Gordon H. Orians

Nature & human nature

People working in quite different fields with different methodologies and research agendas nevertheless often shared a veiled antipathy, trying to keep their distance from the implications of two ideas: Our minds are just what our brains non-miraculously do, and the talents of our brains had to evolve like every other marvel of nature. Their effort to keep this vision at bay was bogging down their thinking, lending spurious allure to dubious brands of absolutism and encouraging them to see small, bridgeable gaps as yawning chasms.

– Daniel Dennett, preface to *Freedom Evolves*[1]

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Throughout human history, people have pondered their relationship to the living and nonliving components of the environments in which they have lived: Where did we and all the other living organisms around us come from? How long have we been here? In what ways are we different from other species? How should we relate to them? Do we have any responsibilities to them? If so, what are they?

Human cultures have generated a rich variety of answers to these and similar questions. Most of these answers reflect the intimate contacts people had with nature because nature, both benign and terrifying, influenced the consequences of most of their activities. Moreover, our ancestors could not have failed to notice the many striking similarities between themselves and some of the other species that shared habitats with them. For people lacking knowledge of both the age of the Earth and the processes by which life evolved, such similarities must have seemed puzzling.

The dominant view throughout Western intellectual history has been to posit an unbridgeable gap between humans

1 Daniel Dennett, *Freedom Evolves* (London: Penguin Books, 2003). I thank Leda Cosmides and Judith Heerwagen for helpful comments on an earlier version of the manuscript.

and other animals. This belief has often been combined with the position that other species were created specially with human needs in mind:

> It was with human needs in mind that the animals had been carefully designed and distributed. Camels, observed a preacher in 1696, had been sensibly allotted to Arabia, where there was no water, and savage beasts "sent to deserts, where they may do less harm." It was a sign of God's providence that fierce animals were less prolific than domestic ones and that they lived in dens by day, usually coming out only at night, when men were in bed. Moreover, whereas other members of wild species all looked alike, cows, horses, and other domestic animals had been conveniently variegated in color and shape, in order "that mankind may the more readily distinguish and claim their respective property." The physician George Cheyne in 1705 explained that the Creator made the horse's excrement smell sweet, because he knew that men would often be in its vicinity.[2]

In striking contrast, the sharp division between humans and other animals that has dominated Western thought is alien to Eastern philosophy. In some of those traditions a reincarnated human soul can take many shapes and forms. A human can become a fish; a fish can become a God. Thus, all living things are spiritually connected. Lacking a religion that grants souls only to one species, Eastern philosophers readily accepted the notion that our species is historically linked to others.

Even in the West, most children do not share the view that a great gap exists between humans and other animals. "Children show no trace of the arrogance which urges adult civilized men to draw a hard-and-fast line between their own nature and that of all other animals. Children have no scruples over allowing animals to rank as their full equals. Uninhibited as they are in the avowal of their bodily needs, they no doubt feel themselves more akin to animals than to their elders, who may well be a puzzle to them."[3]

The fact that human bodily functions are shared with animals is, not surprisingly, one of the many challenges to the belief in an unbridgeable gap between humans and other animals. One response has been to propose that other fundamental differences trump the obvious metabolic similarities. One interesting 'solution' was to suggest that physical modesty about bodily functions distinguished humans from beasts. A passage in the diary of New England clergyman Cotton Mather, written in 1700, illustrates this perspective:

> I was once emptying the cistern of nature, and making water at the wall. At the same time there came a dog, who did so too, before me. Thought I; "What mean and vile things are the children of men .... How much do our natural necessities debase us, and place us ... on the same level with the very dogs."
>
> My thought proceeded. "Yet I will be a more noble creature; and at the very time when my natural necessities debase me into the condition of the beast, my spirit shall (I say at that very time!) rise and soar" ....
>
> Accordingly, I resolved that it should be my ordinary practice, whenever I step to answer one or the other necessity of nature to make it an opportunity of shap-

2 K. Thomas, *Man and the Natural World: A History of the Modern Sensibility* (New York: Pantheon Books, 1983), 19.

3 Sigmund Freud, *Totem and Taboo* (London: Hogarth Press).

ing in my mind some holy, noble, divine thought....

In the nineteenth century, one of the great arguments against vaccination was that inoculation with fluid from cows would result in the 'animalization' of human beings. Why eating other species, a nearly universal practice among those who opposed vaccination, did not have the same effect was never explained! Bestiality became a capital offense in Britain in 1534 and, with one brief interval, remained so until 1861. Incest, by contrast, was not a secular crime at all until the twentieth century. Though these and other beliefs about the gap between humans and other species may seem quaint to us now, some of today's defenses of the gap will probably seem equally quaint to our descendants.

Scientific advances have repeatedly challenged the notion of a gap. New information about the functioning of the physical world, most notably that the Earth was not the center of the universe, raised some concerns, but they were relatively quickly accommodated by religious leaders and their followers. In 1859, Charles Darwin presented by far the most serious challenge. He offered a hypothesis that explained the processes by which life evolved over long time spans, demonstrating that the appearance of design did not require the operation of a designer. Even more importantly, he also suggested that humans had evolved together with other forms of life via those same processes, thereby effectively removing us from the pedestal most people thought we occupied. The repercussions of this dangerous idea still reverberate powerfully today.[4]

4 Daniel Dennett, *Darwin's Dangerous Idea* (New York: Simon and Schuster, 1955).

Among the 'casualties' caused by more recent scientific advances are the claims that possessing a culture, language, music, self-awareness, and an ethical sense are uniquely human traits. Despite the discovery that these traits are shared with at least some other species, new ways continued to be found to defend the gap. Among nonscientists, belief in the gap is now based primarily on the presumed existence of a component, such as a soul, that is implanted in humans, but in no other species, at some point after conception by some supernatural process. Differences among religions concerning when a soul is believed to be implanted in a human body figure prominently in current debates over the ethics of abortion.

Natural and social scientists who still believe in an unbridgeable gap between people and other animals, but who are reluctant to invoke some supernatural process, generally base their belief on a claim that the evolution of human consciousness, combined with our remarkable ability to learn, has emancipated us from the control of our genome. If so, it follows that there is no such thing as 'human nature.' Instead, a human being is born with a mind that is a blank slate. As expressed by José Ortega y Gasset, "Man has no nature; what he has is history." This view dominated Western psychology, sociology, and anthropology during much of the twentieth century.

Today, however, given the amazing recent advances in cognitive neurology, few scientists ascribe to such an extreme view. What has replaced it in the minds of most (but not all) scientists,[5] if not

5 For alternative views, see R. C. Lewontin, S. Rose, and L. J. Kamin, *Not in Our Genes: Biology, Ideology, and Human Nature* (New York: Pantheon Books, 1984); S. J. Gould, "Biological Potential vs. Biological Determinism," in S. J.

among the general public, is the belief that, although behavior may be the product of complex interactions between heredity and environment during an individual's maturation, for humans developmental influences overwhelmingly overpower residual genetic influences. Humans are, accordingly, free to devise remarkably diverse kinds of cultures and to establish rich arrays of behavioral norms. Thus, humans differ fundamentally from other animals in that environmental influences so soundly trump genetic influences on the development of human behavior that genes can safely be ignored. Some scientists have even argued that the human genome is too small to encode much more than a blank slate.

Most scientists have discarded blank-slate models. A major reason is that such models are unable to account for most of the diverse array of problems that humans and other animals routinely solve. All efforts to account for the rates at which children accomplish the extraordinarily complex task of language learning, for example, employing only a blank slate, have failed.

Another reason for abandoning blank-slate models is that geneticists have shown that genes in all organisms are organized into two functional elements – transcription factors and promoters. Promoters are the sequences of DNA that determine whether the adjacent coding regions will be expressed. Promoters, and the various transcription factors that act on them, are largely responsible for the cascade of events during early development that determine the structure and functioning of organisms. Genes that govern development were not discovered until 1985 because geneticists had concentrated their attention on the transmission of inherited characteristics from adult organisms to their offspring. Studying almost exclusively the part of DNA (only about 1.5 percent of human DNA) that codes for proteins, they ignored the regulatory component (about 3 percent of human DNA) that governs development.

Differences in the adult forms of different animal species result from differences in where and when regulatory genes are turned on and off. The factors that govern the formation and patterning of the bodies and body parts of multicellular organisms are referred to as the molecular tool kit, in the sense that a few tools in a carpenter's tool kit can be used to build many things. The number of developmental genes in the tool kit of the human genome turns out to be sufficient to generate a complex neural network capable of yielding such surprising phenomena as the deep structure shared by all human languages.[6]

Although belief that a child is born with a 'blank-slate brain' is no longer scientifically justified, a rich research agenda remains to explore the nature and extent of genetic and environmental influences on components of human behavior. Great variability exists. In considering differences among people, some traits, such as the ability to learn a language early in life, are entirely genetically determined – almost everyone without brain damage has this ability, and when they do not, it is usually because of a rare mutation. Other traits that differ among people, such as which language a

Gould, ed., *Ever Since Darwin: Reflections in Natural History* (New York: Norton, 1977); P. R. Ehrlich, *Human Natures: Genes, Cultures and the Human Prospect* (Washington, D.C.: Island Press, 2000).

6 S. B. Carroll, *Endless Forms Most Beautiful: The New Science of EvoDevo* (New York: W. W. Norton, 2005).

person speaks, are completely environmentally determined.

The distinction is not only of intellectual interest. Social policy is often based on assumptions about the degree of genetic versus environmental influence on human behavior. For example, until recently, psychiatrists blamed mothers for the behavioral difficulties of their autistic or schizophrenic children by accusing them of failing to engage emotionally with them. Today we know that autism and schizophrenia are highly heritable. The likely environmental influences on the expression of those traits include toxins, pathogens, and developmental accidents. Mothering contributes almost nothing to the probability that a child develops either disorder. Many mothers suffered unnecessarily, believing that they had caused their children's disorders.

Fortunately, the persistence of the belief in the West that an unbridgeable gap exists between humans and other animals has not suppressed people's desire to understand the workings of nature. Indeed, understanding the functioning of nature has been regarded as a high calling, an endeavor by which the mind and methods of the creator might be better appreciated.

Nevertheless, some people have resisted efforts to understand natural processes better, fearing that knowledge would rob nature of its wonder.

> Do not all charms fly
> At the mere touch of cold philosophy?
> There was an awful rainbow once in heaven:
> We know her woof, her texture, she is given
> In the dull catalogue of common things.
> Philosophy will clip an Angel's wings,
> Conquer all mysteries by rule and line,
> Empty the haunted air, and gnomes mine –
> Unweave a rainbow.

As he expressed in this poem, "Lamina," part of which I just quoted, John Keats thought that Isaac Newton had destroyed the beauty and mystery of the rainbow by explaining how it was formed. Keats was not alone, then or now. Even today, many people for the same reason resist having nature, and especially human nature, explained.

The physicist Richard Feynman responded in this way to a friend who asserted that scientists miss the beauty of a flower by studying it:

> The beauty that is there for you is also there for me, too. But I see a deeper beauty that isn't so readily available to others. I can see the complicated structure of the flower. The color of the flower is red. Does the fact that the plant has color mean that it evolved to attract insects? This adds a further question. Can insects see color? Do they have an aesthetic sense? And so on. I don't see how studying a flower ever detracts from its beauty. It only adds.

Feynman postulated the wrong pollinator for red flowers (he should have invoked birds), but his point is correct. As any adult who enjoys the pleasure of food or sex should know, understanding the biological function of an activity in no way diminishes the emotions that typically accompany it. Indeed, steps to subvert the intended biological consequences of the behavior may even enhance those emotions.

Nevertheless, resistance to having our emotions explained, and the belief that explaining them will destroy their beauty and our sense of wonder, is still so strong that Richard Dawkins was motivated to write a book, *Unweaving the*

Rainbow, which deals extensively with this issue.

Why human nature has evolved, in part, as a result of the interactions of our ancestors with nature is obvious. Our ancestors lived in environments devoid of modern conveniences. Their survival, health, and reproductive success depended on their ability to seek and use environmental information wisely. They had to know how to interpret signals from animate and inanimate environments and how to adjust their behavioral responses to them. They needed to understand and evaluate relationships between habitats and resources.

These responses may well develop ontogenetically via learning, but not via inefficient, unstructured blank-slate learning mechanisms. Efficiencies are achieved if an organism selectively retains certain information while ignoring or paying less attention to other types of environmental information. It should therefore be no surprise that human learning about the natural environment is caused by content-rich, domain-specialized mechanisms that evolved for specific functions, just as they do in other animals.

Evolutionary biologists expect emotional responses to evolve in response to conditions that strongly influence survival and reproductive success, that is, fitness. Those of our ancestors who did not enjoy food and sex, for example, were more poorly represented genetically in future generations than those who did enjoy – and hence sought out – food and sexual partners. Similarly, individuals who selected inferior environments in which to live should have been less represented genetically in future generations than individuals who made better habitat choices.

The survival value of emotions should not surprise us. Emotions are the major motivators of human behavior. Our actions are strongly influenced by what we like or dislike, what we find pleasurable or unpleasant. Until recently, it was commonly assumed that 'irrational' emotional responses prevented us from making appropriate responses to problems we were trying to solve. However, emotions are fundamental to 'rational' action. As Aristotle said, "Thought by itself moves nothing." Modern cognitive psychologists and neuroscientists confirm that emotions, rather than being the antithesis of rationality, greatly aid thinking and decision making. People can reason and deliberate as much as they want, but if no emotions are attached to the various options in front of them, they never reach a decision or conviction. Moral choices do not, indeed cannot, come about through cool Kantian rationality.

Thus, evolutionary processes have designed the human mind (and the minds of all other species that have them) to assist in making decisions that enhance survival and reproductive success. Antonio Damasio put it succinctly: "The brain is for making decisions about how to enhance reproductive success."[7] The psychological mechanisms that support decision making are adaptations that natural selection has molded over evolutionary time.

An adaptation is an evolved response to a past environmental problem that persistently confronted individuals for long enough periods of evolutionary time to have caused significant cumulative directional selection. To study an adaptation, scientists do not need to

7 Antonio Damasio, *The Feeling of What Happens: Body and Emotion in the Making of Consciousness* (New York: Harcourt Brace, 1999), 35.

identify those precursors. They need to identify only the design of the adaptation and the forces of selection responsible for that design. It is useful to understand the origin of an adaptation, but questions about origins and subsequent history often deal with different historical causes. We can study the function of an adaptation without knowing about or understanding the details of its origin.

Adaptations tend to be possessed by all or nearly all members of a species, although some of them are restricted to one sex or are expressed only at certain ages. Moreover, environments that fail to support normal development can suppress their expression. Adaptations are special purpose, not general purpose, in functional design because the environmental problems to which adaptations are responses are specific problems, not general problems. A general-purpose mechanism is unlikely to be an efficient way to solve specific problems.

The preferences that motivate responses to environments are evolutionary outcomes of complex processes that include perceiving things and spaces, selectively extracting information from them, and reacting to them in terms of their potential value. Discerning 'value' involves asking what an environment offers. J. J. Gibson, in 1979, introduced the concept of affordance.[8] Affordance refers to what an object or environment offers to an individual viewer at a particular time. The perceiver assesses what could be done with that object or in that environment, and evaluates the consequences of doing those things. The observer asks of an object not only, 'What is it?' but also, 'What's in it for me?'

For example, an observer may ask of an environment: How easy would it be to enter it, explore it, and find my way back if necessary? How valuable would the acquired knowledge be? In other words, when we look at trees in a landscape, we think of them not just as objects with recognizable characteristics by which they can be named and classified, but rather as objects suggesting opportunities for doing things, such as picking fruit, seeing further, hiding better, or climbing to safety.[9] We see rivers not simply as morphological components of the landscape, but rather in terms of their ability to provide water, "a basic necessity for the maintenance of life, or . . . as channels along which we can move if we have the means to do so, or as obstacles to impede our passage if we have not."[10]

"Our senses are not transparent windows onto the world. Instead, our senses are adaptations that select, distill, augment, and (sometimes) deceive. We tend to accept our sensations as truthful reflections of reality. But in fact, our senses evolved not to decipher the truth, but to enhance our chances of survival. We perceive 'ugliness' even though there

8 J. J. Gibson, *The Ecological Approach to Visual Perception* (Boston: Houghton Mifflin, 1979).

9 For investigations of human responses to tree shapes and other components of the environment, see R. G. Coss, "The Role of Evolved Perceptual Biases in Art and Design," in *Evolutionary Aesthetics*, ed. E. Voland and K. Gammer (New York: Springer, 2003), 69–130; G. H. Orians and J. H. Herwagen, "Evolved Responses to Landscapes," in *The Adapted Mind: Evolutionary Psychology and the Generation of Culture*, ed. J. H. Barkow, L. Cosmides, and J. Tooby (New York: Oxford University Press, 1992), 555–579.

10 J. Appleton, *The Symbolism of Habitat: An Interpretation of Landscape in the Arts* (Seattle: University of Washington Press, 1990), 25; R. G. Coss and M. Moore, "All That Glistens: Water Connotations in Surface Finishes," *Ecological Psychology* 2 (1990): 367–380.

is nothing in the world that is objectively ugly."[11]

What an environment affords is not static. Affordances vary with season and weather, and the age and current needs of individuals. A farmer whose crops are suffering from lack of rain values an approaching storm differently than a family preparing to enjoy a picnic in the woods does. We cannot simply measure the features of an environment and compute its affordance.

An evolutionary result of making and acting upon such evaluations is that individuals should be able to recognize the kinds of environments in which they function well and to prefer them. That is, high-quality environments should evoke positive emotions, whereas low-quality environments should fail to do so. People should prefer to be in the environments in which they thrive because they would benefit from not wasting time in unsatisfactory environments. Individuals unable to distinguish between good and poor environments would have spent much time in poor environments. They should have left fewer surviving offspring than individuals who were better able to assess environmental quality.

Decisions are based on a combination of information currently impinging on an individual, the accumulated memory related to the significance of information that impinged on the individual in the past (ontogenetic memory), and information stored in the organism's genome (genetic memory). The brain selectively stores information that has proven to be relevant to the welfare of the individual in which it resides. Much relevant ontogenetically stored environmental information concerns the location of things in space. Where were prey animals yesterday? Where did I cache the food I could not carry back to camp? Where are the trees that bear nutritious fruit? Where are the safe hiding places that I may need to use in an emergency?

However, an environment consists of more than its physical and biological components that provide resources and the conditions under which we seek them. Friends, enemies, potential reproductive partners, and dependent offspring are all important components of the environment, too. Indeed, the great importance of other members of our own species is reflected in the composition of modern universities: humans are the subject matter of the majority of departments, including the largest ones.

The processes by which life has evolved have no foresight. Therefore, all adaptations are to past environments. They tell us about the past, not the present or the future. A corollary is that adaptations need not be appropriate under current conditions. Indeed, some of them may be maladaptive if conditions have rapidly changed, as they recently have for humans. Thus we should expect to find some 'ghosts of environments past' in the human psyche. The biological world, like the mental world of Ebenezer Scrooge, is replete with ghosts. There are ghosts of habitats, predators, parasites, competitors, mutualists, and conspecifics past, as well as ghosts of meteors, volcanic eruptions, hurricanes, and droughts past.[12] Some ghosts are the products of ancient events; others derive from recent events. But how long are

11 David Huron, *Sweet Anticipation: Music and the Psychology of Expectation* (Cambridge, Mass.: MIT Press, 2006).

12 A. Öhman and S. Mineka, "Fear, Phobias and Preparedness: Toward an Evolved Module of Fear and Fear Learning," *Psychological Review* 108 (2001): 483–522.

adaptations to past environments likely to persist? Why do they persist? Which of our response patterns were formerly, but no longer are, adaptive? A major challenge in the study of the evolution of human behavior is identifying, characterizing, and interpreting ghosts – and determining their longevity.

One reason we should expect behavioral 'ghosts' in the human psyche is the relatively small number of generations that lie between us and our ancestral hunters and gatherers. Only about ten thousand years have elapsed since the first appearance of agriculture in the fossil record. Only during the past five thousand years have more than half of the human population engaged in agriculture. In the absence of strong selection against a trait, its persistence under today's radically altered conditions is at least plausible.

As Ebenezer Scrooge discovered, ghosts, no matter how inconvenient they may seem to be, can yield positive benefits. If emotional responses evolved because they enabled people to solve life's problems better, exposure to high-quality environments should be restorative; that is, it should reduce feelings of tension and stress. Stress reduction consistently emerges as one of the key benefits reported by users of wilderness areas. Patients recovering from surgery, in hospitals with either views of natural vegetation or simulated views that depict natural scenes with water, recover more rapidly and have less postoperative anxiety than do patients with no access to natural views or who are presented with simulations of abstract designs. Many studies have shown that even a brief exposure to nature – real or via photographs – leads to positive emotional feelings, reductions in stress, and better performance on demanding tasks. The positive responses people have to nature have important implications for the design of work places, living spaces, and health-care facilities.

People have clearly intuitively understood the restorative value of interactions with nature for a long time. The gardens of ancient Egypt, the walled gardens of Mesopotamia, and the gardens of merchants in medieval Chinese cities indicate that, for centuries, people have gone to considerable lengths to maintain and enhance their contacts with nature. More recently, the belief that exposure to nature fosters psychological and physical health has formed part of the justification for providing parks and other nature in cities and for preserving wilderness.

In addition to visual stimulation, the sounds of nature and the sounds we produce ourselves have the power to affect us strongly.[13] Beethoven is reported to have said, "I leave my music to heal the world." Philip V of Spain was cured, so it is claimed, of his melancholia by the singing of a brilliant castrato, Farinelli, who sang the same four arias to him every night for ten years. The "Chalice of Repose" project in Missoula, Montana, offers live music, usually including harpists and singers, to persons in the last stages of terminal illness. Skeptical doctors have been convinced of the value of the music by observing that patients on very high levels of painkillers requested either lower levels of or no pain killers after a visit by the Chalice team. In the 1920s, MUZAK introduced music into elevators in skyscrapers to help calm passengers. Many clinics employ music therapy to calm patients and reduce the need for general anesthetics. Music therapy has been widely used in many societies since antiquity. In fact,

13 Huron, *Sweet Anticipation*.

Americans spend more money on music than on sex or prescription drugs!

Human responses to nature are biased in certain directions by our evolutionary history, by the ways that people lived and the problems they had to solve. Who we are today has been molded by our intimate interactions with the physical and biological components of the natural world, including that component formed by our fellow humans. Therefore, the increasing isolation of people from nature poses serious problems for our attempts to live sustainably on Earth.

It is easy for people not to miss what they never had and never saw. Consider the passenger pigeon. Two hundred years ago there were billions of them. It is estimated that one out of every two land birds in North America was a passenger pigeon. John James Audubon witnessed a flock that took three days to fly past him near Cincinnati in 1813. He described it as follows: "The light of the noonday was obscured as by an eclipse." Today there are none. But how many Americans are aware of what we lost, and how many of us feel that our lives have been diminished by the loss?

Similarly, a few hundred years ago sea turtles were so abundant that ships sometimes sank when they struck vast shoals of them. The turtles may have consumed more plants in the Caribbean than the herds of bison did on the plains. Today all marine turtle species are rare, but few of us miss them or are even aware of the remarkable phenomenon that has been lost.

We are unlikely to care about our environments and other species and be motivated to preserve them unless we live and interact with them and directly experience how they enrich our lives. Conservation success in the United States will depend to a large degree on our willingness to exploit options that fall under 'reconciliation ecology.' Reconciliation ecology is the science of inventing, establishing, and maintaining new habitats to conserve species diversity in places where people live, work, and play.[14] Reconciliation ecology is an applied science that assists us in designing habitats so that we can share them with other species. As the ancient Chinese sage said: "The careful foot can walk anywhere." Nature needs us to walk carefully. So does human nature.

14 M. L. Rosenzweig, *Win-Win Ecology: How the Earth's Species Can Survive in the Midst of Human Enterprise* (New York: Oxford University Press, 2003).