# GENE VIEWS

## *An Overview and Interpretation of Gene-Centric Biological Characterization as Offered by Richard Dawkins's* The Selfish Gene

by Brandon Oto

Richard Dawkins's *The Selfish Gene,* at the time of its first printing in 1976, was a pivotal work for a variety of reasons. It has been praised for its ability to effectively impart challenging and complex concepts to a layman reader, for its elegant yet comprehensive prose, and for its unabashed, uncompromising viewpoint. Most of all, though, it was a milestone on account of its message, an interpretation of genetics (or more accurately, all of biology, and indeed much of the experienced human life, as seen from a genetics perspective) that used proven and accepted scientific data and theory, coupled with unassailable logic, to present conclusions and arguments that addressed a wide variety of "living" realities – allowing both a greater understanding of known facts, as well as providing a model from which future matters could be predicted. Some of Dawkins's assertions were at the time novel, but the bulk of *The Selfish Gene* (as well as most of his other work) lies not in offering new and radical data, but in providing an alternative perspective on already-broken ground.

The central dictum is Darwin's theory of evolution, and as few biologists dispute the veracity of Darwinian theories, the only challenges with the material lie in the exact conclusions Dawkins reaches. Essentially, *The Selfish Gene* is an extended logical bridge, based wholly on Darwinian evolution and propped up periodically with direct evidence. Consequently, objections to the book – which, paradoxically, have grown more rather than less plentiful in the years since it appeared – tend to focus on minutiae of interpretation or subtle differences in prioritization; anything more fundamental is a challenge to evolution itself. And while zealous objections to Dawkins's more wide-reaching statements remain frequent, almost universally they are based on misunderstandings in the meaning or scope of his message.

There is no moral proclamation in *The Selfish Gene,* no value judgement of "right" or "wrong" in human interactions and certainly no application of the book's conclusions to justify one or the other. It is purely a work of science; how it is applied is left up to the living.

## REPLICATORS

In order to reach any understanding of the fundamentals of life, it is necessary first to grasp how life began. While science has no definitive understanding of the first stages of life on Earth – and cannot without direct evidence that is hidden by eons – a certain set of theories has come about which adequately explain the data available, and until a better one is offered, it adequately provides the needed background.

The general environment of a primordial Earth is thought to be a basic collection of several elements: Water, carbon dioxide, methane, ammonia. They existed in a generic, interrelating sea. None of these were by any standard alive. They were merely ingredients, just as flour and water may make bread.

Through basic chemical laws, these ingredients would, from time to time, combine to make larger molecules. If the combined molecule was stable, it would remain cohesive until other factors forced it to decompile; purely random chance was the driving factor, and any combination of elements that "struck lightning" had the opportunity to test its mettle. Gradually, the environment of free elements began to turn into a soup of increasingly stable complex molecules, the most stable lasting longer, the least stable quickly disappearing.

A basic form of "natural selection" was at work already, vying for stability over instability, permanence over weakness. Yet keep in mind that there was no "life" as of yet – only weighted chance.

At some point, one particular molecule (or perhaps several of the same type) arose, with a unique and revolutionary trait: It could create replicas of itself. It was a terribly unlikely occurrence, but in the course of millions of years – the time scale for evolutionary events – it had ample opportunity to worm its way in through the gates of random chance. To "create replicas," of course, no active behavior was required; only a form or composition that tended to attract and mold the correct components from the surrounding soup and do so in such a way that yielded a form identical to the original. Crystals form in the same way, using a "seed" that begins a process of replication using surrounding media – though of course, in the case of the replicator, the new forms broke off, rather than simply adding size to a growing seed.

(An alternative scenario, though perhaps one more complex and therefore even less probable, would be a replicator which exhibited a chemical affinity not for creating copies of itself, but for creating a "negative," which would, when added to a complementary molecule that corresponded exactly, create a sum form which matched the original.)

Whatever the exact form of the first replicators, and whatever their level of stability (as, of course, a natural trend toward stability would help eliminate less-stable forms), they caused a demographic shift in the primordial soup. Rather than a hodgepodge of random molecules, combining and separating as their chemical properties dictated, there began a trend toward replicating molecules, simply because they dominated in numbers. More and more of available resources began to turn from assorted, "dead-end" molecules into one or another replicator, leaving fewer building blocks available for random combination.

In and of itself, this would only imply a process of homogenization. But a second factor was also at work: reproduction error. Every cycle that a replicator reproduced itself, while it would *tend* to yield an identical form (if it did not, of course, it would not be a replicator), there was also a chance that it would introduce changes. Whether called "mutation" or simply botched copies, the effect was the same: generational variation. And with variation came the chance for natural selection to further wield its scythe, pushing each line toward useful mutations and away from harmful ones. ("Useful" and "harmful" referring only to survival likelihood in the current environment, of course, and also referring only to traits that would be "remembered" by newly-replicated forms; a change or mutation that did not also cast its effects on future generations would be meaningless in terms of long-term effects on the line.) Errors compounded upon errors, eventually making very different forms, which were sorted out by the usefulness of their respective traits, and the cycle continued.

Three traits would become most significant when judging the prevalence of a particular form: Longevity (as longer-living forms would obviously exist for greater periods of time, as well as having more chance to replicate), speed of replication (as more frequent replication would yield more "offspring"), and replication accuracy (as a form that replicated with high fidelity would tend to stay in existence longer, whereas one that might replicate often but introduce many changes each time would quickly replicate its *form* out of existence, even if many replicators still existed that technically were *created* from it).

At some point, though it does not matter when, these replicating forms could be called life, and the process that refined them evolution. Currently-existing lifeforms are no more than the result of many, many generations of replicating molecular combinations that trended always toward existing *longer,* reproducing themselves *quickly,* and reproducing themselves *accurately.* The first two factors combine to beget rapid prevalence, whereas the third works to ensure that the offspring are the same as the original. Without the first, the form may disappear; without the last, though it may reproduce many times, the resultant forms will not be recognizable, in the same way that a cat which lives forever and breeds daily but gives birth only to litters of trees will not serve the race of cats well.

Before long, with the basic resources that once were abundant becoming increasingly rare due to the plethora of replicators built from them, competition between differing forms became another catalyst for change, and the improvements of each generation continued to mount. It was almost preordained that a highly successful mutation would soon manifest for the purpose of what we now call homeostasis, or maintaining oneself against outside forces; though the simplest and earliest solution was probably no more than a protective coating, more elaborate answers would eventually build from the thicket of natural selection, and in Dawkins's terminology, the capability to produce quality "survival machines" would become the true mark of a well-adjusted organism.

Millions of years of evolution wrought vast changes, as well as an eventual paradigm shift: In the increasingly elaborate pursuit of the three evolutionary goals, survival machines would become more prominent, more noticeable in the scheme of "life," than the replicators themselves. They would be plants, animals, humans, and indeed all living things that we are familiar with today; the replicators that drove them would be genes.

## KEY GENETIC CONCEPTS

In the current state of life, genes are overwhelmingly "written" in a versatile, durable form named *deoxyribonucleic acid*, or DNA – essentially nothing more than strands of basic materials called nucleotides. Though only four nucleotides are known (adenine, guanine, thymine, and cytosine, or *A, G, T* and *C* for short), they can combine to create the unique varieties of life using commutative variation – the four elements, identical but in *unique orders,* describe everything from a silverfish to an elephant to a bacterium. The DNA itself is only a code, but those codes are the builder's plans for the survival machine that will bear it, and by direct and indirect influence, the overall machine (the elephant, the human) is manufactured in such a way to best ensure the three important evolutionary valuable traits, most noticeably that of longevity, or survival. In other words, the actual forms of the replicators are now essentially identical; DNA was such an overwhelming success that it monopolized the field. Instead, evolutionary change affects genes by weighing its gavel on their survival machines, like armies who offer a champion to battle for their cause. Genes that make good survival machines will succeed.

Genes are made of DNA, but DNA is only an empty book, a useful medium in which to hold the vital genetic code. However, in the complex scheme of DNA and survival machines, the idea of a "gene" is difficult to define precisely. It is tempting to call an individual gene the unit of DNA that codes for a specific trait in the survival machine, such as ten fingers in humans. But this definition is stymied by two shortcomings: First, any such observable characteristic is invariably caused by a combination of many genetic effects, not just one; and second, even were the relevant DNA to be a "single gene" only, it is nearly impossible to judge where in the code one gene actually ends and another begins. That is to say, while protein codes exist to state exactly where one piece of code is delineated, these boundaries (which define regions known as *cistrons*) are not the deciding dividers for many relevant behaviors of DNA. For example, *crossing over,* the process in meiosis which allows a length of DNA from one chromosome to be mixed with the corresponding portion from another, is not performed on cistron-lines but indeed regardless of them, and may occur within a cistron, between two cistrons, or inclusive of two or more.

The precise definition of a gene is perhaps meaningless, but it is important to most genetic discussion that *some* consistent definition be used, and Dawkins uses an output-based description that is similar to the idea of a cistron but centered around the core ideas of natural selection. Citing George Williams as the idea's creator, Dawkins states it thusly: A gene is "any portion of chromosomal material that potentially lasts for enough generations to serve as a unit of natural selection."

Though on first glance it seems contrived, this definition is in fact central to one of the cornerstones of *The Selfish Gene,* and therefore worth elaborating on. The book's example is as follows: Suppose any arbitrary length of genetic code were sectioned off and identified. If it is large – a full chromosome, perhaps – then it is very likely that this section will soon be broken by crossing over, within one or two generations. If it is small – several cistrons in length or less – then it will probably "live" much longer, recurring in many subsequent generations.

This talk of living or being lost recalls our earlier discussion of natural selection, which begs the question: Can the same selective ideas we discussed earlier be applied to these genes? In fact, in Dawkins's terms, it is not only possible but imperative; genes, not individuals, *are* the units of natural selection, *are* the descendants of the original replicators, and the organisms that they live in are merely their tools. Therefore, a gene is *any* length of code, not necessarily on rigid dividing lines such as those of cistrons (for it is not a rigid definition, but a vague one that can stretch to fit the situation) but any portion that is *sufficiently short that it may last for enough generations to be affected by natural selection.* In other words, it must survive the effects of both crossing over and of mutation.

The less obvious but much further-reaching effect of this definition is that it centers the effects of natural selection on small, nearly arbitrary sections of genetic code, rather than on organisms. This is difficult to fathom, but Dawkins states the cause concisely:

> *Natural selection in its most general form means the differential survival of entities. Some entities live and others die but, in order for this selective death to have any impact on the world, an additional condition must be met. Each entity must exist in the form of lots of copies, and at least some of the entities must be potentially capable of surviving – in the form of copies – for a significant period of evolutionary time. Small genetic units have these properties: individuals, groups, and species do not.*

This definition of a gene is in fact self-realizing, for an incontestable reason: Genes *must* survive, be passed down through generations, and in general behave in the "indivisible and independent" mold suggested by Gregor Mendel, because if they do not – if they blended, disappeared, and reappeared constantly – then heredity would be impossible and so would natural selection.

Or at least, they must tend to. Genes may sometimes be destroyed by crossing over, but by our very definition, they will *usually* not be.

Individuals lack this requirement, dying quickly (evolutionarily speaking) and being wholly unable to evolve. But though our actual DNA will die with us, *copies* of our DNA (at least, gene-sections of it) potentially could live forever. (It will not actually live forever, but it does not need to; it need only live long enough to function as a unit of natural selection.) And remember that evolution is not interested in individual forms so much as it is interested in *identical* forms; an actual organism is obviously identical to itself, and therefore good, but as it will eventually die, its children, children's children, and future descendants *ad nauseam* are a better bet.

How can those odds be improved better? By applying again the principles of natural selection. Genes *can* conceivably live for eons, but most probably do not; once again, their "suitedness" at surviving will determine whether or not they thrive, and that is determined by the old standards of longevity, speed of replication, and accuracy of replication. The only difference is that now, these standards are being applied to the gene indirectly; they ask not whether the gene itself is good at them, but whether the gene is good at making *survival machines* that are good at them – for if the boat is sound, then the passenger will be safe.

The usefulness of this explanation becomes apparent when considering many of the quirks of biology that baffle an individual- or *x*-centric view of natural selection. Dawkins gives the example of the huge portion of DNA which actually codes for no known physical trait, makes no proteins, and in fact affects the host body not at all. From the point of view of the individual, this is useless material, or worse than useless; why carry this extraneous data? But from the point of view of the *gene,* to be useful is no requirement. The extra DNA is living in an already-functional body like a resident of an apartment, using the survival efforts of the "functional" genetic code to provide a comfortable home, much in the same way as a parasite uses the actions. What is the "purpose" of the junk DNA? To survive.

## SELFISHNESS

The traits actually beneficial to an organism will depend on its species and the environments it frequents, as well as the strategy already decided on for which to survive (for example, a bird survives in one way, a bear in another, and even if they inhabit the same area, an evolutionary trait that would be highly useful to a bird, such as a jet engine, would probably not be very handy for the bear). However, Dawkins asks the question, are there any traits which would – regardless of the species, whether whale or mushroom or the *escherichia coli* virus – be universally detrimental, or universally beneficial?

At the most basic level, he suggests at least one: That altruism must be basically bad, and selfishness basically good. This is tautological: Any gene that behaves in a way as to help its chances of survival (selfishness) will tend to last longer than a gene that did the opposite (altruism).

Selfishness in this sense is somewhat more complex than the common sandbox definition. It is selfishness as it applies to a gene's alleles – for there is nothing more dangerous to a potential gene than its competition. It is selfishness as it applies to the gene's selfish machine – for if the body dies, or worse, *tends* to die, then the gene is in a bad situation; therefore the survival of the organism is linked with the survival of the gene. But it is *not* selfishness as it applies to unrelated externals, and it is certainly not selfishness as it applies to other genes sharing the same survival machine. In fact, while genes that code for effective traits will help their survival, genes that code for effective traits *in combination with other genes* will do so far more, and be far more relevant, for in this age of highly contentious resources, genes can no longer survive alone. This is no new idea; it applies to the original premise of natural selection, that of changing via differential survival to better fit the environment. But the environment does not only mean the external world; it also means other genes, and a gene that is well-suited for everything *but* its body is no better off than a monkey born underwater.

## BEHAVIOR

Any exploration of life can dwell on physical traits exclusively so long as it discusses only plants, fungi, and other static creatures, but if it wishes to make points about animals, it must before long address their unique attribute of *behavior*, "… the trick of rapid movement which has been largely exploited by the animal branch of survival machines." With this trick, using their evolved tool of the muscle, animals can run from danger, seek out food, and perform other tasks infinitely beneficial to their survival (and to the survival of their genes as a result).

Behavior is nothing more than an extension, using the useful extra dimension of physical motion, of the same survival goals that drive the creation of one's physical form. "Sentience," in the sense that philosophers ponder on, is not necessary; all that is required is for genes to create their machines in such a way that natural forces combine to create the actions they desire. If a rock drops from a cliff, then it will fall until it hits the ground. There is no motivation or desire involved in this, nor must any higher purpose be vested in the action – it is a result of gravity, and friction, and other essential physical forces. More complicated scenarios are also possible ("the rock falls through a tree, knocking loose an acorn, which strikes a squirrel, who runs down the trunk, frightening a child, who runs for her mother"), as well as conditional limitations ("*if* it rained the day before, *then* the rock will fall"), variation based on chance ("... but it *may* not"), and of course many, many levels of nested complexity. Animal behavior need only be an extension of this – basic rules of physical and chemical interaction. A rock will fall. Water will evaporate. A flower will grow. A human will walk.

In what way do the genes affect this process? They affect it in the same way that a programmer creates his programs, a father influences his child, an engineer designs his machine. It is the role of the gene to do its best, in the formative stages of an animal, to create the brain – the master of an animal's behavior – in the best way it can. It can program in rules that will serve the animal well. It can suggest responses to various types of input that the animal might encounter (by way of his senses, the interface to his environment). But there is no manner in which the body or the brain could consult the genes for direct feedback on moment-to-moment matters, for the latent delay in response would impose a crippling limitation on the possible complexity of the creature's behavior. Instead, the genes must do their best to create a brain that can serve the body excellently, responding to daily life in appropriate manners, and do it all *independent of the genes.* Within the DNA is the code by which the brain is created, but after that, it is on its own. Genetic micromanagement is a physical impossibility.

Obviously, this amounts to one's genes attempting to predict the future, even of gambling. The basic predictions of genes are usually straightforward, and indeed implicit – "it has always been sunny around here, so it always will be, and I will make a body that is well-suited for a sunny environment." But smaller gambles must also be undertaken day to day – "I will step out of my safe burrow to find food, even though I am in danger of being eaten if I do, because otherwise I am in danger of starving." And odds in these gambles can be improved with a simple method: Learning. If a method fails once, but the animal who attempted it knows not to repeat it, then the damage is minimized. Conversely, if it is successful, and the animal increases his own odds of repeating it in the future, then the benefit is retained and boosted.

The only problem with this is the usually high cost of failed trials. When a poorly-chosen survival strategem has the result of killing oneself, there is little opportunity to learn from the experience, and unfortunately in nature most mistakes are lethal. The answer of technology has been computer simulations capable of virtually representing realistic scenarios and seeing them through to conclusion without actually expending the high toll usually charged by the real world. Equivalently, the answer of biology has been *imagination,* a natural but basically identical process, wherein a living animal may test an idea without placing himself at risk. "The trouble with overt trial is that it takes time and energy. The trouble with overt error is that it is often fatal. Simulation is both safer and faster."

Of course none of these things are conveniently packaged into single genes, as if a genetic tendency to "imagine" suddenly evolved one day and beat out an alternate allele that was imaginatively-challenged. But the core of natural selection is based only around *change,* and in this sense, very small differences – even single genes – may indeed have very wide-reaching effects. If two creatures are equal in all ways, save for a slight tendency in one to manifest some sort of simulative phenomenon, then that is all that is needed: over time, natural selection will tend to favor the line with the more useful allele, and the onward march will continue, tiny change after tiny change, generation after generation.

Another feat of behavior is *communication,* a means of interaction by which one animal may "influence [another's] behavior or the state of its nervous system" – in other words, a means of exerting influence on other organisms. It is customary to consider the wont of most animals to be a mutually-beneficial, cooperative system of communication, wherein one may warn of an approaching predator and allow its companions to flee from danger, or a scout may find food and communicate the knowledge back to his swarm. But we must remember that the only true vector of influence in any facet that characterizes living things, including behavior, is that of genetic survival, and if it happens that an animal can survive better by *abusing* a system of communication, then that tendency will begin spreading inexorably. For example, if a species of bird evolves a behavioral pattern wherein the first creature to spot an incoming predator will promptly squawk out a warning cry, thereby allowing the entire flock to flee to safety, this is a mutually beneficial trait. However, imagine that by some chance a bird then discovers that he may cry a warning when there is *no* predator, thereby inducing the flock to flap off … and leave the rest of the

### A is for Andromeda

The issue of the genes' influence on animal behavior is illustrated well in *The Selfish Gene* by an example drawn from the science fiction novel *A for Andromeda*, by Fred Hoyle and John Elliot.

An alien civilization, 200 light-years or so from the Earth, wishes to communicate with other civilized races (of which humans presumably are one). The question of how to do so, an age-old favorite of science fiction, is solved by using a radio message broadcasted omnidirectionally and with great power, addressed to any race with the technological capability to receive it. Since a 200-year lag time in both directions would effectively make a two-way conversation impossible, the entirety of the Andromedans' message is included within a single long soliloquy.

The message contains plans and diagrams for the construction of an immensely powerful computer, as well as its accompanying instruction codes. Human forces recieve the message, duly complete the construction, and activate the machine, only to find that the Andromedans are less than benevolent and the computer is programmed to take over the world, which it nearly succeeds in doing.

An obvious parallel can be drawn to animal intelligence: The Andromedans are genes, their problem of communication-lag the same in interstellar space as in the body, the computer is the animal brain, and world domination is the daily challenges faced by any living animal. The Andromedans were the original force that attempted to impose a planetary dictatorship, but they did not do it directly, and could not even have known that their message had been received; instead, they created a proxy, the computer, and infused it with a set of rules and instructions that would allow it to respond to as many possible types of external stimuli as they could imagine. Certainly it would have been impossible to think up every possible example of alien civilization, and therefore a direct "if *x* then *y*" ruleset would have been impossible. Instead, much like in current chess computers, the solution would have to be a series of principles that guided the computer in a general way based on the things that the Andromedans (or the genes) knew to be beneficial to them. Actually interpreting their situation, deciding on a response, and executing it would be left to the computer's "judgement," as it is left to the food for him to gorge on. An excellent strategy, and if this bird has one whit of memory and learning, then he may be inclined to repeat it. If this strategem helps his survival, which it very well may (as he is now better-fed and therefore stronger), then natural selection will smile upon his deception, and before long it may be a commonplace practice within the species. As a result, the usage of warning calls loses all practicality, as none are sure anymore whether a warning is true or faked, and natural selection will favor those birds that do *not* fly away. But then perhaps, once the other end of the spectrum has been reached, the deceptive call will have lost its utility (as nobody is fooled any longer), and in fact the use of true warning cries may become more rewarding as an effective defense against predators than deceptive ones are – and the pendulum may swing the other way.

What this leads to is an idea that Dawkins attributes to Maynard Smith and Smith himself traces to WD Hamilton and RH MacArthur, that of the *evolutionarily stable strategy,* or ESS. A "strategy" is nothing more than a behavioral tendency or policy. It may be linked with communication, aggression, or any other field of behavior, but it need not be necessarily a conscious decision, in fact is probably not: it is merely a subroutine built into the animal brain, one genetic program among many. Strategies abound, but an evolutionarily stable strategy is one that *when prevalent within a population cannot be bettered by any other.* In other words, the only strategy that is truly stable will be that which cannot be exploited or beaten by a different one, even if another is actually more rewarding. A population will usually tend to drift toward a state of ESS, and upon reaching it, will penalize deviant strategies.

In the example above, it is very possible that the most rewarding system for *every* bird is the reliable method of trustworthy mutual warning. However, a population consisting 100% of birds that adhered to the system could not last, for the reasons stated above – it needs only one single bird to introduce the idea of gaming the system for short-term personal advantage, even if in the *long* term he would be better served by behaving himself. Because of the rewards available to him, he will succeed above others, and that gene will therefore spread, undermining the warning system. Yet as shown, a system of no warning is probably not stable either. So will the population oscillate ceaselessly between the two extremes? Probably not; rather, it will settle in some middle point where the two possibilities exist in a self-correcting balance. This is the ESS, and biologists

brain's.

The computer was ultimately destroyed by an axe.

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can find these ESS points by methods familiar to game theory, assigning relative values of reward/penalty to each strategy and simulating a duration of time to allow the strategies to interact until they reach stability.

Using the concept of ESS, it becomes clear that the true measure of a gene's success in the gene pool is not only the value of the gene in an absolute sense, but whether the gene fits effectively into an ESS. If it does not, then the strongest legs or sharpest eyes will not avail that animal, for it will be out of place and unable to fit into the stable environment.

## BEHAVIORAL SELFISHNESS

We may now return to the idea of a "selfish gene" and ask whether altruistic behavior – that is to say, a gene for behavior which endangers the host body in favor of another creature – could ever become prevalent in a population, or even significant. The answer is yes, but it will only make sense when one remembers to view the matter from the perspective of *gene*-centered selection rather than that of the individual.

It has been shown that the "desire" of any gene is to become more widespread (that is to say, a gene becoming commonplace is a milestone that can demonstrate its effectiveness). The survival of any one individual bearing that gene is useful for this goal, but in a purely statistical sense, the gene would stand a better chance of spreading itself by ensuring the survival of *two or more* gene-bearing individuals, even at personal expense. In other words, if one organism could be certain that by sacrificing himself he would save the lives of two others who carried the same altruistic gene, then it would be in the interests of the gene to make that sacrifice.

How can such predictions be made? By association. It is clear that genetic "relatedness" between close family members is much higher than it is between total strangers, for though they will not share all genes, they will share many; siblings will share ½ of their genes, as will a child and a parent; more distantly related family will have a lower degree of relation, and identical twins will have 100% similarity. In short, it is possible to calculate with a great degree of accuracy precisely what fraction of your genes an individual is likely to share, and therefore how probable it is for that individual to also share that same gene which urges you toward altruism. All that is required for the perpetuation of such a gene is for it to tend to aid more carriers than it detracts from.

Thus, it is in the direct interest of parents to both bear and care for their young. Conception is a resource-intensive act, and the customary period of caretaking (which varies between species, but is almost always present in some manner) even more so. Why undertake this? Because by helping to ensure the survival of one's young, the genes to *help ensure the survival of one's young* are perpetuated. The same applies (in lesser degrees, for reasons too complex to elucidate here) to siblings and other family.

The actual applications of this stretch further. While it is clear that "kin altruism," or altruistic behavior between close blood relations, can make genetic sense, is it not also true that within a small population of animals – a flock, a troop, a swarm – the probability of encountering blood relations is higher than it would be among a group of total strangers? For many animals, it is logical; groups tend to stay together for multiple generations, and therefore it is very likely that many of one's next-door neighbors share a drop or two of one's own blood. It need not be much. But if the chance came to save the entire flock from a ravenous predator, there is much opportunity for the altruistic gene to be rescuing manifestations of itself. Thus can a form of "group altruism" be shown, even in the strictest eye of "selfish genetics."

Naturally, this concept is far more elaborate than such a simple explanation can demonstrate. For example, an issue of uncertainty is introduced as well. As humans, how do we know who our kin are? We are told, probably; usually we take them for granted. But for a nest of larks, the matter is far less simple, and differing degrees of reliability can exist. A mother will usually be more certain of her progeny than a father, because she was undoubtedly present when they were created, whereas the father may not have been. Therefore, it is more likely that the mother will devote time and energy into caring for the youth – as she is more vested in their survival, whereas the father may not be entirely sure that the young are even his. (If they are not, of course, then time spent tending to them would be wasted, genetically speaking.) And what of twins? Identical twins share 100% of their genetic makeup, so it would seem to follow that a twin would give his life for his sibling just as soon as he would defend his own. But not so – for is he really so sure that this nestmate *is* his twin? Perhaps he is very sure, but he can never be as sure as he is of the fact that his *own* genes are 100% equal to his own, which is incontrovertible. Therefore, safeguarding his own life is the better bet.

## THE REACH AND GRASP OF GENETICS

It has been shown that, for the larger extent, living things exist to safeguard and perpetuate the DNA that they carry. This is not done with conscious purpose, a la an insidious army of tiny creatures that build us into unwitting slavery to suit their nefarious purposes, but only by the quiet vector of natural selection; if by pure chance, genes appear that do in fact build such "survival machines," they will be successful at surviving longer and replicating more copies of the same gene, creating a cycle of self-perpetuation.

This is not the only way of looking at genetics. Richard Dawkins believes in it firmly, as do many of his contemporaries, but there are those who contest it, some preferring an individual-centric viewpoint of evolution, some preferring to eschew core concepts of Darwinism entirely. But in most scientific circles today it is the prevailing view, to one degree or another, that a gene-oriented take on natural selection is both accurate and useful. Debate continues to take place over the ideas expressed in *The Selfish Gene,* but debate is not the same as dissent.

Perhaps one of the most frequent objections to these concepts is the belief that they seek to excuse a moralistic principle of selfishness – not "selfishness" in the genetic sense explored in the book, but selfishness as humans speak of in terms of ethics, the uninhibited striving for one's self-gain with no heed given to others. And in one sense, this is true, but it misses the point. Dawkins makes no attempt to excuse, justify, or condone *any* sort of human behavior. He is a scientist, and speaks of science, and science explains – it does not judge.

But there is another piece of this puzzle, and it is the necessary limitations to genetics that many armchair-biologists forget. Throughout *The Selfish Gene,* an implicit assumption is made that virtually any facet of a living creation, whether in its physical form, its behavioral instincts, or its genetic makeup, can be influenced or altered by way of simple alterations in DNA, swapping one allele for another, a fortunate or unlucky mutation. To some extent, this is true, but it fails to take into account the fact that *genes are not everything.*

The strongest example of this is *homo sapiens* itself.

Nestled into his technical work, Dawkins has buried a seed of a philosophical point which speaks from a different view than the rest of the book. He mentions a possibility, or even a hope, that human beings – perhaps alone among the animal kingdom – may do something wholly remarkable: use their intellect and their capacity for mental simulation to create a true system of values that overrides their genetic predispositions. Though in many ways, we are still captive to our genes, in others we buck their urges: we do not necessarily have as many children as we can, we take some actions which have no direct value for the future of our genes. And while most of our so-called altruistic acts are still the “false” altruism of gene bookkeeping or of a carefully-balanced ESS, it is not beyond the realm of possibility that we may one day wholly buck our genetic programmers and learn honest, true, dispassionate selflessness.

But not today.

∞

COLOPHON

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