Leadership: a cultural manifestation of evolution

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Leadership: A Cultural Manifestation of Evolution

By

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Richmond, Virginia

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The study of adaptation is not an optional preoccupation with fascinating fragments of natural history, it is the core of biological study.
—Colin Pittendrigh 1958

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a Cultural Manifestation

of Evolution

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with generous assistance from
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12 April 1998
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Prelude

I dreamed I was able to fly, but in such a way that I seemed catapulted into the air and lost all control. The feeling of flying exhilarated me, but exhilaration turned to fear when I saw myself driven higher and higher, becoming more and more powerless. At that instant I made the saving discovery that I could regulate the rise or fall of my flight by holding or releasing my breath.

Pistorius' comment was: "The impetus that makes you fly is our greatest human possession. Everybody has it. It is the feeling of being linked with the roots of power, but one soon becomes afraid of this feeling. It's damned dangerous! That is why most people shed their wings and prefer to walk and obey the law. But not you. You go on flying. And look! You discover that you gradually begin to master your flight, that to the great general force that tears you upward there is added a delicate, small force of your own, an organ, a steering mechanism. How marvelous! Lacking that, you would be drawn up to the heights, powerless— which is what happens to madmen. They possess deeper intimations than people who remain earthbound, but they have no key and no steering mechanism and roar off into infinity. But you, Sinclair, you are going about it the right way. How? You probably don't even know yourself. You are doing it with a new organ, with something that regulates your breathing. And now you realize how little 'individuality' your soul has in its deepest reaches. For it does not invent this regulator! It is not new! You've borrowed it: it has existed for thousands of years. . . ."

And with a peculiar shudder I felt that an organ from an earlier period of evolution was still alive within me.

Hermann Hesse

in Demian
Identity and Purpose:

Biology is literally "the study of life." Amidst a sea of controversy and dissent, leadership scholars at least agree that leadership is a living process. Surely then, biology should shed some light on the study of leadership. Since the unifying theory of biology is evolution, perhaps like all other living processes, leadership is also linked to evolution. My hypothesis is that leadership is a cultural evolutionary effort. By "cultural" I mean the assumptions, beliefs, values and behaviors that constitute a group's social strategy. I use the word "effort" to suggest that leadership is hard work and involves purposeful action although the intent may or may not involve a specific vision. Finally "evolutionary" means that the culture is in a dynamic process of adapting with the environment. The environment is simply the sum total of everything around an organism, including other organisms and the organism itself. While it is impossible to identify and independently analyze all of these variables, evolution gives biology an extremely flexible lens to analyze the complex sets of relationships in nature without necessarily knowing all the components. Linking evolution to leadership should provide a more comprehensive view of human change that incorporates far more situational complexity without needing to define every detail of a situation.

The evolution and leadership link is built on the foundation of general systems theory. Essentially, I believe evolution and leadership are best characterized as the interaction of two dynamic forces: the Principle of Creativity and the Principle of Excellence. They are Principles in the sense that they represent fundamental, patterns in all dynamic systems. The Principle of Creativity is the natural tendency of systems to generate tremendous diversity. This diversity tends to increase the turbulence in a system. The Principle of Excellence is the process of selective feedback. This feedback helps the system to maintain order by selecting the forms that work well. Like the Yin and Yang of Taoism, they appear to be polar opposites, but without each other, neither could exist. Too much creativity can throw the system into unrecoverable chaotic fluctuations. Too much selection can cause a system to stagnate and die. Working together, balanced on the edge of chaos, they produce a rich diversity of excellent living forms.

The ancient Taoist were well aware of this dynamic relationship as it related to leadership. The Tao Te Ching literally means "The Book of How Things Work" (Heider Introduction). It was intended to inform rulers of the dynamic nature of the world so that they
could be better leaders. But this awareness is largely absent in the contemporary theories of leadership. In my previous studies, I had only encountered three well circulated books that discussed leadership from a systemic perspective—Peter Senge’s *The Fifth Discipline*, Ron Heifetz’s *Leadership Without Easy Answers*, and Meg Wheatley’s *Leadership and the New Science*. Thus, the original purpose of this paper was to describe the social phenomenon of leadership in terms of the evolutionary behavior of dynamical systems.

However, during the literature review I quickly discovered that numerous theorists over the past 60 years have already built comprehensive leadership models using systems theory. One particularly thorough systems theory of organizations is from Daniel Katz and Robert Kahn. In their words:

“Open-system theory is an approach and a conceptual language for understanding and describing many kinds and levels of phenomena. It is used to describe and explain the behavior of electronic equipment, living organisms, and combinations of organisms. The open-systems approach and the major concepts of open-systems theory are applicable to any dynamic, recurring process, any cyclical pattern of events that occurs in some larger context. . . . We have attempted such a theory for human organizations” (752-753).

I was pleased that I wouldn’t need to re-create the wheel, but a bigger question popped up. Why haven’t I—an intolerably curious student with over 240 semester units from various academic discipline—ever seen more than a passing reference to this relationship? Fully answering this question would require a senior project unto itself, and it is too late to shift. But I’m sure part of it stems from a general fear and distrust of biology (Dennett 21), which is where systems thinking got its start (Gareth 45).

Evolution seems to threaten our most cherished social values (Dennett 21). I believe that this fear, like many kinds of fears, is based on a lack of information. Even within the bounds of biology, evolution is frequently misunderstood, so how can the public be expected to have a clear understanding of it? Therefore, instead of introducing a systemic theory of leadership, the real work that needs to be done is to make more people aware that leadership and evolution are connected but that this connection is nothing to be afraid of. Strengthening and smoothing the link between evolution and leadership is still important work.

The work will be divided into three parts. I believe the reason most people have difficulty making the leap from evolution to leadership is that they do not know the biology that they are
leaping from. The first objective of this paper will be to present the most current general theory of evolution as it applies in biology. I do not intend to provide a refutation of creationism. I leave that in the very capable hands of other authors.\(^1\) However, I shall spend time dispelling some of the major myths of evolution. I think most myths are simple misunderstandings that research has only recently clarified. Unfortunately, many evolutionary myths are actually purposeful misuses attempted to scientifically justify heinous political agendas. I think this has significantly hurt the marriage of leadership and evolution, but again many authors, especially Stephen Jay Gould, have already done an excellent job of exposing these shams.

The second objective will be to demonstrate that evolution equally applies to humans and societies at large. Einstein said that the barrier between nature and man is largely a thin veil constructed to boost our egos:

> A human being is part of the whole that we call the universe, a part limited in time and space. He experiences himself, his thoughts and feelings, as something separated from the rest—a kind of optical illusion of his consciousness. This illusion is a prison for us, restricting us to our personal desires and to affection for only the few people nearest us. Our task must be to free ourselves from this prison by widening our circle of compassion to embrace all living beings and all of nature (Mitchell 191).

We feel that to think of ourselves as special, we have to somehow place ourselves apart and above everything else. As Dennett says, “This is an error in both fact and strategy” (23).

It is an error of fact because the principles of the general theory of evolution are substrate neutral. They apply to any dynamic system whether chemical or cosmic. Of course the time scales and specific mechanisms may differ. Everything has some uniqueness; the difference is a matter of degree. Comparing the moon racing across the night sky to a car is metaphorical. But you don’t say that a Corvette relates metaphorically to a Model T. Even though they are made of completely different materials with vastly different engines and performances, they both are cars. Similarly, while organismic and organizational processes of change are unique, both are evolutionary.

It is an error of strategy because evolution doesn’t shatter our worth and systems thinking doesn’t obliterate our autonomy. Instead of cautiously tip-toeing around the connection, we should jump right in and see what we find. I believe that once we take that frightening step off our

\(^1\)According to Dennett, Kitcher (1982), Futuyma (1983), and Gilkey (1985) have done an admirable job of
fragile ego pedestals, we will find we are indeed very special but also a member of much larger family. We will find that “what really matters to us—and ought to matter to us—shines through, transformed but enhanced by its passage through the Darwinian Revolution” (Dennett 23).

The third objective of this paper is to simply drop the word “like” from the phrase, “leadership is like evolution.” While organizational leadership has been compared to organismic evolution before, most authors treat the connection only as a metaphor. As a metaphor, social scientists have drawn important lessons from the comparison. I believe that so much more can be learned if we stopped looking at leadership as if it was like evolution (but not really) and started looking at leadership as human, sociocultural evolution. In particular, I will examine the notions of adaptation and conflict as they relates to Heifetz’s description of leadership.

Darwin saw the obvious implications for social theory when he wrote *The Origin of the Species*: “In the future I see open fields for far more important research... Much light will be thrown on the origin of man and his history” (458). The general theory of evolution is firmly established, but researchers have only begun to figure out all the details. Similarly, while “cultural evolution” is an accepted term of cultural anthropology (Alland, 1973 in Csányi 148), the added complexity of social learning and consciousness make those details all the more murky.

There are three conceptual swamps which I have no intentions of getting bogged down in. First, there is a raging and healthy debate over the origins of culture. I feel justified that meaningful theories can be drawn about the operation of culture without knowing where, when, and how it started because Darwin offered a good theory for the origins of new species without knowing how the original species got started. Second, I do not intend to map out exactly how human sociocultural systems interact with the other biological and physical systems. Humans have physical bodies subject to the same biological pressures as all other animals. Where these processes end and culture begins is impossible to tell. Finally, while the emerging field of cognitive/neural/perceptual psychology is very exciting, it is in an ambiguous growth stage clearly demonstrated by its numerous names. Consciousness is an important unique feature in human evolution. I will discuss how it changes the game in interesting ways, but I make no claim
to explain how it works. Again, Darwin had no problem describing the foundation of evolutionary theory even though he knew nothing of the inheritance mechanisms. Future insights from these areas will profoundly clarify the specific processes of human cultural evolution. For now, we will focus on the major systemic principles at work in human organizations.

In order to establish the relationship between leadership and evolution, I will primarily rely on presenting cogent arguments. Since this paper is largely intended to be a theoretical exploration of concepts, sound reasoning from justifiable premises will be my guide. Of course, deductive logic has its limits. At some point the ideas need to be tested. Rather than inundating the world with yet another battery of questionnaires based on a half-cocked hypothesis, I will spend some quality time drawing extensively from the rich literature on evolution, cultural evolution, and leadership that already exists. Given the sheer quantity and co-evolution of the ideas floating around, it will be difficult for me to accurately determine the original sources of many concepts. For the most part I will use parenthetical citations to identify the source of quotes or specific concepts. Footnotes will be used to explain quirky or ambiguous references as well as provide curious and amusing but non-essential asides.

While the mass of information will be overwhelming, I will trust Meg Wheatley’s advice to let the hypothesis spontaneously emerge from the mountains of data. In a kind of parallel or circular irony, my method will consist of the same self-organizing process that my method is trying to prove exists. In that sense, this paper will not be completely void of new empirical evidence—its very completion gives credence to itself.

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4 Personal conversation February 18, 1998
Part I: The General Theory of Evolution

My intent in this section is to provide a complete review of the general theory of evolution and address major misunderstandings and common challenges associated with it. I shall avoid reconstructing the evolutionary history of the concept of evolution as much as possible. Charles Darwin and Alfred Wallace brought the concept into the limelight for examination in *Origin of the Species*, but by no means did they get it all right. Since then, various components have been added or sloughed off as new evidence has arisen. Despite the continuous revision of the theory, the fundamental concept has remained unchanged. Appropriately, the theory’s ability to consistently incorporate the sharp attacks it has received lends credence to its own inherent fitness.

While the story of the theory of evolution is certainly fascinating, I am going to present the current state of the idea including the modern synthesis with genetics and the most recent additions of systems theory over the past twenty years. The theory is constantly evolving itself, so I am not going to worry about nailing down its taxonomy. Defining theories in culture is just as problematic as defining species in biology. I do not care whether the most current idea should be called neo-Darwinism or if it has changed enough to warrant a new “Neo-something-ism” name. I will simply refer to it as the general theory of evolution.

The basic theory of evolution was well summarized by Darwin in *Origin of the Species*:

> If under changing conditions of life organic beings present individual differences in almost every part of their structure, and this cannot be disputed; if there be, owing to their geometric rate of increase, a severe struggle for life at some age, season, or year, and this certainly cannot be disputed; then, considering the infinite complexity of the relations of all organic beings to each other and to their conditions of existence, causing an infinite diversity in structure, constitution, and habits, to be advantageous to them, I think it would be a most extraordinary fact if no variation ever had occurred useful to each being’s own welfare, in the same manner as so many variations have occurred useful to man. But if variations useful to any organic being ever do occur, assuredly

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5 Nor were Darwin and Wallace the first to report on the phenomenon. A Scottish naturalist (go Scott boys) named Patrick Matthew articulated a very similar argument in an appendix to his 1831 book, *Naval Timber and Arboriculture*. As quoted in Dennett (49) who quotes from Gould (1985, 345-46), Matthew said, “To me the conception of this law of Nature came intuitively as a self-evident fact, almost without an effort of concentrated thought. Mr. Darwin here seems to have more merit in the discovery than I have had—to me it did not appear a discovery. He seems to have worked it out by inductive reason, slowly and with due caution to have made his way synthetically from fact to fact onwards; while with me it was by a general glance at the scheme of Nature that I estimated this select production of species as an a priori recognizable fact—an axiom, requiring only to be pointed out to be admitted by unprejudiced minds of sufficient grasp.”
individuals thus characterized will have the best chance of being preserved in the struggle for life; and from the strong principle of inheritance, these will tend to produce offspring similarly characterized. This principle of preservation, or survival of the fittest, I shall call Natural Selection (Origin of the Species, 129-130).

For those who are suspicious of any statement that uses words such as “certainly” (and rightfully so), as well as to incorporate the subsequent refinements of the theory, we now turn to a thorough reconstruction of the general theory of evolution.

I. Evolution: Dancing at the Edge of Chaos

Evolution is driven by two fundamental principles. These principles have been given numerous names—Yin and Yang, Order and Chaos, Stability and Change, Reason and Passion, etc. In this paper I characterize them using words frequently encountered in leadership studies—Creativity and Excellence. In our society, they are often characterized as combative, polar opposites. Both evolutionary theory and leadership studies have suffered from viewing these principles as being “either-or”. As humans have known for millennia, both are necessary. They co-exist in an “and” relationship. They balance each other like a couple spinning in a Viennese waltz. As they spin, each principle is extremely vulnerable to falling, but their mutual lack of balance provides incredible total balance. Before examining the intricacies of the dance as they relate to evolution and leadership, let’s couch them in a general context from their physics and poetry origins.

The Principle of Creativity: Everything Changes

The Principle of Creativity is the idea that everything in the universe is constantly changing. From decade to decade, a tree grows taller and thicker until ultimately it dies and withers away. From season to season, leaves bud, grow, discolor, fall, and bud again. From second to second, the tree exchanges biotic wastes for life giving fluids and minerals to continually rejuvenate itself. From nanosecond to nanosecond, the vibrating molecules and atoms reposition themselves in countless arrays and patterns. The net effect is that the same tree is never composed of the same particles in the same position. The pocket knife engraving that commemorates a first kiss is outlined by different atoms than when the mark was made. This is also true of humans. Your pancreas is not the same pancreas you went to bed with last night (Capra 271-272). Your skin is completely replaced about once a month. Your brain cells are a
little more stable (in some people more than others) but even those cells have their constituent proteins replaced.\textsuperscript{6}

Constant change has the potential to create incredible diversity. With an almost infinite number of variables\textsuperscript{7} that can be arranged in an infinite number of configurations, the possibilities compound themselves so that it is impossible for two things to ever be exactly identical. Mathematically, the number of possible structures is something like infinity raised to the infinite power (infinity\textsuperscript{infinity}). This is a big number which represents the potential for a lot of diversity. As the Greek Heraclitus stated more simply, “You can’t step twice into the same river” (Mitchell 8).

\textit{The Principle of Excellence: Things Tend to Stay the Same}

In contrast to the constant change generated by the Principle of Creativity, the Principle of Excellence tends to maintain very stable patterns. Sting captures this when he sings, “Inside every turning leaf is the pattern of an older tree.” While a particular tree is never exactly the same tree, we aren’t surprised that it tends to stay in the same place year after year. Similarly, while our pancreas completely replaces itself daily, it retains the same shape and function in the same place. Our skin changes monthly, yet we wake up every morning and reliably discover that our left hand has not reconfigured into a right hand, or a foot, or a lizard’s tail, or a mouse’s ear. Every human is unique, but the small, medium and large clothing categories seem to work pretty well. We die at totally different times for different reasons, but insurance companies reap considerable profits by betting that each of us will live 75 or so years.

The world is extremely conservative.\textsuperscript{8} The Christian ceremony of death explains, “Ashes to ashes, dust to dust.” The Tao explains that life is a circle that has no end but merely is. Emerson observed, “Every thing in nature contains all the powers of nature. Every thing is made up of one hidden stuff; as the naturalist sees one type under every metamorphosis. . . . Each new form repeats not only the main character of the type, but part for part all the details, all the aims, furtherances, hindrances, energies, and whole system of every other. . . . The world globes itself in a drop of dew” (Mitchell 179). Einstein is best known for explicating the most painfully

\textsuperscript{6} For this reason, the Invisible Man wouldn’t remain invisible very long if he didn’t get frequently re-zapped
\textsuperscript{7} There are a vast but finite number of particles in the universe. . . we think.
\textsuperscript{8} Especially in Virginia.
obvious and simple relationship—energy and mass are two forms of the same thing. Whether expressed as a rock, a hair, a tree, or an elephant, matter is nothing more than condensed energy. Chuang-Tzu, ever following his policy that “the best thing is to use clarity,” often stated (after clarifying that it really could be somebody else talking) that “the ten thousand things are one” (Mitchell 20). Heraclitus described it as such: “From all, one; from one, all” (8). The mathematician says it simplest: “1.”

Integrating Diversity and Similarity

There seems to be a sharp paradox between these two principles. How can everything stay the same if it is constantly changing? The problem lies with the assumption that change and diversity are opposite from stability and similarity. Fritjof Capra explains that “the dictionary meanings of the word ‘stable’ include ‘fixed,’ ‘not fluctuating,’ ‘unvarying,’ and ‘steady,’ all of which are inaccurate to describe organisms” (271). He continues, “The stability of self-organizing systems is utterly dynamic and must not be confused with equilibrium. It consists in maintaining the same overall structure in spite of ongoing changes and replacements of its components” (271). As Wheatley said in an interview, “You are always changing, but paradoxically you are changing to become who you think you already are.” From a limited field of view, it may appear that broad and flat is the opposite of long and thin. Removing the blindfold reveals that both are part of an elephant—the ear and tail, respectively. Although the parts may appear to be different, the whole relates all parts together. The paradox is resolved when we equate the infinite number of variables that can be arranged in an infinite number of structures with a composite unity. Thus, $\infty \times \infty = 1$.

Thus we see stable, self-replicating patterns in the universe that incorporate tremendous diversity. William Blake’s famous quatrain summarizes this well:

To see a World in a Grain of Sand  
And a Heaven in a Wild Flower,  
Hold Infinity in the palm of your hand  
And Eternity in an hour (Harmon 368).

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9 Energy=mass*constant, where the constant is the square of the speed of light.
10 Like all skills, resolving paradoxes takes practice. Here is a simple exercise from Franz Kafka: “Idleness is the beginning of all vices, the crown of all virtues” (Mitchell 197). Or how about Buddha’s “What is the sound of one had clapping?” Or my personal favorite, “If a chicken and a half lays an egg and a half in a minute and a half, how many pancakes does it take to fill up a football stadium?” (Hint: Ice cream doesn’t have hair.)
This understanding is nothing new, but the advent of Chaos Theory has given us a new language and set of tools to study and observe the stability and dynamism of natural processes. Although leadership study would benefit from a thorough synthesis with the mathematics of Chaos Theory, I will focus on the general concept of strange attractors. Strange attractors can be visualized as a marble rolling over a dimpled surface. When the marble is within a dimple or basin, it continues to move but in a well-defined space or basin and produces shapes like the one shown to the right. Larger basins tend to be more stable than smaller basins. At times the marble may wander out of a basin. As it leaves one basin, it rolls into another. This phenomenon of leaping from basin to basin is called a transformation or evolution. The Principle of Creativity describes the wandering motion of the marble, and Excellence describes the stabilizing ability of the basins.

2. The Principle of Creativity

The general theory of evolution is a relatively simple argument. It began with the simple observation that all individual organisms vary in certain traits. These traits can be genetic, morphological, behavioral, geographical, etc. Superficially it is obvious that each organism is unique. We all are different shapes and sizes with our own unique fingerprints and other physical characteristics. But this is a crucial fact, the implications of which are often underestimated. No two organisms are ever the same, not even "identical" twins or "clones" (Dennett 36). As we saw earlier, even the same individual is constantly changing.

For example, picture in your mind a tree. We all know what a tree is. It is a universal emblem of life. They are the majestic plants we climb as children. Suspend for a moment the nostalgia, and look carefully at this mental image. Do you see a mighty oak? Perhaps it is a maple or a dogwood? Is it a palm on some tropical coast, or a primeval pine buried deep in the mountains? While we all know what a tree is, there are thousands of types of trees around the world. Each of these types of trees are different in form. Some are tall; others are stunted. Some have broad leaves; some have needles; some barely have any leaves. Each form represents a unique strategy for living in a given environment. All the individual organisms that generally

11 See Gleick 1987 for an excellent review of Chaos Theory
share the same form are considered a species. “In fact, the word ‘species’ was at one point a standard translation of Plato’s Greek word for Form or Idea, *eidos*” (Dennett 36).

In practice species can be very difficult to define. It is easy enough to tell the difference between a dog and a dogwood tree or a slug or even a cat. But are wolves, foxes, and your faithful pet dog separate species or just different varieties? Plants can be even more complicated. Darwin noted, “Certainly no clear line of demarcation has yet been drawn between species and sub-species” (67). Identifying the shortcomings of the various attempts to draw that line is beyond the scope of this paper. For our purposes a “species” is a rough grouping of similar forms or types of organisms.

When we expand our imagination to think of all the different species of the world, we are quickly overwhelmed by “the prolific diversity of living things—literally millions of different kinds of plants and animals” (Dennett 35). Nobody really knows just how many species there are, but the estimates keep growing. A few years ago, scientists were tossing around estimates like 30 million currently living species. Now they are guessing around 300 million. This number excludes all extinct species and doesn’t even begin to fathom the number of possible species. The diversity represented by the number of species of organisms is huge, and it gets even bigger when all the unique individuals are considered.

**Identity is Largely Heritable: “The strong principle of inheritance”**

The diversity of living organisms is heritable. Characteristics of the parents tend to be passed on to the next generation so that “a typical organism resembles its parents more than it resembles unrelated individuals” (Giffiths et al. 14). Traditionally, organismal inheritance has been considered to be largely a function of genetics. An individual’s characteristics are coded in a molecule called DNA that forms genes. That DNA is passed on to offspring through the germ line, also known as the gametes. Those gametes then develop into the new organism.

Of course, inheritance is much more complicated than that. There are a thousand ways of playing with the genetic opening, packaging, and reopening process (asexual, sexual, unisexual, haploid, diploid, polyploid, nuclear parasites, gene splicing, “cloning”, etc.). Furthermore, even

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12 Because something has to be!!!)

13 At the time, Darwin did not understand the mechanism for inheritance, but he recognized that kids tend to look like their parents. Although Gregor Mendel had published his work on inheritance, his work was largely unnoticed until
though these genetic processes are relatively standardized within each species, genes do not absolutely dictate the emergent characteristics of an organism. This is "the fallacy of 'genetic determinism,' the belief that various physical or mental features of an individual organism are 'controlled' or 'dictated' by its genetic makeup" (Capra, 269). Biologists recognize that the environment greatly influences development (Griffiths et al. 13).

Genetically identical plants growing in different soils may look nothing alike. In addition, even if there are no environmental differences, genetically identical cells can develop differently. This phenomenon is called developmental noise (17). For example, the left eye of a single Drosophila fly may have 1017 facets while the right eye only has 982 facets. There is no genetic difference between the eyes and it is hard to think of there being any significant environmental differences from one side of the head to the other. Thus, "to prevent such confusion between genes (which are inherited) and developmental outcomes (which are not), geneticists make a fundamental distinction between the genotype and phenotype of an organism" (14). It is important to note that the term "phenotype" includes all the emergent traits of an organism, not just its physical characteristics. To make sure that behavioral traits of an organism are not excluded, biologists often refer to an organism’s phenotype as its life strategy or simply its strategy.

Unfortunately, the relationship of the environment in the development of the phenotype has been poorly understood, primarily because development is consistently divided into environmental "stimuli" which are interpreted by genetic "rules." The dichotomy between genes and environment is extremely problematic because it is very difficult to distinguish "genetic" from "environmental" influences, especially considering that the most important "environmental" factors are other living organisms (Griffiths and Gray, 277). Genetics has made great strides in clarifying the inheritance process, but its DNA focus has tended to obscure the dynamic relationships that underlie life.

The desire to distinguish organisms from the environment is reminiscent of science’s Newtonian heritage. We still want to classify things into distinct, separate parts. Thinking of organisms as isolated from the environment is largely responsible (social and political agendas

its rediscovery after Darwin published Origin of the Species in 1858. Ironically, Darwin had a copy of Mendel’s work in his library, but he had not read it. Personal conversation Ginnett.
aside) for the entirely fallacious Nature vs. Nurture debate. The quick and dirty response is that it takes two to tango. It is not the presence of a man or a woman alone that creates the dance; it is their interaction. Few would deny that genes and the environment are closely interrelated. The proper environmental stimuli must be received for the DNA to transcribe and send its information. The proper nutrients must be available for the ribosomes to manufacture the proteins specified by the DNA. The types of proteins manufactured make an organism, which in turn influences the environment. Unfortunately, “the insistence that all traits depend on both genetic and nongenetic factors is followed by an attempt to separate the contribution of the two and evaluate which is more important in a particular case” (Griffiths and Gray, 304). Again, this division misses the point. Just as you cannot say whether the man or the woman is more responsible for producing the intricate patterns of a tango, you cannot say whether genes or the environment contribute more to development. By themselves, neither do anything. Even Konrad Lorenz, who originally introduced the notion of innate behaviors that are insensitive to the environment, changed his mind.\textsuperscript{14} We shift our focus to the systemic relationships in development because it is the interaction of the components, not the components themselves, that produces the phenomenon in which we are interested.

Providing a refreshing insight is Griffiths and Gray’s description of inheritance as an iterated developmental system. They argue that inheritance is best viewed as a developmental system that “consists of the resources that produce the developmental outcomes that are stably [sic] replicated in the lineage” (278). Developmental systems theory provides a much richer understanding of Darwin’s “strong principle of inheritance”:

As Oyama argued in “The Ontogeny of Information,” species-typical traits are constructed by a structured set of species-typical developmental resources in a self-organizing process that does not need a central source of information. Some of these developmental resources are genetic, others, from the cytoplasmic machinery of the zygote to the social events required for human psychological development, are nongenetic. The spatio-temporal disposition of the resources is itself a critical resource, as it helps induce self-organization (283).

\textsuperscript{14} As quoted in Griffiths and Gray (280), “Lorenz noted that his earlier ‘atomistic attitude’ of conceiving complex behaviors as chains of elements, some of which were innate and some acquired, ‘was a serious obstacle to the understanding of relations between phylogenetic adaptation and adaptive modifications of behavior. It was Lehrman’s (1953) critique which, by somewhat devious route, brought the full realisation [sic] of these relations to me’ (op. cit., p. 80).”
This perspective of “transgenerational stability of form” (also known as inheritance) replaces “the traditional metaphor of evolved traits being ‘transmitted’ from one generation to another. . .[with]. . .the metaphor of ecological succession. . .[in which]. . .species-typical traits are reconstructed in the next generation by the interaction of the same sorts of developmental resources that were present in earlier generations” (284-285). This pattern is observed in embryology. Offspring do not just pop out looking exactly like their parents. Instead, they start as a single zygote which rebuilds from the organism from the bottom-up, retracing from scratch billions of years of evolutionary history. The zygote is reminiscent of our single eukaryotic cellular ancestor. The blastula stage is similar to primitive multicellular clusters like Volvox. The process continues through the basic vertebrate forms, gills and post-anal tail and all. Even late in embryological development, it is difficult to distinguish a human embryo from a pig or even a chicken. When the organism finishes catching up with everything its ancestors have done, it then adds its own life cycle to the history book and passes it on to its offspring.

This new perspective is also supported by some very interesting empirical evidence. Many herbivorous species have a symbiotic relationship with bacteria to provide the enzymes necessary for breaking down tough plant material. These bacteria cannot be passed through the genes, yet they are necessary for survival. Instead, this resource gets passed down when offspring eat the feces from previous generations, as is the case with iguanid lizards, or through direct transfer through the anus, as is the case with termites (Sues and Reisz 144).

Griffiths and Gray provide a simple illustrative model of the developmental systems theory (285). Figure 1 shows four asexual generations of developmental processes (D). Those processes are influenced by four general resource categories as follows: (A) persistent resources—like sunlight and gravity which persist with little reference to these activities; (B) collectively generated resources—like burrows and termite mounds or established hunting grounds which “are generated over different periods of time by the collective activities of a population” (285); (C) parental resources—like genes, as well as supporting cellular machinery, food, nests which “are created by the immediate precursors of the generation in question” (285);

15 Please keep in mind that I am not saying that evolution follows a ladder of progression from single celled to Volvox to fishes to birds to mammals to humans. It is just that each of these groups share a common ancestor at some point.
and finally (E) self-generated resources—like stored food or self-built shelters which “are generated by earlier stages of the developmental process itself” (285).

This approach broadens the theory of evolution to be the “differential replication of total developmental processes or life cycles” rather than replication of genetic resources (278). As we shall see later, this view also “makes it impossible to maintain the distinction between biological and cultural evolution” (278-279).

Figure 1: “Causal influences in four asexual generations of a lineage of developmental processes. Each arrow represents multiple inputs. Influence of each resource is contingent on the presence of the others. The effects of temporal order of interaction have been overlooked. The broad categories of resources are not intended to be exhaustive, and are made largely for convenience of exposition” (285).

A. Persistent Resources
(sunlight, gravity, air)

B. Collective Resources
(shelters, territory)

C. Parental Resources
(genes, food, training, endosymbionts)

D. Developmental Processes
(organisms)

E. Self-generated Resources (stored food, self-built shelter, extracellular matrix)
The Conservative Process of Creating more Diversity:

“There are many more ways of being dead than being alive.” -Darwin

Inheritance is a high fidelity process, but it isn’t perfect. The developmental systems perspective illustrates the many opportunities that exist for making offspring unique. For simplicity, I shall expand on the potential for “errors” present only in the genetic resource. I will use a human as my example because that is what interests us, but the general concepts equally apply to non-mammalian or non-multicellular organisms.

DNA is quite good at copying itself (Griffiths et al. Chapter 11). Mutations—changes in the molecular DNA—are relatively rare (191). The nucleotides almost never fail to pair up with their complementary bases. Environmental factors like free radicals and carcinogens can increase the number of mutations, but even then they are pretty rare.

When mutations do occur, there is an elaborate cascading system that seeks to minimize their effects. First there are copy editors that usually catch and repair the mistake. Furthermore, once too many copy mistakes occur, there are other senior editors that will trigger the cell to suicide so that the “mutant DNA” will not be transmitted to offspring. Even when those senior editors fail, the cell naturally monitors its mitotic rate, so a single mutated cell will not produce too many mutated offspring cells. If the mitotic regulators fail, the cell divides uncontrollably, which is called cancer. Even at this point, the body’s immune system may round up and destroy the cancerous cells. If the immune system fails, then the organism itself will probably die and thus cease to reproduce. Even if the organism survives long enough to reproduce, the mistake would have to be in the germ line to be passed on. You can have tons of skin cancer, but as long as your gametes are fine, then those errors are not going to be transferred to your children. Finally, if a bad gamete does slips through, if its information is too compromised, then the embryo will either not develop or be spontaneously aborted.

Essentially, inheritance is a highly conservative process. The odds are stacked against any mistakes slipping through the cracks. Yet, given the trillions of cells in a body and the massive turnover of those cells, the sheer reproductive numbers assure that some mistakes will happen and will get through. Unfortunately, most mutations have either a deleterious or null effect on the organism’s phenotype. Much of our DNA doesn’t code for anything. In between genes are

16 For greater details of these processes, see Griffiths et al
large regions of non-functioning DNA. A mutation in these regions probably isn't going to hurt anything in the short term because they don't do anything anyway. If the mutation takes place in an active region, it still may not change the particular amino acid called for in the protein. The genetic nucleotide language is fairly flexible in its spelling. It has several similar nucleotide sequences that code for the same amino acid, so changing a letter or two might not have any effect. But sometimes, the change might spell a word that calls for an entirely different amino acid that has a different property and may totally change the nature of the protein.

Mutations can also do more than change a single base pair. Whole segments of DNA can be erased, chopped in half, inserted into another strand, etc. If the breaks occur in dead regions there may be no effect. However, if the breaks occur in the middle of important sentences, then chances are it isn't going to be coherent. In this case, the DNA either won't work at all or will work in a drastically different way.

However, sometimes changes in a sentence may produce a more provocative sentence. Griffiths et al. explain:

Because mutation events introduce random genetic changes, most of the time the result is loss of function. The mutation events are like bullets being fired at a complex machine; most of the time they will inactivate it. However, it is conceivable that in rare cases a bullet will strike the machine in such a way that it produces some new function. So it is with mutation events; sometimes the random change by pure chance confers some new function on the gene. (186).

While it is certainly conceivable that once in a million trials a mutation will produce a valuable, new characteristic, it is hard to believe that mutations are accountable for all the diversity of life on earth. What the Principle of Creativity lacks in design ingenuity, it makes up for with tenacity by generating an enormous volume of trials.

The Exponential Potential for Creative Growth

As first noted by Thomas Malthus in his 1798 Essay on the Principle of Population, all populations have the potential to increase at a geometric rate (Dennett 40). For example, a single bacterium divides into two daughter cells. Then, those daughter cells both divide into two more daughters for a total of 4 bacteria. The population doubles every generation. After only 20 generations, the population would be over a million or $2^{20}$. After 100 generations, the population
would be $1.26 \times 10^{30}$. This geometric growth potential is also true for any other population although the rate of geometric increase will vary (Darwin 76).

To summarize, Nature has an explosive reproductive capacity—whether it is rejuvenating cells within an organism or creating more individuals in a population. Even with the tiniest probabilities of creating an adaptive mutation, this sheer volume has no trouble producing sufficient diversity. Thus the extraordinary fertile, high fidelity but imperfect inheritance system of Nature is an incredibly creative engine. It begins with massive diversity and continually generates greater diversity so that organisms can continually explore untapped regions of possibility. This tendency is what I call the Principle of Creativity.

The Principle of Creativity means that offspring are going to be very much like their parents, but never exactly. Most of the time, if the offspring are substantially different than their parents, they won’t survive. But once in a while, a viable mutation occurs and manages to break past all the conservative sentries. The emergent strategy is then given an opportunity to test its merit. Unfortunately, that new strategy has to compete with billions of other organisms that are sticking to the tried and true status quo strategies. To figure out how Nature discovers these needles in a haystack, we now turn to the Principle of Excellence.

3. The Principle of Excellence

*Limits to Creative Growth*

The problem with the Principle of Creativity is that it can quickly get out of hand. We saw that there was a tremendous amount of diversity already present in the universe. Each of these diverse forms has a powerful capacity to reproduce. Each offspring introduces a little more diversity because of mutations and its unique developmental history. Fortunately, this exponential increase of diversity does not continue indefinitely. Some organisms have to die and/or they have to reproduce less, or we would be quickly swamped with bacteria, butterflies, and elephants\(^{17}\) as well as mutant butterfly-elephants.

Darwin portrayed the necessary condition that some organisms die as a competitive “struggle for existence” (74-87). Unfortunately, Darwin’s description is heavily laden with

\[^{17}\text{Darwin ran the numbers for a single pair of reproducing elephants. \textquotedblleft The elephant is reckoned the slowest breeder of all known animals, and I have taken some pains to estimate its probable minimum rate of natural increase; it will be safest to assume that \ldots after a period of from 740 to 750 years there would be nearly nineteen million elephants alive, descended from the first pair\textquotedblright (Darwin 77). Thanks to Dennett for pointing this out.}\]
destructive warlike imagery. While it is true that death is inevitable, it is only the death of individual components of the system. The system as a whole is trying to survive, but in perpetuating itself, individual components are constantly shed. We don’t think twice about the millions of innocent skin cells we kill when we bathe, dress, sleep, or anything else for that matter. Capra explains:

Self-renewal—the breaking down and building up of structures in continual cycles—is an essential aspect of living systems. But the structures that are continuously replaced are themselves living organisms. From their point of view the self-renewal of the larger system is their own cycle of birth and death... Indeed, all living things around us renew themselves all the time, and this also means that everything around us dies all the time... Death, then, is not the opposite of life but an essential aspect of it (283).

While population growth is limited, it is not limited by a fixed quantity of resources. As organisms interact, they may create more opportunities for other living organisms. Capra describes this synergy, “Most organisms integrate themselves harmoniously into their surroundings, and some of them re-shape their environment in such a way that it becomes an ecosystem capable of supporting large numbers of plants and animals” (277).

Shifting the perspective from an individualistic, “brutish, nasty, and short” competition to a creative, systemic cooperation has profound implications. Nonetheless, populations cannot grow indefinitely. In nature, population growth tends to follow a logistics curve pattern, growing quickly at first but then tapering off at a stable equilibrium with seasonal or other periodic fluctuations (Ginnett 3). This implies that something is providing feedback to limit population growth.

**Natural Selection: The Biological Principle of Excellence**

Given the vast diversity of organisms, Darwin inferred that some will have variations in characteristics that make better use of resources than other organisms (88-132). Characteristics that are conducive to surviving within the current local environment are called adaptations. An organism’s cumulative adaptive value is its fitness. Fitness is a relative measure of how well an organism’s strategy works in its “environment.” It is important to note that from the systems perspective, the “environment” is composed of biotic elements (other living organisms) and abiotic elements (climate, geography). “Fitness is no longer a matter of ‘fittedness’ to an independent environment” (Giffiths and Gray, 301). Thus, fitness is a function of an organism’s...
relationship with both the land and its neighbors. A fitness landscape is a graphical representation of the characteristics of the environment. Given the tremendous reproductive capacity of organisms and the limits to population growth, some organisms have to die. Those organisms that have a higher fitness (i.e. have strategies that are better adapted with the environment) will tend to live longer and/or leave more offspring. The tendency to select more fit individuals will increase the concentration of the adaptive characteristics in a population. Darwin calls the differential survival and reproduction of biological organisms “Natural Selection” (130).

For example, say a group of diverse organisms are living in the desert. An important characteristic of deserts is the limited amount of water so an important variable in the fitness landscape will be tolerance for aridity/dryness. There are many other variables, but for now we will focus on the single abiotic variable of aridity. Given the diversity of organisms, some are bound to have strategies that make better use of the limited water than others. Their adaptation to an arid environment makes them relatively more fit. They will be more likely to reproduce offspring so that in the next generation, a greater percentage of organisms will possess the adaptive strategies.

This example is the simplest form of adaptation in which organisms adapt to a relatively stable abiotic environmental element. Again, from the systems perspective, the environment is composed largely of other organisms as well as the abiotic elements. Even abiotic components are influenced by the activities of organisms. Coral reefs change the impact of tides on coasts, and beavers change the course of rivers. Of course humans have clearly shown that we can turn deserts into farms and jungles into deserts.\(^{18}\) Hence, it is more accurate to think of organisms co-evolving with each other and the environment.

Darwin distinguishes “Natural” from “Artificial” Selection. Artificial Selection is the differential survival and reproduction of organisms under the influence of man. Breeders have created many new varieties of organisms by concentrating characteristics through the deliberate selection and breeding of individuals with certain desirable traits. Humans have created many new varieties of plants, animals, and protists. They have also caused the untimely demise and extinction of many other organisms. Given the vast distribution and huge ecological impact of

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\(^{18}\) Unfortunately, we seem to be particularly adept at doing the latter rather than the former
humans, it is difficult to conceive of any differential survival and reproduction not having any influence from humans. Besides, as I have said before, it is untenable to think of humans as distinct and separate from the rest of Nature. Like all other organisms, we are a creation of Nature and dependent on Nature to survive. Thus, to avoid the semantic confusion between "natural" and "artificial," I will call the general pattern of selection The Principle of Excellence. The Principle of Excellence is a general selective pattern in which the more fit individuals—those that relate with the environment relatively well—tend to survive longer and reproduce more offspring and thereby increase the representation of their adaptive characteristics in subsequent generations. But before visions of eugenics start dancing in our heads, we must consider a few more dynamics of the system.

*The Principle of Excellence gets Messy: Fuzzy Fitness and Luck*

When describing the Principle of Excellence above, I specifically used the term "tend" because it is not a simple, linear doctrine. The selection algorithm is extremely messy. There are two major sources of the turbulence: the fuzzy determination of fitness and the involvement of luck. I'll begin with an examination of the fuzziness of fitness because, well, it's the most fuzzy.

I think Darwin's use of language such as "survival of the fittest" and "the war of nature" is grossly misleading for several reasons. It implies some sort of battle between organisms. Within an organism, we don't think of our skin cells competing with each other. They are cooperating to help us survive. If our skin cells were fighting with each other, then our skin would no longer be able to protect us and we would die—including the cells that were bickering. Of course, this is basically what happens with cancer.

The cooperative relationship also holds between multicellular organisms. Predators kill prey for food. If the predators didn't hunt, then the predator population would starve to death, and the prey population would be sick from starvation and disease as a result of over population. On the other hand, if the predators over hunt, the prey population would be killed off and the predator population would starve. Predator and prey rely on each other for survival. Capra explains that "most relationships between living organisms are essentially cooperative ones, characterized by coexistence and interdependence, and symbiotic in various degrees. Although there is competition, it usually takes place within the larger context of cooperation, so that the larger system is kept in balance" (279).
Regardless of whether the competitive or cooperative perspective is used, "survival of the fittest" does not mean perfect. The Principle of Excellence can only select from the available diversity of the group. There may be a great strategy possible for a given environment, but if it isn't present in the group, it doesn't matter. Even if all the strategies available have a poor fitness, the Principle of Excellence is going to act on their relative fitness. However, it is possible that none of the available strategies survive. If a lung fish and a shark are placed in the desert, sure the lung fish can gulp air and last longer, but neither are going to survive. Thus, the Principle of Excellence only considers the relative fitness of available organisms above a survivability threshold.

Furthermore, fittest does not necessarily mean best. It is more accurate to think of the Principle of Excellence as the "survival of the fitter." Nature does not run a cost-benefit analysis and then exclusively pick the optimum strategy. In our desert example, the single organism with the best strategy for conserving water wasn't specifically chosen while all other candidates automatically keeled over. Each strategy was tested, and those that were good enough reproduced. Those that have a better cost-benefit ratio will tend to do better, but less fit organisms manage to squeak by all the time. The Principle of Excellence does not select just the right or best answer. It accepts those answers that are good enough to work.

The Principle of Excellence isn't slack by letting a slew of also-rans stick around. Ironically, while only a fraction of the candidates are passed from iteration to iteration, the quality of the strategies are improved by preventing the utter extinction of undesirables in any given iteration. Recall from the Principle of Creativity that the environment—both the biotic and abiotic elements—is extremely dynamic. At any time, a shift in a fitness landscape could put those organisms that used to have the highest fitness below the threshold for survival. A strategy for large size worked great for the dinosaurs as long as there was plenty of sunshine for the plant life to sustain such huge appetites. But they couldn't sustain themselves when sunshine was significantly reduced by debris from a comet impact.19 As the environment changes, what used to be an adaptive characteristic may become maladaptive. The only hope life on earth has for survival is to maintain a tremendous pool of diverse options. Sure, the dinosaur option lost favor,

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19 Even if a comet impact didn't really cause the extinction of the dinosaurs, it serves as a good hypothetical.
but Nature keeps the alligator around just in case. You never know when you may need a
“terrible lizard.”

Fitness then is a very fuzzy notion. Evolution does not have some secret strategic plan for
the optimum organism. It simply runs with whatever works. As the Principle of Creativity
generates more diversity, new opportunities for relating to other organisms appear. These
dynamic pressures combine to produce the evolutionary equivalent to the idea of equifinality,
which is a fancy way of saying that there is more than one way to skin a cat.

Further blurring the process of selection is the influence of luck. When you think about it,
everything alive today is extremely lucky because they are the result of a perfect ancestral
survival record. Bad luck also plays an integral role. For example, a human may have mutations
that makes her immune to AIDS, malaria, and influenza and makes her metabolism twice as
efficient. But when her strategy is tested in the system, she may die childless in a car accident,
fall off a cliff, or be struck by lightning. Even the most well adapted individuals can die and the
most fit populations can go extinct from a sudden fluke accident. In a sense, this bad luck helps
us out. If we didn’t get knocked down from time to time, populations would become stranded on
plateaus or niches in the fitness landscape.

For example, during a flood, the fitness landscape is going to be determined by the
géographical landscape—the higher the ground, the higher the fitness. Someone might suggest
that a good strategy would be for everybody to move uphill. If we took this advice literally and
never allowed ourselves to go downhill, some of us would be stranded on small grassy knolls. A
better strategy might be to generally move uphill, but every once in a while run down hill like a
madman and start over. In evolution, bad luck forces populations to take a step back so they can
be free to try a different route and perhaps get farther.

How much of a role luck plays in the system is difficult to determine, but for our
purposes, it really does not matter. As long as there is some preference for organisms with a
relatively higher fitness, the Principle of Excellence works. It just takes longer and is much
more messy.

Despite the often chaotic process of selection, the Principle of Excellence still has a
discernable order. It is an algorithm for picking out from a vast pool of available options those
strategies that seem to work. It isn’t a perfect merit based process. It never fails to eliminate
incompatible strategies, but it does have difficulty discerning good from great. Many fantastic strategies get passed by while many marginal strategies stick around. Whereas the Principle of Creativity when left to its own devices would generate too many options, the Principle of Excellence working alone would cut out too many options. Independently, these processes are extremely sloppy. Working in concert, they make a brilliant team.

4. Linking the Principles of Creativity and Excellence

The Principle of Creativity generates a diversity of organisms. The Principle of Excellence selects those that seem to work the best. Creativity then tinkers with the selected candidates to further diversify the available strategies. As the two stroke process continues over many generations, minor strategy changes in a population will accumulate. Eventually, enough differences may accumulate so that the population becomes a new species. Of course, the process of generating new species is much more complicated. In general, speciation follows a pattern of diversification similar to the pattern of diversifying characteristics. It merely takes place at a higher level of organization.

We have now completed our summary of the general theory of evolution. Figure 2 is an outline of the deductive argument describing evolution. Essentially, evolution is driven by two powerful engines—the Principles of Creativity and Excellence. The Principle of Diversity is the natural creative and exploratory tendency of systems. Organisms and groups of organisms constantly change their form to explore unknown territory and test new life strategies. The Principle of Excellence is the feedback mechanism known as Natural Selection. As new forms and strategies are generated, those that are relatively better tend to be selected. The selected forms are regenerated with new modifications in offspring to begin the cycle of generate and test again. Evolution, then, acts like a giant learning algorithm that discovers good, but not perfect, solutions by simultaneously trying lots of slightly different answers. From the interactions of components in a biological system, evolution automatically and blindly produces a rich diversity of excellently adapted species through the algorithmic process of generate-test-change-and regenerate.
Figure 2: Logical Outline of the General Theory of Evolution

The Principle of Creativity
1. (Fact) All individuals different.
2. (Fact) Characteristics of offspring are inherited from parents.
3. (Fact) Mutations occur.
4. (2+3) Inheritance is imperfect.
5. (1+4) New individuals tend to be similar to parents but are still different or unique.
6. (Fact) All populations have the potential to increase geometrically.
7. (5+6) Therefore, living systems are tremendously creative.

The Principle of Excellence
8. (Fact) Populations do not increase geometrically forever.
9. (6+7) Some organisms must die and/or reproduce less.
10. (Infer from 5) Some organisms will have characteristics that make it better able to relate to the environment and other organisms (i.e., differential fitness).
11. (9+10) The more fit individuals tend to live longer and reproduce more (i.e., at least some of the differential survival and reproduction is based on differential fitness).
12. (5+11) The adaptive or fit traits will increase in frequency in the population.
13. (Fact) The world is always changing (i.e. fitness landscapes shift).
14. (10+13) A characteristic’s degree of fitness may change.
15. (12+14) A population’s set of characteristics will change.
16. (Infer from 15) With enough accumulated change, a population may develop something significantly different from the original population.

In this way, a system evolves. We now turn to a brief examination of some of the most common myths and misunderstandings of evolution

5. Myths and Misunderstandings of Evolution

Perhaps no other collection of ideas has been more cruelly misunderstood and misapplied than the general theory of evolution. Some of the worse crimes of the 20th century have been abuses of the theory of evolution. Various groups—such as the Nazi’s, eugenicists, and other “Social Darwinists” including at times the U.S. government—have maliciously used the “survival of the fittest” sound bite to justify policies of oppression, exploitation, prejudice, and murder (Gould 1996a). “Darwinism has always had an unfortunate power to attract the most unwelcome enthusiasts—demagogues and psychopaths and misanthropes and other abusers of Darwin’s dangerous idea. . . . It is all too easy to run off half cocked with some poorly understood version of Darwinian thinking” (Dennett, 264). A few of the more treacherous misunderstandings linger today and need to be illuminated and properly disposed of.

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20 Except for the Bible perhaps.
The most notorious evolutionary fallacies have been efforts to rank organisms by their inherent superiority. "Scientific" racism is completely false because races as well as species cannot be ranked. Race A is not superior to race C; they are merely different because they have adapted to different environments. Light skinned humans are favored in Northern Europe where predominately cloudy skies limit sunlight because they need to maximize their absorption of UV light to manufacture vitamin D. Dark skinned humans are favored in Africa where UV light is excessive and people need to shield themselves from over producing vitamin D. Which race is superior? Neither, because 1) it depends where you live and 2) with the advent of vitamins, clothes and sunblock, we can regulate vitamin D concentration without skin pigments. The regional preferences are shattered leaving blacks and whites on a level solar playing field.

Second, a hybrid race B may be better equipped than either pure A or C parent. For example, people with two mutated genes for red blood cells have a disease called sickle cell anemia. They live at most into their twenties because the hardened blood cells cannot squeeze through the capillaries to deliver adequate O₂. People with two normal blood cell genes are very susceptible to malaria, a common blood born pathogen passed by mosquitoes. Yet, sickle cell hybrids, with one good gene and one mutated gene, are resistant to malaria without overly stressing their circulatory systems. The literally mixed blood offspring is much better off. In another case, the royal houses of Europe, in an effort to keep the bloodlines pure, effectively concentrated a rare genetic blood disease called hemophilia that prevents proper clotting of wounds. The pure blood offspring literally bled to death. Inbreeding sickness is well documented in endangered species. Plants have mechanisms to prevent self-pollination. Baboon females prefer visiting "foreign" males. Young animals are often forced to leave the group to find mates from other groups. And as a final test against Nature’s drive towards racial purity, raise your hand if you have sex with your brother or sister. That gut wrenching, shocked reaction to that thought is a simple demonstration of nature’s preference for mating with genetically different partners to insure diversity.

Hitler was an especially effective producer of this fallacy, but he certainly wasn’t the only one. Versions of this fallacy have been promoted by self-titled Social Darwinists. For example, large industrialists have tried to justify the monopolization of markets on the with the soundbite “survival of the fittest.” They emphasize the tendency of the Principle of Excellence to
competitively exclude all but a few organisms while ignoring the necessary antecedent of adequate diversity. "Survival of the fittest" does not necessarily mean survival of the biggest and strongest. Perhaps larger sizes are advantageous, perhaps not. When food is scarce, smaller sizes are at a definite advantage. Even in times of plenty, the supposedly "weaker" males may outsmart the "dominant" males by sneaking copulations with the females while the "dominant" males fight with each other.

Fitness also does not necessarily mean more complex or specialized. Nature prefers whatever works in any given situation. If the simpler structural strategy is more favored, then that is the characteristic that Nature will select (Gould 1996b). Unfortunately, Darwin missed this key distinction. He saw evolution as primarily a progressive march towards higher beings. Even a hundred years later, scientists are still struggling to shake this blatantly false egotistical assumption. In the special introduction to the 1958 edition of *Origin of the Species*, Sir Julian Huxley says that "evolution came to [involve] an element of progress" (xvi). He continues saying evolution is a ladder of succession—"in which an earlier successful or dominant type is wholly or largely replaced by a new and biologically improved type"—is "indeed a general fact" (xvi). He does not hesitate to give evidence to support his claim. "The reason that the reptiles were largely replaced by the mammals as dominant land vertebrates was because the mammals were in a perfectly legitimate sense of the word *higher* [italics in the original] organisms than the reptiles. It further emerged that man is the latest dominant group" (xvi). Huxley, in many respects a brilliant scientist and great contributor to evolution, captures the essence of the egotistical assumption that humans are the natural product of a steady progression towards superior, more complex organisms.

How can we be so blinded by our egos? This notion of a linear succession towards progressively "higher organisms" ignores the painfully obvious fact that the vast majority of the world is occupied by "simple" organisms (Gould 1996b). Humans are not the superior creation we like to think we are. The emergence of the complex human body and brain can easily be attributed to perfectly random selection with no preference for either increased or decreased

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21 I thank S. J. Gould for educating me on this topic in his wonderful book *Full House: The Spread of Excellence from Plato to Darwin*. Most of what follows comes from this source.
complexity (Gould 171, 1996b). Complete randomness would produce a perfect bell curve of complexity with the starting point remaining as the mean, median, and mode. Since life (as we know it) does not get much simpler than a single bacterium, the distribution would have a left wall. Thus, the distribution has no where to spread but to the right towards increasing complexity. Over time, it slowly creeps outwards, continuously pushing the envelope of complexity. This precisely matches empirical evidence. If evolution was inherently progressive, the mass of the distribution curve should shift away from the origin. Alas, the mass stays solidly put. The right skewed tail that produced humans is merely a secondary effect of the Principle of Creativity in concert with a limiting left wall.

If Nature does have a particular favorite strategy, it is clearly marked by the location of the mean, median and mode on the distribution curve of Life. In terms of the number of species, the number of individuals, the number of habitats, the total biomass, and the influence on the world’s environment, there is only one true dominant organism—bacteria (Gould 167-216, 1996b). Yes, those tiny, ugly, single celled, spineless, brainless, non-nuclear, asexual bacteria are Nature’s pride and joy.

Of course, I don’t mean to go so far as to say that we should drop and worship the almighty bacterium. Humans, like all other living species, are unique. Over millions of years, they have developed a special combination of talents that certainly has powerful implications. But this is true for all other living organisms. We are not “higher” or “more advanced” than anything else. It isn’t like bacteria stopped evolving when a few of them started to cooperate and became eukaryotes. Living bacteria or any other “primitive” species is just as much the result of millions of years of evolutionary advancement and fine tuning as humans are.

The point here is that Nature does not have a preconceived notion of the “perfect organism”. Evolution simply selects those life strategies that work. The strategy can be specialized or general, bigger or smaller, simpler or more complex, or whatever. When those strategies are tested in the mix with all the other strategies, the Principle of Excellence is going to keep those strategies that worked.

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22 [Natural Selection] leads to the improvement of each creature... in most cases, to what must be regarded as an advance in organisation [sic]. Nevertheless, low and simple forms will long endure for their simple conditions of life” (130).
To conclude, the general theory of evolution as it occurs in nature is nothing more than a shotgun or spray-and-pray algorithm—throw out as many possible creative and diverse combinations as possible and hopefully some of them will hit a target. A new batch of diverse options is created from the winners and is thrown against the target again. The specifics of any given target will differ, so it should be no surprise that the specific combinations that work will be different. But in each case, the measure of success is survival. Life just wants to live, and it doesn’t care how it does it. Nature is only concerned with "Did it work?" Who could ask for a better goal?

Well, one of Life’s fringe projects has just started to question that measure of success—or at least so it seems. They are also far too impatient and cheap to conduct the necessary number of trials over billions of years to figure out better ways of doing things. In Part II, we will take a closer look at evolution as it operates in the fringe experimental population of Homo sapiens.
PART II: Sociocultural Evolution

1. Organizations and Organisms

Levels of Organization: From Cells to Species to Populations to Ecosystems

In Part I, the general theory of evolution was presented. Evolution was described as a pattern of organization—characterized by the Principles of Creativity and Excellence—that apply to any open system. The examples used to demonstrate evolution were purposefully drawn from various levels of organization—atoms, molecules, cells, organs, organisms, populations, and ecosystems—to demonstrate that evolution occurs at all levels of life. “At each level of complexity we encounter systems that are integrated, self-organizing wholes consisting of smaller parts and, at the same time, acting as parts of larger wholes” (Capra 280).

Vilmos Csányi describes five major organizational levels that can be distinguished on Earth: molecular, cellular, organismic, ecological, and global. Between each of the major levels of organization there are numerous gradations of sublevels. For example, there are tissues, organs, and organ systems between the cellular and organismic levels. In Figure 3 it is painfully obvious to see the repeating patterns of organization. While each level has unique characteristics (Csányi, 108-112), they all follow the same basic principles of evolutionary organization. It is like looking at a fractal where zooming into or out of a level reveals unique manifestations of the same fundamental shapes.

The levels are simply listed, but in reality they exist as a system tree where “every subsystem is a relatively autonomous organism while also being a component of a larger organism” (Capra 280). It is difficult to define the boundaries of an “organism.” An individual human being can be considered an individual organism. But as we look closer at ourselves, we find that our cells have similar signs of being an autonomous organism—identity, metabolism, and reproduction (Sherwood 2). They are basically the same thing as an independent amoebae. Closer still we find the mitochondria of our cells have their own DNA and can replicate independently (Sherwood 26). It is believed that they are bacteria that was engulfed by the first eukaryotic cells and have developed a tight symbiotic relationship (Kleinsmith and Kish 663-

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23 Molecules aren’t typically thought of as “living” although viruses and prions are borderline cases. But as the Nobel laureate Ilya Prigogine has shown, completely inorganic chemicals can operate just like any other open system.
24 The largest single cells known are ostrich eggs.
25 Hope you read that carefully.
The more one studies the living world the more one comes to realize that the tendency to associate, establish links, live inside one another and cooperate is an essential characteristic of living organisms" (Capra 278).

The same phenomenon appears as we zoom away from organisms. Capra says it well:

"Similar patterns of coordination exist in tightly knit animal societies of higher complexity. Extreme examples are the social insects—bees, wasps, ants, termites, and other—that form colonies whose members are so interdependent and in such close contact that the whole system resembles a large, multicreated organism. Bees and ants are unable to survive in isolation, but in great numbers they act almost like the cells of a complex organism with a collective intelligence and capabilities for adaptation far superior to those of its individual members. This phenomenon of animals joining up to form larger organismic systems is not limited to insects but can also be observed in several other species, including, of course, the human species [italics added]" (277).

It doesn’t stop there. “Close coordination of activities exists not only among individuals of the same species but also among different species, and again the resulting living systems have the characteristics of single organisms” (Capra 277). Analysis of the global level of organization has produced some particularly delicious insights. James Lovelock and Lynn Margulis have revived the ancient notion of the Earth as a living organism in their Gaia hypothesis. Quantum physicist would add even smaller subatomic levels of organization to Csániy’s list. Why stop there? As our understanding of life extends, we might even realize that our solar system, indeed the entire galaxy, is nothing more than the minute atoms of some great, super-organism.26 Not to let our egos be disheartened, we may also discover within ourselves that each of our atoms is a little galaxy with its own stars, planets, and little people trying to figure out their place in the universe.27 The net result is that “we do not have solitary beings. Every creature is, in some sense, connected to and dependent on the rest” (Thomas, 6, as quoted in Capra 278).

Within each level, there are numerous types or “species” of individuals. There are huge differences between a water molecule and a strand of DNA, an ostrich egg and a bacterium, a fungus and a football player (ok maybe not), or the coasts of Antarctica and the Amazon rainforest. Again, according to the Principle of Creativity, each type of individual within each level is going to be slightly different. But, again, despite this diversity, each of them follow the

26 Or some failing biology student’s lab exercises.
27 While I would certainly love to go there, we see again the dynamic effect of evolution. My creativity wants to go everywhere, while the identity of this paper selects against it.
Figure 3: Levels of Organization

Atomic

Molecular
as simple as $\text{H}_2$
or complex as DNA and proteins.

Bacterial (Prokaryotes)

Cellular (Eukaryotes)

Colonial Volvox colony and Portuguese-MEN-of-War.

Organismal Lioness and Lionesses

Social and Cultural

Ecological

(Above) Termite mounds and skyscrapers—the abiotic structures of organizational systems.
same basic principles of evolution and organization. Should it come as any surprise, then, that humans, human organizations, and human societies operate under the same fundamental principles as everything else in the universe?

_Organizations and Organisms as Open-systems_

In his book *Images of Organization*, Morgan Gareth offers a compelling invitation at the beginning of Chapter 3: “Let’s think about organizations as if they were organisms” (39). Numerous social scientists have characterized organizations as social systems susceptible to evolution (Darwin, 1859; Katz & Kahn, 1966; Weick, 1969; Capra, 1982; Csányi, 1989; Conner, 1992; Dennett, 1995). Gareth provides a good summary of how organizational and management theories have been strongly influenced by biological concepts over the last 50 years (39). Before the 1920’s, classical management theorists viewed organizations as machines (41). Known as Taylorism, theorist saw the primary task of organizational design as a matter of putting in the right technical pieces for the machine to run smoothly. After the Hawthorne Studies in the 1920’s and 30’s, theorist began to question the mechanical, Newtonian perspective of Taylorism. “A new theory of organization began to emerge, built on the idea that individuals and groups, like biological organisms, operate most effectively only when their needs are satisfied” (41). The Tavistock Institute was particularly active in trying to integrate the human elements with the technical elements (Katz and Kahn 277). “This dual focus on the technical and human aspects of organization is now reflected in the view that organizations are best understood as ‘sociotechnical systems’” (Gareth 42).

The term “sociotechnical systems” describes exactly how both organizations and organisms are composed of biotic (organic) and abiotic (technical) elements. Organizations are composed of people living in and working with buildings, tools, and factories that they have built from raw materials in the environment. Similarly our bodies are a collection of living cells that build their own “dead” support materials. Cells construct extracellular matrices made of calcium, cartilage, and other fibers that they use to support themselves and do work (Kleinsmith and Kish 224). For example, bones are nothing more than calcium levers manufactured by bone cells that are used by the muscles for more efficient locomotion. The only difference is the level at which they are used. Individual cells use proteins. Humans use the millions of cells in concert
with the mechanical structures they have built to form the hands. Organizations use millions of people in concert with the cranes and telephones that they have built.

The term “sociotechnical systems” also shows how organizations do not exist in a vacuum as the strict mechanistic approaches assumed. Biology formed the foundation for General Systems Theory where the organization is viewed as an open system (45). The organization is interdependent with the surrounding environment and with its interrelated subsystems. “If we define the whole organization as a system, then the other levels can be understood as subsystems, just as molecules, cells, and organs can be seen as subsystems of a living organism” (45). Great! So what’s all the fear of evolution about?

2. Criticisms Contained

What’s the point? To Survive or To Thrive?

Few theorists would dispute the open-systems perspective of organizations. We easily accept that “no man is an island.” Like all organisms, people cannot operate in a closed system or they would disintegrate from entropy. When people are integrated into a larger system, the energy they consume is constantly regenerated by the system because their own activities feed back into the system. The planet Mars has a geological composition similar to Earth. If any one species was placed on Mars, it would die almost immediately. But if we transferred an entire ecosystem, then the activities of each species symbiotically creates the conditions for each other to survive. Of course even the most impersonal bureaucracies aren’t nearly as harsh as the Martian environment. People can survive in them, but the question is “Can they thrive?”

Abraham Maslow created a theory of hierarchical needs to distinguish “survival” from “thriving” (Gareth 43). While the specifics of Maslow’s theory may be too linear and bound to Western culture, the idea that there is more to life than steak and potatoes cannot be disputed. However, the idea that non-human organisms have emotional and social needs above a basic physiological threshold has been a sticky point for some theorists.

Research has shown that animals in pounds have depressed immune systems even though they receive adequate shelter, food, and water. In rats, “the mother's touch is essential for normal growth,” and in primates, “given a choice, the monkeys preferred maternal touch over maternal nutrition” (Sapolsky 52). Play is an excellent example of having needs beyond survival.
Numerous mammals show play behaviors, but even some species of electric fish play catch by tossing stones with their heads back and forth.

I am not denying that these social and emotional needs don’t enhance an organism’s survival. It is a good thing that baby monkeys are emotionally attached to their mothers because the mothers are the baby’s only source of food and protection. But if you want to say that the only reason animals have social behaviors is because it enhances their survival, then you have to also accept that human social behaviors are also only designed to enhance the survival of the species. As far removed as TV and video games may seem from survival, we can make the same argument that they are just opportunities to learn social skills or hand eye coordination that are helpful in modern day survival.28

Alternatively, we could say that a myopic, survival-only focus has produced the capacity for considering purposes other than survival. In a strictly physiological sense, social behaviors such as cooperation are often far superior than trying to go it alone. Since cooperatives are so effective, it creates the capacity to consider things other than where the next meal is coming from. In general, it makes sense that living systems don’t limit themselves to “just getting by.” If Nature was only interested in survival, then evolution would have stopped at the wildly successful bacteria. The Principle of Creativity is always playing and tinkering to see if something new can be created. As the level of complexity increases, the system has an enhanced ability to stabilize itself. Social systems are a great way to ensure the survival of the species by buffering the affects of environmental fluctuations.

It doesn’t really matter whether living systems are seeking survival or self-actualization—the results are the same. If they are seeking survival, they’ll figure out that seeking self-actualization helps to smooth out the dry periods. If they are seeking self-actualization, they’ll figure out that being alive makes fulfillment much easier.

The realization that life frequently considers purposes other than survival dissolves one of the barriers that Heifetz has constructed to limit the concept of evolution as “a useful, if inexact, metaphor” (30). He argues that “evolution has no ‘purpose’—survival is our only measure of success; societies generate purposes beyond survival” (31). Heifetz is two-thirds correct. Non-cultural evolution does not have a “purpose” in the sense that it lacks foresight and

28 Of course, because fitness is “fuzzy,” TV and video games can have negative consequences as well
intent. But just because organismic evolution lacks intent does not mean that “survival is our only measure of success.” We can congratulate birds for their wonderful societies even though they didn’t plan for it to be that way. He is also correct in that societies do generate purposes beyond survival. A single amoebae may not be interested in art, but a pod of dolphins are definitely interested in having fun. The point here is that organizational evolution can be motivated by the need to literally survive or by a desire to make survival a little more enjoyable, and this is no different than what we see in Nature. Besides, let’s not kid ourselves. Sure we have art galleries, but when was the last time you went to one? Humans have created tremendous capacity for seeking excellence for the sake of excellence, but how often do we? Unfortunately, organizations usually don’t attempt major change until a severe crisis threatens its very existence.

*The State of Nature is Too Competitive—no wait—Too Cooperative to be Like Human Societies*

Gareth cites an additional distinction between organizations and organisms. He says, “If we look at organisms in the natural world we find that they are characterized by a functional interdependence where every element of the system under normal circumstances works for all the other elements. . . . If we look at most organizations, however, we find that the times at which their different elements operate with the degree of harmony discussed above are often more exceptional than normal” (75). This represents a dramatic shift in opinion by social scientists. Traditionally, human societies are said to be distinct from Nature because they are more “civilized.” Thomas Hobbes characterized the state of nature is a state of war where life is “solitary, poor, nasty, brutish and short” (Pojman 43). Now theorists are saying that comparing human systems to natural systems seduce us into believing the wild idea “that the unity and harmony characteristic of organisms can be achieved in organizational life” (75).

Neither Hobbes nor Gareth’s view of Nature are accurate. Nature is not the hellish struggle for life as Hobbes and Darwin saw it, nor is it the peaceful collective as Gareth sees it. It is true that humans tend to be much more combative than Nature. Most confrontations between organisms in Nature are ritualized combats so they can figure out who the winner is without risking life and limb. But we can’t forget that Nature has had a billion or so years to balance competition and cooperation. Sure mitochondria and cells make a great team now, but before this symbiotic relationship evolved the mitochondrial precursors were considered lunch. Imagine
the massive labor negotiations that took place when multicellular organisms first tried to separate the working somatic line from the reproducing germ line. And don’t think that the queen bee just one day told the other bees that she’ll have all the sex and make all the babies while they do all the work without having some serious resistance.

Even after billions of years of trial and error things still aren’t always so nice. Go to any hospital and you’ll see hundreds of people with bodies that have gone on strike. What cell in its right mind would become a malignant tumor and literally kill its own flesh and blood? But it happens all the time. At the ecological level, some species of insects go to war with other insect species to pillage their food supply and enslave their children to produce food for the colony. Ideally, parasites should only sap enough resources of the host to survive without killing the host. Yet we see the sea lampreys have almost completely wiped out the fish population of the Great Lakes. Fungal infections wipe out whole populations of trees. Even in the more social mammals we see runts getting tossed out of the nest, babies being eaten by adults. Chimps have been known to commit murder. We’ve got stars exploding, galaxies colliding, and Gareth says the view’s too rosy?

Systems theory is not encouraging us all to be one happy, hippie, cohesive, collective commune. Life as a living systems makes no promises. In the long run, cooperating usually works better than not, and we see that over evolutionary history organisms have moved towards greater integration and synthesis. But conflict is alive and well. The Principle of Creativity makes us thankful for all the deviants, skeptics, and criminals, and cancers, thieves and parasites. Sure they can be real annoying and sometimes they end up killing us, but without them, we wouldn’t have the diversity to stay alive. Evolution doesn’t produce perfect organisms, just different organisms. If they don’t work, they’ll find out soon enough from the Principle of Excellence. If they do work, they may get to participate in another round.

I do agree with Gareth that we should never take an “is” for an “ought,” but that’s another reason to embrace the evolutionary perspective. We shouldn’t have hierarchical societies just because wolves have alpha, beta and omega social tiers. Likewise, we shouldn’t have loosely structured societies just because sponges have cells that can specialize and despecialize as needed. Evolution teaches us that those species have those strategies because that is what works for them. We still have to figure out works for us. And even the best built strategies are subject
to change. Evolution encourages viewing the status quo not as something that should be but as something that happens to be. There are various reasons why things are the way they are—historical constraints, lucky breaks, etc. But the Principle of Excellence is always willing to switch tracks if the Principle of Creativity produces something better. Should individuals viciously compete or politely cooperate? If we look to Nature we'll see the answer is sometimes one, sometimes the other, often both, and on occasion neither. Evolution works so well because it doesn't limit what it ought to do to what it is doing. If anything, our imaginations make us even more free to shift tracks. And, well, it does.

**Memes and Consciousness—the Cool Extragenetic Resources of Humans**

The critics are right about one thing. The advent of brains adds an exciting new twist to evolution. But instead of severing ties with evolution, the brain opens up many new possibilities for the Principles of Creativity and Evolution to explore—just as the advent of lungs made it possible for vertebrates to diversify on land and wings made it possible for birds to expand into the air. Well-developed brains give humans two powerful benefits—cultural evolution and consciousness.

The argument that we aren't bound by evolution because our genes don't dictate our behavior is false. Genes don't dictate anybody's behavior. We've already seen that limiting evolution to genetics is inaccurate. With the developmental systems model, we saw how evolution works on a system that is composed of genes and various extragenetic resources. Extragenetic resources are often transmitted as a package deal with the genes. As soon as the eggs hatch, the baby iguanas can immediately pick up the gut symbionts from their parents. Other extragenetic resources could come from any individual, even from a member of a different species like an abandoned burrow or nest. Again, these may be only once in a lifetime transfers.

The presence of more fluid and frequently traded extragenetic resources constitutes the basis of cultural evolution. ""Cultural evolution' is an accepted term of cultural anthropology (Alland 1973), although there is no generally accepted definition of culture" (Csányi 148). Mundinger (1980) has defined culture as "a set of populations that are replicated generation after generation by learning—an overt population of functionally related, shared, imitable patterns of behavior (and any material products produced) and, simultaneously, a covert population of acquired neural codes for those behaviors" (in Csányi 150).
From the developmental systems model we see that these cultural units are just another extragenetic resource. Recognizing this, Richard Dawkins referred to material, social, and mental cultural units as memes (1976). Memes are "distinct memorable units such as the ideas of the arch, wheel, wearing clothes, vendetta, right triangle, alphabet, calendar, the *Odyssey*, calculus, chess, perspective drawing, evolution by natural selection, impressionism, 'Greensleeves,' deconstructionism" (Dennett 344). Dennett describes memes in more detail:

"Intuitively, we see these as more or less identifiable cultural units, but we can say something more precise about how we draw the boundaries—about why *D-F#-A* isn't a unit, and the theme from the slow movement of Beethoven's Seventh Symphony is: the units are the smallest elements that replicate themselves with reliability and fecundity. We can compare them, in this regard, to genes and their components: *C-G-A*, a single codon of DNA, is 'too small' to be a gene. It is one of the codes for the amino acid arginine, and it copies itself prodigiously wherever it appears in genomes, but its effect are not 'individual' enough to count as a gene. A three-nucleotide phrase does not count as a gene for the same reason that you can't copyright a three-note musical phrase: it is not enough to make a melody. But there is no 'principled' lower limit on the length of a sequence that might come to be considered a gene or meme (Dawkins 1982, pp. 89ff.). The first four notes of Beethoven's Fifth Symphony are clearly a meme, replicating all by themselves, detached from the rest of the symphony, but keeping intact a certain identity of effect (a phenotypic effect), and hence thriving in contexts in which Beethoven and his works are unknown" (344).

Originally introduced in 1976, Dawkins coined the term "meme" to embody the notions of imitation (Greek "mimeme") and memory in a word that sounded like gene. Dawkins explains:

Examples of memes are tunes, ideas, catch-phrases, clothes, fashions, ways of making pots or of building arches. Just as genes propagate themselves in the gene pool by leaping from body to body via sperm or eggs, so memes propagate themselves by leaping from brain to brain via a process which, in the broad sense, can be called imitation. If a scientist hears, or reads about, a good idea, he passes it on to his colleagues and students. He mentions it in his articles and his lectures. If the idea catches on, it can be said to propagate itself, spreading from brain to brain (1976, p. 206 from Dennett 345).

As we can see the idea of "memes" is a meme in itself. It's a conceptual unit that began with the idea of genes, mutated in Dawkins' head to be called "memes," then passed on to Dennett, myself, and now you. Of course, it's not nearly as prolific as Nike's "Just Do It" meme. The interaction of different memes through written, verbal, or non-verbal communication forms the basis for cultural evolution.
Cultural evolution is not unique to humans (Dawkins, 1976; Bonner, 1980; Mundinger, 1980; Cavalli-Sforza & Feldman, 1981; Plotkin & Odling-Smee 1981; Durham, 1982, 1990; Hull, 1982; Boyd & Richerson, 1985; Csányi 1989). Cultural evolution tends to be most developed in mammals (Csányi 149) but is also seen in social insects, schooling fish, mollusks like octopuses and squid, and flocking birds. The cultural evolution of songs in birds has been particularly well studied (Jenkins, 1978; Lynch, Plunkett, Baker, and Jenkins, 1989). At the most basic level, memes are transmitted by mimicry, which occurs in all kinds of species. A simple example might be a cougar teaching its young how to sweep the back legs of prey. It can also occur between unrelated individuals. One monkey can see another monkey using a stick to catch termites and start doing the same.

The potential applications for memes explodes exponentially with the advent of language. Languages are themselves memes that linguists and historians have been studying from an evolutionary perspective long before Darwin was even born. We can clearly see how the different languages have evolved into different species of French, Spanish, Russian, Mandarin, English, etc. At the borders of these languages we see intermediate or hybrid languages. Given its geographical isolation, the presence of small pocket languages like Basque is perfectly explained by evolutionary memetics given the populations geographical isolation. Unfortunately, the best proof that languages are evolutionary cultural units is that many of them are threatened by extinction (Diamond 1993).

Creativity). Only a small percentage of them receive positive book reviews, if they receive any attention at all (Principle of Excellence). Like genes, typically the books selected tend to be better books, but not always. Lots of poorly written books make the Best Sellers Lists while many an excellent manuscript has gone unpublished. On the whole certain books like Shakespeare's plays tend to attract more readers than say *The Gardner's Slug*, and thus they spread more profusely through the population. As more books are published in a particular subject, the more competition there tends to be between them. This is particularly poignant among romance novels. Even here, evolution predicts what will happen. Books try to reduce the competition by either carving out sub-niches or teaming up into anthologies or series so they all tend to do better.

Non-written communication makes tracking memes much more difficult, but it isn't like tracking genes is a piece of cake. It took a couple hundred years after Darwin before we could fully translate a single human individual's genome. We still have a long way to go before we completely understand genetics, and the study of memes is no different. Continued discussions among evolutionary biologists, mathematical modelers and social science communication theorists should reveal future insights.

While a full Science of Memetics or Communication has not been created, we do know some basics. Like genes and other extragenetic resources, memes evolve through the Principles of Creativity and Excellence. According to the Principle of Creativity, memes are continuously being generated in a vast variety of forms. Previous memes are further changed as they flow through the population, such as in the game "Telephone." With our minds are inundated with memes, the Principle of Excellence takes over by filtering most of them out. A few catch our attention enough that we think about them, add our own little twists and pass it on.

As an extragenetic resource, memes can be transmitted much more freely than genes. Typically, genes are inherited from ancestor to descendent. This isn't exactly true because bacteria can transfer genes among themselves. Viruses can also introduce new genetic material into eukaryotic cells. Still, genes are pretty much stuck in the nucleus. On the other hand, memes can flow between any two individuals at almost anytime in development. Because of proximity, memes still tend to flow most strongly from parents to children. The process of socialization
shows that we tend to take on the memes of our native cultures. But I was still able to learn Spanish and Russian, even if I had to go out of my way.

The other advantage memes have is that they can easily hybridize. Genes don’t typically mix from separate lineages. Sexual reproduction allows for some recombination. For example, plants show a greater capacity for hybridization. Different types of corn can be crossed to get the advantageous traits from both lineages. But we can’t inject a bat’s genes for wings into a pachyderm and get flying elephants. By contrast, two separate lineages of memes can hybridize to form new memes. The memes for “military” and “intelligence” don’t have even remotely related ancestors, yet we see them mingling together today in the famous oxymoron. The Native Americans invented the canoe. When Europeans first saw canoes, instead of evolving their own new meme, they just took the Indian name.

Language allows for advanced learning. Imagine trying to go through college where the only way to transfer memes was through playing charades. The meme for written language and books was a particularly advantageous adaptation. The power of memes is very telling when we consider that humans beings have used their capacity for memes to advance our culture by massive leaps and bounds. That change cannot be attributed to genetic evolution. Human DNA is only 1% different than the DNA in chimpanzees, and that slight genetic difference has not changed for thousands of years (Csányi 163). Memetic evolution has taken cave art to IMAX films, tripled our life expectancy, and given us ice cream. Like regular evolution, memetic evolution doesn’t limit its creativity to just good ideas. On the down side we now have homework and nuclear bombs.

The ability to leap from individual to individual across lineages and within the same lifetime make memes extraordinarily powerful. Basic mimicry forms the basis for primitive cultures in many species. The advent of verbal and written communication allows memes to transfer even more rapidly within the human cultures. Still, we see that dolphins and monkeys have the capacity for language, yet they don’t have nearly as elaborate societies as ours. What really makes humans so unique is that our capacity for mental manipulating memes is so advanced that we are conscious.

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29 Some would say that that is exactly what college is like.
Animals have no difficulty constructing and interpreting symbols. Consciousness gives us the ability to do it on purpose. I don’t claim to know how it works, but somehow the mind allows humans to construct mental models of the world to generate and test new memes without having to actually try them in real time. Typically, the Principle of Creativity only gets to play with the variables during the creation of a new generation. This tiny opportunity is almost always squandered because the changes are random. Most new strategies don’t have a chance. The Principle of Excellence is equally limited because it can only see which strategy works out once the generation is created. It’s easy to see why evolution takes so long when you have such a messy, clunky process. Memes make a big difference by allowing the process to occur across individuals in the same lifetime. Instead of taking a 100,000 years to create a new species, a new culture can be generated in about 500 to 1000 years (Soltis, Boyd, and Richerson 1995).

With consciousness, new memes can evolve within a matter of minutes even within the same individual. Humans can just sit and think in a closed room and pop out a great new idea. The ability to create and immediately assess new strategies in the mind makes evolution tremendously more efficient. Once the crappy ideas have been filtered, the ones that have the best chance of success can be tested in the real world. This saves valuable time and physical resources, but not without costs.

There are two drawbacks to modeling. First, it is impossible to ever exactly model the real world. There are simply too many variables to predict with certainty what will happen, which is one reason we still make so many mistakes. Consciousness has to balance incorporating greater complexity to achieve better answers with computational speed to get a decent answer within a reasonable amount of time. Since minds must filter out vast numbers of variables and alternatives, modeling runs the risk of skipping over a strategy that might have been a homerun. Fortunately, for whatever reason, human minds tend to be pretty good at picking out the pertinent variables. The second drawback is that the brain consumes a massive amount of energy. The human mind has to be pretty good at guessing what works so that it can capture more food to support the ravenous brain.

Learning can occur within an individual lifetime without modeling, but it uses the same sloppy trial and error method that regular evolution uses. Experimentation can be very costly for organisms because a single mistake may cause death. Typically, species have a fairly rigid set of
behaviors. Some individual flexibility may be allowed, but most organisms tend to stick to the plan. As I have said, this makes sense in most species because what worked for mom and dad (or just mom) will probably work for you. The Principle of Creativity does its thing during procreation instead of trying to change strategies midstream. However, consciousness gives us the freedom to experiment. "We, unlike the cells that compose us, are not on ballistic trajectories; we are guided missiles, capable of altering course at any point, abandoning goals, switching allegiances, forming cabals and then betraying them, and so forth. For us, it is always decision time, and because we live in a world of memes, no consideration is alien to us, or a foregone conclusion" (Dennett 460). Modeling makes learning much more effective by conducting much of the trial and error process in a simulated mental environment. Consciousness gives humans excellent learning, modeling and predictive abilities, which makes our evolution relatively faster and less messy.

In that sense Heifetz is correct in that natural evolution is "a fortuitous fit between random variation and new environmental pressures; societies, by contrast, can respond to new pressures with deliberation and planning" (30). Sure, consciousness makes humans unique, but that doesn't mean that we are no longer operating under evolutionary self-organizing pressures like everything else in the universe. What Heifetz is really resisting is the idea that such a seemingly blind, random, and deterministic process can even remotely relate to humans. We don't dare give up our freedom to such a lifeless process.

In reality we have nothing to fear. Let's assume that evolution really is a completely deterministic process. Then, given the initial conditions back during the big bang, there would be only one path the universe could follow. There is some evidence to believe so because the present tends to be determined to some degree by the past. Memetic and genetic innovation depends in large part on the history of previous ideas or species (Handwerker, 317). New ideas don't fall out of the sky; they build on previous ideas. I could say that my writing this paper was a direct result of having the right books fall in my lap as a teenager, not throwing away the envelope the University of Richmond sent me about the Jepson School, etc. If I exactly knew all the variables today, then I could predict exactly how Dr. Richard Cuoto would vote for the rest of his life. The problem with this approach is that it is impossible to know exactly all the variables. Sensitivity to initial conditions is the foundation of complexity theory. It's a good bet
that Dr. Cuoto will vote liberal for the rest of his life but who knows? The gravitational pull of
the star Xenar can be pulling him slightly to the right so that he ends up like a raving
Republican.\textsuperscript{30} The universe is so vast and so complex we might as well be making it up as we go
along.

Personally, I don’t buy the absolute determinism theory. I mean what good is a universe
that starts from a single point, expands, collapses, and that’s it? And what is that theory based on
anyway—that for the last fifty years the universe seems to be expanding at a decelerating rate?
That’s like saying an atom in my heart notices the rib cages contracting during one nano-
nanosecond and predicts total implosion in a minute. Quantum physics shows that nothing is
concrete or certain. If matter and energy exist only as tendencies and probabilities, how can we
expect the systems they comprise to offer anything more? But before we pound the drums of free
love and anarchy, it is important to note that even if things aren’t deterministic, they have some
order to them. Evolution describes the general patterns without dictating the details.

“Theories of evolution deal only with system parameters and can predict only the
system’s general features: they cannot be regarded as deterministic theories. Evolution on
Earth—and within this evolution the history of human societies—is a \textit{unique story},
singular and irreproducible. There is no contradiction between the predictability of
changes in the general system parameters and the unpredictable nature of the particular
forms manifested by the system. Humans, as replicating beings, are a product of
evolution and are subject to its general laws, but humans can choose their own path of
history, and this comprises their \textit{freedom}” (Csányi 192).

Because of the high costs of maintaining a well developed brain, modeling is going to be
very rare. Humans are an important exception. We still rely heavily on trial-by-error learning, but
we at least have the capacity to model relatively easily. Humans are special in that we were the
first species to develop consciousness, but that doesn’t sever our roots. “Among the many kinds
of animal culture, human culture is by far the most complex. . . , but it is by no means unique. . . .
There is no basic difference between animal and human culture, although human culture
represents a new level of organization” (Csányi 150). There is no question that human cultural
systems \textit{are} evolving. We just happen to have some influence over \textit{how} we evolve. When we
choose to influence how we are evolving, that is the phenomenon of leadership.

\textsuperscript{30} I’m convinced that’s Newt’s excuse. Nobody can be that conservative.
Part III: Implications for Leadership

"The idea of applying the natural scientific self-organizing, evolutionary, and non-equilibrium or 'chaos' theory associated with the names of Prigogine and others to world problems of impending social, political, economic, and ecological 'chaos' is gaining ground.

The leap from natural science to social action, however, is impossible without considerable attention to the main intervening step: the development of 'chaos'-equivalent, evolution-, systems-, and action-oriented theory" (Loye and Eisler 53).

In Part II I tried to dissolve some of the barriers that have been constructed to keep evolutionary theory out of the social sciences. In Part III I would like to show how evolutionary theory offers important insights into the study of leadership. What can we expect the intermediate step Loye and Eisler discuss to look like? Quite honestly, I don’t know. Brilliant theorists have been working on this problem for years, so it comes as no surprise that I wouldn’t solve the problem in a semester. That admission in and of itself offers the biggest two lessons we can learn from evolutionary theory. The first lesson is an appreciation for the time it takes to create excellence. Well-adapted forms take a long time to evolve. Memes can speed up the process, but we still shouldn’t be trying to make changes overnight. The second lesson is the importance of relying on people working within the system to find what works instead of turning to ivory tower experts. Consciousness allows us to be creative as isolated individuals, but independent creativity can’t compare to the creativity possible when individuals collaborate. Although I don’t intend to present a comprehensive theory of leadership that incorporates all of the intricacies of evolutionary theory, I would like to point out a few important implications.

1. Previous Leadership Theories

Traditional Leadership Theories

The realization that leadership occurs within an evolutionary framework explains why traditional theories have been inadequate. Leadership study over the last century can be divided into roughly three approaches: trait, behavior, and contingency (Wren 83). \(^{31}\) Trait theory asks the question, “Who are leaders?” It is a very static theory that assumes leadership is a manifestation of the internal and immutable personality characteristics of the leader. It proposes that successful

leadership is dependent upon finding a leader with the right traits. Despite extensive testing throughout the first third of the century, no reliable or coherent pattern has been discerned that produces consistent results (84). This comes as no surprise. It is extremely difficult to predict the behavior of a system in general, so why should we expect a the characteristics of single component—a leader’s personality—to account for much?

The behavioral or style theory introduced greater flexibility. Rather than focus on “the internal state of leaders,” style theory asks, “What do leaders do?” Research revealed that there were two basic forms of leadership behavior (85). Task behaviors (also called initiation of structure or production oriented) emphasize the attainment of a goal. Relationship behaviors (also called consideration or employee oriented) emphasize the interpersonal satisfaction of the group. Style theory then attempts to describe the outcomes of various combinations of those behaviors in an effort to select the “perfect” style of leadership. While the style approach begins to appreciate the dynamic nature of a system, they are still trying to explain the dynamics on the characteristics of a single component. Again, researchers found that the application of similar styles did not consistently yield similar results.

The problem with trait and style theories is that they are extremely narrow and static. They focus exclusively on the leader as the causal factor—the relationships within the system are ignored. Contingency theories took a giant stride forward by incorporating followers and the environment. In Blanchard’s Situational theory, the leaders modify their styles according to the followers’ level of development. A leader can choose from the four possible combinations of task and relationship behaviors. Follower development is described in the four possible combinations of follower commitment and competence. A leader must accurately diagnose the follower’s maturity and apply the appropriate leadership style to be effective.

Fieldler’s Contingency theory broadens the situation by considering three variables—leader-member relations, task structure, and position power—which produce 8 possible situations (Northouse 75, 76). A leader is described on a linear scale from “task motivated” to “relationship motivated” as determined by a score on the Least Preferred Co-worker (LPC) scale. Through extensive research, Fieldler has successfully matched High, Middle, and Low LPC scores with the 8 situations. However, the theory has three significant inadequacies. First, it is unclear exactly what the LPC is measuring, so theorists have been unable to explain why or how
the model works. Second, it assumes that leaders “can’t change their stripes.” While leaders may not have complete flexibility to effortlessly switch styles as Blanchard’s theory suggests, they certainly are not as rigid as Fieldler assumes. Finally, both Blanchard and Fieldler’s theories consider only the internal variables of the organization or group. There is no consideration of issues outside of the organization, which can drastically change the nature of the situation.

House’s Path-Goal theory focuses on the most effective means of motivating the followers to achieve a stated goal (Northouse 88-93). While other contingency theories allude to it, Path-Goal theory explicitly incorporates motivational theory. The situational aspects of the path-goal theory are limited to the characteristics of subordinates and the task.

The contingency theories make an important contribution by considering situational variables, but their perspective puts the environment as an extrinsic factor. The theories tell how leaders should read the situation and adapt to it. Like some of the original evolutionary theories, contingency theories are primarily reactive. They do not close the loop and consider how group behaviors affect the environment. As the general theory of evolution shows, groups are closely linked with the environment, working together in a co-evolving system.

The other major shortfall of the contingency theories is that they still assume leaders have far more control over the situation than they really do. They treat the leaders as the causal factors, where the leaders have a clear “vision” of where they want the group to be and how they want the group to get there. “Leadership” is merely getting the followers to buy into the vision and carry it out.

The theories do not address from where the vision comes. Visions do not spring forth from leaders’ minds as a result of their isolated independent thought. The theories also denigrate the role of followers. There is some effort to incorporate the ideas of empowering the followers and eliciting their feedback. But by and large, while followers may modify the leader’s proposed solution, their role is primarily to march to the leader’s orders. The Vertical Dyad Linkage theory attempts to bridge this gap by focusing on “the relationship between leader, follower, and situation, [encouraging] a broader and more dynamic approach,” but it “does not elucidate the causes of good and poor exchanges” (Wren 91). Also, by limiting itself to the study of dyads, it fails to see the important relationships that form among three or more interacting bodies.
Leadership takes place within a larger context composed of historical, social, economical, cultural, and political forces that all affect the process of leadership.

Taken as a whole, traditional theories have a great deal in common. They all consider leader behavior to be a function of "goal-directed task functions versus morale-oriented interpersonal functions" and their manifestation as "autocratic, directive styles versus democratic, participative styles" (Wren 96). These leader behaviors are then matched to the situation—particularly "the degree of predictability, certainty, and control which the environment affords to the leader" (96). These assumptions have given us a stable set of conclusions:

"Autocratic decisions and directive styles in which the leader tells followers what to do are most likely to work when the leader knows exactly what to tell the subordinates (that is, a structured task) and when the subordinates are inclined to do what they are told (that is, good follower acceptance and loyalty). When the leader is not so sure what to do or not so sure that the followers will go along, considerate and participative styles have the double benefit of encouraging follower acceptance and increasing follower input to the problem-solving process" (Wren 97).

Traditional leadership theories consider three important variables—leaders, followers, and the environment—but they only consider the variables two at a time in a mechanistic, linear, cause-and-effect manner. Because of their mechanistic focus, traditional theories have done a better job with the more static and certain types of situations. However, leadership in the first case isn't all that important. If the leader knows what needs to be done, then chances are the followers could also figure it out. Having a leader is just a convenient division of labor. When the leaders do not know what to do, the theories have a difficult time describing what is or should be happening. Unfortunately, that is precisely when we need leadership the most. Thus, I believe that:

The next major era of leadership research will begin with the recognition that group and organizational performance are dependent upon the interplay of social systems. A social-systems approach will recognize the leadership process as a complex, multifaceted network of forces. Personal characteristics of the leaders and followers interact in the perception of and reaction to task demands and each other. The small group is further embedded in an organizational and societal context which influences personal characteristics, social roles, and situational contingencies. If general leadership theory can begin to span the gaps between the various levels of analysis (that is individual, group, organization, society), the resultant theories will provide us with a much stronger base, not only for understanding leadership but also for improving its quality (Wren, 99).
It is probably painfully obvious that this quote, along with the quote at the beginning of this section, provided that specific motivation for writing this paper. Of course, I’m not the only one who has been so motivated.

Modern Leadership Theories

One of the first bold steps into this new era of leadership studies was James MacGregor Burns’ theory of Transformational leadership. As the name implies, Transformational theory finally takes a close look at the nature of change. Amazing as it now seems, the trait, behavior, and contingency theories were concerned with how leadership operates within the status quo. Burns begins to look at the more interesting phenomenon of how leadership changes the status quo.

Burns believes transformational leadership “occurs when one or more persons engage with others in such a way that leaders and followers raise one another to higher levels of motivation and morality” (Wren, 101). Leaders are “those individuals who tap the motives of followers in order to better reach the goals of the leaders and followers” (Northouse, 131). Burns distinguishes transformational from transactional leadership where “one person takes the initiative in making contact with another for the purpose of an exchange of valued things” (Wren, 101). While transformational theory begins the break from the leader-exclusive approaches, it is still tightly bound to the notion of charismatic leaders. While the goals are for the common good, the leader is still responsible for creating those goals and clearly articulating them to the followers. “This gives the strong impression that the leader is acting independently of followers or putting himself or herself above the followers’ needs” (Northouse 145). Like all traditional leadership theories, Burns puts a tremendous amount of pressure on the leader. It is just unreasonable to expect one individual figure to figure out the solutions to complex systemic problems.32

According to Ronald Heifetz, in his book Leadership without Easy Answers, the answer is that leaders shouldn’t try to figure out the solutions by themselves. Like Burns, Heifetz believes that the core of leadership is transformation and change. But Heifetz puts the

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32 Obviously, since Burns first presented transformational theory twenty years ago, he has had a lot of time to consider these and many other objections. I’ve seen his name in some complexity theory articles (e.g. Loye and Eisler, 1987), so I am curious what he is thinking about nowadays.
responsibility back where it belongs—the system. He accomplishes this by making two key points. First, he distinguishes the exercise of leadership from the exercise of authority. So often, the understanding of leadership as a process gets confused with leadership as a position of authority. Yet all around us we see that many of our “authorities” are lousy leaders, while many people without formal authority make excellent leaders. By freeing leadership from a position, it enables leaders to become the catalysts for change instead of the dictators of change.

The second key point is that Heifetz connects leadership to evolution. Human organizations exist within a larger social environment. As a component of that environment they tend to encounter three types of situations (Table 1). Type I and to some extent Type II situations are addressed fully by the traditional theories of leadership. The solutions require the application of an already known technical response. But in Type III situations (the ones “without easy answers”), significant social learning is required to evolve out of the tremendous uncertainty. Traditional theories are too simplistic to accurately model the messy process of systems evolution. Instead, Heifetz defines leadership as the activity or process of mobilizing people to engage in adaptive work (22). In type III situations, “adaptive work consists of the learning required to address conflicts in the values people hold, or to diminish the gap between the values they hold and the realities they face” (22).

Table 1: Situational Types (modified from Heifetz, page 76)

<table>
<thead>
<tr>
<th>Situation</th>
<th>Problem definition</th>
<th>Solution and Implementation</th>
<th>Primary locus of responsibility</th>
<th>Type of adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I</td>
<td>Clear</td>
<td>Clear</td>
<td>Authority</td>
<td>Technical</td>
</tr>
<tr>
<td>Type II</td>
<td>Clear</td>
<td>Requires learning</td>
<td>mostly Authority and some Group</td>
<td>Technical and Evolutionary</td>
</tr>
<tr>
<td>Type III</td>
<td>Requires learning</td>
<td>Requires learning</td>
<td>Group and Authority</td>
<td>Evolutionary</td>
</tr>
</tbody>
</table>

Other theorists have compared evolution to leadership before. In the Social Psychology of Organizations, Daniel Katz and Robert Kahn provided a wonderful systemic model of organizations, but they got the roles of authority and leaderships confused. They said that leadership was about leaders either making policy (origination), clarifying existing policies (interpolation), or making the organization compliant with policies (administration) (540-557).
These are the activities of "formal" leaders, a.k.a. authorities. The authorities primary responsibility is to establish structure and order. Leadership is not concerned with the stability of the system per se. Survival (or self-actualization, depending on your perspective) is the priority and to survive, a system may need to undergo some harsh conflict. Leadership is evolutionary in that it generates the changes necessary for survival.

In my opinion, Heifetz's work represents the most comprehensive and practical integration of a systemic evolutionary theory and leadership to date. Recall that evolution is the process in which a population adapts with its environment. In evolution, adaptation occurs to alleviate internal genetic conflicts or diminish the gap between the population's ability to gather resources and the available natural resources. According to Heifetz, in leadership, "adaptive work consists of the learning required to address conflicts in the values people hold, or to diminish the gap between the values they hold and the realities they face" (22). These descriptions are strikingly similar, and Heifetz does not hide the influence evolution has on his concept. He claims that evolution is "a useful, if inexact, metaphor" (30). We've already seen how the distinctions he made don't really separate leadership from evolution. Still, after the initial hesitation on pages 30 and 31 he doesn't worry too much about the issue, and he goes on to build a beautiful social theory of evolution. I would like to expand on Heifetz's consideration of adaptation and the role of conflict.

2. Adaptation and the Role of Conflict

The Three Types of Adaptations

Adaptation is "an essential characteristic of living organisms and social systems" (Capra 273). The quote on the title page of this paper says "the study of adaptation . . . is the core of biological study." I also believe it is the core of leadership studies. Adaptations are changes a system undergoes in response to conflict in an effort to ensure survival (or self-actualization). When we think of adaptations occurring in response to conflict instead of to a stimulus, we focus our attention on the relationships involved in the conflict instead of on an external stressor. As systems adapt, they change the conditions of their existence and thus create new pressures to adapt. Adaptation is not a linear march towards a fixed goal. Every adaptation changes the goal itself. The conflict can also be positive, like starting a new job, or negative, like getting fired from a job. To avoid some of the negative connotations of the term conflict, Peter Senge uses the
term creative tension. I’ll use the terms creative conflict, conflict, and tension interchangeably. It is also important to note that conflict can be real or perceived. The anticipation of a confrontation can produce profound effects even if it never occurs.

Adaptations can be categorized into three types—remove the conflict, absorb the conflict, or evolve with the stimulus (Capra, 273). I use the word “evolve” in the sense that a significant new form has been created such as in a speciation event. All adaptations are influenced by evolution in the sense that the Principles of Creativity and Excellence are still at work generating and testing alternatives. Also, the alternatives available for removing or absorbing the conflict is determined by previously “evolved” adaptations. Each kind of adaptation has its own advantages and disadvantages.

The first option is for an organism to remove the conflict. If animals that are used to living in the hot and humid swamps of Florida are placed in Minnesota, they will be uncomfortable. The first type of adaptation is to simply walk back to Georgia. For a human example, let’s say that a once peaceful city experiences a sharp rise in gang activity. The city can remove the stress by shooting all the gang members, or less drastically, putting them in jail. Or the residents could move and form a new peaceful city.

This type of adaptation is similar to the fight or flight psychological response. The system removes the conflict by either destroying the source of it or running away. This strategy has the advantage of relieving stress relatively quickly. If you put your hand on the stove, you quickly move your hand. If a hurricane is coming, you evacuate. However, your alternatives are limited because many kinds of stress cannot be removed or avoided so easily.

The second form of adaptation is to absorb or acclimatize to the conflict. For the tropical animals that find themselves in Minnesota, they may eat more frequently to maintain a higher metabolism and to store more fat for insulation. The city with the drug problem can declare a curfew and recommend that all residents lock their cars and put bars on their windows. This type of adaptation is basically a process of acclimatizing to the conflict to make it more bearable. While this change may be slower than the fight or flight response, it still produces results quickly. The downside is that the system has less capacity to deal with other conflicts. “Although the system is more flexible after the [acclimatization] than it was before, when it was under stress, it is still less flexible than it was before the original stress occurred” (Capra 274). This
trade off may be worth it if the stress will be short lived, such as the week before finals. Compensating the demands by cutting back on sleep is better than simply dropping out of school. However, the prolonged accumulation of stress may not be sustainable without serious ill effects. The cold, fat, and constantly eating animals are more likely to get sick, and putting bars on the windows may just encourage smarter thieves.

The third kind of adaptation is when the system fundamentally shifts its characteristics to create a new, more stable form. For example, over many generations the tropical animals may grow thicker fur or learn to dig burrows and hibernate. The city could improve the educational system and develop economic opportunities for those individuals and families that would otherwise turn to gangs. This is the type of adaptation with which Heifetz is most concerned.

Creating an entirely new and better form has the powerful advantage of both restoring stability and making the system more flexible. Being willing to change the whole system offers far more alternatives than the previous choice between fight or flight. For example, residents might adopt-a-gang where certain gangs have contracted rights to rob certain residents of their unwanted stuff. No violence occurs, the gangs get to rob residents, the residents don’t have to hold embarrassing garage sales and get to buy new stuff, businesses have increased sales which creates jobs, etc., etc., etc.33

The downside is that the third kind of adaptation typically takes much, much longer to achieve. You don’t negotiate with an oncoming train about how you can harmoniously coexist; you get off the tracks. The third type of adaptation is also much messier work than simply adjusting one or two parameters. It has to generate many options (Principle of Creativity) across the spectrum of parameters and test them (Principle of Excellence) with the expectation that most of the options will fail. In addition, the very process of substantially changing a system's identity in itself causes a lot of stress. As I described under the Principle of Creativity, systems are extraordinarily conservative. They don’t like to change their identity, and rightfully so because usually that identity has worked well for years. Creativity has to be balanced with Excellence. If a city was totally creative and adjusted itself to every single change, it would fall apart. Whatever changes are made, those changes have to work well or the system may not survive. Furthermore, once changes are made, it is much more difficult for the system to return

33 I may be on to something here
to the way things were. It has to go through another messy process of evolution to undue the changes. Fortunately, these disadvantages balance themselves. By only letting evolutionary changes occur over a long period of time, it means that the system probably doesn’t want to go back to the way it was.

The first two types of adaptations are forms of negative feedback. Ironically, minor changes are implemented to dampen fluctuations so that major changes are not necessary. The purpose is to preserve the identity of the system. By contrast, evolutionary adaptation is a form of positive feedback. Fluctuations are amplified so that a new stabilized system can be created. The system’s identity is changed in order to preserve the system. This is a key distinction. The first two try to preserve the *identity* of the system, the third tries to preserve the *system*.

The first two types of adaptations relate with the role of authority because they are primarily concerned with stability. When leaders are not limited to the structure providing notion of authority, they are free to become change agents. Being a change agent isn’t about dictating new policies. It is about catalyzing the self-organizing tendency of the system to evolve from one strange attractor to another (Figure 4). And that involves creating much more conflict before the benefits of stability can be enjoyed.

**Figure 4: Leaping from attractor peak to attractor peak in a fitness landscape.** The Principle of Excellence tends to push the system up whereas the Principle of Creativity pushes in all direction. Without sometimes taking a step back from a peak, the system could never climb to a new peak. (The figure can be inverted so the peaks are basins.)
Creative Conflict

In his article "Life at the Edge of Chaos," Chris Langton shows how systems can be characterized into four states according to their complexity—fixed, periodic, complex, and chaotic (46). These nicely correspond to Heifetz's situational types. Type I situations are simple, Type II gets a little messier but not too much so, and Type III gets very complex. Heifetz doesn't list a fourth situation to represent total chaos, but it would probably be something like Armageddon or complete anarchy. Furthermore, the complexity of Langton's systems are linked to the $\lambda$ coefficient, which represents the percentage of "living" activity versus the ambient background in the system (44). The $\lambda$ coefficient corresponds to what we might call the "leadership" coefficient that tracks the percentage involvement of the group. In stable Type I situations, only the authority needs to be responsible for applying the technical solutions. As things get a little more confusing in Type II, more of the group needs to be engaged in creative problem solving. In Type III, the leadership coefficient reaches a critical phase transition where the group needs to be heavily involved but still operates with facilitation from the authority. Finally, if too many people are involved, we see groups descend into chaos.

Like the complex Class IV states, Heifetz describes Type III leadership as dancing "on a razor's edge" (125). Langton's notion of a critical phase transition provides a more specific model for Heifetz's description. Life is not too stable or it would simply wind down and die, yet it is not too chaotic or it would destroy itself. Instead, life exists in a constant state of moderate conflict where periods of relative stability fluctuate with periods of relative turbulence. The turbulent periods generate the freedom necessary for the system to leap from the stable basin of one strange attractor to another. Thus Langton's description of living systems describes leadership in human social systems:

Living systems can perhaps be characterized as systems that dynamically avoid attractors. The periodic regime [Class I and II] is characterized by limit cycle or fixed point attractors, while the chaotic regime [Class III] is characterized by strange attractors, typically of very high dimension. Living systems need to avoid either of these ultimate outcomes, and must have learned to steer a delicate course between too much order and too much chaos—the scylla and Charybdis [in our parlance, the Principles of Creativity and Excellence] of dynamical systems.

They apparently have done so by learning to maintain themselves on extended transients—i.e., by learning to maintain themselves near a "critical" transition. Once such systems emerged near a critical transition, evolution seems to have discovered the
natural information-processing capacity inherent in near-critical dynamics, and to have taken advantage of it to further the ability of such systems to maintain themselves on essentially open-ended transients (85).

The "open-ended transients" explain why it is futile to try to perfectly predict future outcomes. As conscious beings we have some foresight and can plan some, but we must always be flexible to new information lest the sensitivity to initial conditions wipes our best laid plans out after a few iterations. Langton continues with his diatribe:

Of course, climbing out of one attractor just pushes the problem back to a higher-dimensional phase space, in which the system is again in the basin of some attractor. It is therefore possible to view evolution as a repeated iteration of the process whereby a system climbs out of one attractor into higher-dimensional phase space, only to find itself in the basin of a higher-dimensional attractor (85).

This is precisely what we experience in society. Every cultural evolution makes the environment just a little more complicated.

This is a drastic shift from previous perspectives of conflict. Typically, conflict is seen as something to be avoided. The absence of conflict is the goal of the group. Colleges offer courses in “Conflict Resolution,” not “Creating Conflict.” This mental model of conflict is ineffective. First, it is unrealistic because conflict is never resolved. The dynamic nature of the universe ensures that there will always be conflict. Second, it is undesirable. The absence of conflict is only an indicator that the group isn’t doing anything important. Groups need conflict in order to grow and move towards its purpose. The term “Creative” conflict is not meant to imply a unique form of conflict. We have plenty of types of conflicts to deal with already without needing to find new ones. "Creative" means that the conflict can be used to generate something new—i.e. evolution. Creative conflict is the pressure on groups to change because of a difference between where a group needs to be and where it is.

In some cases, a conflict may require the application of a known technical solution. Being hungry is an example of this kind of conflict. We don’t restructure our DNA, we just go get something to eat. The first two types of adaptation are adequate for dealing with these types of conflict. There is no need for the system to undergo major change because previous evolutions have already equipped it with the tools it needs to deal with the problem. Frequently, however, the conflict may require fundamental memes to be assessed and changed. Thus leadership is not
about creating comfort—about applying technical Band-Aids to soothe the pain of systemic wounds. Leadership is about sparking creative conflict—raising awareness of the problems, sometimes by prying them wide open, so that the entire system can mobilize to fix it.

Of course, too much conflict can also be counterproductive. It can become destructive and overwhelm the group. "The strategic challenge is to give the work back to the people without abandoning them. Overload them and they will avoid learning. Underload them and they will grow too dependent, or complacent" (Heifetz). Cultures are very resistant to change. Groups seek stability and avoid stepping out of their comfort zones at all costs. Mobilizing the group to adapt to its problems requires the generation of enough conflict so that the group must step out of its comfort zone but not so much conflict that it paralyzes the group. The leadership task is to keep a group within a productive range of conflict—the range of Creative Conflict.

Unfortunately, creating more conflict in a system is usually the last thing we expect from a leader even though that is precisely what the system needs to evolve. The absence of comfort is a vacuum that sucks people into trying to re-establish a sense of security. The group lures potential leaders into providing a false sense of security by taking responsibility for the group’s problem. The danger is that it prevents the other members from accepting their own responsibility for the problem. A handful of people cannot bear the burden of society’s inconsistencies alone. Further, they cannot be expected to find a lasting resolution to the problem that they can simply deliver painlessly to the group. Yet it is easier for the group to rely on somebody else to solve its problem than taking responsibility to make tough decisions.

The same phenomenon happened in Nazi Germany. Germany was left devastated in the wake of World War I. To recover some level of comfort, Germans were willing to accept practically any source of security even if it was based on the utterly unethical premise of exterminating all Jews, Blacks, and Gypsies. Northern Ireland is undergoing a related process. Both Catholics and Protestants say they want peace, but what is really most important to them is the comfort and the security of their established identities. Unconsciously, the parties are willing to sacrifice peace and are perpetuating bloodshed in a bitter effort to hold onto their threatened identity. To avoid dealing with the major underlying challenge of figuring out how they can live together, they fill the void with explanations why the other side isn’t willing to compromise. It is more comfortable to blame the other side than admit your own responsibility for the problem.
Both cases illustrate how counter productive the group's demands for comfort can be. Dr. Hugh O'Doherty has said in classes that "the very efforts to provide comfort only provoke more uncertainty and dissension, and this in turn makes us look harder for a fixed recipe as a way to provide comfort." The unease quickly grows into rage. This rage creates a stronger and stronger vacuum that compels somebody, anybody, to provide comfort.

As the level of uncertainty grows, some people are stretched beyond their comfort zone and might begin to recognize the underlying problem. Here the powerful and seductive desire for certainty becomes even more tempting. Those people who begin to see the problem might start trying to tell the group what to do to fix it. While this might seem like an effort to adapt to the problem, it is premature. It is motivated more by a desire to decrease the discomfort caused by the problem than a genuine desire to solve the problem.

This is the trap that many would-be leaders fall into. They have the best intentions, but since establishing comfort is primary, they cannot hold steady with their interventions. This is the problem with Greenleaf's notion of "servant leaders." The idea of service to suggests that it is something that leaders do for the group. Servant leadership makes an important contribution by breaking down the old "the followers exist for the leader" mentality, but it is equally ineffective to think that "the leader exists for the group." The evolutionary perspective of leadership emphasizes the system. The group exists for the group. Leadership isn't about service to but collaborating with the members of the group to accomplish change.

Although the discomfort hurts, leadership requires the generation of even more conflict in order to create change. Margaret Wheatley argues that leaders should "stir things up and roil the pot, looking always for those disturbances that challenge and disrupt until, finally, things become so jumbled that we reorganize work at a new level of efficacy" (116). Psychologists recognize this need for adversity in order to get people to learn. Adversity is basically the Principle of Excellence. In general, we learn more from defeat then we do from success. Alcoholics need to slam up against the wall, sometimes several times, before they recognize how destructive their behaviors are. Similarly, as children we never listened to our parents when they told us not to do something. We had to try it for ourselves. We had to be burned several times before we started to catch on. Frustrating as it is, even though our parents were usually totally right, it was futile for them to believe that we would do what they said. The best parents could
hope for was to provide an environment where their children could experiment and fail so that they could learn for themselves. Parents monitor the potential for defeat carefully so that the children are never exposed to something totally lethal. Evolution shows us that conflict and adversity are requisite for growth, as long as they don’t kill us.

Like genes, memes are extraordinarily resistant to change. Social systems will do everything in their power to use one of the first two adaptive strategies before upsetting its core memetic foundations. When we are trying to exercise leadership, we see the challenge of mobilizing people clearly enough. People aren’t interested. They aren’t motivated. They call us names for trying to get them involved. But when we aren’t leading, we are blind to our own efforts to undermine change. When we get asked to attend a charity event, we’re suddenly too busy to make it. This resistance comes under many names: we always do this, everybody does it, it’s a tradition, I don’t have time, I’m too busy with more important things, it happens all the time, so what? Whatever the specific strategy, they are all task avoidance (Figure 5).

Evolutionary leadership is concerned with overcoming the group’s task avoidance strategies (resistance) and mobilizing the group to make the necessary changes in its assumptions and behaviors. This takes time because all members of the group need to be involved in the creation of the changes. The leader can’t parachute the answers in because the leader doesn’t know what the answers are any more than anybody else. Ideally, we would like to implement these changes before it is too late. It’s relatively easy to overcome resistance once the situation has become super critical. Of course, at this point it may be too late or at least much more costly.
Figure 5: Task Avoidance Strategies

Scapegoating: Picking someone to blame for the group's problems. Since somebody else caused the problem, the group can easily avoid seeing its own involvement in the problem. Scapegoating can reach elaborate levels of conspiracy theories.

Sainthood: Creating saviors avoids responsibility by putting the job of solving the problem on somebody else. Saviors are often charismatic individuals who don't know when to quit. The group is so impressed by the leader that they figure he or she will take care of everything. The savior isn't much help usually because he or she wants nothing more than to champion the group and fight their battles for them. While this glorification is intoxicating, it doesn't get anything accomplished. Only the group can solve its own problems. The task is simply too daunting to be tackled by anything less than a full collective assault by the group.

Conflict to avoid conflict: War is another classic task avoidance. It gives a great sense of certainty and an outlet for our energies. People divide into factions and dig in. Staging a battle distracts us from the task of working together. Rather than change the way we live, we'll fight. If we win, then we don't have to change. If we lose, well, we got to buy some time. But chances are, no side will ever win, so conveniently no side will ever have to change.

Avoiding by Ignoring: The simplest and most frequent of all task avoidance is to simply deny the need to change.

Hiding behind diversity: Groups also avoid conflict in the name of respecting diversity. When a group bogs down in a discussion because of significant differences of opinions, the conflict can be swept away by simply saying, “Everybody is different and we just have to accept that.” Of course we are all unique. That inherent diversity is the true strength of groups, but it is only a strength if we try to learn from our differences. What good is diversity if we isolate ourselves from the rich source of information that having different perspectives can generate?

Busywork: A common but unconscious task avoidance is when a group rallies around a task just so that they won't have to face more important tasks. We see this when we have to write a paper. We clean the desk, wash the dishes, vacuum, make a gourmet dinner, do laundry and pay bills so that we can have an illusion of productivity. Having clear tasks provides a strong sense of meaning and comfort, but if they aren't the most important tasks, then we are deceiving ourselves.

Hidden agendas: Tasks are only beneficial if they bring us closer to our purpose, but their may be purposes other than the spoken purpose. We see the effects of other hidden (or not so hidden) agendas all the time. Americans want to eradicate welfare, homelessness, poverty, and drugs... but only as long as I don't have to give up anything (including my nice government subsidies and my little drug habit on the side). We need this change BUT NOT IN MY BACKYARD. The hidden agendas need to be made explicit and dealt with. Stepping on the gas is only going to help us if we take our foot off the brake.
The evolutionary perspective offers a way out of this dilemma by making us more willing to engage change in the first place. The original Indo-European root of *lead* is “leith,” which means “to go forth, die” (1526). This probably referred to the leading of the troops into battle and possible death. Evolution provides us with a similar concept without being quite as morbid:

**Evolve** – v. 1. To develop or achieve gradually; devise; formulate. 2. Biology. To develop by evolutionary processes from a primitive to a more highly organized form. 3. To yield, give or throw off; set free. – *intr.* 2. To be developed, disclosed, or unfolded; come forth; emerge. 3. To undergo change or transformation; develop; lead (455).

Sure, it’s the last word, but it’s there. The words used in the definition of evolve—develop, set free, come forth, emerge, change or transform—are the kinds of words the Burns, Heifetz, and Wheatley are using to describe leaders. Most theories of leadership attempt to describe it as a cycle of processes. Well, that’s precisely what evolve implies. The Indo-European Root of *evolve* is “wel-” (as in wheel) which means “to turn; to roll” (1548). It’s no coincidence. The Principle of Creativity relates to the “go forth” part of the root whereas Excellence relates to the “die” part.

Peter Senge’s recommendation to balance dialogue with discussion is exactly the same thing as balancing Creativity with Excellence. Dialogue generates diversity. It puts out as many ideas as possible in as many different combinations as possible. The primary tool of the Principle of Creativity is mutation of existing genes or memes. The Indo-European root of mutate is “mei,” which means “to change, go, move” (1528). Mutation is closely related to words such as amoebae, common, communicate, mutual, municipal, migrate, minister, mystery, permeate, permute, remuneration, and transmute (1528). The prevalence and necessity of mutations in evolutions makes change much less fearful. Evolution puts change back in the heart of leadership, which is ultimately what I think Burns is trying to do, instead of emphasizing the regulatory behaviors of authorities. This is the encouragement to shake things up so that meaningful change can occur.

The Principle of Excellence is the discussion part that carefully evaluates the merits of each alternative to select the most viable option. Sure, in biology, the Principle of Excellence is still pretty morbid. It “evaluates” organisms by killing off 99% of the offspring in each generation. But as we saw with the advent of memes and consciousness, we don’t need to kill
organisms to learn. In humans, the primary tool of Excellence is self-reflection and feedback. As changes are made, their effects are evaluated in order to guide future changes.

For conflict to be truly creative, it must include effective communication. Much of the leadership challenge is building that capacity for the group to engage in dialogue and discussion. The evolutionary perspective helps us to give us the patience to let that capacity evolve. It takes a long time for each member of a new group to check everybody else out before they can come together as a collective unit. Not that they now all think the same and agree on everything. It is more that a certain level of partnership has been created. Getting the members to be more open and trusting with each other so that double loop learning can occur does not happen overnight.

We don't share our ideas openly because we fear causing conflict. Open honest dialogue may reveal that we don't all agree. It may rock the boat. Furthermore, we don't want to talk about our fear of conflict because that in itself may also cause conflict. Rather than openly address conflict, we offer technical solutions to lessen the pain. Exposing our thoughts makes us vulnerable. We may see that we have maladaptive mental models. But only by seeing how our own inaccurate models are contributing to the problem can we take true responsibility for the challenge and adapt to it.
Conclusion:

This essay has sought to expand the perspective of leadership studies by incorporating the general theory of evolution from the discipline of biology. Evolution has been compared to leadership by other researchers but they have limited themselves to a metaphorical comparison. The primary purpose of this paper was to show that such a distinction was inaccurate when we have a full understanding of general evolutionary theory. Once this connection was established in Part II, we turned to examine some of the implications for leadership studies in particular. While a new theory was not presented, a foundation for such a theory was laid by examining the evolutionary implications for Heifetz's consideration of adaptation and conflict. An effort to construct a more comprehensive theory would greatly benefit from further research integrating communication, anthropology, economics, politics, physics, and theology. The challenge is daunting but at a minimum it promises to expose a rich new understanding of leadership. At most, it may revolutionize (or should I say evolutionize) the way we see our world.

The preliminary lessons that we have learned are exciting. We have found that we should not look to Nature to justify what we are doing or to tell us what we should be doing. Instead, we should be looking to Nature to learn about how we came to be doing what we are doing. When we do that, I believe that we will start evaluating our actions by their own merits. Instead of looking for the answers "out there," we'll start thinking about what affect our own actions will have in the system. We will be free to create our own answers for ourselves. We won't feel so pressured by conflict. We will appreciate change as the surest sign of the vitality of life. We will look within ourselves to ask four important questions: where are we, how has what we have done lead us to where we are, where do we need to be, and how can we get there?

I opened the paper with a quote from Hermann Hesse. Leadership is like trying to fly. Many people are afraid to even try. Many who do take the plunge soar off as madmen. The evolutionary perspective promises to enable those people—who in the past have stayed on the ground because they thought leadership was an activity only for authority figures—to jump into the air and enjoy the exhilaration of flight. It also promises to give those who are swept away by power a greater ability to focus their energy towards good ends. Evolution has been here all along, Creatively churning out Excellence for billions of years. Isn't it time that we started tapping into the wisdom of the world around us?
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