4
Actuality Versus Optimality

In one of Charles Schulz's *Peanuts* cartoons, Charlie Brown laments that the big kids always get to go to the front of the line and take everything. The dog Snoopy comments, "In the animal kingdom we call it SURVIVAL OF THE FATTEST."[1]

This cartoon illustrates how pervasive in Western popular culture is the notion of survival of the fittest. In general, that idea and other aspects of the theory of evolution have become part of conventional wisdom and folk psychology in the industrialized countries (except among some religious fundamentalists). Charles Darwin's original theory was rightly hailed as a progressive advance over a narrow religious view of humans as specially created by a divine being and apart from other living organisms. But many people have distorted evolutionary theory over the years into an explanation, and justification, for a view of human nature that stresses narrow, selfish survival and reproduction needs and downplays compassion, love, and cooperation.

Evolution has had particular influence on both natural and social scientists. This underlies the tendency of behavioral biologists of the sociobiology school[2] to look for evolutionary advantage to the organism in every observed behavior. If humans tend to be cruel in warfare, or prejudiced against people outside their own group, or hierarchical in their work place organization, so the argument runs, this behavior is human nature and must provide some survival advantage. There is an implicit assumption, although many scholars are moving away from this, that the behavior which has survived natural selection is in some way *optimal*, that is, the best possible behavior under the circumstances that the organism encounters.

There seems to be in many scholars a "teleological itch," a need to find a purpose to everything that is prevalent. Much of their outlook, however, was anticipated by the Nineteenth century Social Darwinists, such as William Graham Sumner.[3] Sumner and others used evolutionary theory to justify inequalities between rich and poor people as based in nature. In fact, the phrase "survival of the fittest" was coined by the Social Darwinist Herbert Spencer, not by Darwin himself.

But a more careful examination of evolutionary theory tells us that a trait that survives is *not* necessarily optimal. Moreover, it tells us that choices among competing behaviors, particularly moral and ethical choices, can't rely on natural selection alone.

What Evolution Can and Can't Tell Us

The teleological itch has been criticized by the evolutionary biologist Stephen Jay Gould, who argued that evolution shouldn't be equated with progress. In reviewing Charles Darwin's work, Gould said that "organisms are integrated systems and adaptive change in one part can lead to nonadaptive modifications of other features."[4] Also, "an organism built under the influence of selection for a specific role may be able, as a consequence of its structure, to perform many unselected functions as well."[5] What Gould said about biological functions in general is especially true of human behavioral and cognitive functions.

Moreover, Darwin's theory of natural selection simply says that the traits which win the genetic competition are those which promote *survival*. It does *not* say the winning traits are necessarily those which promote living *at one's best*. I am not convinced, for example, that there is an *individual evolutionary survival* value in choosing to have a creative, exciting, risky job rather than a dull, stable job that is comfortable but doesn't meet one's potential. After all, risk takers don't always live longer than cautious types — or produce more children! In general, there doesn't seem to be an evolutionary preference for the trait of self-actualization. If such a preference existed, the percentage of people who are steadily self-actualizing would probably be much higher than the one percent Abraham Maslow estimated. But it has been convincingly argued that under the current threats of nuclear war and environmental catastrophe, enhancing human potential is necessary for our survival as a *species*. If so, natural selection doesn't even ensure survival in the long term!

Also, two competing traits may *both* be compatible with survival. When that happens, evolutionary theory gives little if any guidance for choosing between them. So at any given moment in the process of evolution, some traits are present that are not optimal but not immediately lethal.

ACTUALITY VERSUS OPTIMALITY

In the case of personality traits, cruelty, prejudice, and tyranny are indeed part of human nature. Kindness, tolerance, and democracy, however, are also part of human nature. This book is based on theories of human nature which emphasize the potential for choice between opposites such as these. This type of choice is dynamic and depends heavily on context.[6] The biologist and futurist Barbara Marx Hubbard promoted the idea that in order to preserve the earth's life-support system we now as humans need to *consciously direct* our own future evolution, rather than let nature do it unaided.[7] This book strongly supports Hubbard's idea of conscious evolution and describes how our brains are involved in the process.

Evolution of the brain and nervous system, like everywhere else in the body, is full of accidents that aren't optimal but persist as long as they don't kill the animal or prevent it from reproducing. The neural network modeler David Stork, for example, has shown that the neural circuit in the crayfish for flipping the tail to escape from predators contains a synapse that is useless for that purpose.[8] The synapse evolved when the animal was in a different environment and needed it for a different function — swimming rather than tail flipping. Other neural modelers have suggested that functions that are optimal in the long run may not be optimal in the short run.[9] Also, the tendency to optimize has to be balanced by another tendency to explore a range of alternative behaviors before any of them have been proved to be optimal.[10]

A careful reading of Darwin's writings reveals that his own take on human moral and ethical development was quite a bit different from that of the social Darwinists! The social psychologist David Loye[11] has shown that Darwin, particularly in his classic *Descent of Man*, pointed to the importance of cooperation and love in directing the evolution of human moral and decision-making capacity.[12] The moral capacity had emerged with the development of sexual relations and emotional bonding between partners. Moreover, in the preface to that book, Darwin specifically disavowed the notion that natural selection was a purely random process, but stated that there was coordinated evolution of interrelated traits — in a manner that, according to Loye, anticipates late Twentieth Century ideas about dynamical systems and the usefulness of chaos!

All this illustrates that if we want to make decisions so as to enhance human potential, whether related to individual behavior or institutional structure, we can't rely on natural selection to do the choosing for us. If our genetic makeup includes both the qualities we find desirable and the qualities we find undesirable, is there a general theory that tells us how we can selectively encourage one set of qualities in preference to another? In other words, how can knowledge of neurobiology help us direct our own cultural and social evolution? At the very end of this book I will return to the implications of this for society's future.

Some partial answers may be found in the modern study of simulated neural networks (see Chapter 2). Neural networks use mathematical metaphors to identify and describe the fundamental processes of mental and emotional life. Mathematical theories of neural networks have described the "state" of the overall system as the collection of numerical values of all the different electrical and biochemical variables in the system. Is there a way to direct which "state" we approach?

Multiple Stable States

Neural networks, like many other complex systems, are described using a branch of mathematics known as *dynamical systems theory*, developed in the Twentieth Century for understanding systems with many interacting processes. This theory allows for use of the same mathematical language, regardless of whether the system arises in biology, physics, economics, or anywhere else. A dynamical system can be defined roughly as a description of the changes over time in some set of interacting variables.[13] In general, the state of the system is the collection of values of all the variables at any given time.

Dynamical systems theory is the same branch of mathematics that is more popularly known as *chaos theory*.[14] Chaos is a mathematical way to describe a set of seemingly unpredictable shifts between states. It has captured many natural and social scientists' imaginations because it appears to explain many unpredictable phenomena in nature and society. I will return in later chapters to the constructive uses of chaos. But chaos is only a small part of what can happen in dynamical systems.

ACTUALITY VERSUS OPTIMALITY

A dynamical system often reaches an *equilibrium*, that is, a state of the system at which all influences on the system are in balance and so the state doesn't change. Typically a complex dynamical system will have many, not one, possible equilibrium states. This fact may sound uninteresting, but we will see that its ramifications, for humans and societies, are staggering.

In a dynamical system, a *stable equilibrium* or *attractor*[*] is defined as a state the system naturally tends to approach. That is, if the system is moved slightly away from the attractor, it will return to the attractor; in anthropomorphic terms, the state is "attractive" to the system. A simple example is shown in Figure 4.1. As that figure shows, if a card or other thin object is balanced on its side, the state it currently occupies is unstable, and it tends toward a stable state of falling flat on the ground. But there are at least two possible equilibrium states, both of them attractors: the object can fall down on either side, depending on how it is tilted.

Most interesting dynamical systems contain more than one attractor, and often a lot more. This includes dynamical systems that describe the interactions in neural networks. Neural systems, or social systems built of individual people, are of course much more complex than the system representing a card balanced on its side. In neural systems, we also have a lot more difficulty in specifying quantitative variables. At this stage of knowledge, the variables in our model networks are crude approximations that only capture *some* of the essential properties of real behavioral phenomena. Besides, since the human brain is composed of billions of cells (*neurons*) and social systems contain large numbers of human beings, the number of essential variables in neural or social systems is vastly larger than it is for the falling object of Figure 4.1.

With these caveats, it is a useful intuitive notion that every complex neural or social system has more than one attractor, that attractors compete with one another, and that the system has the potential to move toward any one of the attractors. For example, love and hate are both attractors for a person, and he or she can move toward either one. Analogously, a society can move toward

---

[*] Technically, there is a mathematical distinction between a "stable equilibrium" and an "asymptotically stable equilibrium" (see, for example, Hirsch and Smale, *Differential Equations, Dynamical Systems, and Linear Algebra*, Academic Press, New York, 1974). An "attractor," if it is a single point, is actually equivalent to the latter. But that distinction is not needed for the nontechnical discussion in this book, so I will use the simpler term "stable equilibrium" for both.

liberty or repression, and a nation toward peace or war. Mathematical formulations have led researchers to see some common patterns to all these pairs.[15] My narrative will move back and forth between the common patterns ("abstractions") and specific examples of them.

When two states of a system compete, sometimes it is *easier* to fall into one of these two equilibrium states than the other. It takes less effort, for example, to build a dictatorial system with clear lines of command than to build a democratic system where commands are ambiguous. But just because one state takes less effort to reach, that does not mean it is the only "natural" state for humans in general, or that group of humans, to be in. It does not even mean the easier state is the optimal, or most desirable state possible for the system. It simply means that it may take tremendous energy or courage to push people into a state near enough the more desirable alternate stable state to fall into that one instead.

Again, natural selection doesn't provide a guide here. Evolution may select for our whole personality profile which includes competing attractors (such as competition and cooperation, or growth and stagnation). But since both of these attracting states are present in adult life past the reproductive years, evolution hasn't chosen one of these personality states over another.

In later chapters I will discuss strategies to push people or societies toward changing the state they approach. First, let us look at examples of actual and optimal behaviors that are opposed to each other. As the theories of brains and of social systems develop, there may well turn out to be common organizing principles to many of these pairs of opposing behaviors, principles that can be studied mathematically. An understanding of these principles should guide us toward more innovative approaches to various situations where choices have to be made among competing beliefs or cognitive structures.

Power Inequalities

One example of actuality (what is)* opposed to optimality (what could be) is in the creation of power relationships. We often find it easiest to create hierarchical power relationships, even

* It might seem paradoxical to use Maslow's term "self-actualization" for optimal behavior, and "actuality" for behavior that may not be optimal. Maslow's term comes from making the best of oneself "actual," so the two terms shouldn't be confused.

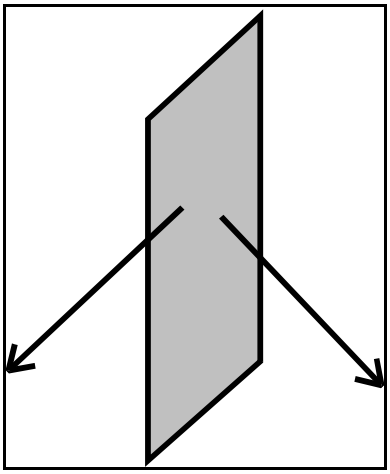

Figure 4.1. A card standing on its end can fall in either one of two directions ("equilibrium states").

though democratic relationships are often more appropriate. I am not arguing for anarchy in governments, businesses, or other organizations; people need to be delegated, or choose for themselves, to perform well-defined tasks, and one of those tasks may be that of "President," "Chief Executive Officer," "Facilitator," "Minister," "Parent" or the like. The best managers or executives, though, tend to be those that promote the maximum access to information, and freedom to share the information they have, among people performing other tasks in the organization. But those types of managers, unfortunately, are still in the minority.

The social psychologist Gregory Bateson identified two levels of communication in any verbal interaction between two people.[16] One level is the actual content of a spoken message: "please take out the garbage," "I like the job you're doing," etc. The other level is the ground of

interaction: “My relationship to you is ... .” It is at the second level that we must be careful as to whether the relationship is an intimidating or a nurturing one.

Some readers will argue that intimidation and nurturing can go together. For example, I have fond memories of a high school English teacher who bullied the class into memorizing every line of *Macbeth*; several martinet choral conductors who stopped angrily at every sour note; and a mother and father who made me buckle down to homework instead of watching television. These people cared about me and taught me valuable lessons that have lasted.

Many of us, however, can engage in tyrannizing behavior that doesn’t bring out the best in others. This is done largely out of habit, because we can’t think of another way to achieve our goals. Parents, for example, are most likely to yell and intimidate their children when their own stresses inhibit them from figuring out more creative and softer methods of persuasion.

Not only individuals but societies as well tyrannize out of habit and suffer from it. The examples of Pharaonic Egypt and Ming China (Chapter 1, Case 2) illustrate this as well as any. Unequal, mutually distrustful power relationships ultimately harm not only the person “on the bottom” but also the person “on the top.” This is even more true when those on top and those on the bottom fall into recognizably different groups. For example, in modern America, because whites have oppressed blacks for so long, blacks have resorted to crime which threatens whites as well as themselves. Even many former rich white “fortress” neighborhoods are no longer safe. Analogously, because men have oppressed women, women have built expectations of men which include physical protection and economic support. The result has been stresses on men, such as restraint of emotional expression and of other “feminine” behavior. Such restraints tend to inhibit self-actualization and may even shorten life. Finally, because rich nations have oppressed Third World nations, the rising population and discontent of the poorer nations is a major fuel for war. In this age of global communication, Third World wars increase the likelihood of terrorism that can threaten the rich nations.

All these situations are different in detail, but all illustrate similar types of common nonsense. They point to the theme that gross, persistent power inequality can be seductive, but ends up creating

tension for everyone. This, I believe, is the meaning of the prophecy that "he that lives by the sword shall perish by the sword." (*Revelations* 13:10).

War, and Excessive Fear of Danger

War itself is another example of actual behavior which is often not optimal. This was documented by the historian Barbara Tuchman.[17] Tuchman discussed several separate historical events: the Greek war against Troy, the Protestant succession during the Renaissance, the British loss of America, and finally the American involvement in Vietnam. In each of these cases, she argued, war was not inevitable but was the result of failed policies. The conflicts between the parties involved were significant, but could have been resolved through negotiation. In fact, negotiations had sometimes begun to lead to solutions, but policy makers on one or both sides of the conflict rejected these solutions for reasons that look trivial from the viewpoint of our detached hindsight. This is why Tuchman called her book *The March of Folly*.

The attraction to war, even when peaceful solutions are available, has complex causes in human nature. Two mutually opposing factors, however, stand out as dominant psychological causes of war. One is adventurism, arising from excessive self-confidence based on national economic power. The historian Paul Kennedy traced examples throughout modern history of nations becoming economically strong and then overextending themselves in military conquest.[18] Subsequently, the drain of resources in war led to partial loss of that economic power. (Kennedy, writing in 1987, hinted that the United States had already moved somewhat down that road!) But the other side of the coin to excessive self-confidence is excessive fear of danger, which can also be a cause of war. Pairs of opposites play a major role in the formation of human psychological constructs (see Chapter 1, Case 3). Later, we will see that such pairs of psychological opposites have been modeled by a type of neural networks.

Recall the example of early airplanes that went wildly off course when overcorrected. Analogous overcorrection on a societal scale can explain the national security obsession that often

governs states, at the cost of those social policies that would improve the quality of everyone's lives. Is the stifling of the human spirit by a concern for national *security* merely a reaction to emotional *insecurity*?

The national security mania has sometimes been used in the modern United States as an excuse for stifling the rights to free speech guaranteed by the First Amendment to the Constitution. The security obsession has been even more stifling in nondemocratic military powers like the now defunct Soviet Union. It is an example of one of the more prevalent classes of nonoptimal behavior: repressing part of our needs because of excessive anxiety about satisfying another part. While some of this repression is done by dictatorial governments and rigid social systems, much is done by ourselves; otherwise, dictatorships would never be allowed to arise.

This suggests that a society which fulfills human potential has to be less obsessed with safety and more willing to take risks than most current societies. All the world's major religions exhort letting go of our anxiety about security, having faith that our needs will be taken care of. Of course, organized religion itself is often used as an instrument of repression. But a religious faith that is authentically felt, not imposed by authority, promotes a confidence that Maslow's "lower" needs will be satisfied. That confidence enables the "higher" needs, the ones that define the spiritual and godlike in us, to be given a chance for fulfillment. This is why, for example, giving up aspirations is a goal of Buddhism.[19] This is also why "take therefore no thought for the morrow" (*Matthew* 6:34) is part of the gospel of Christianity.

How is the brain involved in safety obsession or risk taking? We don't know yet, but partial answers can be suggested by what we know about the brain's handling of emotions in general.

Repression of Feelings

From the last chapter (the sections on "Hedonistic Neurons ..." and "Reason and Emotion ...") we see that the frontal lobes integrate inputs both from brain areas involved with complex verbal and intellectual functions (other parts of the cortex) and from other brain areas involved with

motivation and emotion (the limbic system and hypothalamus). More generally, the frontal lobes are the areas of the brain that integrate signals from the largest number of other areas. This led the neuroscientist Karl Pribram to call them the "executive of the brain."[20]

In a joint article with Sam Leven and Paul Prueitt, I extended Pribram's executive idea by speculating that because of their connections to so many other brain areas, the frontal lobes are required for de-repression, that is, allowing play to all the parts of our personality.[21] We proposed that if a person has two apparently conflicting impulses, say toward "strength" and toward "generosity," nonfrontal areas of the brain would incline us toward a "winner-take-all" outcome where the stronger of the two impulses simply suppresses the weaker. If the difference is relatively small, the frontal lobes become active as a kind of high-level arbiter. Then, we believe, through connections from frontal lobes to areas below the cortex, the frontal lobes direct an active search for an outcome that is no longer winner-take-all but synthesizes both sets of desires (e.g., allows one to be strong *and* generous). This kind of synthesis is one of the cornerstones of self-actualization as Maslow saw it.

For example, in the absence of effective frontal integration of reason with emotion, either reason or emotion could be repressed if the other is dominant. Both types of repression are harmful to the individual. And both are analogous to harmful states in society. Reason is repressed when the right of free speech or freedom of conscience is disallowed, either through social control or self-censorship. This is an example of a prevalent nonoptimal behavior. But repression of emotions and feelings is another kind of prevalent nonoptimal behavior.

Feelings are often repressed in the name of reason itself. Feelings can also be repressed in the name of a higher ideal such as capitalism or socialism. In modern Western culture, males in particular have been encouraged to be unemotional. At worst, this means being out of touch with their feelings and so unable to meet their own needs, sometimes even to neglect of physical health. At best, this means refraining from publicly expressing their feelings, that is, "playing it cool." Our folk wisdom, challenged by youth movements from the 1960s but still not dislodged, equates

unemotionality with efficiency in job performance and regards it as a bulwark of our advanced technological society.

Does self-censorship of feelings really produce more efficient workers? Studies by the management theorist Chris Argyris hint that this conventional wisdom is common nonsense.[22] Argyris found that organizations where employees were free to air their feelings to management were actually the most efficient. There are at least two reasons for this. One has to do with the fact that people who are able to discuss their feelings have a sense of emotional relief which enables them to concentrate more effectively on work problems. The other has to do with the work problems themselves. To the extent that employee knowledge of work situations, whether in an office, factory, or anywhere else, is freely shared with management and with other employees, everyone is better able to make informed decisions. As we move into the Information Age, where job requirements become ever more unpredictable, the need for reasonably accurate sharing of knowledge becomes even more critical. Too many work places, at all salary levels, still function by rumor and by job and turf insecurity. These work mores are justified by a common nonsense that keeping employees "on their toes" brings out the best work in them.

Distrust of feelings is not really rational; it is actually *emotional bias against emotion*! Self-censorship of feelings takes a toll not only on organizations but on individuals. Its contribution to male crime, suicide, alcoholism, mental illness, and early death has been discussed by men's movement activists like Marc Feigen Fasteau and Herb Goldberg.[23] This branch of the men's movement supports the much larger women's movement, which is a powerful counterforce to the male anti-emotional bias. Many have argued that the prevailing female style is particularly adaptable to the requirements of information technology. (This *doesn't* mean that women are inherently superior in feeling or intuition, just as men aren't inherently superior in rational thinking or science! As a man I have learned much of the traditional female style and find it congenial.)

We need to combat a collective fear we have of strong feelings. Since strong feelings can "hit us on a gut level," this fear is perhaps analogous to our fear of bright lights and loud sounds. Common sense tells us that the long-term effects of strong feelings are often more favorable than

their short-term effects. Love of family and friends can lead to clannishness and prejudice toward strangers, but a deeper love leads us to generalize our kindness to all humanity. Desire for sexual excitement can lead to pornography, rape, and exploitation, but a deeper sexuality bonds us powerfully with the best in each other and in nature. Religious feelings can lead to intolerance toward people with opposing beliefs, but a deeper religious awe promotes concern for the welfare of all people and other living things.

Some Neural Prototypes of Nonoptimal Behavior

How can we understand actuality versus optimality in the brain? Neurobiological and neural network studies of general cognitive themes are excruciatingly difficult to carry out. Both the actual network of our brains and the web of our thoughts and feelings are intricate beyond any human artifice. Understanding must be achieved slowly by scientific studies of specialized behaviors that are easier to explain and are fairly good examples of larger themes. Let us now look "neurally" at a few examples of nonoptimal human behavior, or, more specifically, of human difficulty in breaking bad habits.

One example occurs in the card sorting studies of Brenda Milner[24] (see Figure 3.3). Subjects with damage to the dorsolateral frontal cortex can learn one way of classifying cards (by color, shape, or number of the designs on their faces), but can't switch their classification scheme when the experimenter changes the rules. Many of the frontally damaged subjects said they *knew* they were making mistakes, and got increasingly more frustrated, yet still were unable to correct themselves! Also, most of them appeared to figure out what the possible rules were, making statements like "it has to be the color, form, or number."

Sam Leven and I designed a neural network to simulate Milner's data.[25] Since our network provides an excellent metaphor for one common type of nonoptimal human behavior, I am describing it in somewhat more detail than other neural networks mentioned in the book.