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THE INHERITANCE OF PERSONALITY:

Behavioral Genetics and Evolutionary Psychology

THE NEXT MEMBER OF New York's Rockefeller family will be born rich. Why? The reason, of course, is *inheritance*. The child's parents are already rich, so he or she will join a wealthy family and have all of the advantages (and perhaps disadvantages) that accompany large amounts of money. But why are this child's parents rich? Why are *all* the Rockefellers wealthy? The explanation goes back more than 100 years to the career of John D. Rockefeller, a fabulously successful and utterly ruthless businessman. Using tactics such as secret buyouts, intimidation, and market manipulation, between 1870 and 1882 he built Standard Oil of Ohio into the Standard Oil Trust, which for years held a near monopoly on the U.S. oil business. After many battles with competitors and the legal system, he retired in 1911 with a fortune almost beyond imagining. His family name has been a synonym for wealth ever since.

Now consider a question that might seem unrelated. Where did your personality come from? Why are you so friendly, competitive, or stubborn? Maybe you have chosen to be this way, or maybe it is a result of everything you have experienced in your life, but we need to consider the strong possibility that this answer also concerns inheritance. Are your parents especially friendly, competitive, or stubborn? If the answer is yes, as it may well be, then a further question arises: Where did this trait come from in the first place? The answer might lie in the careers of some ancestors who lived a very long time ago.

Chapter 7 talked about personality development, the way personality changes and remains the same from childhood to old age. The topic of this chapter goes back even earlier, to the very foundation of personality. Two different approaches consider personality's ultimate biological roots (Penke, Dennisen, & Miller, 2007). The first, *behavioral genetics*, addresses how traits are passed from parent to child and shared by biological relatives. The second approach, *evolutionary psychology*, addresses how patterns of behavior that characterize all humans may have originated in the survival value these characteristics provided over the history of the species.

This chapter will consider the inheritance of personality from both perspectives. First, it surveys research on behavioral genetics that examines how personality traits are shared among biological relatives, including recent studies seeking to uncover the molecular genetic basis of personality. The chapter will also examine how inheritance interacts with experience: Two people with the same genes might have very different attributes, depending on the environments in which they are raised, and, as recent research is beginning to show, environments can actually shape how and even whether genes are expressed. Second, the chapter will summarize theorizing on how modern human nature and personality may be results of the evolutionary history of the human species going back hundreds of thousands of years. It will also consider controversies over this approach, and the light that evolutionary theory can shed on understanding human nature. The chapter ends by reconsidering the question that began this section of the book: Are people just animals? Or, to put the question another way, is an explanation of the biology of behavior sufficient for explaining human psychology?[1]

BEHAVIORAL GENETICS

People tend to look somewhat like their biological parents, and at family reunions it can be fascinating to see how aunts, uncles, and cousins share a certain resemblance. The similarity may be obvious, but its exact basis can be surprisingly difficult to pin down. Is it a similar shape of the eyes, curl of the hair, characteristic facial expression, or some complex combination of all of these? No matter how the similarity manifests, the reason biological relatives look alike is because they share genes.

Physical appearance is one thing, but now consider some other questions: Is there family resemblance in personality? Did you inherit your traits from your parents? Are you psychologically similar to your brother or sister because you are biologically related? Questions like these motivate the study of behavioral genetics. This field of research examines the way inherited biological material—genes—can influence broad patterns of behavior. A pattern of behavior that is generally consistent across situations is, by definition, a **personality trait** (Plomin, Chipuer, & Loehlin, 1990). Thus, "behavioral" genetics might more accurately be called "trait" genetics, but in this chapter I will stick with the traditional term.

[1]Spoiler alert: The answer is No.

Controversy

The field of behavioral genetics has been controversial from the beginning, in part because of its historic association with a couple of notorious ideas. One is *eugenics*, the belief that humanity could (and should) be improved through selective breeding. Over the years, this idea has led to activities ranging from campaigns to keep "inferior" immigrants out of some countries, to attempts to set up sperm banks stocked with deposits from winners of the Nobel Prize. A second controversial idea to emerge from eugenics is cloning, the belief that it might be technologically possible to produce a complete duplicate—psychological as well as physical—of a human being. Both of these ideas have dodgy histories (e.g., Adolf Hitler promoted eugenics), and seem to imply nightmarish future scenarios. A less dramatic, but still worrisome concern is that research on genetic bases of behavior might lead the public to think that outcomes such as intelligence, poverty, criminality, mental illness, and obesity are fixed in one's genes rather than changeable by experience or social circumstances (Dar-Nimrod & Heine, 2011).

Most modern behavioral geneticists are quick to dissociate from these ideas. They view themselves as basic scientists pursuing knowledge both for its own sake and because understanding genetic influences can help to develop ways to treat behavioral disorders. After all, ignorance never got anyone very far (see the discussion of research ethics in Chapter 3). But a more reassuring observation may be that neither eugenics nor cloning turns out to be very feasible. Because personality is the result of a complex interaction between an individual's genes and the environment, as we shall see, the chances of being able to breed people to specification or to duplicate any individual are, thankfully, slim. Even if you could create an exact genetic clone of yourself, this other person would differ from you in numerous ways.[2] And no modern behavioral geneticist views genetically influenced traits as being inevitably fixed, though some popular accounts might lead one to think so. The real contribution of behavioral genetics is the way it expands our understanding of the sources of personality development to include its bases in both genes and the environment.

Calculating Heritability

The oldest and still most common research method in behavioral genetics is based on a simple idea: To the degree that a trait is influenced by genes, people who are closer genetic relatives ought to be more similar on that trait than people who are more distantly related. The classic technique focuses on twins. As you probably

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[2]However, as a colleague of mine once remarked, meeting your clone would still be "pretty danged weird."

know, there are two kinds of human twins: identical (also called monozygotic, or MZ) twins and fraternal (dizygotic, or DZ) twins. Monozygotic ("one-egg") twins come from the splitting of a single fertilized egg and therefore are genetically identical.[3] Dizygotic ("two-egg") twins come from two eggs fertilized by two different sperm, and so, although born at the same time, they are no more genetically related than any other two full siblings.

Humans are highly similar to each other genetically. More than 99 percent of all human genes are identical from one person to the next. Indeed, 98 percent of these same genes are also found in chimpanzees (Balter, 2002)! Behavioral genetics concentrates on the less than 1 percent of the human genome that commonly varies across individuals. MZ twins are effectively the same in all of these varying genes; DZ twins share about half of them, on average, as is also the case for parents and offspring. Thus, for example, the statement that a mother shares 50 percent of her genetic material with her child really means that she shares 50 percent of the material that varies across individuals. This rather technical point highlights an important fact: Like trait psychology (see Chapters 4 to 7), with which it is closely aligned, behavioral genetics focuses exclusively on individual differences. Inheritance of species-specific traits that all humans share is the focus of evolutionary biology, which is discussed in the second half of this chapter.

Behavioral genetic studies have made great efforts to find twins of both types (MZ and DZ), and also to seek out the rare twins separated at birth and reared apart. Researchers then measure their personalities, usually with self-report instruments such as those discussed in Chapters 3 and 6. The Eysenck Personality Questionnaire (EPQ), the California Psychological Inventory (CPI), and the NEO-PI, a measure of the Big Five traits (see Chapter 6), are particular favorites. Less frequently, researchers have directly observed twins in laboratory contexts to assess the degree to which they behave similarly (Borkenau, Riemann, Angleitner, & Spinath, 2001).

The next step is to compute the correlation coefficient (see Chapter 3) across the pairs of twins, separately for the MZs and DZs.[4] When a trait or behavior is influenced by genes, then the trait and behavioral scores of identical (MZ) twins ought to be more highly correlated than the scores of fraternal (DZ) twins. By the same logic, closer relatives (siblings) ought to be more similar on a gene-influenced, inherited trait than more distant relatives (cousins).

A statistic called the *heritability coefficient* is computed to reflect the degree to which variance of the trait in the populations can be attributed to variance in

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[3]Actually, that's not quite true (Li et al., 2014), because of *somatic point mutations* that occur as cells divide and multiply throughout the life span. But pretty close.

[4]For technical reasons, a related statistic called the *intraclass correlation coefficient* is used.

genes (see the hypothetical example in **Table 9.1**). In the case of twins, one simple formula is

$$\text{Heritability quotient} = (r_{MZ} - r_{DZ}) \times 2$$

(that is, twice the difference between the correlation among MZ twins and the correlation among DZ twins). Across many, many traits, the average correlation across MZ twins is about .60, and across DZ twins it is about .40, when adjusted for age and gender (Borkenau et al., 2001, p. 661). The difference between these figures is .20; multiply that by 2, and you arrive at a heritability coefficient of .40. This means that, according to twin studies, the average heritability of many traits is about .40, which is interpreted to mean that 40 percent of phenotypic (behavioral) variance is accounted for by genetic variance. The heritabilities of the Big Five traits are a bit higher; according to one comprehensive summary they range from .42, for agreeableness, to .57, for openness (Bouchard, 2004).

Twin studies are simple and elegant, and the calculations are easy because MZ twins share on average twice as many variable genes as do DZ twins. However, these studies are not the only way to estimate heritability. Other kinds of relatives also vary in the degree to which they share genes. For example, children share 50 percent of their variable genes with each of their biological parents, whereas adopted children (presumably) share no more of their personality-relevant genes with their adoptive parents than they would with any other person chosen at random. Full siblings also share, on average, 50 percent of the genes that vary, whereas half-siblings (who have one parent in common) share only 25 percent, and first cousins 12.5 percent.

Table 9.1 | CALCULATING HERITABILITIES

	Identical (MZ)		Fraternal (DZ)	
	Score of First Twin	Score of Second Twin	Score of First Twin	Score of Second Twin
Pair 1	54	53	52	49
Pair 2	41	40	41	53
Pair 3	49	51	49	52
. . .	. . .	. . .	. . .	. . .
. . .	. . .	. . .	. . .	. . .
	r = .60		r = .40	

Note: Heritability quotient = $(r_{MZ} - r_{DZ}) \times 2$

Calculation: $.60 - .40 = .20$

$.20 \times 2 = .40$

Conclusion: Heritability = 40%.

Notice that I have been careful to say that these figures are *averages*. For example, the statistic that full siblings share 50 percent of the variable genes is a theoretical average of all siblings, and does not necessarily describe the similarity between any particular pair of brothers and sisters. It is possible, though highly unlikely, that two full siblings could share none of the variable genes at all—or all of them (Johnson, Penke, & Spinath, 2011)! This point underlines the fact that behavioral genetic analyses and the statistics they produce refer to groups or populations, not individuals. In particular, when research concludes that a personality trait is, say, 50 percent heritable, this does not mean that half of the extent to which an individual expresses that trait is determined genetically. Instead, it means that 50 percent of the degree to which the trait varies across the population can be attributed to genetic variation.

An alternative way to estimate heritability is to calculate similarities in personality across relatives other than twins. For most traits, the estimates of heritability garnered from non-twin studies are about 20 percent, or half the average heritability estimated from twin studies (Plomin, Chipuer, & Loehlin, 1990). Why this difference? One likely explanation is that the effects of genes are interactive and multiplicative rather than additive. That is, estimates of heritability based on twin studies assume that individual genes and the environment act independently to influence personality, and these influences can simply be added up. If that were true, then because DZ twins share (on average) half of the variable genes that MZ twins do, we could assume they are half as similar in gene expression. But things aren't so simple. As will be described later in the chapter, genes often operate differently depending on the other genes that are present. Moreover, genes will express themselves in different ways in different environments and even members of the same family may grow up and live in different social contexts. As a result, while heritability estimates based on twins may be too high, those based on broader family relationships may be too low.

What Heritability Tells You

Admittedly, heritability calculations are rather technical, and a more basic question should be asked: Regardless of how you compute it, what does a heritability statistic tell you? Two things.

GENES MATTER First, heritabilities tell you that genes matter. For years, psychologists presumed that all of personality was determined environmentally; that is, by early experiences and parental practices. Heritability estimates challenge that presumption whenever they turn out to be greater than zero—and they nearly always do (see **Table 9.2**). Indeed, it has been seriously suggested that the first law of behavioral genetics should be "Everything is heritable" (Turkheimer, 1998, p. 785; Turkheimer & Gottesman, 1991). Not all of personality comes from experience; some of it comes

Table 9.2 | HERITABILITIES OF SOME PSYCHOLOGICAL TRAITS

Personality	
Big Five	
Extraversion	.54
Agreeableness (aggression)	.42
Conscientiousness	.49
Neuroticism	.48
Openness	.57
Big Three	
Positive emotionality	.50
Negative emotionality	.44
Constraint	.52
Psychiatric illnesses	
Schizophrenia	.80
Major depression	.37
Panic disorder	.30–.40
Generalized anxiety disorder	.30
Phobias	.20–.40
Alcoholism	.50–.60
Antisocial behavior (adults)	.41
Social attitudes	
Conservatism (age 20 and older)	.45–.65
Right-wing authoritarianism (adults)	.50–.64
Religiousness (adults)	.30–.45

Source: Adapted from Bouchard (2004), p. 150.

from genes. This important realization is relatively new to psychology. It is not yet accepted by everyone, and its far-reaching implications are still sinking in.

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INSIGHT INTO EFFECTS OF THE ENVIRONMENT

A second important contribution of heritability studies is to provide a window into *non*-genetic effects; specifically, how the early environment does—or does not—operate in shaping personality development.

For a long time, many researchers believed that one of the major findings of behavioral genetics was this: Growing up together in the same home does not tend to make children similar to each other. When measured using standard personality questionnaires such as measures of the Big Five, the traits of adoptive siblings raised in the same family resemble each other with a correlation of only .05. Early writers interpreted this finding to mean that hardly any variation in personality is due to the context shared by siblings who grow up together. Instead, they concluded, the portion of the childhood environments that siblings do *not* share is more important. These include the degree to which children in the same family are treated differently, friendships outside the home, and other outside interests and activities (Loehlin, Willerman, & Horn, 1985, 1989; Rowe, 1994).

Of course, these were just speculations. The research just cited did not specify *which* aspects of a child's environment are important (Turkheimer & Waldron, 2000). It did suggest that whatever the key aspects may be, they do not do much to make family members the same. But other, more recent research tells a somewhat different story.

Several developmental outcomes, including juvenile delinquency, aggression, and even love styles, *have* been found—using standard methods of behavioral genetics—to be affected by the shared family environment (Rowe, Rodgers, & Meseck-Bushey, 1992; N. G. Waller & Shaver, 1994). A major meta-analysis that summarized the results of many studies concluded that the shared family environment was important in the development of many forms of psychopathology between childhood and adolescence, including conduct disorder, rebelliousness, anxiety, and depression (Burt, 2009). The only exception was attention deficit hyperactivity disorder (ADHD), for which the shared family environment did not seem to matter.

To some extent, results vary depending on the methods used (Borkenau, Riemann, Angleitner, & Spinath, 2002). Going beyond self-report questionnaires, one large study gathered ratings of twins' personality traits based on direct observations of 15 different behaviors, including introducing oneself to a stranger, building a paper tower, and singing a song. The result was that "extraversion was the only trait that seemed not to be influenced by shared environment" (Borkenau et al., 2001, p. 655). Every other trait measured in the study *was* affected by the shared environment.

As Borkenau and colleagues pointed out, their result has two important implications. The first is that the widely advertised conclusion that shared family environment is unimportant for personality development was reached too quickly, on the basis of limited data. For many years, behavioral genetics research was based almost exclusively on self-report personality questionnaires, and these S data show little similarity across siblings raised together. But when personality is assessed by directly observing behavior, the picture looks different. The second implication returns us to the message of Chapter 2: Personality research can employ many kinds of data, and they all should be used. Conclusions based on only one kind are at risk; consistent results across several kinds of data are more likely to hold up in the long run.

What Heritability Can't Tell You

Heritability calculations remain a key part of behavioral genetics, but they have a couple of important limitations that are often overlooked.

NATURE VERSUS NURTURE First, heritability calculations do not solve the nature-nurture puzzle. Ever since scientists realized that heredity affects behavior, they have longed for a simple calculation that would indicate what percentage of any given trait was due to nature (heredity) and what percentage was due to nurture (upbringing and environment). To some, the heritability coefficient seemed like the answer, since it yields a figure between zero and 100 percent that reflects the percentage of the variation in an observable trait due to variation in genes.

But consider, as an example, the number of arms you have. Was this number determined by nature (your genes) or by nurture (your childhood environment)? Let's use some (hypothetical but realistic) twin data to calculate the heritability of this trait. Look again at Table 9.1. For the score of the first identical twin of Pair 1, plug in the number of arms he has, which you can presume to be two. Do the same for the score of the second twin of Pair 1, which presumably also is two. Repeat this process for both twins in all the identical pairs. Then do the same thing for the scores of the fraternal twins. When you are finished, all the numbers in the table will be two. The next step is to calculate the correlation for the identical twins, and the correlation for the fraternal twins. Actually, you cannot do that in either case because the formula to calculate the correlation (not shown in Table 9.1) will require a division by zero, the result of which is undefined in mathematics. This fact makes the formula at the bottom of the table a bit awkward to use, but we can presume that the difference between two undefined numbers is zero, which multiplied by two is still zero, and so the heritability of having two arms is zero. Does that mean that the number of arms you have is *not* biologically influenced? Well . . .

What went wrong in this calculation? The problem is that, for the trait "arm quantity," there is practically no variation across individuals; nearly everyone has two. Because heritability is the proportion of variation due to genetic influences, if there is no variation, then the heritability must approach zero.

If you are still following this discussion, you might now appreciate that your calculation of the heritability of number of arms did not go wrong at all. If you look around at people, occasionally you will see someone with one arm. Why? Almost always, it will be because of an accident—an environmental event. The *difference* between people with one arm and those with two arms—the variation in that trait—therefore is produced environmentally and not genetically. This is why the heritability coefficient for the number of arms is near zero. Heritability statistics are *not* the nature-nurture ratio; a biologically determined trait can have a zero heritability.

HOW GENES AFFECT PERSONALITY Second, heritability statistics are not really very informative about the process by which genes affect personality and behavior. Here is a fact that may astonish you: To a statistically significant degree, television watching is heritable (Plomin, Corley, DeFries, & Fulker, 1990). Does this mean an active gene in your DNA causes you to watch television? Presumably not. Rather, there must be some related propensities—perhaps sensation seeking, or lethargy, or even a craving for blue light—that have genetic components. And these components, interacting somehow with biological development and early experience, cause some people to watch a lot of television. The original research did not examine any of these transactions, however, and 25 years later no study has offered so much as a hint as to what the actual inherited propensities related to television watching might be.

Divorce is heritable, too: If one or more of your close relatives have been divorced, you are more likely to get divorced than if none of your relatives has been divorced—even if you have never met these relatives (McGue & Lykken, 1992). What does this finding imply about the causes of divorce? Maybe not much (Turkheimer, 1998). The finding does imply that one or more genetically influenced traits are relevant to divorce. But as to which traits are involved, or how they influence divorce, behavioral genetics analyses cannot say. It could be that impulsiveness is heritable and that impulsive people have affairs, which cause them to divorce. Or perhaps financial irresponsibility is heritable, or alcoholism, or depression—any or all of which might make a person more likely to divorce. Since, as Eric Turkheimer says, just about everything is heritable, so too every personality trait that might affect divorce is also probably heritable; as a result, divorce may turn out to be indirectly heritable as well. The same is true for many, many other outcomes. Anything affected by personality will also be affected, indirectly, by genes. But heritability analyses, by themselves, cannot tell us just how.

Molecular Genetics

The field of behavioral genetics has changed dramatically in recent years as it begins to move away from the study of relatives, such as twins, toward using the methods of molecular biology. New research seeks to unravel the mystery of how specific genes influence life outcomes by diving into the actual DNA.

For example, a complex program of research examines the relationship between traits associated with behavioral and emotional control and a gene called *DRD4*, which affects the development of dopamine receptors. As we saw in Chapter 8, dopamine is part of the brain system that responds to reward, and some psychologists have theorized that a shortage of dopamine, or an inability to respond to it, may lead people to crave extra stimulation to the point of engaging in risky behavior. The dopaminergic systems of the brain (the parts of the brain influenced by dopamine) also play broad roles in the control and regulation of behavior and even bodily movement. An early study found that different forms of the *DRD4* gene are associated with variations in sensation seeking, and so concluded that the gene might affect this trait via its effect on dopaminergic systems (Benjamin et al., 1996; see also Blum et al., 1996). The *DRD4* gene is also associated with the risk for attention deficit hyperactivity disorder (ADHD), which makes sense given the association between dopamine and brain regulation of cognition and behavior, as well as the related personality trait of impulsivity (Munafó, Yalcin, Willis-Owen, & Flint, 2008). But there is more to impulsivity than this one gene. *DRD4* apparently has nothing to do with risky behavior among skiers and snowboarders (Thomson, Rajala, Carlson, & Rubert, 2014). Other groups of related genes, not just *DRD4*, are related to dopamine and sensation seeking. Moreover, sensation seeking is also relevant to serotonin and its related genes (Zuckerman, 2012).

Many researchers are working on understanding the genetics associated with serotonin. Recall from Chapter 8 that a shortage of serotonin has been blamed for a wide variety of emotional disorders ranging from depression to anxiety and social phobia, and that drugs (such as SSRIs) that increase the level of serotonin in the brain effectively treat these disorders, at least sometimes. The *5-HTT* gene, associated with a serotonin transporter protein, has two variants, or **alleles**. They are called "short" and "long" based on their chromosomal structure. Several studies have shown that people with the short allele score higher on measures of neuroticism, a broad personality trait that (as we saw in Chapter 6) is relevant to anxiety and overreaction to stress (Canli & Lesch, 2007). Even more interesting, the amygdala in people with the short allele also shows stronger responses—as viewed through fMRI images, PET scans, and other imaging techniques (see Chapter 8)—to viewing fearful and unpleasant stimuli such as pictures of frightened-looking faces, accident victims, mutilated bodies, and polluted scenery (Hariri et al., 2002; Heinz et al., 2004; Munafó, Brown, & Hariri, 2008). In people who suffer from social phobias, the same thing happens if they have to give a public speech (Furmark et al., 2004). This gene also appears to regulate the degree to which the amygdala and the prefrontal cortex work together, which may offer an important clue to the brain structure of depression (Heinz et al., 2004).

A fascinating—and somewhat disconcerting—finding is that the prevalence of the short allele of the *5-HTT* gene may vary across cultural groups. In particular, the allele appears to be present in about 75 percent of Japanese people, more than double its frequency in Caucasians (Kumakiri et al., 1999). What does this finding mean? Some writers have speculated that it may be one reason why Asian cultures emphasize cooperation and avoiding conflict over the kind of individualistic striving said to be characteristic of Western cultures (Chiao & Ambady, 2007). Because of the emotional sensitivity associated with this allele, Asians might tend to find interpersonal conflict more aversive than do Westerners, and so make extra efforts to smooth it over. But we are skating on thin ice here. Attempts to account for behavioral differences between cultural groups on genetic grounds have a long, nasty, and sometimes tragic history.

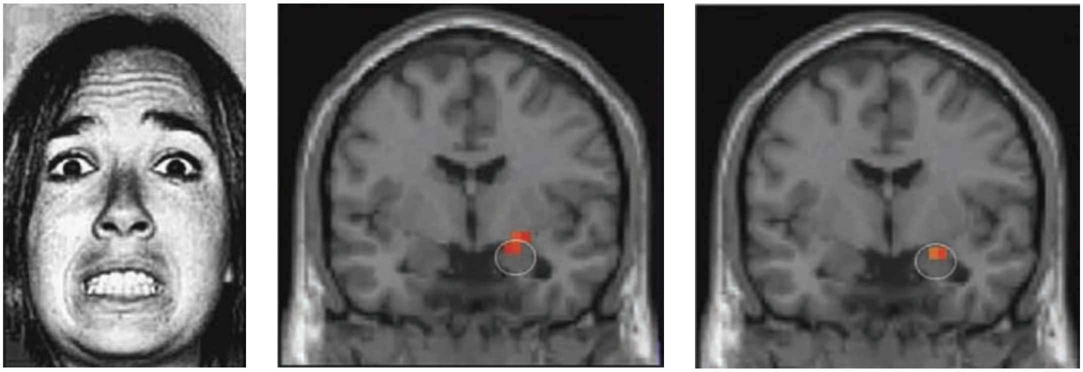

Figure 9.1 Genetics and Amygdala Response The amygdala of people who were shown (a) a frightened-looking face and other fear-invoking stimuli responded more strongly if they had (b) the short form of the *5-HTT* gene (left-hand picture) than if they had the long allele (right-hand picture). Each picture represents data averaged across 14 participants; the circle shows the average location of the amygdala, and the color-coding shows the difference in response between fearful and non-fearful stimuli in terms of T-scores (which are based on the mean difference divided by the standard deviation).
Source: Hariri et al. (2002), p. 401.

It is also important to remember that, as complex as the findings linking genes to behavior have become, they are still not the whole story. About a quarter of the Japanese population does *not* have the short allele of *5-HTT*, and more than a third of Caucasians *do* have it. Moreover, the effects of *5-HTT* on personality and behavior are fairly small and can't always be replicated (Plomin & Crabbe, 2000). In addition, as has already been mentioned, no single gene accounts for more than a trace of the variance in personality. Thousands of different genes may be involved in complex traits such as sensation seeking or proneness to anxiety. The chance of finding a single gene that has a simple, direct, and easily understood effect on impulsiveness, anxiety, or any other aspect of personality, therefore, is virtually nil. The real connection between genetics and personality is surely much more complex.

Yet, despite all the complexity, the rate of accumulation of knowledge over the past decade or so has been no less than astonishing. Up until about the year 2000, nearly everything that was known about the interplay of genetics and personality came from studies of genetic relatives such as twins. Since then, serious efforts to explore molecular genetics have yielded tantalizing hints concerning the biological bases of anxiety, impulsiveness, depression, and even criminal behavior. A gene called *COMT* (for catechol-O-methyltransferase) was recently found to be associated with higher levels of dopamine in the prefrontal cortex and also with extraversion and reasoning ability (Wacker, Mueller, Hennig, & Stemmler, 2012). This finding is especially exciting because it suggests a connection between a gene, a neurotransmitter, a personality trait, and an important aspect of intelligence. The next few years should see further rapid advances, as well as a better understanding of how one's genes transact with experience. We consider this issue next.

"We think it has something to do with your genome."

Gene-Environment Interactions

It was only natural for the study of behavioral genetics, including molecular genetics of personality, to begin with the study of main effects, of how particular genes or patterns of genes are associated with particular behavioral or personality outcomes. But in the final analysis, genes cannot cause anybody to do anything, any more than you can live in the blueprint of your house. The genotype only provides the design, and so affects the behavioral phenotype indirectly, by influencing biological structure and physiology as they develop within an environment (Turkheimer & Waldron, 2000). The next challenge, therefore, after figuring out how specific aspects of the nervous system are affected by genes, is to understand how their development interacts with environmental experience to affect behavior.

Genes cannot cause anybody to do anything, any more than you can live in the blueprint of your house.

The environment can even affect heritability itself. For example, when every child receives adequate nutrition, variance in height is genetically controlled. Tall parents will tend to have tall children, and short parents will tend to have short children; the heritability coefficient for height will be close to 1.0. But in an environment where some are well fed while others go hungry, variance in height will fall more under the control of the environment. Well-fed children will grow near the maximum of their genetic potential while poorly fed children will grow closer to their genetic minimum, and the height of the parents will not matter so much; the heritability coefficient for height will be much closer to 0.

Consider a more psychological trait such as IQ. From the logic just used, we could expect that, in an environment where intellectual stimulation and educational opportunities vary a lot from one child to the next, IQ might be more under the control of the environment. The children who are stimulated and educated will grow up to have intelligence near the top of their genetic potential, while those who are not so lucky will fall far short of what they could achieve, and heritability of IQ will be low. But if we could achieve a society where all children received sufficient stimulation and education, then the differences in IQ that still remained would be due to their genes. In other words, as the intellectual environment improves for everybody, we should expect the heritability of IQ to go up! And that is exactly what happens. One major study found that, for children from impoverished families, more of the variance in IQ was accounted for by their environments, whereas more of the variance in IQ in affluent families was due to genes (Turkheimer, Haley, Waldron, D'Onofrio, & Gottesman, 2003; see **Table 9.3**).

Genes and the environment transact in several other ways (Roberts & Jackson, 2008; Scarr & McCartney, 1983). For example, a boy who is shorter than his peers may be teased in school; this teasing could have long-term effects on his personality. These effects are due, in part, to his genes because height is genetically influenced, but they came about only through an interaction between the genetic expression and the social environment. Without both, there would have been no such effect. Or a girl who inherits a genetically based tendency to be easily angered may tend to create and thereby experience hostile social situations, a process parallel to the *evocative person—environment transaction* introduced in Chapter 7.

Another way genes and environments interact is in how people choose their environments, a process sometimes called "niche picking." It is parallel to the *active person-environment transaction* described in Chapter 7. People tend to select and even create environments that are compatible with and may magnify their genetically influenced tendencies. A person who inherits a predisposition toward sensation seeking may take dangerous drugs. This practice might harm his health or involve him in the drug culture, either of which could have long-lasting effects on his experience and his personality development. Let's say that from hanging around with criminals, he develops a criminal personality. This outcome was only indirectly due to the inherited trait of sensation seeking; it came about through the transaction of the inherited trait with the environment he sought out because of that trait.

A more positive example involves the trait of extraversion. Attempts to find genes directly associated with extraversion have generally been unsuccessful (McCrae, Scally, Terracciano, Abecasis, & Costa, 2010). However, people who are

Table 9.3 | HERITABILITY OF IQ AS A FUNCTION OF SOCIAL-ECONOMIC STATUS

Status	DZ correlation	MZ correlation	Heritability
Low	.63	.68	(.68 − .63) × 2 = .10
High	.51	.87	(.87 − .51) × 2 = .72

Source: From data reported by Turkheimer, Haley, Waldron, D'Onofrio, & Gottesman (2003).

physically attractive and strong are relatively likely to be extraverted, probably because these traits make interactions with other people more likely to be frequent and rewarding (Lukaszewski & Roney, 2011). This example not only shows how genes and environments transact with each other, but it also suggests that if one wants to find the genes responsible for personality one might be better off studying the bases of attractiveness, strength, and other attributes that affect how a person gets along with others.

Genes may even affect how a child is treated by his parents, which can be seen as an extreme example of an evocative person-situation transaction. The usual expectation, as described in Chapter 7, is that parenting affects the development of children's personalities. But the influence can run in the reverse direction, as was also mentioned in Chapter 7. At the genetic level, one recent meta-analysis that surveyed 32 studies of twins concluded that boys with genetic tendencies toward poor self-control received less attention from their mothers (Avinun & Knafo, 2014). This tendency only became stronger as the boy got older. And here we thought mothers would put up with anything.

The most basic way in which genes and environments interact is that the same environments that promote good outcomes for some people can promote bad outcomes for others, and vice versa, a process parallel to the *reactive person–environment transaction* described in Chapter 7. A stressful environment may lead a genetically predisposed individual to develop mental illness but leave other individuals unscathed. More generally, the same circumstances might be experienced as stressful, enjoyable, or boring, depending on the genetic predispositions of the individuals involved; these variations in experience can lead to very different behaviors and, over time, to the development of different personality traits.

Two pioneers in exploring the implications of gene-environment interactions are psychologists Avshalom Caspi and Terrie Moffitt. Along with their colleagues, Caspi and Moffitt work closely with a major project based in New Zealand that has followed a group of children for decades. One groundbreaking study assessed the degree to which participants experienced difficulties such as unemployment, financial setbacks, housing problems, health challenges, and relationship problems between the ages of 21 and 26, and then whether they experienced depression at the end of this period (Caspi et al., 2003). Building on the results summarized in the preceding section of this chapter, Caspi, Moffitt, and their coworkers found that people who had the short allele for the serotonin-related gene *5-HTT* were more likely to experience depression after these stressful experiences than those without this allele. But—and this is important—there was no difference in outcome between those with the long allele and those with the short allele if they had not suffered any stress. This is a perfect example of a genotype-environment interaction: The genotype is important, but only for people who have experienced a certain kind of environment.

Another study, similar in design, examined why some maltreated children become delinquents or adult criminals, while others do not (Caspi et al., 2002). In this case, the targeted gene was a part of the X chromosome that affects the enzyme *MAOA* (monamine oxidase A), which influences functioning of a range of neurotransmitters, including norepinephrine, serotonin, and dopamine (see Chapter 8). An earlier study showed that when this gene is "knocked out" (neutralized) in mice, the mice become highly aggressive, but when the gene is turned back on, they return to normal (Cases et al., 1995). The gene might help regulate aggression in humans as well. In Caspi's study, children whose gene was associated with low expression of this enzyme showed little difference in antisocial behavior from those whose gene was associated with high expression. In contrast, among maltreated boys who had the allele related to low *MAOA* activity, 85 percent exhibited "some form of antisocial behavior" (Caspi et al., 2002, p. 853). The findings were replicated by a study conducted in Virginia, which found that 15 percent of boys with adverse backgrounds and the high *MAOA* gene developed antisocial behaviors, whereas 35 percent of the boys who had adverse backgrounds and the low-activity form of this gene had this outcome (Foley et al., 2004). In other words, the low *MAOA* gene more than doubled the risk of developing antisocial behaviors, but only if the child had suffered maltreatment. Children who enjoyed good parenting and family backgrounds were at low risk regardless of their genes.

These findings received a great deal of attention and have been very exciting for the field of behavioral genetics, but recent work has shown the true picture to be more complicated than it seemed at first. Isn't that always how it goes? The provocative result concerning the interaction between the *5-HTT* gene and stressful life environments is not found in every study, and one meta-analysis summarized the literature by saying that it found "no evidence" that the gene "alone or in interaction with stressful life events is associated with an elevated risk of depression in men alone, women alone, or in both sexes combined" (Risch et al., 2009).

This discouraging outcome, and other failures to replicate provocative findings, have led some researchers to argue that "studies of gene-environment interactions are very unlikely to enhance our understanding" (Zammit, Owen, & Lewis, 2010, p. 65). Yet, this conclusion seems unduly pessimistic. For one thing, giving up on an area of research has yet to yield an increase in knowledge. For another thing, the serious pursuit of genotype-environment interactions is still a very new enterprise—the stimulating findings by Caspi and his colleagues are barely more than 10 years old. As improved methods of studying genes continue to be developed and, perhaps even more importantly, better methods for assessing the environment[5] become available, solid progress may yet be made. After

[5]This is a surprisingly neglected topic in behavioral genetics.

all, it is not really in doubt that the same environment can have different results on people with different genes. The main problem may be that any one gene can have only a small effect.

For example, consider the trait of neuroticism. As we saw in Chapter 6, this trait is an important risk factor for poor mental health outcomes, and may be bad for physical health as well (see Chapter 17). Where does this trait come from? According to a recent theoretical model (see **Figure 9.2**), it is a result of a series of complex transactions (Barlow, Ellard, Sauer-Zavala, Bullis, & Carl, 2014). First, a person may have a general biological vulnerability to stress that is genetically influenced in ways such as discussed above, probably by many different genes. At the same time, the person may have general *psychological* vulnerability caused by environmental factors such as poor parenting or the lack of a warm, supporting environment during early childhood. These two influences combine to produce a general inability to handle stress well, which is pretty much the definition of neuroticism. What happens next depends, again, on the person's environment. If the person has experiences that teach him, for example, that illness is dangerous—such as having a relative who becomes gravely ill or living in a family that overreacts whenever somebody catches cold—then he may develop

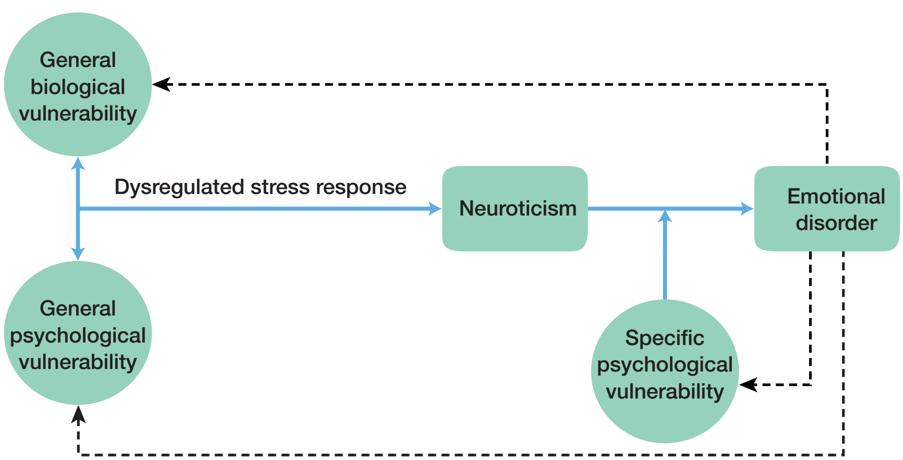

Figure 9.2 A Model of the Sources of Neuroticism According to this theoretical model, general biological and psychological vulnerabilities combine to create an inability to handle stress, which leads to the trait of neuroticism. This trait can interact with specific experiences to create phobias or other vulnerabilities that may, over time, lead to mental illness. Notice that although biological vulnerability is an important factor, it does not lead to either neuroticism or mental illness unless the person also has negative experiences in his or her environment.

Source: Barlow et al. (2014), p. 482.

a specific phobia to germs or a generally maladaptive response to illness. If he learns that being rejected by other people is a dire threat, perhaps from early negative experiences with peers, he may develop a social phobia. In the end, neuroticism can have any number of negative consequences for mental health, but the specific result will depend not on genes or biology, but on the way these factors interact with experience.

Epigenetics

Even at a biological level, the effect of a gene on behavior may depend on more than the gene itself. Recent work on **epigenetics** has begun to document how experience, especially early in life, can determine how or even whether a gene is expressed during development (Weaver, 2007). Some of the evidence comes from studies of rats, which differ in the expression of a gene related to their stress response as a function of how much licking and other grooming they received from their mothers when they were young (Weaver et al., 2004). Another study showed that genetically identical mice that explored their environments grew more brain cells than mice that did not, a perfect example of how experience can affect biology (Freund et al., 2013). All the mice had the genetic potential to grow their brains, but only the ones who bothered to look around developed this potential. Presumably, they became smarter mice.

There is no reason to think that the basic mechanisms of epigenetics will prove to be much different in humans. Recent evidence indicates that the experience of social stress can activate expression of genes that lead to vulnerabilities to depression, inflammatory diseases, and viral infections (Slavich & Cole, 2013). The bottom line is that transactions between genes and the environment can go in both directions and can reinforce or counteract each other. As was described earlier in the section on gene-environment interactions, genes can *change* environments and, as we are beginning to discover, environments can change genes. For this reason, one scientist wrote that, when it comes to the nature-versus-nurture controversy, we should probably just "call the whole thing off" (Weaver, 2007, p. 22).

Behavioral genetics sometimes is portrayed as a pessimistic view of human nature because, as was mentioned earlier, it might be taken to imply that people cannot change what they were born to be (Dar-Nimrod & Heine, 2011). The more we learn about how genetic influence on behavior really works, the clearer it becomes that this view is mistaken. As we have seen, while two different genes seem to put a person at risk for depression or antisocial behavior, the risk may go away—regardless of genes—with good parenting and a supportive family environment. For another example, in Chapter 6 I quoted a psychologist who suggests that persons with a genetically influenced determined tendency toward sensation seeking might be deterred from crime by participating in less damaging occupations that satisfy the need for excitement (such as race-car driving or hosting a radio talk show). Frankly, I'm not sure whether this was a serious suggestion. But it makes a point: If we understand an individual's genetic predispositions, we might be able to help her find an environment where her personality and abilities lead to good outcomes rather than bad ones.

The Future of Behavioral Genetics

The most significant news from the study of behavioral genetics over the past couple of decades is that genes have important influences on personality. This lesson constitutes a dramatic change from the conventional view that psychologists held for many years. The future of behavioral genetics, however, does not lie in further documenting this fact (Turkheimer, 1998). As behavioral geneticist Wendy Johnson and her colleagues have argued, "the ubiquity of the presence of substantial genetic influence on psychological traits is important . . . but the magnitudes of the heritability estimates are not" (Johnson et al., 2011).

Indeed, for behavioral genetics, the easy part is over. The next steps will require better understanding of the gene-environment correlations and interactions involved in personality development, and exploring for the genes that are associated with personality using techniques such as the *genome-wide association* (GWA) study. In a GWA study, data concerning hundreds of thousands of genes and patterns of genes in thousands of people are dumped into a computer, together with data about these individuals' personalities. The computer then searches to find which genes or patterns are associated with particular traits. Needless to say, this is a very difficult and expensive technique because extremely large numbers of people need to be examined to provide sufficient data, and so many analyses are performed that many and maybe nearly all the results that arise will be due merely to chance (Hewitt, 2012). The trick, then, is to figure out which associations are dependably found in different samples of subjects, a trick that has turned out to be easier said than done (McCrae et al., 2010).

Progress is coming, but it's slow. One large study found patterns of genes associated with all of the Big Five traits except extraversion, but only the pattern associated with agreeableness was consistent across three separate samples (Terracciano et al., 2010). Discouraged by findings like these, some researchers are suggesting that the attempt to connect traits to genes is doomed at the outset (Joseph & Ratner, 2012). Sound familiar? Again, this pessimistic argument is almost certainly premature. The most likely outcome, in the long run, is that major personality traits each will turn out to be associated with many different genes, each of which has a small effect that depends upon the effect of other genes as well as the environment. In other words, the ultimate picture is going to be complicated. But science is often like that.

EVOLUTIONARY PERSONALITY PSYCHOLOGY

Evolutionary theory is the foundation of modern biology. Modern extensions of the theorizing that began with Charles Darwin's *Origin of the Species* (1859, 1967) are used to compare one species of animal or plant to another, to explain the functional significance of aspects of anatomy and behavior, and to understand how animals function within their environments. More recently, an increasing number of researchers have applied the same kind of theorizing and reasoning to human behavior and even social structure. One landmark book, E. O. Wilson's *Sociobiology: The New Synthesis* (1975), applied evolutionary theory to psychology and sociology. Other earlier efforts, such as Konrad Lorenz's *On Aggression* (1966), also explained human behavior using analogies to animals and their evolution.

Evolution and Behavior

Evolutionary theorizing begins with this recognition: Every human being is the latest in a long, unbroken chain of winners. In particular, your parents somehow managed to find each other and produce a child who has progressed at least far enough as to be able to read this book. Their parents (your grandparents), similarly, all successfully survived to adulthood, found mates, and had children who themselves survived to have children. So did their parents, and their parents, and so on back to the misty origins of time.

Consider the magnitude of your family's achievement. History has included challenges ranging from volcanic eruptions to epidemics to wars. Many people died, and many of those died young, before they even had a chance to become parents. But this did not happen to any of your ancestors. Every single one of them, without exception, overcame these challenges with the result that they were able to have and protect families that survive up to the present day.[6]

Cultures who worship their ancestors may be on to something.

In other words, your grandparents and great-grandparents knew a few things, and cultures who worship their ancestors may be on to something. The evolutionary approach to personality assumes that human behavioral patterns developed because they were helpful or necessary for survival in the evolutionary history of the species. The more a behavioral tendency helps an individual to survive and reproduce, the more likely the tendency will be to appear in subsequent generations.

Some specific traits fit this pattern. People higher in extraversion but lower in conscientiousness and lower in openness to experience tend to have more children and grandchildren; higher agreeableness correlates with having more

[6]So don't you be the one to blow it.

grandchildren but not more children (Berg, Lummaa, Lahdenpera, Rotkirch, & Jokela, 2014). If you were to project these tendencies into the future, you might predict that future humans will be more extraverted and agreeable than they are now, but less conscientious and open to experience. But be patient; the process may take a few thousand years before the results are noticeable.

"Whenever Mother's Day rolls around, I regret having eaten my young."

AGGRESSION AND ALTRUISM A wide range of human behavior has been examined through the evolutionary lens. Lorenz (1966) discussed the possibly necessary—and sometimes harmful—role of the instinct toward aggression throughout human history. A tendency to be aggressive can help a person to protect territory, property, and mates, and also lead to dominance in the social group and higher status. But the same tendency can produce fighting, murder, and the industrial-scale murder called war.

Biologist Richard Dawkins (1976) considered the evolutionary roots of the opposite behavior, altruism. A tendency to aid and protect other people, especially close relatives, might help ensure the survival of one's own genes into succeeding generations, an outcome called *inclusive fitness*. It pays to be nice to those around you, especially your relatives, according to this analysis, because if those people who share your genes survive, some of your genes may make it into the next generation through those peoples' children, even if you produce no offspring yourself.

SELF-ESTEEM Evolutionary theory has also been used to explain why self-esteem feels so important. According to the "sociometer theory" developed by psychologist Mark Leary, feelings of self-esteem evolved to monitor the degree to which a person is accepted by others. Humans are a highly social species, and few things are worse than being shunned by the community. On the African savannah where the human species evolved, ejection from the tribe could mean death. On the reality television program *Survivor*, the dreaded words "The tribe has spoken" may touch a deep, instinctual fear.[7] Signs that we are not adequately valued and accepted cause our self-esteem to go down, motivating us to do things that will cause others to think better of us so that we can think better of ourselves. The people who did not

[7]In the unlikely event you have not seen this program, the host intones the phrase just after a member of the tribe is voted off the island. He then symbolically extinguishes the ex-member's torch.

Figure 9.3 **"The Tribe Has Spoken"** These words may touch a deep, evolutionarily based fear of being shunned by one's social group.

develop this motive failed to survive and reproduce (Leary, 1999). We, on the other hand—all of us—are the descendants of people who cared deeply what other people thought about them. And so we do too.

DEPRESSION Even depression may have evolved because of its survival value. According to one analysis, different kinds of depression[8] have different causes (M. C. Keller & Nesse, 2006). Depression that follows a social loss—such as a breakup with a boyfriend or girlfriend, or bereavement—is characterized by pain, crying, and seeking social support. Depression that follows failure—such as flunking an exam or being fired from a job—is more often characterized by fatigue, pessimism, shame, and guilt. Psychologists Matthew Keller and Randolph Nesse speculate that, in the history of the species, these reactions may have promoted survival. Pain signals that something has gone wrong and must be fixed. Just as it is important to be able to feel the pain of a broken leg so you won't try to walk on it,

[8]Actually, "depression" is a diagnostic classification that has several specific requirements; the theorizing here is really about "depressive symptoms" such as sadness, crying, social withdrawal, and so on.

so too it may be important to feel emotional pain when something has gone wrong in your social life, because that signals that your chances for reproducing or even surviving may be at risk. This is a process similar to Leary's sociometer theory. But Keller and Nesse go further to suggest that crying may often be a useful way of seeking social support, and that fatigue and pessimism can prevent one from wasting energy and resources on fruitless endeavors. One fascinating implication is that in the same way that blocking fever may prolong infections, blocking normal depressive symptoms with antidepressant medication could increase the risk of chronic negative life situations or poorer outcomes in such situations, even as the sufferers feel better. Similarly, individuals who lack a capacity for depressive symptoms should be more likely to lose valuable attachments, more likely to persist at unachievable pursuits, less able to learn from mistakes, and less able to recruit friends during adverse situations (M. C. Keller & Nesse, 2006, p. 328).

Have you ever told anyone to "go ahead, have a good, long cry"? It might have been good advice. Sometimes we need to feel the pain.

MATING BEHAVIOR A behavioral pattern that has received particular attention from evolutionary psychologists is the variation in sexual behavior between men and women. Particular differences stand out in **mate selection** and attraction—what one looks for in the opposite sex, and **mating strategies**—how one handles heterosexual relationships.

Attraction When seeking someone of the opposite sex with whom to form a relationship, is an average heterosexual more likely to be interested in his or her (1) physical attractiveness or (2) financial security? Across a wide variety of cultures, including those in early 21st-century North America, men are more likely than women to place higher value on physical attractiveness (D. M. Buss, 1989). In these same cultures, by contrast, women are more likely to value economic security in their potential mates. Indeed, there is some evidence that men and women consider attractiveness and resources, respectively, as essential attributes of potential mates, not just nice benefits (N. P. Li, Bailey, Kenrick, & Linsenmeier, 2002). In other words, being unattractive or poor can be a deal-breaker, depending on your gender.

In addition, heterosexual men are likely to desire (and typically do find) mates several years younger than themselves (the average age difference is about three years, and increases as men get older), whereas women prefer mates who are somewhat older than themselves. This difference can be documented through marriage statistics and even personal ads. When age is mentioned, men advertising for women usually specify an age younger than their own, whereas women do the reverse. The dichotomy between attractiveness and resources mentioned earlier also can be found in the personals: Men are more likely to describe themselves as financially secure than as physically attractive, whereas women are more likely to describe their physical charms than their financial ones (Kenrick & Keefe, 1992). Presumably, individuals of each sex sense what the other is looking for and so try to maximize their own appeal.

The evolutionary explanation of these and other differences is that men and women seek essentially the same thing: the greatest likelihood of having healthy offspring who will survive to reproduce. But each sex contributes to and pursues this goal differently, and thus the optimal mate for each sex is different. Women bear and nurse children, so their youth and physical health are essential. Attractiveness, according to the evolutionary explanation, is simply a display, or cue, that informs a man that a woman is indeed young, healthy, and fit to bear his children (D. M. Buss & Barnes, 1986; D. Symons, 1979).

In contrast, a man's biological contribution to reproduction is relatively minimal. Viable sperm can be produced by males of a wide range of ages, physical conditions, and appearances. For women, what is essential in a mate is his capacity to provide resources conducive to her children thriving until their own reproductive years. Thus, since a woman seeks a mate to optimize her children's circumstances, she will seek someone with resources (and perhaps attitudes) that will support a family, whereas a man seeks a mate who will provide his children with the optimal degree of physical health.

We can see already that these explanations gloss over some complications. For example, a woman who lacks sufficient body fat will stop menstruating and therefore will be unable to conceive children, yet many women considered by men to be highly physically attractive are thin, nearly to the point of anorexia.[9] In previous eras, larger (and better fed) women were considered ideal. Moreover, the degree to which we consider someone attractive can be influenced by how much we like them, as well as vice versa. One study found that when people are told someone is honest, they come to like them more and, as a result, rate them as more physically attractive (Paunonen, 2006). In this and other ways, so-called physical attractiveness is more than just physical.

Likewise, males' looks are more important to many women than the standard evolutionary explanation seems to allow. In other species, male displays of large manes or huge fans of plumage appear to be signs of health that attract females, so their visible attributes clearly matter. It is not clear why the situation would be so different in humans. However, it must be admitted that physical attractiveness does not seem to be as important to women as to men. The question is why this

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[9]However, women generally overestimate the degree of thinness that men find most attractive. Conversely, men overestimate the degree of muscularity that women find most attractive (Frederick & Haselton, 2007). Perhaps because of this, pictures of men in men's magazines are more muscular than pictures of men in women's magazines (Frederick, Fessler, & Haselton, 2005). Conversely, we might expect pictures of women in women's magazines to show thinner women than pictures of women in men's magazines, but I have not seen a study that documents this.

is. In addition to whatever evolutionary basis the difference has, culture seems to matter. In countries where men and women have smaller "gender gaps" in earnings and opportunities, the sex difference in mate preference is also smaller (Zentner & Mitura, 2012). Specifically, women and men are more likely to have similar preferences in Finland, the Philippines, and Germany than in Mexico, South Korea, and Turkey. This finding suggests that differences in mate preference may reflect practical considerations in the current context rather than just instinctive, evolved biases.

Mating Strategies Beyond the stage of initial attraction, men and women also differ in the strategies they follow in establishing and maintaining relationships. According to the evolutionary account, men want more sexual partners than women do, and are less faithful to and picky about the women with whom they will mate. This approach appears to be particularly common in men characterized by traits sometimes called "the Dark Triad": narcissism, psychopathy, and Machiavellianism (Jonason, Li, Webster, & Schmitt, 2009). Most women probably already know this. In a famous (or infamous) study, attractive male and female research assistants walked up to fellow students of the opposite sex and asked them to go to bed with them. Most men accepted; not one woman did (Clark & Hatfield, 1989). But a follow-up study clarified what was going on (Conley et al., 2011). The women thought that any man who would approach them like that was probably a creep. They preferred a little more finesse.

More generally, men appear to be prone to certain kinds of wishful thinking in which they are quick to conclude that women are sexually interested in them, even when they are not (Haselton, 2002). Women, in contrast, are more selective about their mating partners and, having mated, seem to have greater desires for monogamy and stable relationships.

These differences also can be explained in terms of reproductive success. A male may succeed in having the greatest number of children who reproduce to subsequent generations—which evolutionarily speaking is the only outcome that matters—by having as many children by as many women as possible. In a reproductive sense, it may be a waste of his time to stay with one woman and one set of children; if he leaves them, they will probably survive somehow and he can spend his limited reproductive time trying to impregnate somebody else. A woman, however, is more likely to have viable offspring if she can convince the father to stay to support and protect her and the family they create. In that case, her children will survive, thrive, and eventually propagate her genes.

Men and women are not different in all respects, however (Hyde, 2005). For example, once a stable relationship is formed, both have interests in maintaining it. People "attach" to their romantic partners in much the same way that parents and children do, and the same evolved psychological mechanism might underlie both kinds of attachment[10] (Fraley & Shaver, 2000; Hazan & Diamond, 2000). Relationship maintenance might also be the reason that both men and women who are in steady dating relationships find opposite-sex strangers less attractive than do those who are not in such relationships (Simpson, Gangestad, & Lerma, 1990). It is adaptive to find prospective partners attractive if you still need one, but once you are in a relationship the attractiveness of others—and your response to that attraction—could end up threatening what you already have.

Sociosexuality "Sociosexuality," as was described in Chapter 5, is the willingness to engage in sexual relations in the absence of a serious relationship (Penke & Asendorpf, 2008; Simpson & Gangestad, 1991) (see **Try for Yourself 9.1**). Men generally score higher than women in this trait, as you might expect, but it has other implications as well. For example, both men and women who are "unrestricted"—who score high on this trait—are especially interested in the physical attractiveness and social visibility of potential partners. Those who are more "restricted"—who score lower—are more interested in partners' personal qualities and their potential to be good parents (Simpson & Gangestad, 1992).

Another implication of this trait was illustrated in a "speed dating" study, in which men and women had a series of brief conversations and then, at the end of the evening, nominated who they were interested in getting to know better (Back, Penke, Schmukle, & Asendorpf, 2011). They also tried to guess who had chosen them. Men higher in sociosexuality were more accurate in these guesses. They knew their "mate value" in the sense that they had a realistic view about whether many or few women had chosen them.

Apparently, a man who desires to have sexual relations with numerous women, if he is going to be successful, has to develop an accurate eye for who might be interested. You can also see, from **Figure 9.4**, that men high in sociosexuality actually were chosen more often than were men low in this trait. For women, by contrast, this trait was not associated with the accuracy of their assessments of their own mate value, nor with how often they were chosen. Instead, women's accuracy was predicted by their agreeableness—a finding that is harder to explain.

Men higher in sociosexuality also are more likely to engage in "conspicuous consumption"—buying and displaying expensive objects, such as designer watches and expensive cars—to try to attract women for short-term encounters (Sundie et al., 2011). To some degree, this is effective. Women rated a man described as driving a Porsche Boxster as a more desirable date—but not a better possible marriage partner—than a man who drove a Honda.[11] You can almost hear what the women

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[10]Have you noticed how many love songs include the word "baby"?

[11]Recall the finding reported in Chapter 8, that driving a Porsche can raise a man's testosterone level. I guess there's just something about Porsches.

TRY FOR YOURSELF 9.1

The Sociosexuality Scale

Instructions: Please respond honestly to the following questions:

1. With how many different partners have you had sex within the past 12 months?

☐	☐	☐	☐	☐
0	1	2 to 3	4 to 7	8 or more

2. With how many different partners have you had sexual intercourse on one and only one occasion?

☐	☐	☐	☐	☐
0	1	2 to 3	4 to 7	8 or more

3. With how many different partners have you had sexual intercourse without having an interest in a long-term committed relationship with this person?

☐	☐	☐	☐	☐
0	1	2 to 3	4 to 7	8 or more

4. Sex without love is OK.

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Totally disagree				Totally agree

5. I can imagine myself being comfortable and enjoying "casual" sex with different partners.

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Totally disagree				Totally agree

6. I do not want to have sex with a person until I am sure that we will have a long-term, serious relationship.

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Totally disagree				Totally agree

7. How often do you have fantasies about having sex with someone you are *not* in a committed romantic relationship with?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Never	Very seldom	About once a month	About once a week	Nearly every day

Continued

TRY FOR YOURSELF 9.1

The Sociosexuality Scale—cont'd

8. How often do you experience sexual arousal when you are in contact with someone you are not in a committed romantic relationship with?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Never	Very seldom	About once a month	About once a week	Nearly every day

9. In everyday life, how often do you have spontaneous fantasies about having sex with someone you have just met?

1 ☐	2 ☐	3 ☐	4 ☐	5 ☐
Never	Very seldom	About once a month	About once a week	Nearly every day

Scoring: Score each response from 1 to 5, with the lowest response (on the left) scoring 1 and the highest (on the right) scoring 5. Divide the total by 9.

Norms: For men: average = 3.08, high = 3.77 or above, low = 2.32 or less. For women: average = 2.65, high = 3.42 or above, low = 1.88 or less. (Compared to an online sample of 511 male and 1,203 female German-speaking college students. High scores are one standard deviation above average or more; low scores are one standard deviation below average or more. For other norms and instructions on scoring subscales, see http://www.larspenke.eu/en/research/soi-r.html.)

Note: This scale, by Lars Penke and Jens Asendorpf, is a refinement of the original version by Simpson and Gangestad (1991).

Source: Penke & Asendorpf (2008).

were thinking: "A date with this guy might be fun, but who would want to be married to somebody who wastes money like that?" Other results suggest that women understand exactly what these high-sociosexuality men are up to. They know that someone who flashes wealth in a dating context is more likely to be interested in a short-term fling than a long-term relationship.

Jealousy A related difference between men and women is the way they experience sexual jealousy. One study asked participants to respond to the following vignette (D. M. Buss, Larsen, Westen, & Semmelroth, 1992, p. 252):

> Please think of a serious committed relationship that you have had in the past, that you currently have, or that you would like to have. Imagine that the person with whom you've become seriously involved became

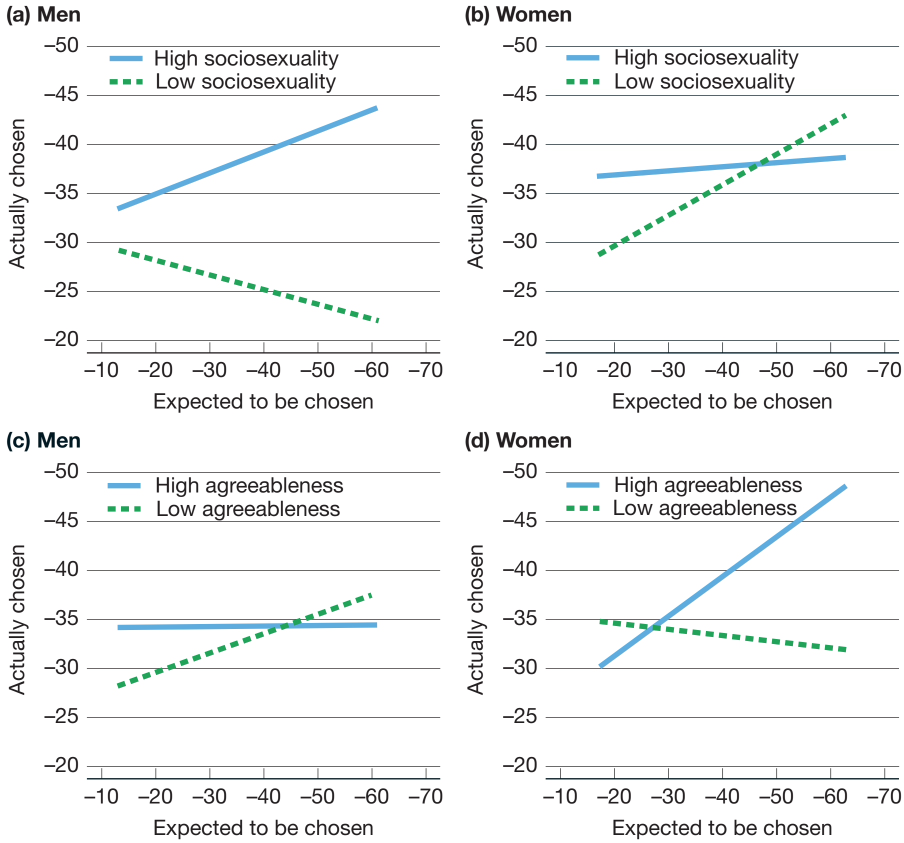

Figure 9.4 Sociosexuality, Agreeableness, and the Accuracy of Perception of Mate Value The figures show the mean proportion of the times participants' partners in a speed-dating study said they wanted to get to know them better, as a function of the mean proportion of times the participants thought they were interested. Men who were higher in the trait of sociosexuality were more accurate; among women, accuracy was associated with agreeableness.

Source: Back, Penke, Schmukle, & Asendorpf (2011), p. 987.

interested in someone else. What would distress or upset you more? (Circle only one.)

(a) Imagining your partner forming a deep emotional attachment to that person,

or

(b) Imagining your partner enjoying passionate sexual intercourse with that person.

In this study, 60 percent of the males chose option b, whereas 82 percent of the females chose option a. In a follow-up study, the final question was changed slightly (D. M. Buss et al., 1992, p. 252):

> What would upset you more?
>
> (a) Imagining your partner trying different sexual positions with that other person, or
>
> (b) Imagining your partner falling in love with that other person.

This time, 45 percent of the males chose option a, whereas only 12 percent of the females chose option a. In other words, option b was chosen by 55 percent of the males and 88 percent of the females. Notice that this question does not produce a complete reversal between the sexes; most members of each sex find their partner falling in love with someone else more threatening than their partner having intercourse with him or her. But the difference is much stronger among women than men.

Why is this? Evolutionarily speaking, a man's greatest worry—especially for a man who has decided to stay with one woman and support her family—is that he might not be the biological father of the children he supports. This fact makes sexual infidelity by his mate his greatest danger and her greatest betrayal, from a biological point of view. For a woman, however, the greatest danger is that her mate will develop an emotional bond with some other woman and so withdraw support—or, almost as bad, that her mate will share their family's resources with some other woman and her children. This makes emotional infidelity a greater threat than mere sexual infidelity, from the woman's biological point of view.

Related evolutionary logic can even explain some seeming paradoxes or exceptions to these general tendencies. For example, why are some women attracted to men who are obviously unstable? Consider the situation described by many country-and-western songs. Some women prefer men who may be highly physically attractive (and/or own motorcycles) even when such men have no intention of forming a serious relationship and are just "roaming around." I have no idea how common this situation is, but from an evolutionary standpoint it should never happen, right?

Wrong. The theory is rescued here by what has been called the "sexy son hypothesis" (Gangestad, 1989). This hypothesis proposes that a few women consistently—and many women occasionally—follow an atypical reproductive strategy (Gangestad & Simpson, 1990). Instead of maximizing the reproductive viability of their offspring by mating with a stable (but perhaps unexciting) male, they instead take their chances with an unstable but attractive one. The theory is that if they produce a boy, even if the father then leaves, the son will be just like his dad. When he grows up, this "sexy son" will spread numerous children (who of course will also be the woman's grandchildren) across the landscape, in the same ruthless, irresponsible, but effective manner as his father.

Some evidence does support this hypothesis, if not prove it. Women report more interest in having sex with someone other than their primary partner when the "other man" is significantly more attractive than their regular partner and they are themselves near ovulation (Pillsworth & Haselton, 2006). Moreover, women's short-term sexual partners tend to be more muscular than men with whom they have longer-term relationships (though it turns out to be important that they not be *too* muscular; Frederick & Haselton, 2007). But male attractiveness is more than just a matter of muscles: Women in their fertile period also find creative men especially attractive (Haselton & Miller, 2006). It might be in order to attract these attractive, muscular, creative men that women tend to dress more provocatively when they are in the middle of their cycle (Durante, Li, & Haselton, 2008).

Individual Differences

Evolutionary psychology has, so far, been more concerned with the origins of general human nature than with individual differences. Indeed, evolutionary influence on human characteristics was sometimes taken to imply that individual differences should be unimportant, because maladaptive behavioral variations should have been selected out of the gene pool long ago (Tooby & Cosmides, 1990). However, the basic mechanism of evolution *requires* individual differences. Species change only through the selective propagation of the genes of the most successful individuals in earlier generations, which simply cannot happen if everybody is the same. So not only is it fair to expect a "theory of everything" like evolutionary psychology to explain individual differences, such an explanation is essential for the theory to work.

ADAPTATION Diversity is what makes adaptation to changing conditions possible. At the level of the species, a trait that used to be maladaptive or just irrelevant can suddenly become vital for survival. A classic example is the story of the English peppered moth (Majerus, 1998). These moths were mostly white until the Industrial Revolution arrived in the mid-19th century along with factories that spewed coal dust. The white moths stood out in this new environment and became easy prey for birds, but the few individuals in the species who happened to be darker colored were able to survive and propagate. Soon almost all the moths were black. But by the end of the 20th century the air had been substantially cleaned up, and white peppered moths became common again.

The same thing can happen at the level of the individual. A trait that is adaptive in one situation may be harmful in another (Nettle, 2006; Penke et al., 2007). The Big Five personality trait of neuroticism can cause needless anxiety in safe situations, but might promote lifesaving worry in dangerous ones. Similarly, agreeableness can make you popular, but also vulnerable to people intent on cheating you. The end result is that, over hundreds of generations, people continue to be born who are near both ends of every trait dimension, even while most are near the middle.

An individual difference variable that may encompass both kinds of adaptation is called "life history" (or LH for short). The idea is that animals generally exhibit one of two different approaches to reproduction. In one, the animal reproduces multiple times at a young age but does not devote many or any resources to protecting offspring; in the other, the animal does not reproduce until relatively late in life, has fewer offspring, but invests more in each one. Rabbits are an example of the first approach; elephants (and most humans) are examples of the second. The first approach is called "fast-life history" (fast-LH) because it seems best adapted to species that live in dangerous circumstances and typically die young (Ellis, Figueredo, Brumbach, & Schlomer, 2009; Figueredo et al., 2010). The second is called "slow-life history" (slow-LH) because it seems to work better for long-lived species that have a chance for extended protection and nurturing of their offspring.

Early in the history of the human species, the fast-LH strategy may have worked better for reproductive success, but in modern times, in most environments, the slow-LH strategy seems to be more effective. But individuals of both kinds still exist, and may even appear to a different extent in different environments. Safe, predictable environments promote the appearance of slow-LH individuals who marry late, have few children, and put extensive resources into raising them. Dangerous, unpredictable environments are more likely to produce fast-LH individuals who have children when they are very young but—especially if they are male—may not stay around to help support and raise them. Most current writing on LH tends to describe the slow-LH history as better overall, but there are tradeoffs. In one study, slow-LH individuals were observed to display behavior described as considerate, kind, hardworking, and reliable, but also socially awkward, insecure, and overcontrolling (Sherman, Figueredo, & Funder, 2013). For their part, fast-LH individuals came across as unpredictable, hostile, manipulative, and impulsive, but also as talkative, socially skilled, dominant, and charming. From an evolutionary perspective, neither LH strategy is "better"; each is adapted to a different set of environmental circumstances.

ACCOUNTING FOR INDIVIDUAL DIFFERENCES Overall, evolutionary psychology accounts for individual differences in three basic ways (D. M. Buss & Greiling, 1999). First, behavioral patterns evolve as reactions to particular environmental experiences. Only under certain conditions does the evolved tendency come "on line," sort of like the way the skin of a Caucasian has a biological tendency to darken if but only if it is exposed to the sun. For example, a child who grows up without a father present during the first five years of childhood may respond with an evolved tendency to act as if family life is never stable, which might in turn lead to early sexual maturity and frequent changes of sexual partners, but this same child may reach sexual maturity later if childhood is spent with a stable father present (Belsky, Steinberg, & Draper, 1991; Sheppard & Sear, 2012). Or, as just related, a person who grows up in an unpredictable and dangerous environment may be stimulated to follow a fast-LH lifestyle; the same person growing up in a safe, predictable environment may do the reverse.

Second, people may have evolved several possible behavioral strategies, but actually use the one that makes the most sense given their other characteristics. This may be the reason for the finding, cited earlier in this chapter, that physically attractive people are more likely to be extraverts—social activity may be more rewarding for people who are good looking (Lukaszewski & Roney, 2011). Similarly, we may all have innate abilities to be both aggressive and agreeable. But the aggressive style works only if you are big and strong; otherwise, the agreeable style might be a safer course. This may be why big, muscular boys are more likely to become juvenile delinquents (Glueck & Glueck, 1956).

Third, some biologically influenced behaviors may be *frequency dependent*, meaning that they adjust according to how common they are in the population at large. For example, one theory of *psychopathy*—a behavioral style of deception, deceit, and exploitation—is that it is biologically influenced in only a small number of people (Mealey, 1995). If more than a few individuals tried to live this way, nobody would ever believe anybody, and the psychopathic strategy for getting ahead would become evolutionarily impossible to maintain.

These are interesting suggestions, but notice how they all boil down to an argument that human nature has evolved to be flexible. I think that is a very reasonable conclusion, but, at the same time, it tends to undermine the idea that evolution is the root of specific behavioral tendencies—such as self-esteem, depression, mate selection, and jealousy—which has been the whole point of the approach. This is just one reason why evolutionary psychology is controversial. Psychologists have pointed out several difficulties with an evolutionary approach to human personality, to which we now turn.

Five Stress Tests for Evolutionary Psychology

Much like Darwin's foundational theory of evolution, the evolutionary approach to human behavior has been controversial almost from the beginning. Its account of sexual behavior and sex differences, in particular, seems almost designed to set some people off, and it certainly does. At least five serious criticisms have been levelled, and each one provides a "stress test" that assesses the degree to which the evolutionary approach to behavior can stand up to challenge. Let's see how it does.

METHODOLOGY The first challenge concerns scientific methodology. It is interesting and even fun to speculate backward in the way that evolutionary theorists do, by wondering about what circumstances or goals in the past might have produced a behavioral pattern we see today. Indeed, such speculation is suspiciously easy, and even sometimes reminiscent of the "just so" stories of Rudyard Kipling, which explained how the whale got its throat, how the camel got its hump, and so forth (Funder, 2007). Evolutionary psychologists sometimes proceed almost in the same way, with the result that they seem ready to explain anything from preferences for salty foods to spousal murder. Remember the "sexy son hypothesis" summarized a few pages back? It conveniently disposed of the contradiction between the evolutionary idea that women seek stable mates, and the empirical fact that some women do the reverse. Was this hypothesis a little too convenient?

How can such evolutionary speculations be put to empirical test? What sort of experiment could we do to test the sexy son hypothesis, or to see whether men really seek multiple sexual partners in order to maximize their genetic propagation? Consider the even more radical proposals that males have an evolved instinct toward rape because it furthers their reproduction (Thornhill & Palmer, 2000), or that step-parents are prone to child abuse because of the lack of shared genes (Daly & Wilson, 1988). These are provocative suggestions, to say the least, but they also entail problems.

For one, there is something odd about postulating an instinctual basis for behaviors like rape or child abuse when most men are not rapists and most step-parents are not abusive. Primatologist Frans de Waal calls this the "dilemma of the rarely exercised option" (de Waal, 2002, p. 189). Furthermore, it is unwise to assume that every genetically influenced trait or behavior pattern exists because it has an adaptive advantage. Because of the human genome, people walk upright, and because we evolved from four-legged creatures, this design change makes us prone to backache. Apparently, walking upright had enough advantages to counteract the disadvantages, but that does not mean that lower-back pain is an evolved mechanism. In the same way, behavioral patterns such as depression, unfaithfulness, child abuse, and rape—even if they are genetically influenced—may be unfortunate side effects of other, more important adaptations. As de Waal noted, "the natural world is rampant with flawed designs" (2002, p. 188) because evolution always has to build, step-by-step, on what is already there. It doesn't have the luxury of going back and designing a whole new organism from scratch.

Evolutionary theorists usually acknowledge that criticisms such as these are fair, to a point, but they also have a reasonable response: For any theoretical proposal in science—not just those in evolutionary psychology—alternative explanations are always possible. Moreover, whole, complex theories are seldom judged on the basis of one crucial, decisive study. Instead, numerous studies test bits and pieces as methods become available. Complex evolutionary theories of behavior are difficult to prove or disprove in their entirety, and some alternative explanations may never be ruled out, but empirical research can address specific predictions. For example, the evolutionary theory of sex differences not only predicts that males should prefer mates younger than themselves and females should prefer mates who are older, but that this should be true in all cultures (Kenrick & Keefe, 1992). The prediction has been confirmed everywhere it has been tested so far, including India, the United States, Brazil, Kenya, Japan, and Mexico (Dunn, Brinton, & Clark, 2010). This finding does not prove that the reproductive motives described by evolutionary theory cause the age differences, nor does it rule out all possible alternative explanations; but in fairness it must be considered encouraging empirical support.

REPRODUCTIVE INSTINCT A second challenge is that evolutionary psychology's assumption that everybody wants as many children as possible can seem strange in a world where many people choose to limit their own reproduction. For example, how can it make sense to say that a woman who dresses provocatively is seeking an attractive mate who will provide good genes for her children, if at the same time she is on the pill? Evolutionary psychologists have a good response to this objection too. For evolutionary theorizing about behavior to be correct, it is not necessary for people to consciously try to do what the theory says their behavioral tendencies are ultimately designed to do (Wakefield, 1989). All that is required is for people in the past who followed a certain behavioral pattern to have produced more members of the present generation than did people who did not follow the pattern (Dawkins, 1976).

Thus, although you might or might not want children, it cannot be denied that you would not be here unless somebody (your ancestors) had children. (Neither sterility nor abstinence runs in anyone's family.) The same tendencies (e.g., sexual urges) that caused them to produce offspring are also present in you. Thus, your sexual urges are based on a reproductive instinct, whether or not you are consciously aware of it or wish to reproduce. It is also the case that your sexual urges do increase your chances of reproducing, whether you want them to or not, since birth control methods sometimes fail. According to evolutionary theory, people have tendencies toward sexual behaviors in general because of the effects of similar sexual behaviors on past generations' reproductive outcomes—not necessarily because of any current intention to propagate.

Neither sterility nor abstinence runs in anyone's family.

CONSERVATIVE BIAS A third criticism of the evolutionary approach to behavior is that it embodies a certain conservative bias (Alper, Beckwith, & Miller, 1978; Kircher, 1985). Because it assumes that humans' current behavioral tendencies evolved as a result of the species' past environments, and that these tendencies are biologically rooted, the evolutionary approach seems to imply that the current behavioral order was not only inevitable but also is probably unchangeable and appropriate.[12] This implication troubles some people who think that male infidelity, child abuse, and rape are reprehensible (which they are, of course), and others who think that human tendencies toward aggression must be changed.

Evolutionary theorists respond that objections like these are irrelevant from a scientific standpoint. They also observe that with this criticism, opponents of evolutionary theories themselves commit the "naturalistic fallacy" of believing that anything shown to be natural must be assumed to be good. But evolutionary theorists do not assume that what is natural is good (Pinker, 1997). As philosopher Daniel Dennett, who writes frequently about evolutionary theory, has stated, "Evolutionary psychologists are absolutely not concerned with the moral justification or condemnation of particular features of the human psyche. They're just concerned with their existence" (cited in Flint, 1995). If an ideological bias does underlie evolutionary psychology, it is more subtle. The basic assumption that our personalities have been selected over the millennia to favor behaviors that promote our individual survival may itself come from the larger culture. As one critic has observed, "In totalitarian regimes, dissidence is treated as a mental illness. In apartheid regimes, interracial contact is treated as unnatural. In free-market regimes, self-interest is treated as hardwired" (Menand, 2002, p. 96).

HUMAN FLEXIBILITY A fourth and more powerful challenge is that evolutionary accounts seem to describe a lot of specific behavior as genetically programmed into the brain, whereas a general lesson of psychology is that humans are extraordinarily flexible creatures with a minimum of instinctive behavior patterns, compared with other species. Indeed, we saw in Chapter 8 that the prefrontal cortex (which is uniquely developed in humans) has the function of planning and thinking beyond simple responses and fixed patterns of behavior. Yet, evolutionary accounts sometimes seem to suggest built-in behavioral patterns that cannot be overcome by conscious, rational thought.

The issue here is not whether the basic theory of evolution is correct; the scientific community settled that question to its satisfaction long ago. Rather, the issue is whether, in the domain of behavior, people evolved general capacities for planning and responding to the environment, or specific behavioral patterns (called *modules*; Öhman & Mineka, 2001). When evolutionary psychology tries to explain behaviors such as mate preference, sex differences in jealousy, and even child abuse and rape, it seems to favor a modular approach (C. R. Harris, 2000). But when it addresses the question of individual differences, evolutionary psychology

[12]Notice that in this context the word "conservative" means tending to favor the status quo, not necessarily any of the various political viewpoints that share this label.

acknowledges that the evolution of the cerebral cortex has given the human brain the ability to respond flexibly to changing circumstances and even to overcome innate urges. These two kinds of explanation are difficult but perhaps not impossible to reconcile, and debate in the next few years is likely to focus on this issue. What is the human evolutionary heritage? Is it a collection of specific responses triggered almost automatically by particular circumstances? Or is it the ability to plan, foresee, choose, and even override instinctive tendencies?

BIOLOGICAL DETERMINISM OR SOCIAL STRUCTURE? A final criticism of the evolutionary approach to personality is closely related to the idea that people evolved to be flexible. Many behavioral phenomena might be the result not of evolutionary history but of humans responding to changing circumstances, especially social structure. For example, the sex differences discussed earlier may be caused not by biological hard wiring, but by the current structure of society.

Psychologists Alice Eagly and Wendy Wood have provided an alternative to the evolutionary account of the differences in the criteria used by men and women in choosing mates (Eagly & Wood, 1999; W. Wood & Eagly, 2002). They hypothesize that because of men's greater size and strength, and women's role in childbearing and lactation, societies have developed worldwide in which men and women are assigned different jobs and social roles. Men tend to be warriors, rulers, and controllers of economic resources. Women are more likely to be restricted to staying near the home, gaining power and affluence largely as a function of the men with whom they affiliate. This difference is enough, Eagly and Wood argue, to explain why women value the wealth and power of a man more than his looks, and why the wealth of a woman matters less to a man. The difference comes not from a specific innate module, but from a reasonable and flexible response to the biological and social facts of life (see also Eagly, Eastwick, & Johannesen-Schmidt, 2009).

The argument is important for both theoretical and practical reasons. On a theoretical level, it goes to the heart of the question of how much of human nature is evolutionarily determined and biologically inherited. On a practical level, the world is changing. In an industrial culture where physical strength has become less important than it was in the past and alternative child-care arrangements are possible, the traditional division of labor between men and women no longer seems inevitable. But it continues anyway, because societies are slow to change. What happens next?

According to the evolutionary view, the differences between men and women in mate selection and other behaviors are built-in through biological evolution. This view implies that it might be almost impossible to change these differences; at best, any change will occur at the speed of evolution, thus likely requiring thousands of years. According to the contrary societally based view, as the necessity for

Figure 9.5 We Have the Power These are political posters portraying the German Prime Minister Angela Merkel. She won the election. As the power differential between the sexes becomes smaller, mating strategies of both men and women may change.

a gender-based division of labor melts away, societies will change, and sex differences will change (and perhaps lessen) as a result. The process may be slow—it still might take hundreds of years—but will be much quicker than the processes of biological evolution.

It may be happening already. According to one analysis by Eagly and Wood (W. Wood & Eagly, 2002), in modern cultures where women have power relatively equal to men, the sex differences in preference for a wealthy spouse are much smaller than in the cultures where the power difference is intact (see also the findings cited earlier by Zentner & Mitura, 2012). This finding suggests—but it does not prove—that as societies begin to provide equal power to women, some of the sex differences discussed earlier in this chapter may begin to erode. A natural experiment may be underway. In the early 21st-century United States, unlike in past decades, more women are completing college than men. As a result, some women are finding it necessary to "settle" for husbands who make less money than they do, or not marry at all (Taylor et al., 2010; see **Figure 9.6**). This difference reverses the traditional sex roles and, from an evolutionary perspective, may counteract biology as well. How flexible will men and women turn out to be in the face of changing social circumstances? Time will tell.

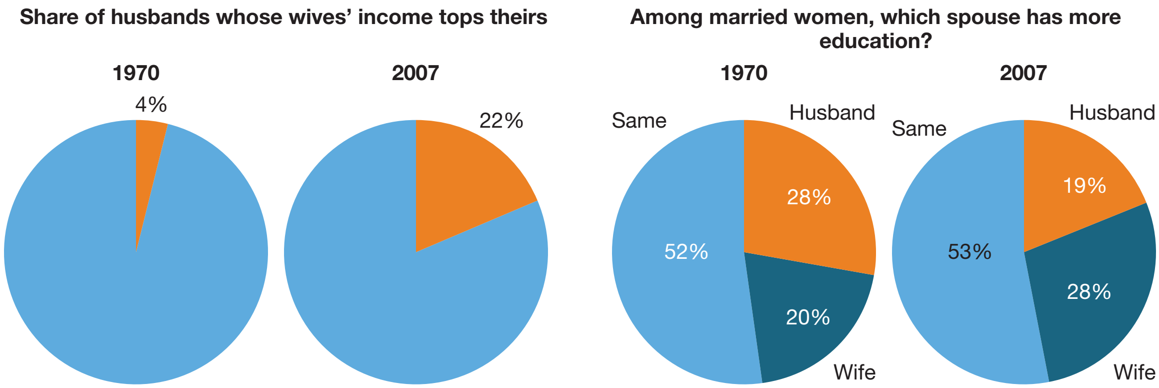

Figure 9.6 Changes in Educational and Income Differences Between Husbands and Wives Increasingly often, married women have more education and make more money than their husbands. What does this fact imply for the future of marriage and traditional social roles?
Source: Taylor et al. (2010), p. 1.

The Contribution of Evolutionary Theory

Researchers will continue to argue about the details of evolutionary theory as applied to human behavior for a long time to come. But one fact is already beyond argument: Since the introduction of evolutionary thinking into psychology, the field will never be the same (Pinker, 1997). Darwin forced humans to acknowledge that *Homo sapiens* is just another animal—a recognition that encounters resistance even now. Evolutionary psychology goes even further, by placing human thought, motivation, and behavior into a broad natural context.

Not every aspect of thought or behavior exists because it specifically evolved. But researchers now always have to consider the possibility. Whenever an investigator is trying to explain a brain structure, thought pattern, or behavior, he can no longer avoid asking, Is this explanation plausible from an evolutionary perspective? How might this (brain structure, thought process, or behavior) have promoted survival and reproduction in the past? Does the answer to this question help explain why people today—the descendants of past survivors and reproducers—have it?

INHERITANCE IS THE BEGINNING, NOT THE END

At the end of Chapter 8, I returned to the problem of Hippocrates' MP3 player by noting that once he figured out how it worked, he still would not have begun to answer questions concerning why people like music, how the economics of the music industry works, or why some artists achieve fame and others do not—all of which are important if he wants to fully understand the sounds that come out of that box.

Let's conclude this discussion of the inheritance of personality by returning to the Rockefellers and the way they transmit large amounts of money from one generation to the next. In the short run, this is easily explained because each new Rockefeller has wealthy parents. In the longer run, the wealth of the extended clan can be traced to one spectacularly successful ancestor. But let's look at little Baby Rockefeller and ask a few more questions. What will she do with her share of all this inherited wealth? Will she spend it on luxury, give it to charity, use it for a career in politics, or fritter it away on drugs and die broke? Previous Rockefellers have done all of these things. The inheritance is just the beginning; what she does with it depends on the society in which she lives, the way she is raised by her parents, and, yes, on her biological genes. The personality you inherited from your parents and your distant ancestors may work the same way. It determines where you start, but, as we saw in Chapter 7, where you go from there depends on many things, and is ultimately up to you and the world you inhabit and influence.

WILL BIOLOGY REPLACE PSYCHOLOGY?

This chapter and the previous one reviewed the implications for personality of four different areas of biology that apply equally to humans and animals: anatomy, physiology, genetics, and evolution. Each has a lot to say about personality. Indeed, the contributions from each of these fields can be taken to imply that personality is rooted in biology. This implication was anticipated by Gordon Allport's classic definition, which predated by many years nearly all of the research just surveyed. Allport wrote that personality is "the dynamic organization within the individual of those *psychophysical systems* that determine his [or her] characteristic behavior or thought" (originally offered in Allport, 1937; also in Allport, 1961, p. 18; my emphasis).

The rapid progress of biological approaches in recent years has led some observers to speculate that, as an independent field of study, psychology is doomed. Because personality is a psychophysical system, once everything is known about brain structure and physiology, there will be nothing left for psychologists to investigate! This point of view is called *biological reductionism*—in the final analysis, it reduces everything about the mind to biology.[13]

[13]Just within the past few years, the Departments of Psychology at Dartmouth College, Indiana University, and the University of California at Santa Barbara all changed their names to the "Department of Psychological and Brain Sciences." I wish they hadn't done this. The word "psychology" already includes brain science, and these name changes imply that it doesn't.

Obviously, I have a vested interest in this issue; nevertheless, I will state that I do not think biology is going to replace psychology. It certainly will not do so any time soon. As we have seen, too many huge gaps remain in our knowledge of the nervous system to replace the other approaches to human personality—yet.

But what about—ever? Even in the distant future, I don't think biology will replace psychology, and the reason is fundamental. Biological approaches to psychology, by themselves, tell us much more about biology than about psychology. This biology is extremely interesting, but it does not provide a description of how people act in their daily social environments, or of the consistencies that can be found in their behaviors (topics we considered in Part II of this book). A purely biological approach will never describe what psychological conflict feels like, or how such conflict might be revealed through accidental behavior, or what it means to face one's existential anxiety (topics to be considered in Parts IV and V). A purely biological approach does not address how an individual's environment can influence behavior, or explain how an individual interprets that environment or plans a strategy for success (topics considered in Part VI). It cannot even say much about what is on your mind at this moment.

For example, the evolutionary process, as it has affected males, gives them a biological tendency to be unfaithful to their mates (according to one theory). But what happens inside the male's head at the moment he is unfaithful? What does he perceive, think, feel, and, above all, want? Evolutionary psychology not only fails to answer this question; it fails to ask it. Similarly, the other biological approaches describe how brain structures, neurochemicals, or genes affect behavior without addressing the psychological processes that connect the brain, neurochemicals, or genes, on the one hand, and behavior on the other.

One theme of this book is that different approaches to personality are not different answers to the same question; rather, they pose different questions. Thus, there is little danger of any one of them completely taking over. The biological approach to personality is becoming more important all the time, and evolutionary theory organizes a huge range of psychological knowledge. But behavioral genetics and evolutionary theory will never supersede the other approaches by showing how behavior is "really" caused by biological mechanisms (de Waal, 2002; Turkheimer, 1998). The greatest promise of the biological approach lies elsewhere, in explaining how biology interacts with social processes to influence what people do.

WRAPPING IT UP

SUMMARY

- Behavioral genetics concerns the degree to which personality is inherited, and shared among genetic relatives.

- Evolutionary psychology concerns the ways in which human personality (and other behavioral propensities) may have been inherited from our distant ancestors, and how these propensities have been shaped over the generations by their consequences for survival and reproduction.

Behavioral Genetics

- Behavioral genetics has always been controversial because of its historical association with eugenics (selective breeding), the concept of cloning, and the belief that it implies people's fate is set at birth, but none of these ideas is part of modern thinking on this topic.

- The most commonly used heritability coefficient is calculated as the correlation across pairs of monozygotic twins for that trait, minus the correlation across dizygotic twins, times two: heritability quotient = $(r_{MZ} - r_{DZ}) \times 2$. It is the proportion of population variance that can be attributed to genetic variation, and does not apply to individuals nor to mean levels.

- Heritability statistics computed from the study of monozygotic and dizygotic twins indicate that genetic variance accounts for about 40 percent of the phenotypic variance in many personality traits.

- But genes interact with each other and with the environment rather than simply expressing the sum total of their independent effects.

- Heritability studies confirm that genes are important for personality and can provide insights into the effects of the environment.

- Although many analyses find that aspects of the environment that are shared among children in the same family have only small influences on personality, this appears to depend on how the study is done. More recent studies suggest that the shared family environment affects many important traits, especially when they are measured via behavioral observation rather than self-report.

- While studies of heritability are informative, the heritability statistic is not the "nature-nurture ratio" because traits completely under genetic control often have low or zero heritabilities.

- Recent research is beginning to map out the complex route by which genes determine biological structures that can affect personality. For example, the *DRD4* gene is associated with dopaminergic systems that may be involved in the trait of extraversion, and the *5-HTT* gene is associated with the neurotransmitter serotonin, which in turn is related to the trait of impulsivity and related patterns of behavior. The amygdala in people with the short-form allele of this gene responds more strongly to unpleasant stimuli; these people are at risk for anxiety disorders or depression.

- While research has begun to document the relationships among genes, brain function, and personality, the situation is even more complex than these relationships: Not only do genes interact with each other, but their effects on development are also critically influenced by the environment. For example, people with the short allele for the *5-HTT* gene (which affects serotonin) appear to be at risk for depression and antisocial behavior, but only if they experience severe stress or maltreatment in childhood.

- Now that it is established that genes matter for personality and life outcomes, and that almost "everything is heritable," the future of behavioral genetics research lies not in calculating heritabilities, but in understanding the interactions among genes and between genes and the environment that affect personality traits and life outcomes.

- Not all findings concerning gene-personality correlations or gene-environment interactions are consistently replicated, leading some critics to portray the entire enterprise as misguided. But such a conclusion is surely premature; the field of molecular behavioral genetics is still in its very early stages, and much remains to be learned.

Evolutionary Personality Psychology

- Evolutionary psychology attempts to explain behavioral patterns by analyzing how they may have promoted survival and reproduction in past generations.

- Evolutionary psychology has considered aggression and altruism in terms of their necessary role for survival and also the potential disadvantages of these behaviors.

- Self-esteem may be a "sociometer," according to Mark Leary's theory, that assesses the degree to which one is accepted by the group. A decline in self-esteem might be an evolved signal that one is in danger of being shunned.

- Depressive symptoms may have evolved as a way to prevent wasting energy on fruitless endeavors and as a means of seeking social support.

- Evolutionary psychology has paid special attention to sex differences in mating behaviors, including differences in what men and women find most attractive in each other and the strategies they use to seek and keep mates. For example: Men high in "sociosexuality"—willingness to engage in sexual relations in the absence of a meaningful relationship—are more accurate in assessing their own "mate value" than men low in this trait, and are more likely to use symbols of "conspicuous consumption" to attract women. Women appear to understand this tactic, however. Additionally, men seem to be more jealous about sexual than emotional infidelity compared to women, and women show the reverse pattern. However, this is a relative difference: Both kinds of infidelity are unpopular with both sexes.

- Individual differences are important in evolutionary psychology because for a species to remain viable, it must include diversity.

- "Life history" is an individual difference variable related to reproductive strategy. The slow-life history strategy involves having few children later in life and putting resources into nurturing them. The fast-life history strategy involves having many children early in life and putting few if any resources into each. Slow-LH is adapted for environments that are relatively safe and predictable; fast-LH is adapted for dangerous and unpredictable environments. Animal species and humans vary in the degree to which they follow these two strategies.

- Evolutionary processes maintain individual differences in three ways. A trait that is adaptive in one situation may be harmful in another; behavioral patterns have evolved to emerge as functions of environmental experience; and some biologically influenced behaviors are "frequency dependent," meaning that their emergence adjusts according to how common they are in the population at large.

- Controversies over evolutionary psychology provide five "stress tests" for the theory. The key issues are the methodology of evolutionary theorizing; the degree to which people are consciously aware of following evolutionary strategies to promote survival and reproduction; the belief by some that evolutionary explanations imply social change is impossible or must be slow; the question of whether people have evolved specific behavioral "modules" or a broader capacity to respond flexibly to environmental demands; and the question of whether behavioral patterns attributed to evolutionary biology might be better explained by social structure.

- One of the most important contributions of evolutionary theory may be that psychologists are now obligated to consider how the behavioral patterns they uncover may have been adaptive to the species over evolutionary history.

Inheritance Is the Beginning, Not the End

- The biological aspects of personality that you inherited from your parents may determine your psychological starting point, but not your destiny.

- Some observers speculate that increases in knowledge will someday allow all psychological processes to be explained in terms of biology, a position called biological reductionism.

- However, biology will never replace psychology because biology does not and cannot, by itself, address many core psychological issues. These issues include the ways people act in their daily social environments, the experience of psychological conflict, the ways people interpret their environments and plan strategies for success, and many others.

Will Biology Replace Psychology?

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THINK ABOUT IT

1. What is human nature? To understand human nature, what topics must you address?
2. Do you think your personality was shaped more by how you were raised or by your genes?

3. When scientists learn that a particular brain structure or chemical is associated with a personality trait, how is that knowledge valuable? Does it help us understand the trait better? Does it have practical implications?
4. If you have siblings, was the family environment in which you grew up the same as, or different from, theirs? If different, do these variations account for how you and your siblings turned out?
5. Is there anything useful about acting depressed? Would a person who was unable to experience depression have problems as a result? Can a person learn anything, or benefit in any way, from feeling depressed?
6. If you could choose, would you rather be high or low on sociosexuality?
7. Women who are high on agreeableness make more accurate assessments of their "mate value," their attractiveness to the opposite sex. The study that reported this finding did not offer a very clear explanation. Can you come up with one?
8. Do you agree or disagree with evolutionary psychology's conclusions about sex differences? Do you think these differences exist in the way the theory suggests? Could they be explained as well or better by culture?
9. If you are a heterosexual woman, would you be comfortable marrying a man who had less education and made less money than you? (If you are a heterosexual man, would you be comfortable marrying a woman who had more education and made more money than you?) Why? Are these attitudes changing?
10. Do you think psychology will eventually be replaced by biology?
11. Are people just another species of animal? In what ways are people similar to, and different from, "other" animals?

SUGGESTED READING

Kenrick, D. T. (2011). *Sex, murder, and the meaning of life: A psychologist investigates how evolution, cognition, and complexity are revolutionizing our view of human nature.* New York: Basic Books.

A survey of evolutionary psychology and the author's own quirky life story that is both witty and profound. A genuinely fun book.

Krueger, R. F., & Johnson, W. (2008). Behavioral genetics and personality: A new look at the integration of nature and nurture. In O. P. John, R. W. Robins, & L. A.

Pervin (Eds.), *Handbook of personality: Theory and research* (3rd ed.), pp. 287–310. New York: Guilford Press.

A relatively brief but thorough review of the current state of knowledge in behavioral genetics, including gene-environment interactions.

Pinker, S. (1997). *How the mind works*. New York: Norton.

A far-ranging, stimulating, and engagingly written survey of cognitive and social psychology from an evolutionary perspective. Pinker provides many creative and startling insights into the way evolutionary history may have shaped the ways we think.

Wilson, E. O. (1975). *Sociobiology: The new synthesis*. Cambridge, MA: Harvard University Press.

The book that sparked the revival of interest in using evolutionary theory to explain human behavior.