Evolutionary Psychology Module

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Psychology

S E V E N T H E D I T I O N

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CHAPTER OUTLINE

Evolution:
A World Brimming with Life

THE WORLD TEEMS WITH LIFE. Beings walk, jump, hop, fly, glide, float, slither, burrow, stride on the water's surface, waddle, swim, and tumble. Damsel flies molt, great cats stalk, antelopes leap, birds chatter, great whales sing as they traverse the ocean, and a universe of microbes swarms in every thimbleful of muck. There is hardly a clod of soil, a drop of water, a breath of air that is not teeming with life. Bacteria reside in the air, jumping spiders live at the tops of the highest mountains, and sulfur-metabolizing worms bury themselves in deep ocean trenches. Organisms eat one another, breathe each other's waste gases, inhabit one another's bodies, disguise themselves to look like one another, construct elaborate networks of cooperation, and engage in aggressive competition. They have generated a web of interaction that embraces the planet (Sagan & Druyan, 1992).

The Evolutionary Perspective

Evolution is the gradual change of an organism's characteristics over many, many generations. In evolutionary time, humans are relative newcomers to Earth, yet by many criteria we have established ourselves as one of the most successful and dominant species. If the entire time span of evolution were a calendar year, humans would have arrived in the very last moments of December (Sagan, 1980). As our earliest ancestors left the forest to feed on the savannas and eventually formed hunting societies on the open plains, their minds and behaviors changed. The effects of evolution on human beings can be seen in our technological advances, intelligence, and longer parental care. How did this evolution come about?

Darwin's Theory of Evolution

In 1831, at the age of 23, Charles Darwin (1809–1882) began a 5-year voyage as an unpaid naturalist aboard the HMS Beagle. What he found was a world of likenesses and differences that no prevailing theory could account for. The animals he saw in the Galápagos Islands off the western coast of South America fascinated Darwin. He was struck by the basic similarities that linked the Galápagos animals to those on the mainland, but also was impressed by how many species differed

from island to island, many only 60 miles or so apart. He found considerable variations in tortoises, iguanas, and finches. On one island, finches had strong, thick beaks used for cracking nuts and seeds; on another island, finches' beaks were smaller and used for catching insects; and yet on another island, their beaks were elongated for feeding on flowers and fruits. Clearly, the finches had encountered different foods on the different islands. Through successive generations, they had adapted so that they were better able to survive in their particular island's environment. Such evidence was critically important to Darwin in developing his theory of evolution.

Darwin was the founder of the modern theory of evolution. He was not the first individual to propose that organisms evolve or change over time, but he was the first to document this idea with a large amount of supporting evidence and to propose a mechanism by which evolution could occur. Darwin presented three types of evidence to support his idea that species evolve: (1) evolution of fossil records through progressively more recent geological layers, (2) striking structural similarities among living species (such as a human's hand, a bird's wing, and a cat's paw), and (3) major changes brought about in domestic plants and animals through programs of selective breeding (Pinel, 1999).

Darwin (1859) published his ideas about evolution in *On the Origin of Species*. He recognized that organisms reproduce at rates that would cause enormous increases in the populations of most species, yet populations remain nearly constant. Darwin reasoned that an intense, constant struggle for food, water, and resources must occur among the overabundant offspring born in each generation, because many of them do not survive. Those offspring that do survive pass their genes on to the next generation. Darwin reasoned that organisms with design features that led to more successful reproduction increased as each generation passed. Over the course of many generations, organisms with these design features would constitute a larger percentage of the population. Over many, many generations, this process could produce a gradual modification of the whole population. If environmental conditions changed, however, then other characteristics might become favored by natural selection, moving the process in a different direction (Johnson, 2000).

Natural selection is the evolutionary process that favors individuals that are best designed to reproduce and survive. Natural selection is a two-part process. First, heritable variations produced by chance appear at random in the population. Second, organisms with favorable design variations are more likely to survive, reproduce, and pass their characteristics on to their offspring. For example, mimicry and camouflage occur by the slow accumulation over many generations of slight favorable variations, each improving the organism's ability to escape predators and to survive and leave offspring. The work of natural selection has resulted in the disappearing acts of moths and the quills of porcupines. Such close resemblances between animals and objects in their environment,Darwin recognized, are reinforced by the animal's patterns of behavior, also a result of natural selection (Curtis & Barnes, 1989).

Two concepts that are important for understanding the role of evolution in behavior are the concepts of function and adaptation (Brown, 1995; Volpe & Rosenbaum, 2000). The emphasis on function grew out of Darwin's evolutionary theory and the psychological theory known as functionalism, which emphasizes the functions of mental processes and behavior in adapting to the environment. **Function** involves (1) how mental processes and behavior occur, (2) what mental processes and behavior accomplish, and (3) why mental processes and behavior occur.

Adaptation is the evolutionary process that leads to the formation of characteristics that give individuals a selective advantage. **Adaptive behavior** is behavior that promotes the organism's survival and reproduction in the natural habitat. Adaptive behavior involves the organism's modification of its behavior to increase its likelihood of survival. All organisms must adapt to particular places, climates, food sources, and ways of life (Crawford, 1998; Wilson, 1975, 1992).

Further Exploration of Evolution

What are some other dimensions of the concept of evolution? They include a distinction between ultimate and proximate causes of behavior, the pace of evolution (macroevolution and microevolution), the modern conception of natural selection—modern synthetic theory, processes of evolutionary change other than natural selection, and cultural evolution.

Proximate and Ultimate Causation of Behavior

Scientists who study animal behavior distinguish two types of causation—proximate and ultimate (Barash, 1977; Wilson, 1975). **Proximate causation** refers to immediate explanations of behavior, that is, the ways behavior is directly produced and controlled. Internal physiology, previous experience, and environmental stimuli are examples of proximate causes. Proximate causation refers to "how" questions.

Ultimate causation refers to explanations of behavior at the evolutionary level. This type of causation refers to "why" questions that are answered in terms of evolutionary function. For example, why does the heart exist? Answer: To pump blood. Why do we have callus-producing mechanisms? Answer: Because those in our evolutionary past who developed them were better able to solve the adaptive problem of damage due to repeated friction; they survived and reproduced more than their counterparts who did not develop these mechanisms. Such evolutionary processes—ultimate causation—have shaped the behavior of different species over hundreds of generations.

Let's consider an example to clarify the distinction between proximate and ultimate causation (Crawford, 1987). Why do ground squirrels hibernate? The proximate explanation is that current climatic conditions trigger physiological mechanisms that cause hibernation to occur. The ultimate explanation is that they evolved—and might still be evolving—in an ecology in which it was adaptive to have physiological mechanisms that mediated hibernation.

Now let's consider a human example. British psychiatrist John Bowlby (1969) revolutionized the study of human caregiver-infant attachment by emphasizing the survival benefit of attachment for the infant (ultimate cause) rather than attempting to account for the bond by satisfaction of the infant's hunger drive (proximate cause).

Some psychologists believe that the proximate causes of behavior are related to ultimate causes. They stress that taking into account how the human species adapted to the environment can enhance our explanation of how particular individuals adapt to their environment. Human beings behave the way they do both because of their evolutionary history (ultimate causes) and because of their own personal history (proximate causes). An important research agenda is to see how our increasingly detailed understanding of the way natural selection operates can shed light on the proximate mechanisms of behavior.

The Pace of Evolution

Macroevolution refers to slow-paced evolution as Darwin described it. Darwin believed that evolution is such a slow process that it could never be directly observed. The lines that led to the emergence of human beings and the great apes diverged about 14 million years ago. Modern humans (*Homo sapiens)* came into existence only about 50,000 years ago, and civilization, as we know it began about 10,000 years ago. No sweeping evolutionary changes in human behavior have occurred since then—our brains have not become ten times larger, we haven't developed a third eye in the back of our head, and we haven't learned to fly.

Nonetheless, modern human civilization has produced strong selection pressures on some organisms. This has led to the occurrence of **microevolution**, small-scale evolution in which it is possible to observe not only the results, but also the actual process, of evolution through natural selection. An excellent example of microevolution is the peppered moth (Curtis & Barnes, 1989). The peppered moth lived on lichen-covered trees and rocks in nineteenth-century England. Against the light background of the lichen, the light coloring of the moths made them virtually invisible. In 1845, the first report of a black moth of this species was made in the growing industrial center of Manchester. With increasing industrialization, more black moths were seen. The black moths blended in against the trunks and the rocks that had become blackened by pollution. With the pollution controls that have recently been instituted in England, the heavy soot accumulation has begun to subside. The light-colored moths are now increasing in proportion to the black moths.

Modern Synthetic Theory

Darwin developed his theory of evolution in the nineteenth century, many decades before scientists began to understand the mechanisms of heredity (at the beginning of the twentieth century). Darwin believed that characteristics of offspring were the result of "blending" of parental characteristics. With the discovery of modern genetics, we now know that traits aren't blended, but are inherited in discrete packages called genes. Modern synthetic theory explains

variation in terms of both the concept of natural selection and genetic influences. In this perspective, evolutionary change over many generations boils down to changes from generation to generation in the specific genes that are transmitted. Genes that increase an organism's ability to adapt, survive, and reproduce in the present environment increase from one generation to the next, while genes that lessen an organism's ability to survive decrease (Alexander, 1974; Williams, 1966).

Modern synthetic theory provided a "gene's eye-view" of how organisms evolve (Daly & Wilson, 1983). Individual organisms don't endure from generation to generation, but genes do. In a way, organisms can be thought of as "survival machines" for their genes (Dawkins, 1989). **Inclusive fitness theory,** the final product of the modern synthesis, explains reproductive success in terms of ensuring the survival of genes into future generations. An organism promotes itself —from a gene's point of view—by promoting the reproductive success of its relatives, which share its genes. Inclusive fitness theory influences the way we view human behaviors like helping, heroics, prejudice, and family relationships.

Evolutionary Processes Other Than Natural Selection: Mutation, Migration, and Genetic Drift

Darwin believed that natural selection is the process that accounts for evolution. We just learned that, according to modern synthetic theory, genetic influences also must be considered. One of those genetic influences is mutation. Two others are migration and genetic drift (Noonan, 1987).

Mutation is random changes in genetic material. Sometimes these changes occur spontaneously, but they can also occur because of chemicals or radiation. Naturally occurring radiation has probably been the most important cause of mutations throughout the history of life. The effects of mutations on the functions of affected genes can vary from highly significant to insignificant. A significant influence occurs when mutations appear in sperm and eggs that are passed on to offspring and thus alter gene frequencies---the proportion of variant genes—in the population.

Migration is the movement of individuals into or out of populations. Migration adds to the variability of most natural populations. Of course, the fate of organisms who move into a new population is determined by natural selection. Some natural populations do live in complete isolation from other populations and are not subject to the effects of migration.

Genetic drift refers to a variety of chance events that may lead to changes in the gene pool. For example, a disproportionate number of individuals carrying particular genes might be killed in a disaster such as a flood or a fire. The random recombination of genes during conception might result in a change of gene frequencies and a loss of low-frequency genes. Genetic drift obviously has a stronger role in smaller populations than in larger populations.

Although mutation, migration, and genetic drift can result in evolutionary change, natural selection is the main evolutionary mechanism (Mader, 2000; Noonan, 1987). Mutation can be ruled out as the main evolutionary process, because the direction of mutation is unrelated to the survival and reproductive interests of the organism. Also, migration is unlikely to produce the accumulation of genes performing a particular function that is characteristic of adaptations. And genetic drift becomes a powerful process only in very small populations. Thus, only natural selection can account for the observed rates of both evolution and adaptation.

Sexual Selection

Sexual selection is adaptive change caused by the differential ability of individuals to obtain mates and reproduce. Darwin introduced the idea of sexual selection (Darwin, 1871). Darwin was intrigued by the number of species in which the males displayed extravagant features that dramatically reduced their survivability compared to females. Features like a moose's enormous rack of antlers, a peacock's colorful plumage, and a cricket's conspicuous chirp increased the struggle to survive. Antlers caught in tree branches, bright plumage attracted predators, and loud chirps revealed hiding places. So why would natural selection design such "poor" adaptations? The answer lay in the males' abilities to attract females. Survival capabilities are only useful in that they promote reproduction. Reproduction requires that organisms attract mates. The male that wins the most mates and has the most offspring is the most successful, even if his life is cut a little short.

Still the question remains, why adapt such "poorly-suited" features? Males that have these features are better able to fight off other males and to win females. Often conflicting with natural selection, sexual selection is a potent force of evolutionary change, particularly in the area of reproductive behavior.

Cultural Evolution

Cultural evolution is adaptive change in a culture in response to recurring pressures over time. Cultural evolution is possible because biological evolution produced changes that allowed human beings to gain considerable control over their environment. As humans evolved, we acquired knowledge and passed it on from generation to generation. This knowledge, which originally told us how to hunt, make tools, and communicate, became our culture. The accumulation of knowledge has gained speed—from a slow swell to a meteoric rise. Hunter-gatherer tribes, characteristic of early human society, changed over thousands of years into agricultural communities. With people rooted in one place, cities grew and flourished. Life within those cities remained relatively unchanged for generations. Then industrialization put a dizzying speed on cultural change. Now technological advances in communication and transportation—computers, fax machines, jet airplanes, and so on—transform everyday life at a staggering pace.

Whatever one generation learns, it can pass to the next through writing, word of mouth, ritual, tradition, and a host of other methods humans have developed to assure their culture's continuity (Gould, 1981). By creating cultures, humans have built, shaped, and carved out their own environments.

Next, we will continue our exploration of evolution as we examine contemporary evolutionary approaches.

Contemporary Evolutionary Approaches

Both ethology and sociobiology have emphasized the importance of evolution in understanding behavior. More recently, a new approach—evolutionary psychology—has considerably expanded the application of evolutionary principles to human behavior.

Ethology

Ethology is the systematic study of the function and evolution of behavior. An important principle in ethology is that behavioral characteristics, like anatomical and physiological characteristics, have evolutionary explanations. Ethology emerged as an important view because of the work of European zoologists, especially Konrad Lorenz (1903–1989) and Niko Tinbergen (1907–1988).

Working mainly with greylag geese, Lorenz (1965) studied a behavior pattern that was believed to be programmed within the birds' genes. A newly hatched gosling seemed to be born with an instinct to follow its mother. Observations revealed that the gosling was capable of such behavior soon after it hatched. Lorenz proved that it was incorrect to assume that such behavior was programmed into the animal. In a remarkable set of experiments, Lorenz separated the eggs laid by one goose into two groups. He returned one group to the goose to be hatched by her; the other group was hatched in an incubator. The goslings in the first group performed as predicted—they followed their mother as soon as they hatched. However, those in the second group saw Lorenz when they first hatched and followed him everywhere as if he were their mother. Lorenz marked the goslings and then placed both groups under a box. Mother goose and "mother" Lorenz stood aside as the box lifted. Each

group of goslings went directly to its "mother." Lorenz called this process imprinting—rapid, innate learning, within a limited critical period of time, that involves attachment to the first moving object seen.

While Lorenz was observing the behavior of greylag geese, Tinbergen (1969) was observing the behavior of the stickleback fish, a small fish that lives in northern European fresh waters. Early in the spring, both sexes are ready to mate. Through an intricate system, each member of a pair engages in certain behaviors that serve as the stimulus for the behavior of the other member. First, the male stickleback marks off a territory and forms a nest at the bottom of the water. Then his belly changes color, becoming bright red. The bright red color signals the female stickleback that he is ready to mate. At some point the female stickleback swims into his territory with her abdomen swollen with eggs and her head in an upward position. Her abdomen and posture signal the male's next behavior, an impressive zigzag dance, which stimulates the female to approach the male. As she does, the male turns and swims toward the nest. The female follows, and the male puts his head in the nest opening. He subsequently withdraws his head, indicating to the female that she should now place her entire body in the nest. Once the female is in the nest, the male begins shaking and taps her in a rhythmic manner at the base of her tail. At this tapping signal, she lays her eggs and then abruptly leaves the nest. Then the male enters the nest and deposits his sperm, thus fertilizing the eggs.

Tinbergen's work with the stickleback fish illustrates two important concepts in ethology—the concepts of fixed action pattern and sign stimulus. A **fixed action pattern** is an unlearned behavior that is universal in a species, elicited by a specific environmental stimulus, and usually more complex than a reflex. A **sign stimulus**, in ethological theory, is any stimulus or well-defined environmental event that produces a fixed action pattern. Modern ethology's concern with four areas of inquiry—causation, development, evolution, and function of behavior—developed from Tinbergen's (1963) views.

Lorenz's and Tinbergen's carefully controlled observations of animals in their natural habitats have implications for human behavior. Lorenz's work suggests the possibility of a critical period in the attachment of an infant to a caregiver. Humans do not experience the short, rigid critical period for learning that has been observed in animals, but humans do seem to have some longer sensitive periods, during which they are particularly skilled at certain kinds of behaviors. For example, a number of attachment theorists and researchers believe the first year of life is a critical or sensitive period for a human infant's attachment to a caregiver (Ainsworth, 1979; Bowlby, 1989). Tinbergen's work with stickleback fish suggests the importance of sequences of actions and of signals between two partners in sexual activity.

Ethologists believe behavior should be observed in the contexts in which the behavior evolved. Therefore, ethologists observe behaviors in natural contexts, not laboratories. An **ethogram** is an inventory of the behavior of a species; ethograms

have been the starting point for many ethological studies. After making observations of an organism's behavior, ethologists then formulate specific questions about the adaptiveness and function of particular behavior patterns.

Sociobiology

Sociobiology relies on the principles of evolutionary biology to explain social behavior. Sociobiologists believe that psychologists have a limited understanding of social behavior because they primarily study one mammalian species—*Homo sapiens*. Sociobiology derives its information from the comparison of tens of thousands of animal species that have evolved some form of social life.

According to E. O. Wilson (1975, 1992, 1995), the purpose of sociobiology is not to make crude comparisons between animal species or between animals and humans, such as simply comparing wolf and human aggression. Rather, sociobiology's purpose is to develop general laws of the evolution and biology of social behavior. The hope also is to extend the principles of sociobiology to help explain human behavior.

Let's consider a sociobiological inquiry. In some species of birds, the young born in one year might not breed the next year, but instead help their parents rear the next year's brood. In other instances, adult birds that have lost their mates might help close relatives rear their young. These social systems that involve helping at the nest occur in Florida scrub jays (Woolfenden, 1975), African white-fronted bee-eaters (Emlen, 1984), and acorn woodpeckers in the western United States (Koenig, Mulle, and Pitelka, 1984). Nests with helpers are more successful—they fledge more young. But the energy expended in such helping behavior does not appear to directly benefit the helper's own progeny. Sociobiologists are interested in how such helping behavior evolved and what the advantages are for helping or not helping.

Sociobiology has helped to clarify the relation between animal behavior and human behavior, focused attention on the costs and benefits of behavior, directed inquiry toward individual and group differences, highlighted the role of ecology in behavior, and broadened our understanding of behavior's causes (Crawford, 1987).

Nonetheless, sociobiology is not without its critics, especially when sociobiology is applied to human behavior. The critics argue that sociobiologists do not adequately consider human adaptability and experience, and that sociobiology portrays human beings as mere automatons in thrall to their genes. The critics also say that sociobiology explains behavior after the fact, lacking the predictive ability that characterizes any good theory. Critics also point out that sociobiology promotes discrimination against women and ethnic minorities under the guise of being scientific (Paludi, 1998). How do sociobiologists respond to such criticisms? They argue that most psychologists have not given adequate attention to the

evolutionary basis of behavior, that sociobiologists do consider both the biological and the experiential sides of behavior, that much of their work does have predictive validity, and that the use of sociobiology to discriminate against women and ethnic minorities has been inappropriate. Such misuses of sociobiology have included the work of "eugenicists," who focus on genetics as a basis for producing superior human beings or a superior race of humans. In addition, sociobiologists believe that political and ideological issues need to be clearly separated from the scientific issues; they hold that the fact that someone finds a scientific theory to be politically objectionable is irrelevant to whether the theory is true or false.

Evolutionary Psychology

Many sociobiologists have skipped or neglected the psychological level of analysis. They go directly from principles of evolution to patterns of social organization—such as the mating system (for instance, polygamy versus monogamy)—without describing or investigating the psychological mechanisms involved. The **evolutionary psychology approach** explores human behavior in terms of adapted psychological mechanisms that evolved to promote reproduction and survival.

In evolutionary psychology, psychological and physiological mechanisms are the product of evolution by selection (Buss, 1995, 1999; Tooby & Cosmides, 1990). These mechanisms owe their existence to the successful solution to adaptive problems that humans faced in ancestral environments. Adaptive problems are numerous, and they are all related to successful survival and reproduction; reproduction is the engine that drives evolution, and survival is important because it aids reproduction. Evolutionary psychology is not about genetic determinism but rather is an interactionistic framework—no human behavior can be produced without input into the evolved psychological mechanisms of the human mind.

The central issue for evolutionary psychologists is the nature of the psychological mechanisms created by selection and the adaptive functions they evolved to serve. According to evolutionary psychologists, human psychological mechanisms are domain-specific, or modular; that is, they solve a specific adaptive problem. Once developed, all mechanisms require particular forms of environmental input to be activated and to function properly.

The domain-specific, or modular, psychological mechanisms that have been discovered include these:

- A highly patterned distribution of fears and phobias that correspond to hazards faced by humans in ancestral environments—for example, the fear of strangers that emerges between 3 and 24 months of age, as well as fears of snakes, spiders, heights, open spaces, and darkness (Marks, 1987)
- Specialized mechanisms for color vision (Shepard, 1992)
- Perceptual adaptations for incest avoidance (Brown, 1991)
- Children's imitation of high-status rather than low-status models (Bandura, 1977)
- The worldwide preference for mates who are kind, intelligent, and dependable (Buss & others, 1990)

Thus, evolutionary psychologists believe that research increasingly supports the concept that numerous mechanisms have evolved because of the large number of diverse adaptive problems humans needed to solve in their past evolutionary environments (Charlesworth, 1995). Let's further explore the nature of evolutionary psychology, by examining how it can be applied to a number of areas in psychology (Buss, 1995).

Evolutionary Social Psychology Many important adaptive problems for humans are social in nature (Buss & Kendrick, 1998). The social group constituted one of the crucial "selection environments" for humans. The cooperative group may have been the primary survival strategy for humans; adaptive characteristics would have included cooperation, loyalty, and fear of social exclusion (Brewer & Caporael, 1990). Individuals whose mechanisms led them to be uncooperative, deviant from group norms, or disloyal presumably would have had more trouble surviving than would their counterparts with the adaptive set of mechanisms.

Survival was only the beginning, however. Because natural selection operates by a process of differential reproduction (not differential survival success), humans had to solve many reproductive problems that were social in nature in their ancestral past. These problems would have included successful intrasexual competition, mate selection, mate attraction, sexual intercourse, mate retention, reciprocal alliance formation, coalition building and maintenance, and child care (Buss, 1986, 1991, 1999).

Mating Relationships In most cultures, the vast majority of people form mating relationships of more than brief duration—more than 90 percent of individuals get married at some point in their lives. However, this special social relationship carries unique adaptive problems.

One adaptive problem is the selection of a suitable mate—one who is cooperative, dependable, resourceful, and reproductively capable (Buss, 1994). In our evolutionary past, men who selected mates who were low in reproductive

capacity experienced lower reproductive success than men who selected mates peaking in reproductive value. Women who selected mates who were unable or unwilling to invest resources in them and their children experienced lower reproductive success than women who placed a premium on these qualities during mate selection. The sex difference in mate preferences for youthfulness and physical appearance, on the one hand, and for resources, ambition, industry, and commitment, on the other, reflects sex differences in the adaptive problems that ancestral men and women faced when selecting a mate (Buss, 1998).

Reciprocal Alliance Formation (Friendships) In many instances, benefits can accrue to individuals who form cooperative reciprocal alliances, or friendships (Trivers, 1971). Initially costs are incurred that provide a benefit to someone else, but at a later time the recipient of the initial benefit bestows a benefit on the initial giver. Both individuals can gain from this process above and beyond what they could have gained by acting alone (Krebs, 1998).

One major condition that limits the evolution of reciprocal relationships is the possibility of "cheating"—failing to reciprocate once a benefit has been received from the other individual (Cosmides & Tooby, 1992). Although such a strategy is vulnerable to exploitation by noncooperators, indiscriminate cooperation under conditions that allow cheating would be selected against (Axelrod, 1984).

Evolutionary Cognitive Psychology

Evolutionary psychology stresses that natural selection forges mechanisms that are designed to take in certain classes of information based on a series of decision rules (Kenrick, Sadalla, & Keefe, 1998). Further, it is argued that information-processing mechanisms underlie all psychological and behavioral phenomena, not just those traditionally described as "cognitive."

Several important programs of cognitive research currently use evolutionary psychology as the main theoretical framework. The research programs span such topics as natural language (Pinker & Bloom, 1990), perceptual organization of colors (Shepard, 1992), spatial skills (Silverman & Eals, 1992), human-reasoning algorithms (Cosmides & Tooby, 1992), and the perception of landscapes (Kaplan, 1992).

Evolutionary Personality Psychology

Personality psychology has always been concerned with the enduring ways in which individuals differ from one another. Evolutionary psychologists make the following points about personality and individual differences: (1) stable individual differences can be caused by differences in recurrent adaptive problems to which individuals are exposed; (2) complex species-typical mechanisms are necessary to explain individual differences,

because without them the individual differences could not occur; and (3) the individual differences are outcomes of recurrently different input into species-typical mechanisms.

There are many recurrent environmental individual differences of this sort (Buss & Greiling, 1999). Firstborn children likely face different adaptive problems than their later-born siblings do. These apparently trigger in firstborns greater identification with the status quo, parents, and the established power structure. Later-borns, who confront a niche already occupied by an older sibling, tend to rebel more against established traditions (Sulloway, 1994).

Individuals who grow up in environments in which resources are unpredictable, such as Hungarian Gypsies, might adopt a more impulsive personality style, and even mating style, because it would be an adaptive mistake to delay gratification (Bereczkei, 1993). By contrast, individuals who grow up in environments in which resources and future prospects are more predictable might adopt a strategy of delaying gratification (Belsky, 1997). The resulting individual differences represent strategic solutions to the different adaptive problems encountered. Recurrently different environmental input into species-typical mechanisms can produce stable, strategically patterned individual differences (Gangestad & Simpson, 2000).

Conclusions About Evolutionary Psychology Evolutionary psychologists believe that their approach provides a much needed emphasis on the functional properties of mental processes and behavior that can help to integrate the entire field of psychology. They believe that in the twenty-first century, evolutionary psychology will infiltrate virtually all of psychology's domains (Barkow, Cosmides, & Tooby, 1992; Buss, 1995, 1999; Crawford & Krebs, 1998).

Not all psychologists agree. Criticisms of evolutionary psychology echo those that were once reserved for sociobiology—for instance, that it does not adequately recognize cultural diversity and that its explanations are developed after the fact. Critics also argue that it is highly unlikely that one grand theory—in this case evolutionary psychology—will ever encompass all of psychology's complexity (Graciano, 1995). Nonetheless, the field of psychology is currently benefiting from the application of evolutionary psychology's principles to a number of adaptive problems (Gangestad, 1995).

SUMMARY

The Evolutionary Perspective

- In his theory of evolution, Darwin proposed that the key process in evolution is natural selection. Natural selection favors the individuals of a species that are best designed to reproduce and survive. Function and adaptation are key concepts in the theory of evolution.

- Two levels of causation can be used to study behavior. Proximate causation refers to the immediate explanations of behavior, that is, the ways behavior is directly produced and controlled. Ultimate causation refers to the explanations of behavior at the evolutionary level; this type of causation refers to "why" questions that can be answered in terms of evolutionary function.

- The pace of evolution varies depending on the level at which it is observed. Macroevolution is slow-paced evolution that occurs so slowly that it cannot be observed. Microevolution is small-scale evolution that can be observed. An excellent example of microevolution is the peppered moth in England.

- Genes had not been discovered when Darwin proposed his evolutionary theory. Modern synthetic theory combines Darwin's concept of natural selection with genetic influences to explain variation. In this perspective, evolutionary change over many generations boils down to changes from generation to generation in the specific genes that are transmitted. Inclusive fitness theory takes the "genes' eye-view," in that relatives are also replicators of an individual's genes.

- Three processes other than natural selection that have been proposed to account for evolution are mutation, migration, and genetic drift. However, the main evolutionary process is natural selection; only natural selection can account for observed rates of both evolution and adaptation.

- Sexual selection refers to the selective pressure imposed on an individual to acquire mates. Sexual selection often results in characteristics that are a cost to the organism in terms of survival, but produce great benefits in reproduction.

- Cultural evolution refers to the adaptive change of culture to recurring pressures over time. Cultural evolution is possible because biological evolution produced changes that allowed human beings to gain considerable control over their environment. Cultural change proceeded at a rapid pace after industrialization occurred.

Contemporary Evolutionary Approaches

- Ethology is the systematic study of the function and evolution of behavior. Ethology emerged as an important view because of the work of European zoologists, especially Lorenz and Tinbergen. Lorenz's research with greylag geese led him to propose the concept of critical period, and Tinbergen's observations of stickleback fish led him to propose the concept of fixed action period. Tinbergen said that modern ethology is concerned with four areas: causation, development, evolution, and function. Ethologists emphasize the importance of observing behavior in natural contexts. They often develop an ethogram as part of their inquiry.

- Sociobiology relies on the principles of evolutionary biology to explain the social behavior of animals. Sociobiology's purpose is to develop general laws of the evolution and biology of social behavior. The hope also is that sociobiology can assist in the explanation of human behavior. Sociobiology has made important contributions to our understanding of social behavior.

- Evolutionary psychology is an approach that emphasizes that behavior is a function of psychological mechanisms, requires input for activation, and is ultimately related to successful survival and reproduction. Psychological mechanisms are the product of evolution. The central issue for evolutionary psychologists is the nature of the psychological mechanisms created by selection and the adaptive functions they were designed to serve. Evolutionary psychologists believe that human psychological mechanisms are domain-specific, or modular. Evolutionary psychology can be applied to such areas as social psychology, cognitive psychology, and personality psychology. Evolutionary psychologists believe their approach provides a much needed integration of psychology's disparate areas, although the approach has been criticized.

WEB LINKS

Personality
http://www.personalityresearch.org/

Human Behavior and Evolution Society
http://www.hbes.com/index.htm

Physical Anthropology Tutorials
http://anthro.palomar.edu/tutorials/physical.htm

The Talk Origins Archive. Deals with Creation/Evolution Issues
http://www.talkorigins.org/

The Origin of Species, by Charles Darwin—online
http://www.talkorigins.org/faqs/origin.html

Center for Evolutionary Psychology

http://www.psych.ucsb.edu/research/cep/

Evolutionary Psychology for the Common Person—down to earth look at evolutionary psychology
http://www.evoyage.com/

Evolutionary Psychology from a Anthropological perspective
http://www.anth.ucsb.edu/projects/human/evpsychfaq.html

Interactive Site about Human evolution
http://www.becominghuman.org/

http://evolution.humb.univie.ac.at/institutes/urbanethology.html

Human Nature Review edited by Ian Pitchford and R. M. Young
http://www.human-nature.com/

The Human Genome Map
http://www.ncbi.nlm.nih.gov/SCIENCE96/

Ontogeny and Phylogeny website
http://freespace.virgin.net/j.squire/

Sociobiology
http://www.psych.nwu.edu/~sengupta/sociob.html

Sociobiology articles on the web
http://cogprints.soton.ac.uk/view-bio-socio.html

GLOSSARY

adaptation An evolutionary process that leads to the formation of characteristics that provide a selection advantage
adaptive behavior Behavior that promotes the organism's survival in the natural habitat.

cultural evolution Adaptive change in a culture in response to recurring pressures over time.

ethogram An inventory of the behavior of a species; the starting point for many ethological studies.
ethology The systematic study of the function and evolution of behavior.
evolution The gradual change of an organism's characteristics over several generations.
evolutionary psychology An approach that explores human behavior in terms of adapted psychological mechanisms that evolved to promote reproduction and survival.

fixed action pattern An unlearned behavior that is universal in a species, elicited by a specific environmental stimulus, and usually more complex than a reflex.

function In psychology, (1) how mental processes and behavior occur, (2) what mental processes and behavior accomplish, and (3) why mental processes and behavior occur.

genetic drift A variety of chance events that can lead to changes in the gene pool.

imprinting The ethological concept of rapid, innate learning, within a limited critical period of time, that involves attachment to the first moving object seen.
inclusive fitness theory An evolutionary approach that explains reproductive success in terms of ensuring the survival of genes into future generations

macroevolution Slow-paced evolution as Darwin described it.
microevolution Small-scale evolution in which it is possible to observe not only the results, but also the actual process, of evolution through natural selection.
migration The movement of individuals into or out of populations.
modern synthetic theory Theory that explains variation in terms of both Darwin's concept of natural selection and genetic influences.
mutation Changes in genetic material.

natural selection The evolutionary process that favors individuals of a species that are best adapted to survive and reproduce.

proximate causation Immediate explanations of behavior.

reproduction The process of creating offspring, which in humans begins with the fertilization of a female's gamete (ovum) by a male's gamete (sperm).

selective breeding A genetic method in which animals are chosen for reproduction based on how much of a particular trait they display.
sign stimulus In ethological theory, any stimulus or well-defined environmental event that produces a fixed action pattern.
sociobiology A view that relies on the principles of evolutionary biology to explain social behavior.
sexual selection Adaptive change caused by the differential ability of individuals to obtain mates

ultimate causation Explanations of behavior at the evolutionary level.

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