Chapter 7
Evolving the Future: Sketching a Science of Intentional Change

David Sloan Wilson

Evolution is a process of change that adapts organisms to their environments. It is therefore ironic that evolution is often thought to result in an incapacity for change when it comes to human affairs. This is the specter of genetic determinism, which has haunted discussions of evolution and human behavior for decades (Ehrenreich & McIntosh 1997, Wilson 2005). According to the reasoning of genetic determinism, if behaviors are coded by genes and genes only change over the timescale of hundreds and thousands of generations, then we are stuck with the behaviors that we would like to change over much shorter timescales. This reasoning has led generations of thinkers to acknowledge the importance of evolution for all other species, for human physical traits and a few instincts such as our urge to eat and have sex, but to regard our rich behavioral and cultural diversity as somehow outside the orbit of evolutionary theory.

This essay describes a seismic shift in our thinking about evolution and human behavior. My use of the term "seismic shift" is carefully chosen. A geological seismic shift occurs when pressures that have been accumulating for a long time suddenly overcome the forces of friction. The intellectual seismic shift that I am describing reflects gradual scientific developments that have been taking place, especially over the last two decades, which now need to overcome resistance based on previous configurations of ideas that no longer make sense. In both cases, the suddenness of the seismic shift is based on gradual changes suddenly overcoming longstanding resistance, not a major event immediately precipitating the change.

D.S. Wilson (✉)
Departments of Biology and Anthropology, Binghamton University,
Binghamton, NY 13902, USA
e-mail: dwilson@binghamton.edu

K.S. Plaisance and T.A.C. Reydon (eds.), *Philosophy of Behavioral Biology*,
Boston Studies in the Philosophy of Science 282, DOI 10.1007/978-94-007-1951-4_7,

The purpose of this essay is to sketch the new configuration of ideas that deserves to replace the configuration associated with genetic determinism. It will help to briefly list the elements of the sketch before fleshing them out in more detail.

1) All organisms are capable of changing in response to their environments, which is called *phenotypic plasticity*. Understanding phenotypic plasticity in other species is an important prerequisite for understanding human phenotypic plasticity.
2) Some kinds of phenotypic plasticity can be described by the paradoxical phrase "rigidly flexible". Your tax preparation software or Big Blue, the chess-playing computer, are examples of rigid flexibility. They are amazingly flexible at executing the task for which they have been designed but can't do anything else. Their flexibility requires rigidly specified environmental information that is rigidly processed in exactly the right way.
3) Other kinds of phenotypic plasticity are based on more open-ended processes that count as evolutionary in their own right. An example is the capacity of our immune system to produce roughly 100 million different antibodies and to select the ones that successfully bind to antigens. This open-ended capacity has been aptly termed a Darwin Machine: a fast-paced process of evolution built by the slow-paced process of genetic evolution (Calvin 1987, Plotkin 1994).
4) Both kinds of phenotypic plasticity are found in most species but humans have a capacity for open-ended behavioral change that is transmitted across generations, therefore becoming cultural change, surpassing all other species (Deacon 1998, Jablonka & Lamb 2006). That makes us highly distinctive but does not remove us from the orbit of evolutionary theory. On the contrary, we need to tell two evolutionary stories for every Darwin Machine: how it evolved by genetic evolution and how it employs open-ended variation-and-selection processes in its own right.
5) All evolutionary processes, fast or slow, lead to outcomes that can be either good or bad for long-term human welfare. It is not the case that evolution automatically makes everything nice. Neither is it the case that evolution makes everything nasty. Rather, evolution can result in the full spectrum of outcomes associated with human welfare, from the best to the worst. To produce desired outcomes, we must become wise managers of evolutionary processes.
6) The prospect of using evolutionary theory to manage cultural change raises the specter of Social Darwinism, the use of evolutionary theory in the past to justify policies such as eugenics, genocide, and lack of welfare support for the poor. Social Darwinism is one form of social engineering, a term with a bad reputation no matter what its theoretical underpinning. The horrifying prospect of social engineering is that it will be used as a tool of exploitation. The solution is to be vigilant against exploitation in all its forms and to decide by consensus how to use knowledge to improve the human condition. Evolutionary knowledge is no different than any other kind of knowledge in this respect. Despite the sorry history of Social Darwinism, contemporary evolutionary theory provides a powerful argument for egalitarianism, since human cooperation can only be achieved by suppressing the potential for exploitation within groups (Boehm 1999, Sober & Wilson 1998, Wilson 2002).

7) These points are so basic (at least in retrospect) that they are unlikely to be wrong. However, they are also abstract and need to be made more concrete to manage behavioral and cultural change in a practical sense. Fortunately, the applied human-related sciences offer many successful case studies, ranging from therapeutic methods for individuals to changing the cultural practices of large populations. When viewed through the lens of evolutionary theory, these case studies can be seen as Darwin Machines in action, intelligently designed to use variation-and-selection processes to produce benign outcomes.

I will now briefly elaborate on each of these points. My main goal is to help the reader conceptualize behavioral and cultural change as firmly inside the orbit of evolutionary science, which not only transforms intellectual understanding but also provides an essential toolkit for managing change in a practical sense.

7.1 All organisms are capable of changing in response to their environments

Some terms that should be part of everyone's vocabulary are *phenotype*, *genotype*, *norm of reaction*, and *phenotypic plasticity* (Pigliucci 2001, West-Eberhard 2003). A phenotype is any trait that can be observed in an organism, behavioral or otherwise. A genotype is the organism's genetic composition. A norm of reaction describes the relationship between the phenotype of an organism with a particular genotype and the organism's environment. A norm of reaction is often displayed as a graph with an environmental variable (such as temperature) on the x-axis and a phenotypic trait of the organism (such as body size) on the y-axis. If the line is flat, then the organism is not phenotypically plastic with respect to that trait. If the line departs from flatness in any way, then the organism is phenotypically plastic with respect to that trait. This graphical portrayal makes it clear that there are many ways to be phenotypically plastic. Every genotype has a norm of reaction and genetic evolution winnows among genotypes, resulting in norms of reaction that cause organisms to change (or not change) in response to their environments in just the right way.

Examples of phenotypic plasticity include but go far beyond behavioral change. Sex is determined by the presence or absence of a Y-chromosome in our species (except in extremely atypical environments), but in other species it is phenotypically plastic. In some reptile species, any individual can become either a male or a female depending upon the temperature experienced during egg development (Crews et al. 1994). Sex is socially determined in some fish species; every individual begins life as a female and physiologically changes into a male when it becomes the largest member of its group (Devlin & Nagahama 2002).

Some species undergo extreme makeovers in response to chemicals indicating the presence of predators in their environment (e.g., Relyea 2002). They change their morphological form (such as growing more muscular tails), behaviors (such as moving less), and life histories (such as maturing earlier). Some species of caterpillars resemble the flowers of their host plant when they hatch during the spring, when the flowers are present, but resemble twigs when they hatch later in the season, when flowers are absent. The environmental cue is their diet (Greene 1996).

Why are some traits more phenotypically plastic than others? It depends largely upon the patterns of environmental variation experienced during genetic evolution. In the caterpillar example, flowers are reliably present in spring and absent in summer, favoring a particular matching of phenotype to environment. In the predation example, some species inhabit environments where predators might or might not be present, favoring the capacity to switch between a predator-absent suite of traits and a predator-present suite of traits. This capacity does not evolve when predators are always absent. On some oceanic islands where large mammalian predators have never existed, the birds confuse people for trees and do not have the capacity to change their response on the basis of their experience. Those species are now largely extinct (MacPhee & Sues 1999). All of these examples illustrate the general concept that the existence and specific pattern of phenotypic plasticity in a given species reflects the existence and specific pattern of environmental variation during the genetic evolution of the species.

Human skin color provides an outstanding example of both the presence and absence of phenotypic plasticity in our own species (Tadokoro et al. 2005). It reflects a tradeoff between the harmful effects of the sun and the need for the skin to receive sunlight to manufacture vitamin D. Too much and too little sunlight are both harmful. In open tropical environments, sunlight is always present and human skin color evolved to be permanently dark. In the temperate zones, sunlight is variable and human skin color evolved to be phenotypically plastic, darkening in response to exposure to the sun. The capacity to suntan is just as much a genetically evolved adaptation as permanently dark skin.

7.2 Some kinds of phenotypic plasticity can be described by the paradoxical phrase "rigidly flexible"

The examples listed above are similar to conditional and unconditional statements in a computer program. If you were writing a computer program, you would assign values to some parameters that don't change during the execution of the program (e.g., let x = 1) but you would allow other parameters to have different values depending upon certain conditions (e.g., if y = 2 then let z = 3). Genetic evolution has endowed organisms with "let" statements for some traits (such as permanently dark skin color in some people) and "if-then" statements for other traits (such as the capacity for tanning in other people).

The computer programming analogy nicely illustrates the concept of *rigid flexibility*. The conditional statement "if y = 2 then let z = 3" specifies a particular phenotypic response (z = 3) to a particular environmental parameter (y = 2).

The right environmental information (the value of y) must be provided for the phenotypic response to occur and any other response ($z \neq 3$) is prohibited. The seemingly opposite terms *rigid* and *flexible* are joined at the hip, like the opposites of a Zen Koan.

The example of human skin color can be used to illustrate an important implication of rigid flexibility. People capable of tanning are also vulnerable to *burning* when their skin is suddenly exposed to sun after a long period of low exposure. Why can't they tan faster? During most of our genetic evolutionary history, our ancestors spent most of their time outdoors and never experienced the situation of being suddenly exposed to the sun after a long period of low exposure. Gradual tanning was always sufficient and rapid tanning was never required. When people changed their lifestyle during very recent times by doing such things as flying to Florida during winter for a week's vacation, they encountered a pattern of environmental change that had no counterpart to anything experienced during their genetic evolution. We are stuck with genes that are only capable of gradual tanning and there is nothing we can do about it—except by wearing clothing, smearing sun blocking lotions on our skin, or staying indoors.

The good news about rigid flexibility is that it can magnificently adapt organisms to the particular patterns of environmental change experienced during its evolution. The bad news is that rigid flexibility can go horribly wrong when the pattern of environmental change itself changes, a problem that only be solved by subsequent genetic evolution or a behavioral and cultural intervention. Might behavioral and cultural interventions also count as evolutionary?

7.3 Other kinds of phenotypic plasticity are based on more open-ended processes that count as evolutionary in their own right

The vertebrate immune system includes many components that are rigidly flexible but it also includes another kind of phenotypic plasticity that is more open-ended in its flexibility. The immune system can produce approximately 100 million different kinds of antibodies. Each is like a hand that can grasp a particular organic surface and collectively they can grasp almost any conceivable organic surface. When a particular antibody latches onto an invading disease organism, it summons other components of the immune system to attack the invader and triggers the cells that produce the antibody to reproduce. In this fashion, antibodies that *vary* are *selected* based on their ability to bind to antigens (Sompayrac 2008).

This is not a happy accident. Every part of the process, from the mechanisms that create different antibodies to the mechanisms that amplify the ones that successfully bind to antigens, is a sophisticated product of genetic evolution. Yet, the variation-and-selection process built by genetic evolution results in a new kind of phenotypic plasticity that can rapidly adapt to new environments, rather than merely following if-then statements winnowed by past environments. If a new disease organism invaded from outer space that never before existed on earth, our immune systems could probably take care of it.

Learning of the sort that B.F. Skinner made famous is an open-ended process similar to the immune system. In operant conditioning, an organism behaves in different ways and is capable of detecting which behaviors work better than others, for example by resulting in a food reward. The most successful behaviors are adopted, enabling the organism to rapidly adapt to new environments, just like the immune system can adapt to new disease organisms.

Skinner (1981) explicitly described operant conditioning as a rapid evolutionary process in its own right, built by the slow-paced process of genetic evolution. He grasped the basic concept of a Darwin Machine but erred in other respects. For example, he tried to explain too much with his principle of operant conditioning and perversely insisted that the study of behavioral change should be restricted to input-output relationships without actually opening the black box of the mind and directly studying the mechanisms that accomplish the transformation. Thinking of the human capacity for behavioral change as comparable to the immune system enables us to keep the "baby" of the Skinnerian tradition without the bathwater, as I have elaborated elsewhere in an essay titled "Learning from the Immune System about Evolutionary Psychology" (Wilson 2010a).

Two points need to be stressed for the purpose of this essay. First, the variation-and-selection process of a Darwin Machine results in a different kind of phenotypic plasticity than rigid flexibility, one that is capable of producing genuinely new adaptations to new environments. Second, Darwin machines do not replace rigidly flexible mechanisms but complement them and are utterly dependent upon them. In his lucid book on how the immune system works, Sompayrac (2008) compares the open-ended component to a quarterback who cannot possibly function without other members of the football team, all of whom are relying upon if-then statements winnowed by genetic evolution.

An example from the immune system will show why these two points matter for our understanding of human behavioral/social/cultural change. Throughout our evolutionary history, the bodies of our ancestors were inhabited by a diverse community of species living in our guts. They weren't necessarily *welcome*, but they were always *there* and the immune system evolved to rely upon their presence to develop antibodies against them. With the advent of modern medicine and public health measures such as sanitary water supplies, it became possible for the first time in human history to largely eliminate elements of our gut biota such as intestinal worms. This might seem like an unambiguous blessing but instead it results in the same kind of problem that we encounter when we fly to Florida for a winter vacation. In the absence of intestinal worms, our immune system can react inappropriately and unleash a storm of friendly fire against our own bodies (Yazdanbakhsh et al. 2002). We call these immune system disorders but in most cases they are examples of normal immune systems malfunctioning in modern environments. Our immune system cannot solve this problem any more than our skin can speed up its tanning capacity. There must be solutions comparable to clothing, sunscreen, and staying indoors or there will be no solutions at all.

How many human behavioral/social/cultural disorders are comparable to sunburns and immune system disorders? We'll never know until we begin to understand the human capacity for change from a sophisticated evolutionary perspective.

7.4 Both kinds of phenotypic plasticity are found in most species but humans have a capacity for open-ended behavioral change that is transmitted across generations, therefore becoming cultural change, surpassing all other species

Even pigeons have the capacity for open-ended learning that Skinner made famous by putting them in his boxes. To get from pigeons to humans, we must tell a story about human evolution per se. Three distinctive features of our species that we need to explain are a) our distinctive *cognition*, including our capacity for symbolic thought; b) our distinctive ability to transmit learned information across generations, resulting in cumulative *culture*; and c) our distinctive ability to *cooperate* with individuals who are not our close genetic relatives or narrow reciprocators. A consensus is emerging that of these three C's, cooperation came first and the other two C's are themselves forms of cooperation (Wilson 2007, Wilson et al. 2008, Tomasello 2009, Tomasello et al. 2005).

In all group-living species, natural selection can occur among individuals within groups or among the groups in the total population (Wilson & Wilson 2007). The balance between levels of selection is not static but can itself evolve. When between-group selection becomes sufficiently strong compared to within-group selection, groups become so functionally organized that they qualify as organisms in their own right (Maynard Smith & Szathmary 2005, 2009). All of the entities that we currently recognize as organisms, including multicellular organisms such as ourselves, are tightly regulated social groups whose members led a more autonomous and conflictive existence in past ages. Social insect colonies also qualify as organisms by virtue of their group-level functional organization, even though their members are not physically connected to each other (Seeley 1995, Holldöbler & Wilson 2008).

Human evolution represents a major transition, similar to these previous transitions (Boehm 1999, Wilson 2006, 2007, Wilson et al. 2008). Our ancestors became the primate equivalent of a social insect colony. The key event was the ability to suppress competition and deviance within groups, so that the driving force of evolution became how well groups succeeded relative to other groups. Achieving a balance of power within groups need not have been a cognitive event—it could have been based on the ability to throw projectiles with deadly force, for example, which originally evolved to deter predators and competitors on the savannah but then could be used to deter would-be alpha males (Bingham 1999). However it happened, this kind of guarded egalitarianism allowed our cognitive and cultural abilities to evolve in a direction predicated on trust and cooperation within groups.

The sharing of learned information takes place to a limited degree in the absence of trust but can take place to a much greater degree in its presence. Symbolic thought is not a private cognitive process but requires an inventory of symbols with meanings that are shared across individuals (Deacon 1998). In this fashion, the major transition that took place in our ancestors was like crossing a watershed, enabling primate intelligence to flow in a cooperative rather than a competitive direction. Our capacity for open-ended behavioral change became so great we spread over the globe, adapting to all climatic zones and hundreds of ecological niches. We remained a single biological species but our cultural diversity was like an entire phylum (Pagel and Mace 2004). Then the invention of agriculture enabled population size to increase many orders of magnitude in only a few thousand years (Diamond 1997).

7.5 All evolutionary processes, fast or slow, lead to outcomes that can be either good or bad for long-term human welfare

Everything that counts as functionally organized is either directly or indirectly a product of evolution (Campbell 1960). Yet, many products of evolution count as pathological from the standpoint of long-term human welfare. It is essential to understand the basic relationships between evolution, adaptation, and long-term human welfare to become wise managers of evolutionary processes.

In the first place, many outcomes of evolution aren't adaptive in any sense. Examples include traits that evolve by genetic drift, traits that were adaptive to past environments but not the present environment, traits that are costly byproducts of adaptations, and costly traits that "hitchhike" on adaptations by being located close to them on the same chromosome. Adaptations evolve by natural selection, which is opposed by many forces, as the late evolutionist Stephen Jay Gould tirelessly argued (Gould 2007). It is theoretically possible for a non-adaptation to benefit long-term human welfare, but only as a happy coincidence.

Even when a trait does count as an adaptation, it can be selfish and short sighted, benefiting some individuals and groups at the expense of others or providing immediate benefits despite long-term costs. Long-term human welfare is inherently about benefiting the common good and restraining ourselves in the present for the sake of the future. Thus, many adaptations are highly functionally organized in their own way but become part of the problem as far as long-term human welfare is concerned.

A good example concerns the "problems" of early pregnancy in women and violent behavior in men. In a landmark study, evolutionary psychologists Margo Wilson and Martin Daly (1997) related these problems to average life expectancy in the city of Chicago. The neighborhoods of Chicago vary greatly in their quality of life, which is reflected in average life expectancy, from the high 70s in the best neighborhoods to the 50s in the worst. There is a very strong positive relationship between age of first reproduction in women and average life expectancy of the neighborhood.

When women in the worst neighborhoods are asked why they begin having babies so young, they give a response that can only evoke sympathy: they want to see their grandchildren and want their mothers to see their children. They observe people "weathering" all around them and have calibrated their reproductive schedule accordingly, consciously or unconsciously. It makes no sense to postpone one's reproduction in such an environment.

There is a 100-fold difference between the worst and best neighborhoods in the rate of homicide among men. Homicides are removed from average life expectancy for this comparison, so this is not a matter of correlating something with itself. This enormous range of variation means that when there are very few opportunities for success, especially reproductive success, many men are willing to "get rich or die tryin'" as the album and movie by the rapper 50 Cent puts it. In safe and secure environments, when survival and reproduction can be achieved non-violently, men are no more likely to commit homicide than women.

The "problems" of early reproduction in women and violent behavior in men are clearly adaptations to highly insecure environments, in the evolutionary sense of the word "adaptation". They remain important problems to solve, but understanding them from an evolutionary perspective points to solutions that might not occur to us otherwise. It is both impractical and morally questionable to counsel women in the worst neighborhoods to delay their reproduction and even men to refrain from violence when these are their best options for their own reproductive success in their current environment. On the other hand, if the kind of environment that leads to a high average life expectancy can be created, then women are likely to delay their reproduction and men are likely to become less violent on their own.

More generally, the traits associated with long-term human welfare *can* win the Darwinian contest, but only under the right environmental conditions, where "environment" is interpreted broadly to include much that is socially constructed by humans. Provide the right conditions and the world can become a better place seemingly by itself. Provide the wrong conditions and even the most heroic efforts to make the world a better place can fail miserably. A sophisticated knowledge of evolution, including genetic evolution and all the Darwin Machines produced by genetic evolution, is required to engineer the right environments.

7.6 The prospect of using evolutionary theory to manage cultural change raises the specter of Social Darwinism

Using evolution to inform social policy is not new. Consider Julian Huxley, one of the pre-eminent evolutionists of the 20th century and grandson of Thomas Huxley, "Darwin's bulldog". Julian Huxley was a passionate humanist who felt that mankind must take charge of is own destiny. In addition to his book *Evolution: The Modern Synthesis* (1942), which literally defined the field of evolutionary biology for the ensuing decades, his humanistic books include *Religion without*

Revelation (1927, 1957), *Evolutionary Ethics* (1943), *Essays of a Humanist* (1964), and *The Future of Man* (1966). Here is an example of his humanistic side:

> There is no separate supernatural realm: all phenomena are part of one natural process of evolution. There is no basic cleavage between science and religion…I believe that [a] drastic reorganization of our pattern of religious thought is now becoming necessary, from a god-centered to an evolutionary-centered pattern.
>
> Many people assert that this abandonment of the god hypothesis means the abandonment of all religion and all moral sanctions. This is simply not true. But it does mean, once our relief at jettisoning an outdated piece of ideological furniture is over, that we must construct something to take its place (Huxley 1969).

This could have been written by Richard Dawkins or even by myself, although as a thoroughgoing atheist I am more respectful of religion than either Huxley or Dawkins (Wilson 2010b). Here is another passage:

> The lowest strata are reproducing too fast. Therefore…they must not have too easy access to relief or hospital treatment lest the removal of the last check on natural selection should make it too easy for children to be produced or to survive; long unemployment should be a ground for sterilization (Huxley 1947).

This passage sounds horrifying to most of us today, certainly to myself. Even more horrifying is the fact that Huxley had lots of company. It was acceptable at that time for social planners to argue that mankind should take charge of its destiny in this particular way. More horrifying still, their talk was not idle and led to social policies on both sides of the Atlantic that can only be looked back upon with shame. Yet, I would argue that the culprit is not evolutionary thinking but a worldview that regarded it as acceptable for the privileged to impose life and death decisions on the unprivileged without their consent. Rebecca M. Lemov's book *World as Laboratory: Experiments with Mice, Mazes, and Men* (2005) chronicles shameful public policies during the same period inspired by the "blank slate" tradition of behaviorism.

Given the history of Social Darwinism, it is important to address the question of whether evolutionary theory inherently lends itself to policies that favor social inequality. Social policies are most likely to become problematic when they involve some people imposing their will on others without their consent. Social policies are most likely to remain benign when they are agreed upon by all who will be affected by the policies. These statements are true regardless of the theoretical perspective that informs social policy.

If anything, modern evolutionary theory is biased in favor of egalitarian social policies. People are horrified by the prospect of other people determining their fate without their consent for the best of reasons—it provides no safeguards against exploitation within groups. Cooperative human life requires these safeguards and always has—suppressing selection within groups is what major evolutionary transitions are all about. In addition to these basic theoretical considerations, there is compelling empirical evidence that inequality is toxic for human social life at all scales, including nations and states within the Unites States (e.g., Wilkinson & Pickett 2009).

It is common for political ideologies to claim the support of *any* authoritative idea, religious, scientific, or otherwise. The solution to this problem is to challenge the association between the ideology and the idea, not to accept the association and shun the idea. Moreover, it's not as if the world was a nice place before Darwin and then became mean on the basis of his theory. Before Darwin, the religious concept of divine right was used to commit genocide, dispossess people of their land, enslave them, and so on.

The nature of ideological thinking, exploitation and cooperation within groups, and exploitation and cooperation among groups, are all subjects that urgently need to be understood from a genetic and cultural evolutionary perspective, leading to knowledge that can be used to formulate humane social policies agreed upon by consensus. In this sense, knowledge derived from evolutionary theory is no different than knowledge derived from any other source. All knowledge is a form of power that can be used for good or ill. It is up to us to use it responsibly. For better or worse, we live in a world of our own making and must use our knowledge to manage our affairs. It is time to make use of the knowledge provided by evolutionary theory.

7.7 The applied behavioral sciences offer many successful case studies

It might seem that an enlightened Social Darwinism only exists in the future, perhaps the far future. On the contrary, outstanding examples of intentional change can be found in the applied human-related sciences (Biglan & Hinds 2009, Luyben 2009). When these examples are viewed through an evolutionary lens, they can be seen as variation-and-selection processes that are carefully managed to achieve desired outcomes. I will briefly describe three examples of changes at very different scales—individuals, small groups, and large populations.

Changing individuals: Hundreds of psychotherapeutic methods exist to help individuals who are functioning poorly and earnestly want to change. Some of these methods actually work and have been rigorously validated in randomized trials. One method called Acceptance and Commitment Therapy (ACT) builds upon previous behavioral and cognitive therapies (which are successful in their own right) by adding a component of mindfulness, which is drawn from meditative religious practices (Hayes 2004).

Stated in evolutionary terms, people who have need to seek therapy have two problems. First, their behavioral repertoire has become limited to avoid exacerbating their problems. Second, their criteria for adopting behaviors does not correspond to their true goals in life. The goal of therapy is to help the client increase the range of behavioral variation and select the behaviors according to the right criteria. This is partially a matter of conscious choice (the rationale of cognitive therapy) but also a matter of managing the psychological machinery of learning that takes place beneath conscious awareness (the rationale of behavioral therapy).

The mindfulness component of ACT encourages the client to distance oneself from one's problems and accept the fact that some problems might not go away, but that this need not prevent the achievement of one's most important goals.

One metaphor employed in ACT therapy asks the client to imagine being a bus driver, stopping to let people on and off on the way to a final destination. You might not like the people who get on the bus. In fact some might be downright scary. However, your challenge is to manage the people on the bus as best you can on your way to your final destination.

Metaphors such as these and other elements of ACT therapy have been proven to be highly effective in randomized trials, even on the basis of a single therapeutic session. The efficacy of ACT is based in part on the capacity of the human mind for symbolic thought and the power of symbolic systems to govern behavior (Hayes et al. 2001, Hayes 2004). Space does not permit a fuller account but I hope that I have described ACT just enough to show how it can be viewed as a managed variation-and-selection process that is informed by a detailed understanding of the human mind as a product of genetic evolution.

Changing small groups: Everyone wants to improve American public school education but no one is entirely sure of the best way to do so. Perhaps surprisingly, then, there is an intervention program called the Good Behavior Game, which has been shown to have transformative effects even in the toughest of inner city public schools (Embry 2002).

Invented by a teacher and perfected over a period of decades by researchers, the GBG begins by having the teacher ask the students what *they* think counts as good and bad classroom behavior. Even first graders are capable of coming up with the same dos and don'ts that the teacher might impose, but the fact that *they* decided upon the rules makes a big difference.

After the dos and don'ts are discussed and conspicuously displayed, the class is divided into groups that compete to be good. At first the competition is for a short period, such as doing schoolwork for a ten-minute period. Any group that manages to avoid committing a certain number of don'ts receives a small prize, such as picking from a prize bowl or even an opportunity to let loose and commit a don't – armpit farts are a popular reward for winning! Competing as a member of a group is highly motivating and causes peer pressure to promote normative rather than deviant behaviors.

Gradually the game is played more often and for longer periods. Sometimes it is played unannounced. The reward for winning is gradually deferred to the end of the day or week. In this fashion, the norms of good behavior become the culture of the class. The benefits of the GBG are astonishing. In one comprehensive study conducted in the inner city public schools of Baltimore, Maryland, the GBG was implemented in some 1st and 2nd grade classrooms but not others in a randomized design. The progress of the children was then carefully followed as they matured. At the end of the 6th grade, the GBG kids were less likely to be diagnosed with conduct disorder, to have been suspended from school, or to be judged in need of mental health services. During grades 6-8, they were less likely to use tobacco or hard drugs such as heroin, crack, and cocaine powder. In high school, the GBG kids scored higher on standardized achievement tests, had a greater chance of graduating, of attending college, and a reduced need for special education services. In college, the GBG kids had a reduced risk for suicide ideation, lower rates of anti-social personality disorder, and lower rates of violent and criminal behavior. The GBG was especially effective at improving the lives of boys. All of the above-cited results are statistically significant and can be attributed to the effect of the GBG, played in the 1st and 2nd grades only, because the students were randomly assigned to the two treatment groups. The detailed results are reported in a 2008 supplement of the *Journal of Drug and Alcohol Dependence* (Volume 95, Supplement 1, pp. S1-S104).

These lifelong benefits might seem too good to be true, until we realize that the classes that didn't play the GBG were so disruptive that almost no learning was taking place. Like money in a bank earning interest, learning the habits of cooperative behavior and harvesting their benefits over a two year period can indeed accrue benefits that last a lifetime.

When the GBG is viewed through an evolutionary lens, it can be seen to provide the conditions that favor cooperative behavior in any human group, not just a group of children. People of all ages hate being bossed around but will conscientiously abide by rules that are established by consensus. Most people are strongly motivated to become respected members of groups and even more motivated when groups are competing with each other. These motivations can be stronger than earning rewards merely for oneself. The same motivations can lead to destructive outcomes, of course, but the whole point of managing the evolutionary process is to intelligently steer them toward productive outcomes. The success of the GBG also enables us to revisit the specter of Social Darwinism. Not only is the GBG a benign social policy informed by evolutionary theory, but it also illustrates the essential role of egalitarianism for cooperative social interactions at any age.

Changing large populations: A program that successfully reduced cigarette sales to minors in the states of Wyoming and Wisconsin shows that change can be accomplished at the scale of large populations, if one knows what to do (Embry et al. 2010). Federal agencies regulating tobacco sales employ underage kids as secret agents who enter retail stores and attempt to purchase cigarettes. When they are successful more than 20% of the time in a given state, the state is put on notice that it stands to lose millions of dollars provided by the federal government in the form of block grants. Wyoming and Wisconsin were in this dilemma, with cigarette sales to minors hovering above 30%, and sought the help of two prevention scientists, Dennis Embry and Anthony Biglan, to do something about it. Biglan and Embry accomplished their mission. How did they do it?

Their first step was to build a meaningful consensus against illegal sales. Biglan and Embry made the rounds among key legislators, state department heads, and other important people to stress the need for action. Even though most of these people had a genuine interest in the long-term welfare of their constituents, the immediate danger of losing millions of dollars in federal support was a more powerful incentive. Anti-tobacco organizations and other stakeholders were also brought into the process, resulting in a declaration endorsed by leaders at the state level that could then be endorsed by leaders at each locality within the state.

The declaration was publicized by an advertising campaign using the same techniques that are effective at marketing cigarettes—social branding, rather than product branding. TV and radio commercials portrayed a convenience store clerk being rewarded for doing the right thing. Slogans were invented such as "Wyoming Wins!" Political figures and celebrities endorsed the cause. Owners of retail outlets were informed of the consensus and provided with materials to distribute to their clerks.

All of this was required to establish the criteria for selecting behaviors, much like ACT at the individual level and the GBG in a single classroom. Much more effort was required to meaningfully establish a consensus at the scale of an entire state but it could still be done, as Biglan and Embry were able to demonstrate.

Now that "the right thing" was clear in everyone's mind, the next task was to reinforce the right thing by making our psychological mechanisms for learning and copying work for us rather than against us. Biglan and Embry created task forces with their own underage secret agents who attempted to buy cigarettes. Clerks who turned them away were richly rewarded with coupons from local businesses, articles in the local newspaper, and their picture on the wall of the store. Clerks who obliged were mildly punished with a reminder to uphold the law. Biglan and Embry also held a contest among the Wisconsin clerks for the most clever thing to say when faced with a minor trying to buy cigarettes. The winning entries were printed in the form of cards that could be handed to the underage customers, which were provided to all the clerks—an exceptionally clever use of a variation-and-selection process to discover and spread best practices.

The program was rigorously assessed and highly effective at reducing cigarette sales to minors. Baseline information gathered before the intervention reported average rates of illegal sales of tobacco of 43% in Wyoming and 35% in Wisconsin. After the intervention, those numbers declined to 10.8% and 8.1%, where they have remained stable to the present day. Even better, reducing illegal sale of tobacco directly to minors was effective at reducing their smoking rate; they did not entirely make up for it by obtaining tobacco from other sources.

What Biglan and Embry accomplished at a statewide scale takes place naturally at a small scale. For our hunter-gatherer ancestors, most challenges to survival were obvious, a consensus was established around the campfire, and social rewards and punishment took place through the spontaneous expression of emotions. What comes naturally at a small scale does not happen automatically at a large scale. Something must be constructed at a large scale that interfaces with our genetically evolved instincts for learning and copying. If that "something" isn't added, then large-scale society cannot be expected to function well. Biglan and Embry had a clear idea of what to do to make a large society function like a small group, preventing thousands of smoking-related deaths over the long term. How many other problems faced by large-scale society might be solved in the same way?

7.8 Summary

The idea that evolution accounts for our physical bodies and a few basic impulses but has nothing to say about our rich behavioral and cultural diversity is bizarre in retrospect. Once our capacity for change is seen as a sophisticated product of genetic evolution and a collection of fast-paced evolutionary processes in their own right, every branch of knowledge about humans is brought inside the orbit of evolutionary science.

How radical a transformation will this be? The study of every human-related subject is sophisticated in its own right and has resulted in the accumulation of durable knowledge. Perhaps this knowledge is consistent with evolutionary theory, even if evolutionary theory was not explicitly invoked. If so, then approaching a given subject from an evolutionary perspective will merely result in reinventing the wheel.

This will sometimes be the case. As we have seen, the applied human sciences offer outstanding examples of intentional behavioral and cultural change that were developed without explicit reference to evolution. However, it will not *always* be the case. Anyone familiar with the human-related disciplines knows that they are a kaleidoscope of perspectives that are not consistent with each other, much less an overarching evolutionary perspective. The implicit assumption that "what I think is consistent with evolution without requiring much knowledge about evolution" will often prove to be false. Adopting an explicit evolutionary perspective will therefore result in new insights for each discipline and a unification of disciplines that has not occurred otherwise.

The situation is similar to biological knowledge in Darwin's day. A great deal of information had accumulated and much of it was accurate, but it wasn't organized so that every branch of knowledge could be interrelated with every other branch. Darwin provided the organizing framework, whereby all aspects of life could be understood in terms of "the same laws acting around us", as he put it at the end of the *Origin of Species*. The integration that took place in the biological sciences during the 20th century (and continuing) is now in progress for our knowledge of humanity. Not only is this an exciting intellectual prospect, but it provides tools for improving the quality of human life in a practical sense. I hope that this sketch will encourage the reader to become involved in the integration that is already in progress.

Acknowledgements This essay is a sketch of a more comprehensive article that will be coauthored with Tony Biglan, Dennis Embry, and Steve Hayes, whose work is featured in Section 7.7. The same themes are presented in trade book form in Wilson (2011).

References

Biglan, A., & Hinds, E. (2009): Evolving Prosocial and Sustainable Neighborhoods and Communities. *Annual Review of Clinical Psychology* 5: 169–196.

Bingham, P. M. (1999): Human Uniqueness: A general theory. *Quarterly Review of Biology* 74: 133–169.

Boehm, C. (1999): *Hierarchy in the Forest: Egalitarianism and the Evolution of Human Altruism*. Cambridge, Mass: Harvard University Press.

Calvin, W. H. (1987): The brain as a Darwin machine. *Nature* 330: 33–34.

Campbell, T. D. (1960): Blind variation and selective retention in creative thought and other knowledge processes. *Psychological Review* 67: 380–400.

Crews, D., Bergeron, J. M., Bull, J. J., Flores, D., Tousignant, A., Skipper, J. K., et al. (1994): Temperature-dependent sex determination in reptiles: Proximate mechanisms, ultimate outcomes, and practical applications. *Developmental Genetics* 15: 297–312.

Deacon, T. W. (1998): *The Symbolic Species*. New York: Norton.

Devlin, R. H., & Nagahama, Y. (2002): Sex determination and sex differentiation in fish: an overview of genetic, physiological, and environmental influences. *Aquaculture* 208: 191–364.

Diamond, J. (1997): *Guns, Germs, and Steel*. New York: Norton.

Ehrenreich, B., and J. McIntosh (1997): The New Creationism: Biology under Attack. *The Nation*, June 9, 1997: 11–16.

Embry, D. D. (2002): The good behavior game: a best practice candidate as a universal behavioral vaccine. *Clinical Child and Family Psychology Review* 5: 273–297.

Embry, D. D., Biglan, A., Galloway, D., McDaniels, R., Nunez, N., Dahl, M. J., et al. (2010): Reward and Reminder Visits to Reduce Tobacco Sales to Young People: A Multiple-baseline across two states. Unpublished manuscript.

Gould, S. J. (2007): *The Essential Stephen Jay Gould*. New York: Norton.

Greene, E. (1996): Effect of light quality and larval diet on morph induction in the polymorphic caterpillar Nemoria arizonaria (Lepidoptera, Geometridae). *Biological Journal of the Linnean Society* 58: 277–285.

Hayes, S. C. (2004): Acceptance and commitment therapy, relational frame theory and the third wave of behavioral and cognitive therapies. *Behavior Therapy* 35: 639–665.

Hayes, S. C., Barnes-Holmes, D., & Roche, B. (Eds.). (2001): *Relational Frame Theory: A Post-Skinnerian Account of Human Language and Cognition*. New York: Springer.

Holldöbler, B., & Wilson, E. O. (2008): *The Superorganisms*. New York: Norton.

Huxley, J. S. (1947): *Man in the Modern World*. London: Chatto & Windus.

Huxley, J. S. (1969): *Essays of a Humanist*. New York: Penguin.

Jablonka, E., & Lamb, M. J. (2006): *Evolution in Four Dimensions: Genetic, Epigenetic, Behavioral, and Symbolic Variation in the History of Life*. Cambridge, MA: MIT Press.

Lemov, R. (2005): *World as Laboratory: Experiments With Mice, Mazes, and Men*. New York: Hill and Wang.

Luyben, P. D. (2009): Applied Behavior Analysis: Understanding and Changing Behavior in the Community–A Representative Review. *Journal of Prevention and Intervention in the Community* 37: 230–253.

MacPhee, R. D. E., & Sues, H.-D. (Eds.). (1999): *Extinctions in Near Time: Causes, Contexts, and Consequences*. New York: Springer.

Maynard Smith, J., & Szathmáry, E. (1995): *The Major Transitions in Evolution*. New York: W.H. Freeman.

Maynard Smith, J., & Szathmáry, E. (1999): *The Origins of Life: From the Birth of Life to the Origin of Language*. Oxford: Oxford University Press.

Pagel, M., & Mace, R. (2004): The cultural wealth of nations. *Nature* 428: 275–278.

Pigliucci, M. (2001): *Phenotypic Plasticity: Beyond Nature and Nature*. Baltimore, MD: Johns Hopkins University Press.

Plotkin, H. (1994): *Darwin Machines and the Nature of Knowledge*. Cambridge, MA:
Harvard University Press.

Relyea, R. A. (2002): Local population differences in phenotypic plasticity: predator-induced changes in wood tadpoles. *Ecological Monographs* 72: 77–93.

Seeley, T. (1995): *The Wisdom of the Hive*. Cambridge, Mass.: Harvard University Press.

Skinner, B. F. (1981): Selection by Consequences. *Science* 213: 501–504.

Sober, E., and D.S. Wilson (1998): *Unto Others: The Evolution and Psychology of Unselfish Behavior*. Cambridge, MA: Harvard University Press.

Sompayrac, L. M. (2008): *How the Immune System Works (Third Edition)*. Hoboken, NJ: Wiley-Blackwell.

Tadokoro, T., Yamaguchi, Y., Batzer, J., Coelho, S. G., Zmudzka, B. Z., Miller, S. A., Wolber, R., Beer, J. Z. and Hearing, V. J. (2005): Mechanisms of Skin Tanning in Different Racial/Ethnic Groups in Response to Ultraviolet Radiation. *Journal of Investigative Dermatology* 124: 1326–1332.

Tomasello, M. (2009): *Why We Cooperate*. Boston: MIT Press.

Tomasello, M., Carpenter, J., Call, J., Behne, T., & Moll, H. (2005): Understanding and sharing intentions: the origins of cultural cognition. *Behavioral and Brain Sciences* 28: 675–735.

West-Eberhard, M. J. (2003): *Developmental Plasticity and Evolution*. Oxford: Oxford University Press.

Wilkinson, R., & Pickett, K. (2009): *The Spirit Level: Why Greater Equality Makes Societies Stronger*. London: Bloomsbury Press.

Wilson, D. S. (2002): *Darwin's Cathedral: Evolution, Religion and the Nature of Society*. Chicago, Ill.: University of Chicago Press.

Wilson, D. S. (2005): Evolutionary Social Constructivism. In J. Gottschall and D.S. Wilson (Eds): *The Literary Animal: Evolution and the Nature of Narrative*. Evanston, Ill.: Northwestern University Press, pp. 20–37.

Wilson, D. S. (2006): Human groups as adaptive units: toward a permanent consensus. In P. Carruthers, S. Laurence & S. Stich (Eds.): *The Innate Mind: Culture and Cognition*. Oxford: Oxford University Press, pp. 78–90.

Wilson, D. S. (2007): *Evolution for Everyone: How Darwin's Theory Can Change the Way We Think About Our Lives*. New York: Delacorte.

Wilson, D. S. (2010a): Learning from the Immune System about Evolutionary Psychology. *Evolutionary Review* 1: 13–17.

Wilson, D. S. (2010b): The Truth is Sacred. In G. Levine (Ed.), *The Joy of Secularism: Eleven Essays For How We Live Now*. Princeton: Princeton University Press.

Wilson, D. S. (2011): *The Neighborhood Project: Using Evolution to Improve My City, One Block at a Time*. New York: Little, Brown

Wilson, D. S., Van Vugt, M., & O'Gorman, R. (2008): Multilevel selection and major evolutionary transitions: implications for psychological science. *Current Directions in Psychological Science* 17: 6–9.

Wilson, D. S., & Wilson, E. O. (2007): Rethinking the theoretical foundation of sociobiology. *Quarterly Review of Biology* 82: 327–348.

Wilson, M. & Daly, M. (1997): Life expectancy, economic inequality, homicide, and reproductive timing in Chicago neighborhoods. *British Medical Journal* 314: 1271–1274.

Yazdanbakhsh, M., Kremsner, P. G. & van Ree, R. (2002): Allergy, Parasites, and the Hygiene Hypothesis. *Science* 296: 490–494.