeatedly—the so-called repeated Prisoner's Dilemma. In the repeated game, if player 1 cooperates and player 2 defects, player 1 may decide not to cooperate the following game. As a result, player 2 will be worse off. In other words, although it is in each player's short-term interest to be uncompromisingly nasty, some other strategy may work better in the long run.

The mathematics of this type of game is typically studied today through high-speed computer simulations. Simulations pitting different strategies against each other suggest that many of the most successful are variations of a strategy known as "tit for tat."[55] Tit for

55. *See* ROBERT AXELROD, THE EVOLUTION OF COOPERATION viii (1984); ROBERT AXELROD, THE COMPLEXITY OF COOPERATION: AGENT-BASED MODELS OF COMPETITION AND COLLABORATION 10-13 (1997); Axelrod, *supra* note 52, at 32-33. For a more technical and comprehensive introduction to game theory generally, see HERBERT GINTIS, GAME THEORY EVOLVING: A PROBLEM-CENTERED INTRODUCTION TO MODELING STRATEGIC BEHAVIOR (2000).

tat has three parts: (1) begin by cooperating ("do unto others as you would have them do unto you"); (2) if the other party defects, punish immediately ("an eye for an eye, a tooth for a tooth"); and (3) if he then responds cooperatively, immediately forgive and return to cooperation ("forgive us our trespasses as we forgive those who trespass against us"). The simulations suggesting this result are, of course, very crude approximations of reality. My theory assumes, however, that while more sophisticated approximations may suggest important refinements, their ultimate conclusions will not be fundamentally different.

If this is so, it follows that some of our most fundamental ethical precepts are mathematically optimal. If adhering to the ethical code implied by tit for tat is adaptive, evolution should favor the survival and reproduction of individuals who adhere to such a code.[56] It is for this reason, I suggest, that the first part of tit for tat—some variation of the Golden Rule—is central to the ethical system of every major religion in the world.[57] We have all, through trial and error, discovered this objective truth and incorporated it in the learned behaviors we pass on from generation to generation.[58]

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56. This does not depend on the "players" being rational or intelligent. All multicellular organisms reflect some measure of cooperation among their constituent parts. More elaborate forms of cooperation can evolve among nonsentient beings. *See* JOHN MAYNARD SMITH, EVOLUTION AND THE THEORY OF GAMES (1982).

57. See in Christianity: *Matthew* 7:12 (New American) ("Treat others the way you would have them treat you: this sums up the law and the prophets"); in Judaism: *Shabbat* 31a ("What is hateful to you, do not to your fellowmen. That is the entire Law: All the rest is commentary"); in Islam: Mohammed, in the Hadith ("Do to all men as you would wish to have done unto you, and reject for others what you would reject for yourselves"); in Confucianism: *Analects of Confucius* 15.4 (Confucius was asked, "Is there any single word that could guide one's entire life?" And he replied, "Should it not be reciprocity? What would you do not wish for yourself, do not do to other."); in Hinduism: *Mahabharata* 5, 1517 ("This is the sum of duty: do naught unto others which would cause you pain if done to you"); in Buddhism: *Udana-Varga* 5, 18 ("Hurt not others in ways that you yourself would find hurtful"); in Taoism: T'AI SHANG KEN YING P'IEN ("Regard your neighbor's gain as your own gain, and your neighbor's loss as your own loss."); and in Zoroastrianism: *Dadistan-i-dinik* 94, 5 ("That nature alone is good which refrains from doing unto another whatsoever is not good for itself.").

58. The premise that cooperative behavior results from the operation of evolutionary forces has been widely explored by others. *See, e.g.*, BOEHM, *su-*

My claim, you will recall, is that we are motivated to be good because behaviors labeled "cooperative" in repeat game theory are mathematically optimal. Consistent with this claim, I label such behaviors "ethical" or "good." (I use these terms interchangeably.) I do not believe I am misappropriating these terms. Loosely speaking, I am simply asserting that a behavior is "ethical" or "good" if it is consistent with the Golden Rule and its enforcement—a premise fully consistent with the meaning we intuitively assign to these terms. More formally, I define a behavior as "ethical" if and only if it is part of the optimal solution to a repeated non-zero-sum game that approximates the real problem to which it is a response. Note that my formal definition avoids specification of the game to which ethical behavior is the optimal solution. This is because even the most sophisticated repeated non-zero-sum games under study today are but crude approximations of reality.[59] We are not yet able adequately to specify either the relevant game or its optimal solution.[60] Nevertheless, I assume that such a game exists and, further, label its optimal solution the "principle of reciprocity." Tit for tat, the various formulations of the Golden Rule, John Rawl's choice from behind the veil,[61] and the classic parental question "How would you feel if Suzie did that to you?" are all approximations of that principle.

It follows that ethics is not merely a cultural artifact. In my model, good and evil exist objectively as part of the mathematics of our universe.[62] Their implementation, of course, may vary from

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pra note 51; ROBERT BOYD & PETER RICHERSON, CULTURE AND THE EVOLUTIONARY PROCESS (1985); ELLIOT SOBER & DAVID WILSON, UNTO OTHERS: THE EVOLUTION AND PSYCHOLOGY OF UNSELFISH BEHAVIOR (1998).

59. *See* THE CAMBRIDGE DICTIONARY OF PHILOSOPHY, *supra* note 2, at 293; TAYLOR, *supra* note 53, at xii.

60. *See id.*

61. *See* JOHN RAWLS, A THEORY OF JUSTICE 136-42 (rev. ed. 1999) (1971).

62. Some may accuse me of having committed the "naturalistic fallacy," a derogatory term that assumes it is inherently wrong to attempt to explain what ought to be in terms of what is. *See, e.g.*, DAVID HUME, A TREATISE OF HUMAN NATURE 455-76 (L.A. Selby-Bigge ed., 1949); GEORGE EDWARD MOORE, PRINCIPIA ETHICA 69-73 (rev. ed. 1993) (stating that good is undefinable and that attempts to define it by reference to anything else are inherently fallacious). *See generally* THE CAMBRIDGE DICTIONARY OF PHILOSOPHY, *supra* note 2, at 507 (explaining how Moore defined "good"); DICTIONARY OF PHILOSOPHY 206 (Dagobert P. Runes ed., 1942) (defining

culture to culture. A behavior consistent with the principle of reciprocity in one culture may not be in another because of the cultures' different overall strategies for dealing with interpersonal relations. For example, a "white lie" about one's reasons for refusing a request may be ethically mandatory in one culture but prohibited as dishonest in another. Notwithstanding differences in implementation, however, good and evil are real and susceptible to objective evaluation. Individuals who ignore the principle of reciprocity tend to live Hobbesian lives: nasty, short, and brutish. Goodness is generally adaptive.

In the real world, any implementation of the principle of reciprocity (an "ethos of reciprocity") is specific to a set of actors who acknowledge that ethos, incorporate it in their behaviors and expect other members to reciprocate. I will call that set of actors the "We" of the ethos and those outside the set "Them" or "Others." Pursuant to the principle of reciprocity, we commonly extend courtesies to members of our We that we would not extend to Others and expect reciprocity only from other members of our We. Each of us is normally a member of multiple We's; each We has its own ethos; each necessarily excludes a Them. The ethos of reciprocity that operates within the We of a person's family (e.g., "We the Setos") may require an individual to undertake duties vis-à-vis family members that she would not feel compelled to undertake with respect to outsiders and would not, in turn, expect them to undertake with respect to her ("Of course your kids can stay at my house the week you're in New York"). The same actor may also consider herself part of a We defined by her church ("Our prayers go out to members who are not able to be here this morning because of illness") or other social unit, and part of another We defined by her ethnicity ("No daughter of mine is going to marry one of Them"). In international affairs, some assert that we should only protect citizens of other countries if doing

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Moore's naturalistic fallacy); A. PRIOR, LOGIC AND THE BASIS OF ETHICS 1 (1949) (discussing Moore's naturalistic fallacy); W.K. Frankena, *The Naturalistic Fallacy*, *in* THEORIES OF ETHICS 50, 50-63 (Philippa Foot ed., 1967) (discussing "good" in light of Moore's notion of naturalistic fallacy). Although it is clearly unpersuasive to argue that whatever is, is right, this does not mean that the normative world is inherently and forever separate from the objective. The fact that no one yet has built a persuasive bridge does not mean the task is impossible. To argue otherwise is to assert that whatever is, is inevitable.

so is in our "national interest"—another way of saying we owe protective duties only to members of We the people of the United States. One of the current frontiers of ethics is whether our broadest We should extend beyond the human species.[63]

History is, in part, a story of the expansion of We's. From the tribe to the city-state to the ethnic group to the nation-state to the species, the set of actors to whom we feel at least some sense of ethical obligation has over the long run consistently expanded. It has done so because development of an ethos of reciprocity between groups otherwise in friction is almost always adaptive. The frictions that arise between two groups who have not yet formed a single We are analogous to those that arise between two individuals who have no ethos of cooperation. In the long run, they hurt both. A Hobbesian international order is no more functional than a Hobbesian nuclear family.

The principle of reciprocity, in turn, is fundamental to many normative values at the core of law. Equality, for example, is a direct corollary. "Do unto others as you would have them do unto you" necessarily implies equality of ethical status.[64] The rule of law itself is required to solve a fundamental problem in game theory: the fact that mutual cooperation is not the only possible equilibrium solution.[65] The second aspect of tit for tat, for example, requires that an actor who defects be punished. Both game theory and common sense tell us that punishment by the victim will not always produce a return to cooperation. It may instead trigger escalating retaliation—what in real life we sometimes think of as a blood feud. Law attempts to solve this problem by removing the punitive role to a neutral third party—at the very least, to a party not itself having the

63. *See, e.g.*, ANIMAL RIGHTS AND HUMAN OBLIGATIONS (Tom Regan & Peter Singer eds., 1976); IN DEFENSE OF ANIMALS (Peter Singer ed., 1985); PETER SINGER, ANIMAL LIBERATION 1-25 (2d ed. 1990); PETER SINGER, PRACTICAL ETHICS (2d ed. 1993); PAUL TAYLOR, RESPECT FOR NATURE: A THEORY OF ENVIRONMENTAL ETHICS (1986).

64. More obviously could and should be said of this claim. An adequate elaboration, however, is well beyond the scope of this paper; I reserve that task for another time. *See* Seto, *supra* note 1.

65. *See* HERBERT GINTIS, GAME THEORY EVOLVING: A PROBLEM-CENTERED INTRODUCTION TO MODELING STRATEGIC BEHAVIOR 443-50 (2000) (discussing the technical exploration of evolutionary stability).

same ethical status as ordinary members of the We.[66] In most contexts today, this party is the state. In the international arena, collective action performs a similar function, collectivity itself diminishing the likelihood of escalation. Also, because law ideally enforces the principle of reciprocity, its rules must apply equally across all members of the We—in Wechsler's terms, it must enforce neutral principles.[67] We are all therefore equal before the law.[68]

Normative obligation is not, of course, limited to the principle of reciprocity. There are many things we *should* do that are at best ethically neutral: "I should do well in school" or "I should abstain from sexual intercourse before marriage," for example. Feeling that one *should* do something is a form of motivation. How it operates is not well understood. Its function in my theory, however, is simple. The adaptivity of many learned behaviors—sharing, for example—only becomes obvious with extensive experience, sometimes possibly even the experience of many generations. Were we motivated solely by reason and self-interest, we might never undertake such behaviors or do so only after painfully inventing the wheel again and again. The process of socialization, through which basic learned behaviors are passed from one generation to the next, facilitates the reproduction of nonobvious but nevertheless adaptive learned behaviors. As we are socialized, we "internalize" these behaviors, by which I mean that we come to feel both a compulsion to perform them and a discomfort (shame, guilt, or unease) if we fail to do so.[69] Within my theory, therefore, an assertion is normative if it attempts to cause the internalization of a learned behavior or to invoke a

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66. Michael Taylor explores this issue in his analysis of Hobbes' and Hume's theories. *See* MICHAEL TAYLOR, THE POSSIBILITY OF COOPERATION: STUDIES IN RATIONALITY AND SOCIAL CHANGE 125-79 (1987).

67. *See* Herbert Wechsler, *Toward Neutral Principles of Constitutional Law*, 73 HARV. L. REV. 1 (1959).

68. Law can, of course, be used for purposes completely inconsistent with this statement—for example, to establish and maintain hierarchy. My premise is not that it cannot be so used, but rather that equal treatment is inherent in the notion of law itself. Its use for inconsistent purposes generates cognitive dissonance that in turn creates pressure for changes in the law to diminish hierarchy.

69. For purposes of my theory, the differences among guilt, shame, and other internal feelings of discomfort are irrelevant.

learned behavior already internalized.[70]

Two conclusions follow. The first is descriptive: a culture's commonly internalized behaviors (its "norms") represent, in effect, its accumulated wisdom about adaptivity.[71] The second is normative: when we assert that a behavior *should* have normative status, we are necessarily asserting that such behavior is adaptive—ultimately that such behavior, however indirectly, will help the entities we care about survive and reproduce. This shift from the descriptive to the normative is my theory's critical move. I begin by explaining why we are motivated to do what is right: we are so motivated because doing what is right is adaptive; we have therefore evolved mechanisms that motivate us to perform such adaptive behavior; these mechanisms include norms and their internal and external enforcement. I then assert that this is, in fact, what norms *are*—that they have no existence independent of their adaptive function. In making this essentialist shift, I appeal primarily to Occam's Razor: if the descriptive portion of my theory can explain most important features of our normative world, there is no reason to postulate an independent origin for that world.[72] Demonstrating that my theory can explain our most salient norms, of course, will be one of the principal goals of my forthcoming longer paper.[73] Here, I ask the reader to assume the conclusion *arguendo*: it is possible to test normative assertions by exploring whether the behaviors they advocate are adaptive.

Adherence to the principle of reciprocity is generally adaptive, but it is not adaptive—and therefore not normative—in all situations. In other words, ethics as I have defined it may be normatively subor-

70. I would further define "morality" as the set of learned behaviors subject to formal or informal punitive enforcement within a culture. "I should do well in school" may be normative, but, at least in American culture, it is not an issue of morality. By contrast, at least in some American subcultures, "I should abstain from sexual intercourse before marriage" is both normative and moral.

71. The fact that a behavior has joined this set and become a norm, of course, does not mean the norm is still adaptive—or even that it ever was adaptive.

72. *See, e.g.*, Francis Heylighen, *Occam's Razor*, PRINCIPIA CYBERNETICA WEB (1995) *at* http://pespmc1.vub.ac.be/OCCAMRAZ.html (last modified July 7, 1997) (explaining that the principle of Occam's Razor dictates that "one should not make more assumptions than the minimum needed").

73. *See* Seto, *supra* note 1.

dinate in some contexts. Consider, for example, the moral "thou shalt not kill."[74] This clearly implements the principle of reciprocity: On the whole, we prefer that others not kill us. For this reason, we limit its application to members of our We—generally, human beings—notwithstanding the apparently unqualified nature of its text. Even with respect to human beings, both law and ethics generally recognize an exception for killing in self-defense.[75] This exception is not necessary for enforcement of the principle of reciprocity itself; after all, the norm could be enforced by someone other than the victim. Its existence is better explained by the fact that, when one is threatened by another intent on murder, survival is more adaptive than the principle of reciprocity. A norm that required us passively to allow our own murder would not help us survive and reproduce.

Assigning less than absolute normative status to ethics may make some uncomfortable, particularly since my theory reserves that status for adaptivity—sometimes also known as "fitness."[76] Fitness, like evolution, is commonly misunderstood.[77] In the lay world, it is often associated with the ability to dominate, a notion quintessentially captured by the Olympic motto: *Citius*, *Altius*, *Fortius* ("faster, higher, stronger").[78] "Survival of the fittest" as a normative goal seems disturbingly reminiscent of Nazism and the notion that "might makes right." My theory requires that we reconceptualize fitness. Fitness is neither strength, nor speed, nor the ability to dominate, nor even intelligence. Rather, the term can usefully be thought of as referring to how well an individual "fits" its environmental conditions.[79] Were we forced to face the conditions that face the common

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74. *Exodus* 20:13.

75. *See, e.g.*, MODEL PENAL CODE § 3.04 (1962) (codification of rules justifying killing in self-defense).

76. THE CAMBRIDGE DICTIONARY OF PHILOSOPHY, *supra* note 2, at 581-82.

77. *See* CHARLES DARWIN, THE ORIGIN OF SPECIES (Gillian Beer ed., 1996) (1897). The second part of Darwin's original title—"or, The Preservation of Favoured Races in the Struggle for Life"—did not help. *Id.* at xix (referring to the original edition of Darwin's book). Unfortunately, even biologists have not yet agreed on a formal definition. *See* John Beatty, *Fitness: Theoretical Contexts*, *in* KEYWORDS IN EVOLUTIONARY BIOLOGY 115 (Evelyn Fox Keller & Elisabeth A. Lloyd eds., 1992).

78. THE OLYMPIC CHARTER § 14.

79. The most common conception of fitness in philosophical literature focuses on traits that contribute to viability, fertility, and overall ability to leave offspring within a particular environment. *See* Beatty, *supra* note 77, at 115-

earthworm, it would be more "fit" than we.

The following parable (which happens to be true) may be useful in thinking about what fitness is and what it is not. We mammals evolved at about the same time as dinosaurs.[80] While *Tyrannosaurus rex* and his kindred stomped, roared, and dominated, our Mesozoic ancestors attempted to live quiet and unobtrusive lives. Most were very small—about the size of a mouse.[81] Most dinosaurs, however, were much larger.[82] By any measure, they were *citius*, *altius*, *fortius;* we were not. Yet we survived, and they did not. Why is not clear; nor would the same answer necessarily be relevant today. (I discuss the epistemology of fitness further below.) But as the loud, the rude, and the powerful dominate today's public discourse, even as we are tempted to envy and emulate them, we should remember the parable's conclusion: We survived and they did not.

Two further implications of my theory merit note. First, it is essential that any species, culture, or other group subject to evolution be able to evolve. The conditions we face are constantly changing; a group unable to adapt to those changes will eventually perish. The ability to evolve is therefore itself adaptive. It follows that, for example, protection of a freedom to explore new ideas and behaviors, implemented in the United States through the First Amendment and rules protecting individual autonomy, is adaptive and therefore normative. Second, speedier evolution is itself adaptive. In general, the faster a group can adapt to new conditions, the more likely it will be able to survive and reproduce. Learned behaviors can evolve much faster than genetically determined ones. This is why human biology makes extraordinary sacrifices to permit learning and explains the adaptive advantage of intelligence.[83]

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16. The definition offered in the text is, I believe, consistent with this.

80. *See generally* MESOZOIC MAMMALS: THE FIRST TWO-THIRDS OF MAMMALIAN HISTORY (Jason A. Lillegraven et al. eds., 1979) (discussing the evolution of mammals); Timothy Rowe, *Phylogenetic Systematics and the Early History of Mammals*, *in* MAMMAL PHYLOGENETIC: MESOZOIC DIFFERENTIATION, MULTIBERCLUATES, MONOTREMES, EARLY THERIANS, AND MARSUPIALS 129 (Federick S. Szalay et al. eds., 1993) (examining phylogenetic systematics to understand mammalian evolution).

81. *See* MESOZOIC MAMMALS, *supra* note 80, at 2-4.

82. *See id.* at 2. *Tyrannosaurus rex* weighed six tons or more; an adult *Compsognathus*, the smallest known dinosaur, weighed one to two kilograms. *See* 17 THE NEW ENCYCLOPAEDIA BRITANNICA 322 (1998).

83. I explore these premises at greater length in my forthcoming article.

B. Articulating an Intergenerational Objective

It is not the purpose of this Article to justify the foregoing theory of motivation and normative obligation; I reserve that task for another day. Here, I ask the reader to accept the theory *arguendo* and propose instead to explore its implications for intergenerational equity.

Within my taxonomy, the most fundamental intergenerational question—"What normative obligations do we owe to future generations?"—is not an ethical question at all. The principle of reciprocity operates in very limited ways between generations. Caring for the elderly makes sense in part because the continued ethos of such care makes it more likely that we will be cared for in turn as we age—an implementation of the Golden Rule.[84] We apologize for past wrongs as a way of signaling our intention to cooperate in the future.[85] Apart from these and a few other discrete behaviors, little of what we commonly refer to as "intergenerational ethics" is subject to the principle of reciprocity. Regardless of how we behave, our descendants will not be able to reward or retaliate against us effectively.[86] More fundamentally, implicit in any invocation of the principle is the premise that our well-being is as important as anyone else's. From an evolutionary perspective, however, our well-being is irrelevant; all that is important is whether we survive and reproduce into the future. Using the Golden Rule to protect present well-being against claims by future generations is precisely what we should *not* be doing. In my view, therefore, attempting to characterize the fundamental intergenerational problem as one of equity—attempting directly to apply, for example, Rawlesian theory[87] or the Golden Rule—is an

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See Seto, *supra* note 1. For our purposes here, one important consequence is that behavioral evolution may now be much more important for humans than genetic evolution.

84. *See, e.g.*, Peter Laslett, *Is There a Generational Contract?*, *in* JUSTICE BETWEEN AGE GROUPS AND GENERATIONS 24, 28 (Peter Laslett & James S. Fishkin eds., 1992).

85. *See, e.g.*, George Sher, *Ancient Wrongs and Modern Rights*, *in* JUSTICE BETWEEN AGE GROUPS AND GENERATIONS 48, 48 (Peter Laslett & James S. Fishkin eds., 1992).

86. *See* Peter Laslett & James S. Fishkin, *Introduction: Processional Justice*, *in* JUSTICE BETWEEN AGE GROUPS AND GENERATIONS 1, 1, 7 (Peter Laslett & James S. Fishkin eds., 1992).

87. Rawls' own treatment of this problem is one of the less satisfactory por-

invitation to conceptual confusion. By this, I do *not* mean we can ignore the future. A group, culture, or species that ignores the future is less likely to have one. Caring about the future is one of the most adaptive motivations a culture can foster. It is intensely normative. But it does not in and of itself involve "ethics"—that is, it does not involve the principle of reciprocity.

Under my theory, a claim that a behavior is normative is necessarily a claim that it is adaptive. It follows, therefore, that what matters—indeed, *all that matters*—is that we survive and reproduce into the indefinite future. This is, after all, the only unimpeachable test of adaptivity. Within my taxonomy, this is a normative assertion: I am asserting that we should internalize behaviors that will maximize the likelihood that we survive and reproduce. Concretely, we should feel a compulsion to perform such behaviors and should teach our children and pupils to feel discomfort if they fail to perform them.

Admittedly, at first blush, this premise may sound bleak. Regardless of how persuasive evolutionary theory may seem to scientists and their intellectual kin, the notion that survival and reproduction are all that matter will evoke from many the plaintive query, "Is that all there is?" Even if the evolutionary story is true, perhaps a different story would be more inspiring, more fun, more meaningful, perhaps even more adaptive.[88] What I hope to persuade you in the pages that follow, however, is that this seemingly simple-minded premise has profound implications, fully consistent with both our most ethical intuitions about how we should behave towards others

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tions of this theory of justice. *See* RAWLS, *supra* note 61, at 284-93.

88. Truth is generally adaptive because it permits us to learn and deal effectively with the world. But absolute truth is not necessarily required. It is said that pessimists are more often right, but optimists more often get things done. *See, e.g.*, Hiram E. Chodosh, *Reflections on Reform: Considering Legal Foundations for Peace and Prosperity in the Middle East*, 31 CASE W. RES. J. INT'L L. 427, 438 (1999) (quoting the Russian proverb: "There are two kinds of people in the world: optimists and pessimists. But actually everyone is an optimist; pessimists just have more information."). There is substantial evidence that, on average, we humans are stubbornly and unrealistically optimistic. *See* Larry Garvin, *Adequate Assurance of Performance: Of Risk, Duress, and Cognition*, 69 U. COLO. L. REV. 71, 149-50 (1998) (reviewing empirical literature on this issue); Jon D. Hanson & Douglas A. Kysar, *Taking Behavioralism Seriously: The Problem of Market Manipulation*, 74 N.Y.U. L. REV. 630, 654-55 (1999) (reviewing empirical literature on this issue). This implies that some detachment from the truth may actually be adaptive.

and our most spiritual yearnings for a life rich in meaning—something close to Aristotle's version of *eudaimonia* (loosely translated, "flourishing" or "fulfillment").[89] Because evolution is often viewed as adverse to religion (or at best irrelevant to it) and because I hope to persuade not merely the secular, I will go further and restate my aspiration in a vocabulary not commonly used in law reviews. Those of you who believe in God, I hope, will conclude that the image I paint of the future and our obligations towards it are fully consistent with faith—that one might readily believe that God wants such an outcome, has built the processes that will lead to it into the mathematics of the universe, and rejoices as we discover and understand them.

Having now perhaps promised more than I can deliver, I turn to the implications of this premise for intergenerational decision making. I will address three questions. (1) First, what does this premise imply about the relationship between the present and the future? Cost-benefit analysis, as I noted at the outset, typically treats the present as most important and the future of diminishing importance as one moves away from the present.[90] Does evolutionary theory require a different stance? (2) Second, what group or groups in the future should we be motivated to help survive and reproduce? A common answer is that we should care about members of the species *homo sapiens*—in other words, that the boundary of our species defines the boundary of our normative obligations. This answer, however, becomes increasingly problematic as we look further into the future. If nothing else, unless we intervene, our species will evolve into something else, as will all the various cultures to which we now belong. Looking to the very long run, if we sacrifice to make the future possible, we will likely benefit beings very different from ourselves, who may not care about any of the things we hold most dear. Our answer to this second question, therefore, cannot be arbitrary; it must justify those sacrifices. (3) Third, within the very serious limits of what is knowable about the future, what kinds of

89. *See* ARISTOTLE, ARISTOTLE'S EUDEMIAN ETHICS 14, 48-52, 93-101 (Michael Woods trans., 1982) ("activity of a complete life in accordance with complete virtue"); THE CAMBRIDGE DICTIONARY OF PHILOSOPHY, *supra* note 2, at 44 ("human flourishing"); ANTHONY KENNY, THE ARISTOTELIAN ETHICS 190-214 (1978) ("the good life").

90. *See* Symposium, *supra* note 24.

choices can we realistically make to maximize the likelihood that the group selected in answer to our first question will survive and reproduce? Some have argued that we know so little about the far future that we should effectively ignore it in practical decision making.[91] Are they right?

1. Relationship between present and future

There is only one adaptive and therefore normative answer to my first question: *The future always matters more than the present*. Indeed, *the present matters only because it makes the future possible*. Consider two groups. Members of the first live happy, productive lives; assume, however, that because of the choices that make such lives possible the group will become extinct at some point in the future—say 1,000 years. Members of the second group live more self-sacrificing lives; assume that as a result the group will survive indefinitely. The fact that the first group is happier or better off today is completely irrelevant from an evolutionary perspective, since it does not contribute to the long-term survival and reproduction of the group. On these facts, all else being equal, the only adaptive and therefore normative choice is that made by the second group. And this is true regardless of how much happier or better off members of the first group may be in the interim.

This conclusion stands in stark contrast to that normally urged by utilitarians and implemented by cost-benefit analysis.[92] The ethical attraction of utilitarianism derives from the equality of ethical status implicit in the principle of reciprocity.[93] If we are all equal, it reasons, the welfare of each of us is equally important. Our normative objective, therefore, should be to maximize the sum of such welfares. Utilitarianism has many problems, which I do not propose to rehearse here.[94] It does differ, however, in two particularly important regards from my approach. First, it assumes that welfare is additive—that is, that the happiness of two is twice as important as the

91. *See* Cowen & Parfit, *supra* note 31, at 144-59 (analyzing and criticizing temporal restrictions on social discount rates).

92. *See generally* Boudreaux, *supra* note 23, at 125-68 (discussing cost-benefit analysis).

93. *See* RAWLS, *supra* note 61, at 138.

94. *See, e.g.*, THE CAMBRIDGE DICTIONARY OF PHILOSOPHY, *supra* note 2, at 824-25.

happiness of one. The problem with this assumption is that the repeated Prisoner's Dilemma is a two-person game. The fact that any two players must be of equal ethical status in their adaptive bilateral relationship does not necessarily imply that it is adaptive to assign two players twice the ethical status of one. Our understanding of multiplayer repeat games is poor,[95] but it is perfectly conceivable that such games may have nonadditive ethical implications. If so, the founding ethical premise of utilitarianism is false.

A second problem with utilitarianism is not as fundamental, but does invalidate most common approaches to its implementation. The present is finite; the future infinite. If we simply aggregate welfare, therefore, the utilitarian calculus implies that the future is infinitely more important than the present.[96] Utilitarians are apparently uncomfortable with this conclusion. Applying the Golden Rule between generations, as utilitarians implicitly do, necessarily involves some effort to protect each generation against undue claims by another. The conclusion that we in the present have *no* normative standing vis-à-vis the future (although we may have standing among ourselves) seems inconsistent with this effort. Utilitarians commonly solve this problem by assigning lower ethical status to future generations—each generation's status being lower than its parent's.[97] This takes advantage of the mathematics of limits, reducing the infinite future to a finite quantity. The mechanism most commonly used to perform this task, of course, is the positive discount rate.[98] This solution, however, is inconsistent with the ethical core of utilitarianism itself. Either generations are of equal ethical status, or they are not. If they are not, as the solution assumes, then utilitarianism has denied its own ethical foundation.[99]

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95. *See generally*, TAYLOR, *supra* note 53, at 82-108 (giving an excellent introduction to the problem of multiperson games).

96. This is so because mathematically any infinite amount is infinitely larger than any finite amount.

97. *See id.*

98. *See, e.g.*, TAYLOR, *supra* note 53, at 144-61.

99. I do not mean by this to imply that discount rates can never have an appropriate role in decision making. Further discussion of their possible appropriate use appears below.

2. What group should we be motivated to help survive and reproduce?

One might expect evolutionary theory to answer this question by asserting that each of us should care about his own closest genetic relatives and no one else—which I will label the "Hitler Principle" after one of its most famous exponents. Adolf Hitler urged his followers to care only about "Aryans," whom he characterized as his and their genetic kin, and, at the extreme limits of his ideology, to exterminate all others.[100] If all that matters is whether genes survive and reproduce, we should care most about those who carry our genes. Hitler's answer is inconsistent with evolutionary theory, however, for several reasons.

First, it is at variance with actual behavior. Mother Theresa should not exist; nor should the young soldier who gives her life to save her comrades and therefore never reproduces; nor should the decedent who leaves her money to charity rather than to grandchildren; nor even should the husband and wife who consciously decide not to have children. We expect gaps between actual and adaptive behavior, but genes that cause a failure to reproduce ought to be washed out of the pool very quickly. No purely genetic explanation of such very common nonreproductive behavior is likely to satisfy; and once we seek explanations elsewhere, there is no particular reason to expect that genetic kin should be specially favored.

Second, the Hitler Principle is inconsistent with the principle of reciprocity. If I care only about my kin and you only about yours, we are likely to be in continuous conflict. The theory of repeat games tells us that such conflict is not adaptively optimal.[101] In other words, the Hitler Principle is not merely evil; it is a poor long-term evolutionary strategy. It therefore cannot be normative.

If any remain unconvinced, the following thought experiment further illustrates this point. Assume that Hitler had won and applied the Hitler Principle rigorously, exterminating all losing peoples and thereby furthering the survival and reproduction of the winners—"Aryans," Italians, and Japanese. His approach would next have required that the Aryans exterminate their allies since, of course, the

100. *See, e.g.*, IAN KERSHAW, HITLER 1889-1936: HUBRIS xxiv-xxx (1999); IAN KERSHAW, HITLER 1936-45: NEMESIS 495 (2000).

101. *See* TAYLOR, *supra* note 53.

survival of those groups would have conflicted with the ultimate genetic domination of the Aryans. Aryans consist of yet further genetic subgroups. The approach would then have required that each attempt to exterminate all others. Taken to its logical conclusion, in fact, it requires the elimination of all except a single breeding couple. Once that couple produces descendants, it requires that the process of exterminations then begin again. Indeed, there is no natural stopping point for the exterminations required if one seriously cares only about one's own. Needless to say, a world of constant attempted extermination is unlikely to be adaptive.

Third, a norm that focuses solely on one's own descendants to the exclusion of all others ignores the mathematics of sexual reproduction. Because we do not reproduce by cloning, our genetic contribution to descendants declines by a factor of two every generation. Thus, the first generation of descendants carries one-half of our genes, the second one-quarter and so on. Assuming no inbreeding, the n^{th} generation carries only $(1/2)^n$ of our genes. If we further assume four generations per century, any given individual's genetic contribution to descendants living 1,000 years from now will be *less than one-trillionth*.[102] Even if we assume substantial inbreeding among our descendants, but assume at least a moderate amount of interbreeding between ethnic subgroups, the chances of a particular human 1,000 years hence having more genes from me than from you in any meaningful sense are insignificant.

More intuitively attractive is the possibility that our normative obligations should be directed towards the future of the human species as a whole. Here, my response is more nuanced: This may be temporarily plausible, but is not inherently true in the long run. To explore this issue, it is necessary once again to return to basics. Why should I care about the progeny of someone I do not know and will probably never meet, simply because she is human? For such caring to be normative, it must be adaptive. Why, then, might such caring be adaptive?

Biology offers one answer, kin selection,[103] which ultimately

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102. At twenty generations, of course, the assumption of no intermarriage between descendants becomes highly improbable.

103. On the theory of kin selection, see ELLIOTT SOBER, THE NATURE OF SELECTION: EVOLUTIONARY THEORY IN PHILOSOPHICAL FOCUS 335 (1984);

proves inadequate. I do not propose here to review the theoretical underpinnings of kin selection. Its relevant premise, however, is that we are motivated to care about others because we share genes with them. If this premise is carried to its logical conclusion, the strength of our motivation to care should depend on the extent to which we share genes. Thus, we should care more about our children than about our cousins, more about our cousins than about strangers, and more about strangers than about nonhumans. Initially plausible, on closer examination this answer fails. My wife, for example, is a genetic stranger to me, yet I care more about her than about my cousins (sorry, cousins). And there are many sacrifices I make daily for my dogs that I do not normally volunteer to make for random human strangers.

Not only does kin selection fail to explain many of our day-to-day ethical priorities, it also implies larger-scale normative orderings that do not match our intuitions. Species, of course, evolve. We are no exception. Assume that time has passed and that 2% of the genetic material in humans has changed. In other words, assume that at some point in the future, our descendants share only 98% of their genetic material with today's *homo sapiens*. Assume further, if it matters, that because of these changes we and these future humans (had we a time machine) would not be able to interbreed. Should we still care about their fate? I assert that we do and should. Yet these hypothetical descendants are no more closely related to us than today's chimpanzees, with whom we share 98.4% of our genetic material and with whom we also cannot interbreed.[104]

These future humans are, of course, our descendants, and perhaps that should make a difference (in other words, perhaps the Hit-

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GEORGE C. WILLIAMS, NATURAL SELECTION: DOMAINS, LEVELS, AND CHALLENGES 19-21 (1992); Egbert Giles Leigh Jr., *Levels of Selection, Potential Conflicts, and Their Resolution: The Role of the "Common Good"*, *in* LEVELS OF SELECTION IN EVOLUTION 15 (Laurent Keller ed., 1999).

104. *See* JARED DIAMOND, THE THIRD CHIMPANZEE: THE EVOLUTION AND FUTURE OF THE HUMAN ANIMAL 23 (1992). Detailed comparison of a sampling of genes from the two species suggests that the genetic distance between humans and chimpanzees is only twenty-five to sixty times greater than that between Caucasian, Black African, and Japanese populations. *See* EDWARD O. WILSON, ON HUMAN NATURE 25 (1978) (citing Mary-Claire King & A.C. Wilson, *Evolution at Two Levels in Humans and Chimpanzees*, 188 SCIENCE 107-16 (1975)).

ler Principle, in this attenuated form, is well taken). Consider, however, the following variation on the preceding hypothetical. Assume that at some point humanity has evolved into two species. Each shares 98% of its genetic material with the other; each shares substantial genetic material with today's humans as well. Assume further, if it matters, that neither group can interbreed with the other. I have asserted above that we do and should care about the fate of each of these two groups. But should each care about the other's? Most of us would answer that they should. They are, after all, sibling species of which ours is the parent. But, of course, they stand vis-à-vis each other in exactly the same genetic relationship as we stand with today's chimpanzee. We too are sibling species of which some other species, now extinct, was the parent. Indeed, most biologists believe we are sibling species with every other species of living thing on this planet, descended from a common ancestor. Yet, few give other species ethical standing, and those who do rarely measure the quantity of that standing by reference to the degree of each species' genetic relatedness to humans. Common descent does a poor job of explaining our normative preferences.

Focusing exclusively on genes also ignores the importance of learned behaviors. At the risk of oversimplification, behavioral kin selection is analogous to genetic kin selection, positing that we are motivated to care about others because we share learned behaviors with them. If we are going to accord kin selection an explanatory role, we cannot ignore its behavioral aspect. After all, we generally do care more about those with whom we share learned behaviors than those with whom we do not. For example, most Americans are either immigrants or descendants of immigrants and, therefore, more closely genetically related to many in their countries of origin than to at least some other Americans. Yet, we commonly identify far more strongly with such other Americans than with our genetic cousins in our respective countries of origin. This is because Americans share a common pool of learned behaviors.

Jonathan Swift neatly framed the tension between genetic and behavioral affiliation in his book *Gulliver's Travels*.[105] He postu-

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105. Jonathan Swift, *Gulliver's Travels*, *in* 36 GREAT BOOKS OF THE WESTERN WORLD 1, 135-84 (Robert Maynard Hutchinson et al. eds., Encyclopedia Britanica Inc. 19th prtg. 1971) (1952).

lated two species, Yahoos and Houyhnhnms. The first were genetically human but behaviorally animal (and apparently incapable of changing); the second were genetically horselike but behaviorally human—civilized in every European regard. Assume that you are called upon to choose which of these two species will survive to succeed humanity. You may choose only one. Many of us, I suspect, would choose the Houyhnhnms, from which I infer that many of us identify more strongly with our behavioral, than with our genetic, heritage.[106]

Ignoring such outlandish hypotheticals, of course, most today would still view the species boundary as a reasonable boundary for normative obligation. The reason, however, has nothing to do with genetics. It is rather the result of an historically temporary coincidence: Our species boundary currently coincides with the boundary of our broadest commonly accepted We. No mainstream philosopher currently argues that this We—the set of actors to whom we owe at least some ethical duty—should be any smaller than all of humanity.[107] A few philosophers, Peter Singer most prominently, now argue that our We should be larger, but this view is still regarded as avant-garde.[108]

I take no position as to the appropriate size of our We. What I do assert is that if we use the species boundary to define the scope of our normative obligations, we do so *not* because there is any normative magic about the possibility of interbreeding.[109] We do so, rather,

106. The line between behavior and genetic evolution is fuzzy at best. At least some biologists argue that an organism's behaviors must be treated as part of that organism, not merely as something external. *See* J. SCOTT TURNER, THE EXTENDED ORGANISM: THE PHYSIOLOGY OF ANIMAL-BUILT STRUCTURES 1-2 (2000); *see also* Michael LaBarbera, *Fuzzing the Boundary of Animal Life*, 289 SCIENCE 1882, 1882 (2000). For a systematic discussion of how behavioral and genetic evolution interact, see WILLIAM H. DURHAM, COEVOLUTION: GENES, CULTURE, AND HUMAN DIVERSITY (1991).

107. *See* Peter Singer, *Ethics and the New Animal Liberation Movement*, *in* IN DEFENSE OF ANIMALS 1-2 (Peter Singer ed., 1985)

108. *See id.* at 6-10.

109. Inability to interbreed between otherwise closely related groups may result, at least initially, from signaling problems. Every species has its own conventional mating signals. These signals are in many ways arbitrary—analogous to our agreeing to drive on a particular side of the road. For most purposes, it really does not matter what the signals are, so long as everyone in

because the species boundary and the boundary of our broadest We happen to coincide. This may or may not change; hypotheticals in which it does are still largely the province of science fiction, not practical public policy. We may discover that we are not the only intelligent species in the universe. We may create artificially intelligent beings with whom we share an ethos of reciprocity. We may uplift dolphins or chimpanzees to become our intellectual and social equals. Or Peter Singer may persuade us to include other species in our We without any such genetic changes. If any of these events come to pass, our We should and probably will expand. My argument does not depend on any of these events being likely. It is simply that *the set of actors we do and should care about is our We, not our species*.

It is for this reason that I care about the hypothetical human I do not know and will probably never meet; she is part of my acknowledged We. It is for this reason that we typically care more about our spouses than about our genetic cousins—our spouses form part of a narrower and more intense We. In the hypothetical above, in which humanity splits into two species, it is for this reason that we believe members of those two species should care about each other's fates; we are merely asserting that the two should form a common We. It is for this reason that many of us would choose Houyhnhnms over Yahoos; it is easy to imagine sharing an ethos of reciprocity with the former. The Yahoos, by contrast, are incapable of internalizing any such ethos.

3. Making choices within the limits of what is known and knowable

The final question I propose to address is this: Within the very serious limits of what is knowable about the future, what kinds of choices can we realistically make to maximize the likelihood that our We will survive and reproduce? The epistemological problem is even more profound than is commonly appreciated. The amount of information in the universe is beyond comprehension. To process it fully would require a machine the size of the universe; indeed, the

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the group uses and interprets them correctly. As the mating signals in different subpopulations of a single species evolve, different subpopulations may end up with different signals. They then become effectively incapable of interbreeding. *See* Megan Higgie et al., *Natural Selection and the Reinforcement of Mate Recognition*, 290 SCIENCE 519, 519-20 (2000).

universe can be thought of as just such a machine. No smaller processor—and I refer in particular to the human brain—is capable of such a task.

Even small parts of the universe can be unbelievably complex. Ecosystems, for example, are notoriously difficult to analyze, even after the fact. Consider, for example, the recent near extermination of the northern Pacific sea otters and devastation of the kelp beds in which they live.[110] Sea otters are among the few documented tool-using mammals and therefore behaviorally among our closest kin. Scientists studying the problem hypothesize the following causal chain. (1) Small increases in ocean temperatures (2) reduced the amounts of food available for the species of fish on which seals and sea lions feed. (3) Populations of those species then plummeted, (4) as did those of seals and sea lions. (5) Killer whales, who had previously fed almost exclusively on seals and sea lions, were forced to find a different food source: sea otters. (6) As a result, sea otter populations declined by more than 90%; in the open ocean they were almost completely eradicated. (7) Sea otters feed on sea urchins; sea urchin populations therefore mushroomed. (8) Sea urchins feed on kelp; the kelp beds then disappeared.[111]

Ascertaining "fitness" is subject to all these epistemological problems. It is difficult to predict in advance that species of kelp that taste good to sea urchins will be less "fit" if ocean temperatures rise slightly, as recent history apparently reveals.[112] The same predictive problems arise in any similarly complex system—they arise, for example, in determining whether any given behavior will "fit" a given culture. The classic algorithms of deductive and inductive logic do have important roles to play. From the fact that a stranger was killed by a car in another city, we can generalize that it may be dangerous for us to play in the street; generalization permits learned behaviors to evolve more quickly and therefore permits us to adapt more quickly to changing conditions. But deduction and induction merely

110. *See* J. A. Estes et al., *Killer Whale Predation on Sea Otters Linking Oceanic and Nearshore Ecosystems*, 282 SCIENCE 473, 473-75 (1998); David L. Garshelis & Charles B. Johnson, *Other-Eating Orcas*, 283 SCIENCE 175, 175 (1999).

111. *See* Jocelyn Kaiser, *Sea Otter Declines Blamed on Hungry Killers*, 282 SCIENCE 390, 390 (1998).

112. *See id.*; *see also* Estes et al., *supra* note 110, at 474-75.

accelerate the evolution of learned behaviors. In the face of information overload, evolution is the only known process reliably capable of identifying optimal results. It is how nature designs kelp; in human society, it determines whether behaviors succeed or fail; in ethics, it helps us identify the paths of righteousness.

If we accept the foregoing, it follows that logic cannot specify the one true path to a normatively successful future. Unlike utilitarianism, which purports to set forth a logical algorithm for determining that path, evolutionary theory says, in effect, "We're just going to have to wait and see what actually works," a posture likely to frustrate lawyers, judges, philosophers, and others who prefer argument to experimentation. What we can do in advance, however, is to define roughly the regions within which that path must lie. Outside those regions, success is unlikely. Within them, we will use intelligence to accelerate the process of learning from failures and successes.

What can we realistically know about the long-term fate of our We and what does that knowledge imply about our normative obligations? First, we know it is normative to seek the indefinite survival of our We. A culture in which survival of the We is not normative is less likely to survive. This proposition may sound trivial; it is not. Most importantly, it means that numbers, in and of themselves, do not matter. More bodies are not necessarily better. Our We may, in fact, be more likely to survive indefinitely if our numbers remain moderate, thereby freeing at least some members of the We to provide more effectively for the future. Although the principle of reciprocity requires that we count existing lives lost as costs in cost-benefit analysis or any other mode of long-term planning, this means that lives *foregone* are not subject to the same requirement. Existing lives are necessarily part of our We; lives foregone are not, and should not be.[113]

Second, we know it is normative to hope for our We's continuing evolution.[114] By this, I do not mean to invoke any notion of

113. I do not here mean to address the abortion controversy in any way. Clearly, pro-life advocates include embryos and fetuses in their We's, and I do not contend that such inclusion is wrong. By "lives foregone" I mean solely lives that never come into being; I do not mean to address the question of when this occurs.

114. My conclusions in this regard are consistent with Braybrooke's. *See*

"progress." Rather, I mean to suggest that, through evolution, we continue to survive and reproduce by adapting to changing conditions or adapting more effectively to existing conditions. A species or society that does not evolve will not succeed in the long run. For utopians, the implication is profound: A static utopia is inherently maladaptive and therefore cannot be normative. But effective evolution is not inevitable. It is therefore normative to seek to create the conditions for effective evolution. Behavioral evolution operates much more quickly than genetic evolution. For this reason, my analysis will focus primarily on decisions we can make today to foster the future evolution of learned behaviors.

Behavioral evolution requires diversity.[115] An intolerant, monolithic culture is less able to respond to changing conditions or even to adapt optimally to existing ones. Far from endorsing a sterile, unidirectional society, therefore, an evolutionary normative stance encourages cultural richness and variety. Integrative expansion of the We, discussed below, itself makes the learned behaviors carried by members of the We more diverse, pushing us to develop new implementations of the principle of reciprocity to accommodate our differences.

Behavioral evolution also requires continuing experimental exploration of behavioral and ethical possibilities. For this purpose, we often use simulation. Fiction, for example, allows us to explore how behaviors and ethics work at relatively low personal cost. So do movies and television. So do the kinds of thought experiments we are commonly asked to perform in school, church, temple, or mosque. A society without these institutions would be substantially less adaptive. Indeed, much of what makes life stimulating and meaningful is essential to the evolution of learned behavior and therefore to the long-term survival of our We. It may also make us happy. But under my theory the *pursuit* of happiness is actually

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David Braybrooke, *The Social Contract and Property Rights Across the Generations*, *in* JUSTICE BETWEEN AGE GROUPS AND GENERATIONS 107, 111-12 (Peter Laslett & James S. Fishkin eds., 1992) (arguing that prior generations may not block the revision of rights).

115. This is certainly true in biological ecosystems. The ability of biological ecosystems to adapt to stress depends in significant part on the diversity of its species' responses to environmental fluctuations. *See Editor's Choice*, 290 SCIENCE 233, 233-35 (Gilbert Chin ed., 2000).

more important than happiness itself.

Third, if we find ourselves in potential friction with individuals who are not members of our We, we know that it is almost always adaptive to develop an ethos of reciprocity with Them—a process I label "integrative expansion." Expansion of the We, of course, can also be achieved through conquest; conquest, however, almost always fosters hierarchy, which is in turn inconsistent with the principle of reciprocity. For this reason, integration is by far the preferable route to expansion. The boundaries of our We, unlike those of our species, are dynamic. Prior to the nineteenth century, international law reflected primarily an ethos of reciprocity between sovereigns; its We included only states in the European sense. The past century has witnessed the beginnings of an ethos of reciprocity between peoples, and all peoples of the world are now included in our largest commonly accepted We. This transformation has occurred, my theory suggests, because it is adaptive. Part of our normative mandate is continually to search for more effective implementations of the principle of reciprocity, at all levels, and in the process to expand our ethical horizons to include any with whom we would otherwise be in potential friction.

It follows that in the long run, use of the species boundary to define the boundaries of our We is likely to become unsatisfactory. Science fiction often portrays galactic societies in which humans form merely one part of a larger We. One can even imagine a scenario in which, like the soldier who gives her life for her comrades, the human species sacrifices itself for this larger We. Were we to do so, I suggest, our deaths would be no more in vain than that of the heroic soldier. The We would survive, and with it our behavioral and ethical legacy.

In sum, we know enough to conclude that our long-term objective should be the survival, evolution, and integrative expansion of our We. Admittedly, this objective is consistent with many possible paths; it therefore does not identify any One True Path. It does, however, exclude important possibilities. It excludes static, intolerant, or culturally homogenous paths. It excludes paths in which only our genetic kin matter. It excludes paths ultimately inconsistent with the principle of reciprocity.

There are other important things we already know that may and should affect our long-term planning. We know that some factors that contribute to our survival and reproduction are subject to compound growth. Information—the inventory of our learned behaviors—appears to be one such factor. Physical capital, to the extent it does not deplete resources, is another. In making decisions with regard to such factors, the use of positive discount rates may be adaptive. This is so because the more we have of such factors today, the more we will have in the future. Importantly, positive discount rates are thus not justified because they maximize current preference satisfaction, but rather because they contribute to the future.[116]

There are, however, factors not subject to compound growth—most obviously nonrenewable resources like oil, soil, and biodiversity. If we use a liter of oil to make a hula hoop today, that liter will not be available millennia hence for perhaps more essential purposes. The principal argument in favor of ignoring the problem of depletion relies on technological substitution. The argument asserts or assumes that technology will provide economically viable substitutes for anything we use up at least as fast as we use it up. History, however, does not tend to support any such assumption. Iraq, after all, was once called the "Fertile Crescent"; it is no longer.[117] Jared Diamond hypothesizes that after serving as the cradle of civilization, Iraq first fell behind southern Europe, then northern Europe, then North America, each in turn depleting essential resources and thereby slowing its further development.[118] The original Native Americans were unable to find a technological substitute for the horse.[119] Madagascar is currently suffering horrible soil erosion.[120] Once that soil is gone, technology is unlikely to be able to replace it in the foreseeable future. If we render our planet uninhabitable, it is unlikely that technology will offer an economically viable substitute.

The adaptive use of factors not subject to compound growth

116. The problem of ascertaining optimal discount rates is beyond the scope of this Article. The problem is further complicated by the game theoretic insight that lower discount rates make long-term cooperation more likely and higher rates, conversely, less likely. *See* TAYLOR, *supra* note 53, at 81.

117. *See id.* at 135, 410-11.

118. *See id.*

119. *See id.* at 358-59.

120. *See* Rosanne Model, Comment, *Debt-for-Nature Swaps: Environmental Investments Using Taxpayer Funds Without Adequate Remedies for Expropriation*, 45 U. MIAMI L. REV. 1195, 1206 (1991).

therefore cannot be determined solely using positive discount rates. This is because positive rates focus on the present, and the present, from an evolutionary perspective, is only important insofar as it makes the future possible. How we should use factors not subject to compound growth is less clear. Arguably, we should generally only use them in sustainable ways. We should only deplete them if there is reason to believe that the resulting net benefit to the future will outweigh the future cost. Neither reliance on free markets, nor the administrative application of cost-benefit analysis using positive discount rates will lead to such optimal use. This is knowable today.

We know something else as well: Existing ecosystems work. If we intervene in an ecosystem, even with the best intentions, we do not know whether the modified ecosystem will work at all. In other words, we lack information, but our ignorance is asymmetric. History tells us that changing ecosystems generally results in reduced biodiversity.[121] Extinctions occur quickly. Biodiversity, by contrast, takes eons to develop.[122] To the extent that ecosystems are potential resources, their destruction is warranted only if the resulting net benefit *to the future* will outweigh the future costs. This determination may be difficult, but the fact of the matter is that it *will* be made, and we know that free markets cannot correctly make it.

I therefore challenge any contention that we do not know enough about the far future to justify action to protect it. Based solely on current knowledge, we know a lot about what we should and should not do. Those that we should do are normative not because we prefer them, as utilitarians assume; they are normative in and of themselves. We prefer them, if we do, because our behavioral cultures are adaptive. Preference satisfaction itself, however, will not always be consistent with adaptivity. Where it is not, intervention is likely to be adaptive and therefore justified.

III. CONCLUSION

Recall that the purpose of this paper is not to justify the theory outlined in Part II.A. Its purpose is rather to put that theory to work

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121. *See* F. Stuart Chapin III et al., *Consequences of Changing Biodiversity*, 405 NATURE 234, 234-41 (2000).

122. *See Editor's Choice*, 290 SCIENCE 1465, 1465-67 (Stella Hurtley ed., 2000).

to address the question: "What normative obligations do we owe to future generations?" I promised in my introduction to identify a long-term normative objective consistent with both evolutionary theory and our intuitions about ethics. I believe I have done so. *Our prime normative obligation is to facilitate the survival, evolution, and integrative expansion of our We.* This is not, per se, an ethical objective—that is, it is not a direct corollary of the principle of reciprocity. It is, rather, an adaptive and therefore normative objective, implicating the principle of reciprocity only because that principle is itself adaptive.

The obligation I have identified is, I assert, consistent with our intuitions about ethics and our need for meaning. It tells us that we must seek the good. We must perfect our implementation of the good. We must build bridges to others. We must try to understand how the world works. We must be tolerant of diversity. We must be open to the new. In short, normative evolutionary theory does not endorse simple-minded answers like the Hitler Principle; its answers instead look far more like Aristotle's *eudaimonia*. The vision I have described is, moreover, fully consistent with many, if not most, varieties of religious faith. Evolutionary theory, it turns out, encourages us to flourish, not for our own sake, but to make possible something much larger than ourselves.

I return, finally, to the Pleistocene Dilemma. I ask you to assume that our decision maker knows no more about her future than we know about ours, but that she understands the theory set forth in this paper and endorses its normative conclusions. Her objective will be the survival, evolution, and integrative expansion of her We. She will therefore care about her descendants, even twelve millennia later and even knowing that their values and behaviors are likely to have radically changed. Indeed, she will encourage such change. Among her hopes for her far descendants is that they will be strong enough to contribute relatively equally to a joint We should they encounter others. But in any event, she will strongly prefer that her We not be annihilated. She will attempt to use available resources in a sustainable way so as to minimize the likelihood that their depletion will close off options. And she will therefore choose to limit hunting.