The Biological Mind

A Philosophical Introduction

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3 Evolution and psychology

In the last chapter I speculated that altruism evolved initially to help us be better parents. This conjecture, however – "altruism evolved in order to do such-and-such" – prompts a more fundamental question. What counts as a good evolutionary explanation for a psychological trait? How do we bring the theory of evolution to bear on the mind? Why does one and the same evolutionary explanation – say, for altruism or jealousy – strike some scientists as plausible and convincing, and others as hopelessly speculative or downright implausible? This chapter sketches the diversity of answers to those questions. In it, I make some suggestions for how, and how not, to do psychology from an evolutionary point of view.

The mind has a history. Minds evolved at various points in our primeval past and have been passed down faithfully, generation after generation, to those alive today. The evolutionary perspective in psychology holds that this fact – *that the mind has a history* – should be the starting point for all future inquiry about what the mind is and how it works.

Evolutionary approaches to the mind have a history, too. They go back at least as far as Darwin. Today, the evolutionary perspective in psychology embraces a rich variety of methods and ideas. These include "evolutionary psychology" proper, evolutionary developmental psychology, cultural evolution, gene-culture co-evolution, and human behavioral ecology. Things get a bit confusing here, because in the 1980s, a research team associated with psychologists at the University of California at Santa Barbara (among other schools) adopted the label, "evolutionary psychology," for its own distinctive package of ideas about the mind, and this particular approach has become quite popular over the last few decades. So, "evolutionary psychology" is an ambiguous label. It can refer to a specific movement, or it can refer more generally to evolutionary approaches to the mind, approaches that now include human behavioral ecology, cultural evolution, and so on. So in the following, I will adopt the following convention: I'll use "evolutionary psychology" to refer to one particular school that emerged in the 1980s out of Santa Barbara, and "the evolutionary perspective on the mind" to refer to the entire range of schools, of which evolutionary psychology is but one representative.[1]

I have two main goals in this chapter. The first is to introduce the reader to the sheer diversity of evolutionary approaches to the mind and to sketch how they emerged over the last 150 years. This is not meant to be a detailed, scholarly history, but a broad outline of major ideas. My second goal is to lay out a critical argument against *adaptationism about the mind*. Adaptation-*ism* about the mind is, very roughly, the idea that most of our distinctive mental characteristics, and even the mind itself, were specially designed by natural selection for specific jobs (I'll clean up this definition later). Now, an important connection here is that evolutionary psychologists (referring to the Santa Barbara school) tend to believe in adaptationism. So in criticizing adaptationism about the mind, I'm also criticizing evolutionary psychology.

These two goals – a discussion of the diversity of evolutionary approaches to the mind, and a critique of adaptationism – are loosely connected. Once we see that there are many rigorous, scientific, and evolutionary approaches to the mind, I think people won't be quite as motivated to embrace evolutionary psychology, along with its commitment to adaptationism. In other words, I suspect (and not without justification) that some people have wanted to defend evolutionary psychology, and its commitment to adaptationism, because they thought that evolutionary psychology was the only game in town as far as a rigorous, scientific, and evolutionary perspective on the mind goes. Once we see that it's not the only game in town, some of that motivation will be sapped. It'll loosen up our convictions about what it *means* to do psychology from an evolutionary point of view.

If I wanted to write a history of, say, Judaism, I would start big then go small. I would start by putting Judaism on the map of world religions, and then I would zoom in to talk about the different types of Judaism there are. That is my plan for the beginning of this chapter. In Section 3.1, I'll show where the evolutionary approach fits in on the big map of perspectives in psychology that were in play around the turn of the twentieth century (that is, the late 1800s and early 1900s). In Sections 3.2 through 3.5, I'll zoom in on the evolutionary perspective and paint a portrait of its *inner* diversity. This perspective isn't a single approach or method but a large ensemble of differing ideas with a shared core of commitments – just as Judaism isn't a single doctrine but a tapestry of differing ideas and practices with a shared history and common themes. In Section 3.6, I'll lay out a case against adaptation*ism* about the mind. I'll also consider some rejoinders, and explain why I don't find them entirely convincing.

3.1 EVOLUTION AND THE MIND

By the early twentieth century, psychology was marked by grand, adventurous theories about how the mind worked. The five main movements that predominated were psychodynamic psychology, physiological psychology, introspectionist psychology, behavioral psychology, and evolutionary approaches (Watson 1979). In 1900, the Austrian psychiatrist Sigmund Freud broke into international renown with the publication of his book, *The Interpretation of Dreams*. In his view, dreams were distorted fulfillments of repressed desires. This marked the birth of *psychodynamic* *psychology*. By diving into the secret meanings of dreams, slips of the tongue, and compulsions, Freud distanced himself from another movement that he had once been a part of: *physiological psychology*. Physiological psychologists studied mind as a product of the brain, and believed that examining the texture of the cortex under a microscope, measuring the flow of electricity in nerves, or dissecting human brains post-mortem, was key to understanding what makes us tick. In some ways, contemporary neuroscience is a continuation of this older tradition.[2]

In addition to psychoanalysis and physiological psychology, two other movements clamored for attention during the same era. These were *introspectionist psychology* and *behaviorist psychology*. One of the founders of introspectionist psychology was, like Freud, another convert from physiological psychology, the German Wilhelm Wundt. He insisted that the study of mental life utilize the data of consciousness (without denying the importance of physiology or animal studies). Since I only have access to my own stream of consciousness and you yours, then my primary subject for observation and experiment must be *myself*. One of the first things its adherents did was to undergo a rigorous initiation in which they'd learn how to observe the sensory structure of experience without filtering it through their own interpretations – or at least that's what they convinced themselves they were doing. Problems began when adherents of different schools started to disagree about what introspection revealed to them, most notably in a controversy about the possibility of "imageless thought" (Hurlburt 1993).

In opposition to what they saw as the excesses of the introspectionist school, the behaviorist psychologists chose to focus on that most observable part of the mental, namely outward behavior (and the inner dispositions that cause it). They would typically seek to analyze complex behavior into simpler units, and explain differences between people in terms of learning. Why is Amari so prone to break into tears? Well, because a long time ago he did that, he was rewarded (by, say, parental affection or candy), so he kept doing it, and even increased the intensity of it. Why does Cynthia break things when she's mad? Because she did that once, she was rewarded (by getting her way), so she kept doing it. The basic mechanism here is "operant conditioning," or more loosely, trial-and-error learning. Whatever its strengths, behaviorists gave awful parenting advice. One of the leaders of the school, the American John Watson, famously advised mothers not to kiss or hug their children for fear of over-coddling them. "If you must," he conceded, "kiss them once on the forehead when they say goodnight" (Watson and Watson 1928, 81–82).

In the din of competing perspectives, we can trace the outline of a fifth paradigm: evolutionary approaches to psychology. The founder of this method, or at least its most important early proponent, was Darwin himself, who sketched an evolutionary account of the mind in two companion volumes, *The Descent of Man* and *The Expression of the Emotions in Man and Animals* of 1871 and 1872, though the psychologist and political theorist Herbert Spencer (1857) already had glimmerings of such a theory. English psychologists such as Conwy Lloyd Morgan and William McDougall, and American psychologists James Mark Baldwin and Wallace Craig, continued this tradition through the turn of the century. This tradition also had a powerful influence on the American physiologist Walter Cannon, who developed the ideas of the "fight-or-flight" response and of homeostasis. Cannon saw himself as continuing the work of Darwin and Spencer on the evolutionary function of powerful emotions (Garson 2013). Freud himself felt the influence of evolutionary ideas and often cited them in developing his theory that the unconscious mind uses a kind of archaic language shaped in our primitive past that can be deciphered by the psychoanalyst (Freud 1966, esp. ch. 10; Sulloway 1979).

The evolutionary tradition in psychology was continued during the first half of the twentieth century by scientists such as Konrad Lorenz and Nikolaas Tinbergen, who shared a Nobel Prize in 1973 in spite of Lorenz's ugly history with Nazism (Laland and Brown 2011, 43). Developmental psychologists like John Bowlby and Jean Piaget in the mid-century applied Darwin's insights to thinking about the growth of the mind from infancy onwards. The 1970s saw an explosion of new evolutionary approaches to the mind, including sociobiology and cultural evolution. The 1980s and 1990s witnessed the rise of evolutionary psychology (which, as I noted above, designates a particular movement within the evolutionary perspective on the mind), evolutionary developmental psychology, human behavioral evolution, and gene-culture co-evolution. Whatever else it may be, the evolutionary perspective in psychology is a time-honored and motley set of approaches to tackling the hardest problems of the mind.

Despite their internal divergences, the evolutionary perspective in psychology that Darwin initiated had four main premises. We can think of these as a core set of themes and that, today, all of the different evolutionary approaches represent variations on those themes. First, the mind isn't unique to human beings. Given Darwin's emphasis on the idea that complex traits evolve gradually, it was inconceivable that humans alone would have consciousness or thought. Hence, the evolutionary perspective has always been intertwined with comparative psychology, the attempt to appreciate similarities and differences in the mental lives of humans and other animals. It is easy to tell whether an early psychologist is part of the evolutionary tradition by looking at how much time that psychologist spends talking about animals. Early on, C. L. Morgan famously set out a rule of research. It has come to be known, appropriately enough, as "Morgan's Canon": don't attribute to an animal a higher mental capacity than is warranted by the data (Morgan 1894, 53). Contemporary commentators dispute its meaning, its measurement, and its continued wisdom (Sober 1998; see Andrews forthcoming for lucid discussion). However, the guideline is still important when we try to understand whether, say, a rat can engage in cause-and-effect reasoning, or great apes (besides us) can contemplate the mental lives of others.

The second premise is that *the mind has a history*. Psychologists in the evolutionary tradition were mainly interested in unearthing the complex and unique play of forces that, over evolutionary time frames, made us who we are. Psychology, as William McDougall (1908) put it, must be an "evolutionary natural history of mind" (15). McDougall felt exasperation toward the social scientists that tried to theorize about society without the foundations laid down by Darwin's *The Descent of Man*. This historical perspective on the mind can be contrasted with introspectionism. The introspectionists simply tried to analyze the stream of consciousness. They didn't ask how it got to be that way. And while the behaviorists appreciated that behavior is rooted in instinct, which, in turn, is rooted in evolution, this fact didn't enter their theory-making in any deep way. Their explanations for any particular behavior always followed the same dull pattern: the animal acted a certain way, it was rewarded/punished, so it kept acting/stopped acting that way. It's not that psychologists in the evolutionary tradition thought those methods were worthless. They just thought those methods, in order to be most fruitful, should be placed in an evolutionary context.

A third distinctive feature of the evolutionary approach was its emphasis on understanding the function or purpose of a mental capacity – the *why* of it.[3] When we try to understand play in animals, or grooming in baboons, we want to know what purpose it serves in the species, such as finding food, avoiding predators, finding mates, raising offspring, and maintaining social harmony. Why do animals play? Why do they groom each other? Understanding the current purpose of a trait often provides clues for how it might have evolved. The phenomenon of play, for example, is proving to be much more complex and valuable than the early psychologists thought. It not only lets us practice certain skills that may be quite useful later on (such as when cats "play-hunt"), but it also stimulates creativity, exploration, and cognitive control (Gopnik 2009). This opens up a treasure trove of ideas for thinking about the role of play in the early history of *Homo sapiens*.

This is not to say that the psychologists in the evolutionary tradition thought that *every* part of our mental lives had some evolved "function" or "purpose." They realized that many of our most cherished capacities were pointless outgrowths of other functions, or mere side effects of the way we're built. Mark Baldwin, for example, thought that our aesthetic capacity – our enjoyment of great art or literature – was a by-product of the capacity for play, but one that didn't have any evolved function. They also recognized that some behaviors result from a kind of random discharge of pent-up nervous energy, like pacing back and forth, or tapping your foot, or feeling shivers down your spine when you listen to Pink Floyd's "Comfortably Numb." Darwin gave a major role to such random flows of energy in his portrait of the mind. He noted that when children are happy, they sometimes run around, clap their hands, or laugh like crazy (Darwin 1872, 76). These actions, he thought, don't have any special purpose, so it'd be a mistake to ask what their "function" is.

One trap it is good to avoid is *adaptationism*, which is the thought that natural selection is the most powerful force of evolution, and hence that practically every well-defined mental trait is an adaptation, shaped by selection for a specific function. I'll develop some problems of adaptationism in Section 3.6. One problem is that it may lead us down the same rabbit hole Freud jumped down when he concluded that every slip of the tongue had some deep meaning. That is, if you're looking for such hidden meanings, you may overlook other possible explanations that have nothing to do with function or purpose. In fact, this habit – assuming that every part of the mind has some special purpose or function – was one of the ideas that made behaviorists like Watson shun the evolutionary school. As he sarcastically quipped, "Unquestionably the reason there are so many 'adaptive instincts' on record and so few 'unadaptive' ones is due to the fact that the naturalist has generally found what he sought" (cited in Kalikow and Mills 1989).

Fourth, and finally, the early evolutionary psychologists did *not* divide up our mental lives in any simplistic way into "innate" and "acquired." Theorists such as Mark Baldwin, C. L. Morgan, William McDougall, and Wallace Craig thought that most complex behaviors, such as starting a fire or riding a bicycle, represent a blend of instinct, trial and error, and cultural learning (such as imitating one's parents and peers). Baldwin, in particular, emphasized how intelligence and culture can shape the course of evolution itself, in a phenomenon that's come to be known as the *Baldwin effect*. The idea was something like this: suppose an animal figures out a new trick, say, it uses a stick to knock the fruit off tall branches. The other animals pick it up by something like imitation. Baldwin reasoned that this new aptitude could eventually become an instinct in its own right. Although Baldwin himself was a bit murky here, one interpretation of his thought is that the discovery (by trial and error) and spread (by imitation) of the new trick sets up a new "selection pressure." Those animals that have an instinctive knack for learning the new trick (or learning parts of the new trick) will flourish, and those that don't will be at a disadvantage. Over the generations, the ability to perform the trick will become an instinct, in the sense that creatures will start doing it without copying it from anyone.[4] Though the "Baldwin effect" is controversial, the basic idea that culture shapes the course of evolution is not.

The crucial thing about the major ideas of twentieth-century psychology, such as behaviorism and psychodynamic psychology, is that they're not cut-and-dried categories with clean edges, but they bleed into one another. The behaviorists and even psychodynamic psychologists such as Freud borrowed from evolutionary reasoning; today, some evolutionary psychologists and even neuroscientists are borrowing from Freud, and the psychoanalytic tradition more generally (Nesse and Lloyd 1992; Solms 2004). Even radical behaviorists like American psychologist B. F. Skinner thought that introspection played *some* role in psychology (Skinner 1974, 18–19). The same holds of the diverse research programs that make up evolutionary approaches to psychology themselves. Each movement adopts different angles in a multifaceted reality. It's tempting to think that the different approaches could somehow be combined together to give us a complete picture of the evolution of the mind. But maybe this is a mistake. Not only do they explore different facets of the mind, but they "parse the causal space" differently (to use Helen Longino's phrase) – that is, each comes packaged with a different way of carving up the total set of influences on human behavior, and even deciding what counts *as* behavior (Longino 2013). This suggests an "ineliminable plurality" at the heart of science.

3.2 SOCIOBIOLOGY

In this chapter, I'll outline four main approaches that make up the evolutionary perspective on the mind: sociobiology, cultural evolution, human behavioral ecology, and evolutionary psychology (Laland and Brown 2011). (Arguably, there are even more, such as evolutionary developmental psychology, though I won't discuss that in any real detail – see Section 8.3.) A crucial point is that all of the proponents of these movements see themselves, rightfully, as promoting a rigorously "Darwinian" or evolutionary approach to the mind and human behavior. In this section I'll discuss sociobiology. In the following sections, I'll discuss cultural evolution, human behavioral ecology, and evolutionary psychology. Sociobiology, at least in the form in which it was initially proposed, has largely disappeared from the scene, though it's important to recognize here, first, because of its historical significance in shaping the field, and second, because its chief insights have lived on in these newer movements.

Sociobiology sprang onto the scene in 1975, with a huge book written by the Harvard biologist E. O. Wilson. The book was called, appropriately enough, *Sociobiology*. It is, in fact, an unusually large book. I don't just mean the total number of pages is high. Its actual dimensions make it somewhat heavy and unwieldy. You can't put it in your backpack or read it on the bus. It was as if the book itself wanted to cry out, "I am a big, important, book."

It was. Sociobiology, in Wilson's hands, had two main goals. The first was to use recent ideas in evolutionary thinking to show how societies work. These included kin selection, reciprocal altruism, and evolutionary game theory (associated primarily with John Maynard Smith and George Price). Secondly, Wilson wanted to show that the basic principles that govern insect society are applicable to *all* societies, from bacteria and insects to the great apes. Prior to sociobiology, Wilson had written mainly about insect societies. He thought that the insights he gained from that endeavor were universal.

Sociobiology attempted to bring about what Wilson called a "Darwinian" transformation of sociology. He felt, like William McDougall decades before, that the study of human society could not flourish until scientists were well grounded in evolutionary concepts and methods. Wilson was not very interested in the details of human psychology or cognition, such as the relation of emotions to thinking or the brain mechanisms that creatures use to navigate their world. (This is why it was called "sociobiology" rather than, say, "psychobiology.") Rather, when it came to humans, he was more interested in analyzing shared social customs, attitudes, or institutions – such as religion, ethics, or ethnocentrism – as adaptations promoted mainly by kin selection. He even speculated that homosexuality could be explained on the same principles that explain sterile insect castes: perhaps homosexuals, like worker bees, give up on having their own children in order to assist their siblings' kids. (See Kitcher [1987] for critical discussion.)

"Sociobiology," as a *label*, waned in importance by the mid-1980s, partly due to its neglect of individual cognitive mechanisms and partly for political reasons. In particular, Wilson was intrigued by – though not committed to – the possibility that human social inequalities could be explained by genetic differences between individuals, rather than environmental differences (Wilson 1975, 554–555). This made it easy for social progressives to accuse sociobiology of being aligned with right-wing conservative movements or even racism (Segerstråle 2000). One of his harshest critics, the Harvard geneticist Richard Lewontin, had an office directly beneath Wilson's where he would hold strategic meetings with Wilson's other opponents (Laland and Brown 2011, 61). Most likely, sociobiology itself never really "died." Rather, its insights were simply incorporated into the other evolutionary movements that it inspired.

To his credit, Wilson's own thought has continued to evolve and change. Wilson is one of the seldom-acknowledged intellectual founders of gene-culture co-evolution, and, more recently, he has embraced group selection as a ubiquitous feature of the natural world (Lumsden and Wilson 1981; Wilson and Wilson 2007). In a sense, Wilson is the exact antithesis of the type of stubborn, bitter scientist that will defend a theory to the death rather than give in to its critics, the type so well portrayed by Thomas Kuhn in his *Structure of Scientific Revolutions*.

3.3 CULTURAL EVOLUTION

A second movement that emerged in the 1970s and 1980s was cultural evolution. Its early proponents, such as the biologists Luigi Cavalli-Sforza and Marc Feldman, and the anthropologists Robert Boyd and Peter Richerson, pushed for a greater recognition of the power of culture as an independently acting force of evolution (Cavalli-Sforza and Feldman 1981; Boyd and Richerson 1985, 2005). They recognized that cultural objects, such as artifacts, customs, linguistic units, and so on, can have their own evolutionary history, in somewhat the same way that genes do. The basic assumptions of their work are remarkably continuous with the work of Darwin himself as well as Darwin's immediate followers such as Baldwin or C. L. Morgan, who emphasized the role of learning and imitation in evolution.

The cultural evolutionists typically see cultural and genetic evolution as two streams flowing in parallel that shape the characteristic features of individuals and groups. (This is why it is sometimes called the "dual-inheritance" theory.) A key difference between genetic and cultural evolution is in the way that traits are "inherited." Genes, embedded in DNA, are passed from parent to offspring through the transmission of chromosomes. Cultural traits, such as clothing styles, food preferences, or religious beliefs, are "inherited" through learning and imitation. We can appreciate the difference between these routes of inheritance by considering that genetic and cultural evolution can tug a population in quite different directions. Dangerous sports such as parachuting, boxing, or American football, can spread through a culture very rapidly through imitation and learning, despite the fact that their practitioners increase their risk of brain damage, paralysis, and death. One point we'll come back to shortly is whether and how these two streams, genetic and cultural evolution, can interact.

Each stream, the genetic and the cultural, is governed by the same set of abstract principles. The most important of these is the "natural selection" of certain variants over others. Certain genes, say, genes associated with enhanced immune function, win out over others in the metaphorical "struggle for existence" because individuals lucky enough to have those genes tend to survive better and leave more offspring. Certain cultural experiments, say, a style of clothing, the taste for spicy food, the consumption of LSD, or the ability to make fire by rubbing sticks, "win out" over others because they are more prone to be transmitted through social learning. In both cases, novel traits pop up, they interact with the environment, and they get "passed on" more or less successfully. Have you heard of jai alai? Most young people probably haven't. This is a sport where players use curved scoops to hurl balls at each other at lightning speeds. Jai alai originated in the Basque region and, despite extensive promotion, never gained a strong foothold in the United States, though American jai alai stadiums still exist in small pockets in Florida. Perhaps we can analyze the fate of jai alai in Florida as a dwindling or unsuccessful cultural variant of sports entertainment, just like a species spiraling toward extinction.

But it's one thing, you might say, to point out an analogy between genes and culture. It's another to build an actual science around it. After all, many people have noticed analogies between genetic evolution and other kinds of processes such as trial-and-error learning or cultural change. The biologist Richard Dawkins, for example, coined the term "meme" to describe a hypothetical gene-like unit of culture (Dawkins 1976). These "memes" were supposed to preserve their identity more or less intact as they traveled from mind to mind, and interacted with other "memes." At an extreme, one might think of the human mind as a vast colony of memes (Dennett 1995; Blackmore 1999). The psychologist Herbert Simon, and later, the behaviorist B. F. Skinner, were, likewise, fascinated by the abstract relation between natural selection and trial-and-error learning (Simon 1969; Skinner 1981). But merely pointing out an analogy isn't the same as creating a science.

What makes cultural evolution a science, rather than a colorful metaphor, is the way that cultural evolutionists join sophisticated mathematical models and field observations to build and test hypotheses. The mathematical models make their work fairly dense and difficult to read. For example, if we wanted to study the popularity of jai alai from the perspective of cultural evolution, we'd probably measure the rate at which jai alai is gaining new fans, the rate at which fans are "converting" to other games, the "fidelity" with which the rules of the game are transmitted, the rate of international migration of jai-alai enthusiasm, and so on. This information could be put into mathematical models that would not only explain its rate of demise but, very possibly, predict the date it will go extinct.

There are two main uses for these models. First, we can use these models to study specific instances of cultural change, and even make predictions about them. One example here concerns the changing sex ratio at birth (SRB) in certain districts in China. In Lueyang and Sanyuan counties, the ratio of male to female live births is disproportionately biased toward males. This is an outcome of the interaction between stringent government birth policies and the cultural transmission of preferences for sons that results in sex selection. On the basis of interviews with rural populations and sophisticated mathematical models, cultural evolutionists have predicted that by 2020, the SRB in these districts will fall somewhere between 1.1 and 1.34 (that is, 110 to 134 boys for every 100 girls) (Li et al. 2000).

Second, we can use cultural evolution models to study fairly high-level and general features of human evolution itself, or to get a better grasp on what distinguishes *H. sapiens* from other great apes. Some cultural evolutionists, for example, believe that *cumulative* cultural evolution (for example, the way a given rite or tool becomes more complex over time) would be impossible were it not for high-fidelity copying of cultural forms (members of one generation scrupulously imitating the practices of the previous one) (Tomasello 1999; Lewis and Laland 2012). This idea was stimulated by the observation that humans are one of the few animals that use strict imitation as a form of social learning – other animals don't tend to be as precise in the way they copy the behavior of others (their "copying fidelity"). (They also differ in what *aspects* of behavior they imitate.) Could it be that high-fidelity imitation is what explains the relative sophistication of our culture and technology over that of other primates? This question can be explored not only through mathematical models and simulations, but also through comparative studies with other primates. Amongst philosophers, William Wimsatt and Kim Sterelny have devoted a substantial amount of work to integrating the theory of cultural evolution into mainstream evolutionary biology (Wimsatt 1999; Sterelny 2012).

Perhaps an idea that was always latent in the cultural evolution movement is that of *gene-culture co-evolution*: cultural and genetic evolution can impact each other. Once we imagine cultural and genetic transmission as two separate streams, it's not a far jump to imagine that they might interact with one another in complex ways, and even create feedback loops. At an extreme, we can imagine genetic and cultural changes stimulating each other in an insane spiral. A well-documented example of gene-culture co-evolution is the evolution of the ability to digest lactose. Genetic changes associated with the ability of adult humans (mainly in the Western Hemisphere) to digest lactose probably originated shortly after the birth of dairy farming in some populations around 6,000 years ago, which in turn may have led to the rapid displacement of hunter-gatherers by agrarians in Europe (Curry 2013). Various lines of evidence, including archeology, comparative genetic sequencing, and mathematical models, suggest that the cultural shift to dairy farming set up a selection pressure that caused the genes associated with lactose digestion to spread. Some scientists speculate that the same may be true for genes associated with the use of language (Fisher and Ridley 2013).[5] Thus, even if there is a "gene for" a trait such as vocal coordination, that doesn't mean that genetic change caused the linguistic change. It could be that the linguistic change, prompted by culture, set up a selection pressure that caused the gene to spread – that "Baldwin effect" again. Culture drives genetic evolution (West-Eberhard 2003).

Cultural evolution doesn't just occur in humans. Another possible example of gene-culture co-evolution involves the domestication of dogs, a transition which some scientists think happened in Asia though the date is controversial. One hypothesis here is that certain wolf packs may have chosen to start spending time around human settlements, perhaps to scavenge for food (Wang et al. 2013). People would have been less likely to kill or scare off wolves with gentle dispositions. This would create a selection pressure for tameness, which may have gradually led toward domestication. The point is that a certain "cultural" change on the part of the wolves (namely, the choice to hang out around human settlements) prompted a "genetic" change (the spread of genes associated with tameness). These sorts of hypotheses can often be tested by archeological evidence and comparative genome sequencing. For example, we can use genome sequencing to calculate the likely date at which dogs branched off from wolves to see if it supports the hypothesis.

This picture of gene-culture co-evolution is associated with the concept of "niche construction." The basic idea is that humans and other animals are constantly reconstructing their environments, or selecting new ones to inhabit. Think of birds building nests, beavers building dams, or naked mole rats digging complex tunnels. These animals are not merely *adapting* to the environments in which they find themselves. They are *creating* them. They are creating the environments, and hence the selection pressures, that they and their posterity will live under. The biologist Richard Lewontin emphasized how humans and other animals are constantly redirecting the future course of evolution, rather than being carried passively along a pre-carved channel (Lewontin 1983; Odling-Smee et al. 2003). Adaptation isn't always like adjusting the shape of a key to fit a pre-existing lock. Niche construction doesn't refer only to the active manipulation of the environment, but also includes what we might call "niche-picking," which takes place when creatures simply *move* to new environments that are more suitable to their needs (Bateson and Martin 1999, 67). Wolves, by "picking" a new niche – namely, in the vicinity of human settlements – shifted the course of evolution toward their own domestication. The crucial point about niche construction is that by choosing our environments, we're changing selection pressures and hence directing the flow of evolution.

The work of the cultural evolutionists, and the gene-culture co-evolutionists, isn't above reproach (Laland and Brown 2011, 157–164). Critics have argued that the very idea of "cultural evolution" strains the metaphor of biological evolution to the breaking point. First, unlike genes, ideas and cultural practices aren't transmitted faithfully from mind to mind. Second, unlike genetic changes, cultural changes are guided by intelligence and foresight rather than blind variation. Third, unlike the gene, there is no fundamental, gene-like, unit of culture. Proponents argue that some of these processes *do* have biological parallels, and that the real differences don't undermine the value of the analogy. Additionally, most of the toughest criticisms, such as the absence of a gene-like "replicator" for culture, only apply to Dawkins' somewhat atomistic notion of the *meme*, rather than to the field of cultural evolution as a whole (Kronfeldner 2011).

3.4 HUMAN BEHAVIORAL ECOLOGY

The last two movements I'll discuss are evolutionary psychology and human behavioral ecology. They have a particularly complicated relationship. Sometimes, evolutionary psychology and human behavioral ecology are seen as complementary, because the first tends to focus on cognition and the second on behavior. On the surface, they fit each other like hand and glove (Tooby and Cosmides 1999; Daly and Wilson 1999). Yet their relationship is just as commonly seen as antagonistic (Symons 1989; Smith et al. 2001; Downes 2001). A major problem is that they differ in their assumptions about the basic "cognitive architecture" of the mind – the fundamental "blueprint" for how the mind works. This leads them to adopt different methods for studying people, and also leads them to make substantially different predictions. In this section I'll focus on human behavioral ecology, but it is helpful to realize that they should be considered side by side.

Human behavioral ecology begins with the observation that human beings have faced various, changing environments over time – not only over the last 200,000 years or so, following the emergence of *H. sapiens*, but the last 2 million years in which humans evolved (the Pleistocene era, which ended about 10,000 years ago). Not only have they weathered many changes over time, but hominin species of the genus Homo also have an extraordinary ability to thrive in very different environments over space. Compare the lifestyle of an Inuit community in Nunavik, Quebec, with the lifestyle of the Pukobyê-Gavião community in the Amazon rainforest. They don't only differ in the way they cope with extreme temperatures, but also in their foraging practices, marriage and mating customs, and religious beliefs. Moreover, these differences are not completely random, but at least some of them are well-suited to the differing ecological demands. For example, Inuit communities tend to be monogamous, and perhaps there is something about freezing temperatures that makes this a good idea.

As a consequence, human behavioral ecologists suspect that evolution did not equip human beings with a lot of highly specific, "hard-wired" abilities, such as aggressiveness, sexual jealousy, or parenting techniques. Rather, we're designed to be flexible in the face of new problems. This ability is called "behavioral plasticity," which is a kind of phenotypic plasticity (see Section 4.3). As an early proponent put it, "Different forms of alternately transmitted behaviors … represent the adaptively flexible expression of genetic material which is basically the same from one human population to another" (Irons 1979, 7; see Smith and Winterhalder 1992, 53, for a similar sentiment). Unlike sociobiologists or evolutionary psychologists, human behavioral ecologists tend to focus on the differences between cultures rather than their similarities.

Moreover, these different practices and lifestyles seem to have the same goal – they maximize fitness, measured in terms of longevity and fertility. We can think of human beings as strategists par excellence, all trying, consciously or unconsciously, to maximize fitness. In different environments, we do different things. This assumption leads human behavioral ecologists to apply mathematical models called "optimality models" to people. The purpose of an optimality model is to show how a person's choice of a certain strategy is the best choice that person could have made fitness-wise, given the alternatives and the limitations that person was working under. For example, behavioral ecologists have studied patterns of turtle hunting amongst indigenous communities in Australia. They found that if the sole purpose of turtle hunting amongst males is simply to obtain protein, it's a poor strategy, since hunters usually have to give away their catch anyway. However, turtle hunting is much more optimal if the aim is to win social status, and the benefits it brings, such as high-quality mates or resources (Bliege Bird et al. 2001).

Note that the use of optimality models in the context of human behavioral ecology does *not* require a commitment to adaptationism, that is, the idea that natural selection is the most important form of evolutionary change, and that traits should typically be seen as well-designed by natural selection for their current roles. One might think, for example, that the mind's general cognitive capacities are a result of random genetic drift, or a by-product of selection for large brains, but that, once humans are equipped with a mind, they're able to make excellent strategic lifestyle choices (consciously or unconsciously). In this situation, optimality models would be useful even though they wouldn't be tied to adaptationism. (By the same token, one might be an adaptationist without thinking that optimality models are very useful. Evolutionary psychologists think that many of our psychological mechanisms are adaptations, but the environment has changed substantially enough since the Pleistocene era that they don't currently produce "optimal" behavior – see next section.)

Optimality models have their critics. Such models are alternatively dismissed as being trivially true or empirically false (Sober 1993, ch. 5; Sterelny and Griffiths 1999, ch. 10). (Models in the field of "evolutionary game theory" have faced similar critiques. Such models ask the question of what is the best strategy for an individual to use, *given* the strategies that the other members of the group are using.) A basic issue is that scientists can always "tinker" with the optimality models until they get the right results, and so the hypothesis that human beings are "optimizers" is never, itself, subjected to scrutiny. Nonetheless, they are very useful "heuristics," that is, they help scientists to make interesting discoveries about cultures. The fact that a certain behavior is "optimal" under certain assumptions, or woefully "suboptimal" under others, gives us reason to think we've hit on something important, and perhaps that we've unearthed the cognitive mechanisms that generate it. Like cultural evolution, human behavioral ecology places a lot of value on mathematical models and quantitative empirical predictions (Downes 2001).

3.5 EVOLUTIONARY PSYCHOLOGY

Evolutionary psychology, in some ways, framed itself as a kind of opponent of human behavioral ecology and the sociobiology that preceded it. Many people think that evolutionary psychology was a reaction against non-evolutionary movements in psychology and sociology, particularly radical environmentalism. (Radical environmentalism is the idea that people are merely products of upbringing and socialization.) Radical environmentalism is an easy target because it is demonstrably wrong.[6] Some of the evolutionary psychologists, and their popularizers, often created a false dichotomy by presenting evolutionary psychology as the only reasonable alternative to radical environmentalism (Pinker 2002; Tooby and Cosmides 1992). Perhaps it was a scare tactic. But it was misleading, since many evolutionary approaches to human cognition and behavior were floating around at this time.

Evolutionary psychologists push a very specific package of ideas about how the mind evolved. In a sentence, they believe that *the mind is built out of a large number of innately specified modules, each of which is an adaptation to an ancestral selection pressure.* I will take a moment to unpack this complex idea. As I see it, there are four main components here: modularity, innateness, adaptationism, and universality.

First, modularity. This idea is very abstract but quite important, so bear with me. One of the major ideas that the evolutionary psychology movement quickly incorporated was the "modular conception of mind." The philosopher Jerry Fodor (1983) developed this idea of modules and in doing so he left a permanent stamp on the "cognitive revolution" in psychology that began in the 1950s.[7] The evolutionary psychologists later developed the idea in a form known as "massive modularity." Here's the idea: the mind is made up of a large number of "modules," somewhat independent information-processing systems.[8] There may be thousands of them. To say that the *mind* is made up of a number of different modules doesn't mean that the *brain* is made up of modules. That's what makes the idea so abstract.

To put it crudely, the idea of "massive modularity" says that we should think about the mind as if it were made up of a large number of different compartments that observe a fairly strict division of labor between them. Advocates of modularity think this is a very useful picture of the mind to have. The mind should be thought of as something like a corporation, where each individual has a specialized role to play. Today, some evolutionary psychologists prefer talking about "evolved psychological mechanisms" rather than "modules," though the idea is similar.[9] When I say that evolutionary psychologists accept a "modular" conception of mind, then, I don't mean that they are wedded to any highly specific theory about what modules are. In embracing this idea of modularity, the evolutionary psychologists were rejecting the idea that the mind evolved as a kind of "all-purpose" machine that operates on the basis of a few simple rules and is extensively modified by experience. This idea was a staple of behaviorist psychology as well as contemporary "connectionist" approaches to human cognition. To some extent, human behavioral psychology also takes this approach.

In Fodor's view, "modules" have two very important features. They are *domain specific* and they are *informationally encapsulated*. First, he said that modules are "domain specific" in the sense that they are highly specialized for dealing with certain problems. One module, for example, may have the sole function of sifting through the stream of auditory input to look for signs of spoken language. Its entire job is to monitor the environment during all waking hours to identify things that sound like spoken words. In the simplest case scenario, the output of a module is used to control outward behavior. In the more complex case, the output is fed into another module, or made available for general cognitive processing. Each module, either directly or indirectly, helps to control the animal's behavior.

To consider a slightly more complex example, consider male-to-male competition, say, for food or mates. Suppose I know that you have a stash of food in your cave, and I want to eat it. One option is to negotiate with you. Another is to take it from you by force, or at least to make the threat of force. We can hypothesize that there is a fairly sophisticated module, or processing device, and its entire job is to take information from other modules about the situation, and to make a decision. Earlier modules in the flow of information give it input regarding, say, the relative body size of my potential competitor; the effect a violent altercation will have on my reputation; the history of that specific individual or the "type of person" my competitor is. Our hypothetical module may encode a rule such as the following: "if my competitor is fairly small, and the probability of acquiring a bad reputation is low, and my competitor is not an aggressive type, then use physical force; otherwise negotiate."

Another important feature of modules is that they are "informationally encapsulated." Modules have very limited access to the creature's background information or knowledge while they process data. The idea of informational encapsulation helps to explain how modules are able to process information very rapidly – though imperfectly (Fodor 1983, 70). Consider a simple example. Suppose there is a module that has the sole function of detecting snakes in the environment, and triggering a rush of adrenalin as a response. Such a module may have been very helpful for our hunter-gatherer ancestors, who had to react quickly and unambiguously to such threats. But the problem is that this module isn't sensitive to the kind of contextual information that would ideally lead it to fine-tune its response. For example, many people get "instinctively" scared when they see a snake in a cage at a zoo, even though snakes are harmless in those circumstances. In Fodor's view, this is an effect of informational encapsulation. Informational encapsulation might explain why we sometimes react to everyday situations in a way that we "know," deep down, to be unwarranted.

In addition to modularity (the first idea), three other ideas play a major role in evolutionary psychology. The second idea is that information about the basic form of these modules is *innately specified*.[10] Most evolutionary psychologists take this to mean that the information is encoded into our genes, and it is hereditary – passed down from generation to generation. (More specifically, the information about the developmental process that gives rise to each module is encoded in the human genome.) Note that something can be "innate" in this sense without being inherited from one's parents. It could be the result of a new mutation, for example. Some stretches of the genome mutate more rapidly than others – these are so-called "mutation hotspots" (Michaelson et al. 2012). Consequently, such "innate" traits that were not inherited from the parents regularly pop into existence. Note also that a trait can be "innate" without being universal – more on this later. I'll return to this idea of innateness and genetically encoded information in Chapter 4.

The third idea is that these modules are *adaptations*. Individual modules, or small clusters of modules, were shaped by natural selection over evolutionary time. Long ago, creatures with certain modules "outcompeted" creatures with others in the "struggle for existence." Evolutionary psychologists believe that most of the modules that make up the human mind were formed during the Pleistocene era, from about 2 million years ago to about 10,000 years ago, when human beings and earlier hominin species lived in small foraging bands (Symons 1989, 138). In short, these modules are adaptations that only exist today because they benefited our hunter-gatherer ancestors. Sometimes evolutionary psychologists use the term "environment of evolutionary adaptedness" (EEA) for a trait to describe the environment in which that trait was selected; since evolutionary psychologists think most traits were selected during the Pleistocene era, the EEA and the Pleistocene era can be treated as designating roughly the same time period.

The idea that most modules are adaptations is crucial. It explains why evolutionary psychologists think that *the best way to understand the function(s) of the human mind is to consider it in the context of the Pleistocene world, not in the context of modern-day society*. This cannot be emphasized enough, for without it, little in the view makes sense. When you look at a certain psychological trait, you don't ask, "how is this trait useful today?" You ask, "how might this trait have been useful back in the Pleistocene era?" One consequence of this view is that patterns of thinking or behavior that seem maladaptive or irrational today may have made perfect sense back then. To use a slogan coined by the evolutionary psychologists Leda Cosmides and John Tooby (1997), "our modern skulls house a stone-age mind" (85). If that's right, we should expect modern humans to be less than perfectly suited to the conditions of late-capitalist civilization, such as nine-to-five jobs, arbitrary power hierarchies, and strictly monogamous marriages. In Section 3.6, I'll return to this "adaptationist" idea. (In Section 8.2, I'll discuss this idea of "mismatches" between the demands of the Pleistocene era and of modern society.)

The fourth idea is that these modules are universal, or nearly so, within the human species. The information for a given module is encoded in my genome, it is encoded in the genome of an Icelander, and it is encoded in the genome of an African pygmy. One might think that universality goes with innateness, but it doesn't have to. For example, biomedical researchers often call diseases like cystic fibrosis "innate" even though they're not universal. This feature of evolutionary psychology – the idea of universality – is sometimes referred to as "the psychic unity of humankind." As a consequence, unlike human behavioral ecologists, evolutionary psychologists tend to focus on the similarities between people rather than the differences. However, there is a major exception to this idea of unity: according to evolutionary psychologists, males and females are hard-wired differently because they have very different goals and interests, particularly concerning mating, sex, and reproduction.

I'll describe one of their experiments to give the flavor of their approach. In the early 1990s, a group of evolutionary psychologists reasoned that, though jealousy is a universal human phenomenon, men and women in heterosexual partnerships should get jealous about different things. Put simply, men should get particularly jealous when they consider the threat of *sexual* infidelity – a female partner having sex with another man. This is because, from an evolutionary perspective, they have a significant interest in ensuring paternity so that they don't waste resources on kids that don't carry their genes. Female jealously, however, should be more easily triggered by the threat of *emotional* infidelity – a male partner forming strong emotional bonds with other women. They reasoned that in the Pleistocene era, women needed to secure the resources of their male partners in order to raise children. If a woman's partner started forming a strong emotional bond with another woman, he might leave and take those resources away.

Evolutionary psychologists tested this hypothesis by asking people to imagine these various kinds of infidelity. In accord with their hypothesis, when men were asked to imagine sexual infidelity, they tended to get much more distressed than when they imagined emotional infidelity, as measured by heart rate, skin response, and verbal reports. Women tended to have the opposite reaction (Buss et al. 1992). These reactions were repeated cross-culturally with European subjects, with similar results (Buunk et al. 1996). Hence, this probably isn't a distinctively American cultural phenomenon. Interestingly, however, these sex-specific differences in jealousy were more extreme in American subjects. This suggests that cultural attitudes can fine-tune, but not destroy, our hard-wired responses. In this case, evolutionary reasoning revealed a somewhat surprising difference between patterns of jealousy in men and women, while also acknowledging some role for cultural variation. Other famous experiments have suggested a universal male preference for certain female body types, and that human beings are quick to detect when someone is breaking a social rule ("cheater detection") (Singh and Young 1995; Cosmides and Tooby 2005).

An obvious problem here is that, at best, the experiments seem to show that people do have a special knack for recognizing cheaters, or for preferring certain female figures, or having sex-specific patterns of jealousy. Some of them may even be universal. But it's not clear whether those experiments support the more adventurous parts of their theories, for example, that those abilities have a modular form, that they are innately specified, and that they are adaptations to early hunter-gatherer conditions! The problem, as I'll discuss in the next section, is that the sorts of methods that evolutionary biologists typically use to reconstruct our evolutionary past are very limited when it comes to telling us about the psychological mechanisms that our Pleistocene ancestors had, and how they got to be that way. So a lot of people feel that the explanations that evolutionary psychologists offer are highly speculative, or even unscientific.

3.6 ADAPTATION AND ADAPTATIONISM

It would be negligent for me to ignore a major controversy amongst psychologists in the evolutionary perspective, surrounding the idea of "adaptationism." *Adaptationism*, in its simplest form, is the idea that most of our characteristic biological and psychological traits – our opposable thumbs, sex-specific patterns of bodily hair, our ability to recognize basic rules of logic – are *adaptations*. What, then, is an adaptation? An adaptation is a trait that was shaped by natural selection for a specific job. So, when we say that a trait is an adaptation, we are making a hypothesis about its history, about how it got to be that way. Another way of putting the idea of adaptationism, then, is to say that natural selection is, hands down, the most powerful force of evolutionary change (Orzack and Sober 1994). (This claim today is sometimes called "empirical adaptationism," as opposed to "methodological adaptationism" – more on that later.) So, to clarify: *adaptations* are facts of nature that anyone who isn't a creationist will recognize. *Adaptationism* is a school of thought that says that most of our characteristic biological and psychological traits are adaptations. You can believe in adaptations without believing in adaptation-ism.

Obviously, this rather vague idea can be made more precise in a number of different ways. The philosopher of biology Peter Godfrey-Smith (2001) identified three different kinds of adaptationism. The philosopher Tim Lewens (2009) recently outdid him, and identified seven kinds. However we choose to define it, it's often coupled with the idea that evolutionary biologists should devote their time and energy looking for adaptations. The way it's relevant here is that evolutionary psychologists (members of the school I discussed in the previous section) tend to believe in adaptationism.

In some cases, it seems pretty obvious that an organ is an adaptation. The heart, presumably, is an adaptation for circulating blood. That means that it was shaped by natural selection to circulate blood. The reason we have hearts today is that, a long time ago, some of our fairly primitive ancestors developed hearts, and that helped them survive and reproduce better than creatures that didn't have hearts. The eye is an adaptation for seeing. This much seems obvious. In many cases, in fact, when biologists talk about the "function" of the trait, all they mean is that the trait is an adaptation and it was selected for doing that activity.

Sometimes, as in the eye, adaptations are fairly obvious. But sometimes they are not. Discovering *that* something is an adaptation, and discovering precisely *what* it is an adaptation for, can represent major scientific discoveries. Recently, paleobiologists discovered the fossilized remains of an ancient flea that lived about 165 million years ago (Huang et al. 2012). This flea was about ten times as large as modern fleas and had a nightmarishly long proboscis and sharp claws. Assuming that the large proboscis was not just a random outgrowth, but that it was shaped by natural selection for a certain function, biologists can ask what it might have been an adaptation for. Many biologists think that the proboscis served the function of penetrating the thick hide of dinosaurs to suck blood, but the details are being investigated. In order to decide that it was an adaptation, and to figure out what it was an adaptation for, one would have to have a lot of information about the specific environment that the fleas lived in, and the kind of challenges they would've faced. The point is that it wouldn't be obvious without some specialized scientific background.

Not all traits are adaptations. As I noted earlier (Section 3.1), some traits arise as mere physical or psychological *by-products* of other traits. For example, the early psychologist in the evolutionary tradition, Mark Baldwin, thought that our capacity to enjoy great art was just a by-product of our ability to play. The biologists Stephen Jay Gould and Richard Lewontin (1979) famously referred to such traits as "spandrels." Alternatively, some traits may "go to fixation" in a population – that is, take over a population – through a process called "random genetic drift." Suppose there are two alternative traits in a population, say, blue eyes and brown eyes. Suppose that the two traits are equally fit, that is, that having blue eyes is just as good as having brown eyes for the purpose of survival and reproduction. Nonetheless, it may happen that one of the two traits is driven to fixation in the population by chance fluctuations. This factor is particularly important in small populations – the smaller the number of organisms in the population, the higher the chance that one or the other trait will be fixed in this way. But drift can be an important factor in large populations as well (Kimura 1983). One traditional debate in evolutionary biology is that between "selectionism" and "neutralism," where the "neutralists" argued that much human variation, particularly in the DNA, is selectively "neutral" in this way. Neutral mechanisms can actually build pretty sophisticated devices (Lukeš et al. 2011). So, in general, we can't assume, as a matter of course, that any particular, well-defined trait that we're interested in is an adaptation.

Moreover, even if we have reason to think a given trait is an adaptation, it's often unclear what, precisely, it's an adaptation *for*. For example, it could be that a trait originally spread through a population because it was selected for some activity, but later became *maintained* in that population because it was selected for some different activity. Stephen Jay Gould and Elisabeth Vrba (1982) signaled this distinction by using the term "adaptation" to describe the activity that something originally served, and "exaptation" for an activity that it came to serve later. So just because a trait serves a function in the life of the organism today, we can't infer that *that's* the function it always served.

Evolutionary psychologists (again, as a specific movement within the broad field of evolutionary approaches to the mind) believe that the psychological mechanisms, or modules, that are the building blocks of the human mind are also adaptations (Buss 2011). In this respect they are just like the bird's wing, the heart, or the giant proboscis on ancient fleas. Just as the human body is made up of many different organs, each of which was designed by natural selection to serve some function, so too were the modules, or "organs of the mind," typically shaped by natural selection for the function they serve (Symons 1987).

You might wonder how we can know whether a given psychological trait is an adaptation and, if so, *what* it was selected for. Unfortunately, we typically can't. That's the main problem for evolutionary psychology. Take male jealousy, a favorite subject amongst evolutionary psychologists. Consider what we're supposing, when we suppose that jealousy is an adaptation for securing fidelity. This is straightforward once we think back to the nature of natural selection, as discussed in Section 1.3. Natural selection involves variation, fitness, and heredity. When we say that male jealousy is an adaptation for preventing sexual infidelity, we are saying three things. First, we're saying that back in the Pleistocene era (or whenever these attitudes were being formed), our male ancestors differed with respect to jealousy. Some got jealous and some did not, or at least they got jealous in varying degrees. Secondly, we're saying that the more-jealous ones were more fit than the less-jealous ones. Jealous males tended to sire more offspring than those who didn't get jealous. The theory here is that the jealous ones were vigilant about preventing their mates from fooling around behind their backs, and so they didn't get cuckolded, and so they didn't get stuck raising someone else's child, and so they got more of their genes into the gene pool. Finally, we're claiming that jealousy is heritable. It is reliably passed down from generation to generation. Jealous fathers, jealous sons.

Sadly, this tale remains little more than speculation. We don't have access to those crucial bits of information about our ancestors' sexual practices: whether there was heritable variation associated with fitness differences when it came to jealousy amongst our male ancestors, or what might have caused such hypothetical fitness differences. We do know that our ancestors had sex; we know that sex sometimes resulted in pregnancy; we know that infants passed through the mother's birth canal; we know that they were nourished at the breast for some indefinite amount of time afterwards. But we don't really know how serious the threat of cuckolding was for males, whether males spent any real time raising their offspring anyway or whether they were raised communally, or even whether they had (more or less) monogamous pairings. It's also not obvious, on the face of it, that jealousy would actually have been *effective* or *useful* for preventing infidelity.[11] Is there a single study that demonstrates jealous partners get cheated on less? It seems like jealous people are just as likely to drive their partners away as to prevent them from sleeping around.

Let me set up what I take to be the core case against evolutionary psychology as simply and concisely as possible. I see it as a two-step argument. First, for any present-day behavior or psychological trait (say, jealousy), we can come up with multiple, competing, and, at least on the face of it, *equally good* evolutionary hypotheses for it. That is, these hypotheses will be equally plausible and equally compatible with the facts at our disposal, or at least the facts that are readily available from pedestrian observation and from psychological labs. Some of these hypotheses will appeal to natural selection acting directly on the trait of interest, and some will appeal to other factors like by-products and drift. So, what should we do?

The most obvious way to break the impasse is to try to find more direct, historical data to back up one evolutionary account over another. The problem – and this is step two of the argument – is that historical data are extremely scarce for the sorts of traits evolutionary psychologists like to study. So, when you put together the multiplicity of plausible evolutionary hypotheses with the scarcity of data, you get a bad situation. In short, when evolutionary psychologists propose adaptationist hypotheses for various features about us, they assume a kind of "epistemic debt" that they can't pay off. A lot of people have made this case, or similar cases, and I just don't know how you get around it (Buller 2005; Richardson 2007).

This isn't to say that we can't know anything about the past! But the methods evolutionary biologists use are pretty limited when we're trying to get information specifically about the origin of human psychological mechanisms – what kinds of mechanisms existed in our ancestral past and how they got there. The question of the precise methods by which evolutionary biologists go about reconstructing the past is fascinating and philosophically rich, and I won't do it justice here – see Sober (1988, 2008). But I'll make a few points to suggest how evolutionary psychology falls short.

Consider three lines of evidence that scientists use for reconstructing the evolutionary past of a trait: the fossil record, archeology, and cross-species comparative studies. One line of evidence for reconstructing our evolutionary past comes from the fossil record. But these sorts of data are effectively non-existent in the case of human psychological traits. This is because, as Richard Lewontin (1998) pointed out, the mind doesn't leave a fossil record. Although we can use data from the fossil record to make inferences about the lifestyles of early humans or our Neanderthal relatives (Austin et al. 2013), they probably won't give us fine-grained information about the existence or origins of the psychological mechanisms we care about.

Another line of evidence comes from archeology: cave paintings, burial rites, arrowheads, and so on. Such data are crucial in helping us figure out how our ancestors lived and, to some extent, how they thought about things (Mithen 2005; Sterelny 2012; Appenzeller 2013). One concern here, however, is similar to the issue we raised above in discussing Batson's work – we're multiplying interpretive problems when we try to infer, from some visible artifacts, the underlying psychological mechanisms they point to. A deeper issue is that, even if we can use such data successfully to make inferences about our ancestors' psychological mechanisms, that alone won't tell us *why* they evolved, which is what evolutionary psychologists want to know.

A third method of gaining evidence about the evolutionary past is to carry out comparisons across species (Sterelny and Griffiths 1999, ch. 10). For example, in Section 3.3 I discussed how we could use comparative genomic sequencing to judge different hypotheses about the domestication of dogs. We can compare, say, the genome of domesticated dogs with that of wolves in the hopes of pinpointing how long ago they diverged. We can then use that estimated date to confirm or disprove various hypotheses. We could also use comparative evidence to look for signs of "convergent evolution," which happens when the same trait evolves independently in different species (such as wings, which evolved independently in birds and insects). Convergent evolution is great evidence for adaptation. A problem for evolutionary psychology here is that most of the mental modules that they postulate (such as cheater detection) have no parallel in other species. In other words, they think those modules arose entirely within *H. sapiens* and perhaps earlier, extinct, ancestors in the genus *Homo*. So comparative methods are of limited value here (Dupré 2013, 247). We're back to pedestrian observations, and the psychological lab.

Some have tried to support the tenets of evolutionary psychology by using a very different line of evidence. They have tried to show that various mental capacities have a "modular" structure. One way to show this is through dissociation studies – that is, to show that the capacity in question can be selectively impaired, while leaving other capacities operational, and vice versa. For example, some scientists have reasoned that human beings have a "module" for the ability to think about the mental states of others, because of the way that the capacity seems to be impaired in certain mental disorders (so-called "mindblindness") (Baron-Cohen 1995). However, evidence that a trait has a "modular" structure shows neither that the trait is innate nor that it's an adaptation. It's certainly possible that the ability to reason about cheating has a "modular" structure, but modular structure can arise as a result of experience (Karmiloff-Smith 1992; Buller 2005). Most of us are familiar with "savant syndrome," in which individuals with otherwise severe cognitive disabilities show remarkable capacity in a limited area. One area is *calendar counting* – the ability to rapidly calculate the day of the week on which an arbitrary date falls. But I don't think that would show calendar counting is innate, or that it's an adaptation.

I'm not saying evolutionary psychologists will never, in principle, develop a sound, rigorously testable adaptationist hypothesis for a human psychological trait. It's always possible that future developments in science will rectify the problem. But consider the following: I've spent much of the chapter developing the point that you can have a rigorously "Darwinian" approach to the mind without being an adaptationist. You can also do so without accepting, in bulk, the package of ideas associated with evolutionary psychology, such as modularity and innateness. I think that when people see that there are a lot of different ways of taking an evolutionary approach to the mind, that will sap some of the motivation for accepting evolutionary psychology and the related adaptationist assumptions. Put as simply and baldly as possible, I suspect that some people defend evolutionary psychology because they don't think there are any scientific alternatives, and that if we drop evolutionary psychology we'll have to embrace radical environmentalism and behaviorism and so on. But that's a false dichotomy. The question of how far we should go to defend a research program can't be separated from the question of how bad things would be if we dropped it.

You might think I'm doing something dodgy here. Wasn't I just endorsing, in the previous chapter, Sober and Wilson's argument for altruism on the basis of group selection? And wasn't that an adaptationist argument? Yes and yes. But, in the last chapter, I noted that Sober and Wilson's argument shares all the weaknesses of adaptationist reasoning. (I was also concerned, there, to show that nothing in evolutionary theory *rules out* psychological altruism.) It wasn't meant as a piece of rigorous scientific evidence. It's an admittedly speculative scenario that could, along with other lines of reasoning, sway us toward thinking altruism is real. There are complex issues here about the relation between the standards of scientific practice, on the one hand, and the philosophical worldviews that we construct atop that practice, on the other. In that context I was using group selection as grist for building a philosophical worldview about people. I think evolutionary psychologists consider their adaptive stories to be a good part of sober science.

There are at least two kinds of rejoinders that one might raise on behalf of evolutionary psychology. The first is an argument from *complex functionality*. The idea is that we don't really *need* the evidence of archeology or genomic sequencing to decide that something is an adaptation. Some evolutionary psychologists, in fact, have said that we just have an intuitive knack for knowing which traits are adaptations and what they're for (Symons 1987, 123–124). A slightly more sophisticated way of putting this argument is to say that the hallmark of an adaptation, rather than an exaptation, or a product of drift, is its *complex functional* character. Think about the eye. It is remarkably complex, and all of the different parts work together seamlessly to enable vision. That doesn't mean it's perfect, or that a good engineer couldn't improve on it. But it's hard to see how such a magnificently complex, well-functioning structure could have come about unless it was *either* designed by God *or* shaped by natural selection for the function of sight. The impression of design is overwhelming. As Tooby and Cosmides (1992) put it, "selection … is the only known account for the natural occurrence of complexly organized functionality in the inherited design of undomesticated organisms" (53).

Perhaps the eye is an unusual example because of its extraordinary complexity and appearance of functional specialization. But we should hesitate to draw the conclusion that the building blocks of the mind are adaptations, too. There are two reasons. First, to the extent that we *do* see unambiguous functional complexity in our mental abilities, we need not suppose it represents an adaptation. It could represent the manifestation of intelligence, trial and error, and cultural evolution. Think about reading ability. Neuroscientists are still discovering how functionally complex, and even neurobiologically complex, the ability to read is. But given that reading ability has only been around for a few thousand years, it probably isn't an adaptation cultivated by natural selection. The ability to play expert chess is another example. When it comes to the mind, having functional complexity and being an adaptation don't necessarily hang together.

A second kind of problem is that we don't possess any clear *measure* of the highly intuitive notion of functional complexity. That suggests that it might mirror our own biases or prejudices. Most of us intuitively think that human beings are the most complex species in the world, but on reflection we should admit that it's probably our own vanity talking. We can develop this problem by breaking down the notion of functional complexity into its two components, function and complexity. These ideas are highly ambiguous or ill-defined. Putting them together into a single phrase may spell trouble. I'll briefly mention problems with each of them.

I won't delve deeply into ambiguities in the notion of *function* at this point, because I'll talk about that in Section 7.1. Suffice it to say that "function" means different things to different people. For example, the recent Encyclopedia of DNA Elements (ENCODE) project is a large consortium of scientists devoted to unearthing the functions embedded in the human genome, sequence by sequence; one of the selling points of ENCODE is the oft-repeated slogan that over 80 percent of the human genome is functional (ENCODE Project Consortium 2012, 57). This is in contrast to the idea that most of our DNA is "junk DNA" with no function. But some scientists, such as the biochemist Ford Doolittle, noted skeptically that the apparent truth in this slogan depends centrally on how we choose to define "function." He also said that the scientists involved in the consortium were probably stretching the definition of "function" beyond any reasonable boundaries (Doolittle 2013; Graur et al. 2013).

Second, complexity. As the biologist Dan McShea points out, biologists don't have any agreed-upon and formal measure of "complexity." In a recent book, McShea and the philosopher Robert Brandon propose a fairly simple measure of complexity as number of part types (McShea and Brandon 2010). For a simple example, eukaryotes (organisms made up of cells with nuclei) are more complex than prokaryotes (organisms made up of cells without nuclei) because the former have more kinds of parts. This is an obvious and fairly well-defined measure though it depends somewhat on the particular level of organization we're interested in examining (e.g., an organism can be highly complex with respect to cell types but not so complex with respect to tissue types or organ types). Their most interesting claim, however, is that increasing complexity is a fundamental and universal fact about evolution. Living forms tend to become more complex over time due to purely random variation. This increase in complexity does not require natural selection. In fact, one of the ways that natural selection often works is by *reducing* unnecessary complexity, rather than building it up (McShea and Hordijk 2013). A mark of adaptation may be relative *simplicity* rather than complexity! This brings into question the idea that complexity per se is a crucial hallmark of adaptation.

A second kind of argument on behalf of evolutionary psychology stems from thinking about the distinction between *two* kinds of adaptationism, "empirical adaptationism" and "methodological adaptationism." So far, I have been talking about the former, which I take to be the idea that natural selection is the most important force of evolution. This is meant as a factual claim, a claim about what the world is really like. But there's a related idea, "methodological adaptationism," which is not a factual claim about the natural world, but a recommendation for practicing biologists. It says that even if not all traits are optimally designed by natural selection, we should work under the assumption that they are.

Why would one ever accept methodological adaptationism (unless one thought that empirical adaptationism is true)? There are at least two reasons. One might argue that, historically, if biologists *hadn't* been looking for adaptations, they *wouldn't* have found them (Mayr 1982, 328). This is the problem of false negatives. In other words, adaptationist reasoning is a good tool of biological discovery, and it helps us see all kinds of facts we would've otherwise been blind to. Of course, you might think that this problem is matched by the problem of "false positives": falsely asserting that something is an adaptation when it's not. Freud seemed to use a similar sort of argument to conclude that we should assume, as a matter of course, that slips of the tongue have some deep meaning behind them, but nobody takes that argument very seriously today (Freud 1966, 54).

Moreover, though proponents of evolutionary psychology sometimes defend adaptationist reasoning on "heuristic" grounds – that is, by saying that it has helped us discover hitherto unknown psychological traits – it's actually not very easy to come up with uncontroversial examples (see Machery forthcoming for an argument to this effect, and Schulz 2012 for a response). Finally, we need to be cautious when we make these sorts of "counterfactual" claims about the history of science ("if not for adaptationist thinking, we never would have discovered

X"). Historians of science are skeptical about this "what if" approach to history, and for good reason. History is fragile and contingent, more like a story than a well-behaved mechanism.

A related argument for methodological adaptationism goes like this: the adaptationist assumption *is the best way of revealing* whether or not something is an adaptation (Orzack and Sober 1994). It works as follows: for any particular trait, assume it *is* an adaptation, make a hypothesis about its function, and then check to see whether the predictions drawn from your hypothesis are correct. If they *are* correct, that confirms that the trait is an adaptation. If they *aren't* correct, that suggests that some other mechanism played an important role in the evolution of that trait, such as drift. In short, we should make the working assumption that adaptationism is true because it's a good tool of discovery. A problem with this line of reasoning, however, is that non-adaptationist modes of reasoning could do an equally good (or bad) job of showing whether or not something is an adaptation (Lewens 2009). If we assume that a trait is purely the product of drift, that would lead us to make certain sorts of predictions about how it fluctuates in the population. If those predictions turned out to be wrong, that would give us evidence that it's not purely the product of drift. So one would have to make out a stronger case for why methodological adaptationism is preferable to some other, non-adaptationist method of reasoning.

It's appropriate to conclude with the words of Darwin himself. Darwin came to criticize earlier versions of his major work, *On the Origin of Species*, because it overlooked the possibility that many organic structures have no purpose at all, "neither beneficial nor injurious." He also came to conclude that his earlier adaptationism was a vestige of a theological way of thinking. He hadn't quite eradicated the traces of natural theology from his mind, so he still saw the world as if everything had a special purpose or design. In what I take to be a remarkable confession, he writes:

> I was not, however, able to annul the influence of my former belief, then almost universal, that each species had been purposely created; and this led to my tacit assumption that every detail of structure, excepting rudiments, was of some special, though unrecognised, service. Any one with this assumption in his mind would naturally extend too far the action of natural selection, either during past or present times.
>
> (Darwin 1874, 61)

CHAPTER SUMMARY AND SUGGESTED READINGS

In this chapter I explored the different evolutionary approaches to psychology. There are two crucial points here. First, evolutionary approaches to psychology are by no means recent, but they go back to Darwin. Second, evolutionary approaches to psychology are not uniform, but differ from one another in terms of their assumptions and methods. We shouldn't talk about "the evolutionary approach to psychology" as if it's some sort of monolithic thing.

In Sections 3.2–3.5, I put each of the four main approaches under the microscope: sociobiology, cultural evolution, human behavioral psychology, and evolutionary psychology. Sociobiology attempted to apply evolutionary mechanisms, such as kin selection, to the study of human societies, but rarely investigated the precise cognitive mechanisms that generated behavior. Cultural evolution (and its sister, "gene-culture co-evolution") recognizes culture as a major factor of human evolution, though it's not clear how strong the analogy between cultural and biological evolution really is.

Human behavioral ecologists assume that evolution shaped the human mind to be *plastic*. As a consequence, there aren't many precise, "hard-wired" abilities, but we should expect people to act differently in different circumstances. The use of "optimality" models is controversial, because it's not clear why we should think that human behavioral traits typically do represent "optimal" solutions to environmental pressures. Finally, evolutionary psychology decomposes the mind into a cluster of innately specified modules, each of which is an adaptation to a challenge that our ancestors faced. The main controversy here concerns whether it is typically possible to gather adequate evidence for their specific hypotheses. This is a problem, more generally, with the idea of adaptation*ism* about the mind: that natural selection is by far the most powerful force of evolution, so most of our well-defined mental abilities are probably adaptations designed by selection for their current roles (Section 3.6). The problem is that there are many ways a given trait *might* have evolved, and we often just don't have the historically relevant information to decide between these hypotheses.

The best recent introduction to evolutionary approaches to psychology is Kevin Laland and Gillian Brown's (2011) book, *Sense and Nonsense: Evolutionary Perspectives on Human Behaviour*. It is a remarkably clear and comprehensive overview to a technically demanding field. Helen Longino's (2013) book, *Studying Human Behavior*, is a good complement though it focuses more on behavior and less on cognitive mechanisms.

If you want to understand early evolutionary approaches to psychology, from Darwin onwards, the best approach is still to read the original sources. There are several major and highly readable works. These include: Darwin's two volumes on psychology, *The Descent of Man* and *The Expression of the Emotions in Man and Animals*, of 1871 and 1872 respectively; C. Lloyd Morgan's (1896) *Habit and Instinct*; Mark Baldwin's (1898) *The Story of the Mind*, and William McDougall's (1908) *An Introduction to Social Psychology*.

Recent works that attempt to better integrate cultural evolution into our understanding of the human mind include the developmental psychologist Michael Tomasello's (2009) book, *Why We Cooperate*, and the philosopher Kim Sterelny's (2012) book, *The Evolved Apprentice*. In 2012, Cecilia Heyes and Uta Frith edited a special issue of the *Philosophical Transactions of the Royal Society B: Biological Sciences* on the role of cultural evolution in shaping human cognition (volume 367), and it includes contributions from both scientists and philosophers.

In addition to *Sense and Nonsense,* Downes (2001) and Smith et al. (2001) give good introductions to human behavioral ecology that help to clarify its (rather vexed) relationship with evolutionary psychology. If one wishes to steep oneself in mainstream evolutionary psychology, David Buss' (2011) textbook, *Evolutionary Psychology: The New Science of the Mind*, is the best starting point (now in its fourth edition). David Buller's (2005) book, *Adapting Minds*, is the definitive critique. Stephen Downes gives a good overview in his entry on "Evolutionary Psychology" for the *Stanford Encyclopedia of Philosophy*. On adaptationism, read Stephen Jay Gould and Richard Lewontin's famous (1979) "The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme." For a current overview of the adaptationism controversy, see Steven Orzack and Patrick Forber's entry on "Adaptationism" in the online

Stanford Encyclopedia of Philosophy, and Tim Lewens' (2009) "Seven Types of Adaptationism" in the journal *Biology & Philosophy*.

NOTES

1 Some use "Evolutionary Psychology" (capitalized) to refer to the specific school, and "evolutionary psychology" to refer to the broader movement (Buller 2005).

2 In a complex bit of historical irony, the editors of today's leading neuroscience textbook chose to grace the cover of the latest edition with the young Freud's superb rendering of the spinal ganglia of the lamprey (Kandel et al. 2013). Two of the editors, Eric Kandel and the late James Schwartz, held out hope for an ultimate reconciliation between psychodynamic psychology and neuroscience.

3 Psychologists sometimes describe the distinction here as one between "structuralism," which purports to classify and analyze the contents of our mental lives, and "functionalism," which seeks the adaptive significance of those contents.

4 See Weber and Depew (2003) for an important philosophical anthology. Mary Jane West-Eberhard (2003) is an important proponent of this sort of mechanism.

5 Brain size is correlated with group size, which some scientists take to suggest that the brain evolved rapidly in humans to help us navigate our social, rather than physical, environment (Byrne 1996; Dunbar 1992).

6 One of the realizations that psychologists were making in the 1970s was that infants' minds aren't sponges that just soak up whatever stimuli are around. Rather, infants are focused on certain stimuli over others, and they are more adept at making certain associations over others. Babies are intensely interested in faces. Rats are much more able to form food aversions than place aversions or color aversions (see Roper 1983).

7 See Miller 1956 for an important starting point of cognitive psychology.

8 Fodor himself mainly restricted talk of "modules" to the mechanisms that process sensory input, rather than the mechanisms involved in reasoning about the world. The more general conception, which sees modularity as a general feature of our cognitive lives, is called "massive modularity." Fodor himself is a harsh opponent of the view – see Fodor 2000.

9 Buss 2011, 49. See Samuels et al. 1999 for an extensive discussion of the sense of "modularity" associated with evolutionary psychology. See Carruthers 2006 and Machery 2007 for more recent treatments.

10 For Fodor in the 1980s, innateness was a defining feature of modules, but not everybody uses the term "modular" in this way, such as Chomsky (1980). The developmental psychologist Annette Karmiloff-Smith (1992) is a prominent defender of the idea that we should separate modularity and innateness, and study how modularity arises in the course of development through interaction with the environment.

11 I'm grateful to Sasha Sobolyewa for this observation.

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