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TARGET ARTICLE

Evolutionary Psychology: A New Paradigm for Psychological Science

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Psychological science is currently in conceptual disarray, characterized by unconnected mini-theories and isolated empirical findings. We lack a theory of the functional properties of the human mind that could provide the needed integration—a theory about what the mechanisms of mind are "designed" to do. Evolutionary psychology provides the conceptual tools for emerging from this fragmented state. In this target article, I outline the fundamental premises of evolutionary psychology; illustrate the application of evolutionary psychology to domains such as reasoning, social exchange, language, aggression, jealousy, sex, and status; and then consider the implications of evolutionary psychology for the key branches of social, personality, developmental, and cognitive psychology and suggest ways in which these disciplinary boundaries can be transcended. I conclude by looking at the emergence of evolutionary psychology as our field matures into the 21st century.

> After more than a century, the social sciences are still adrift, with an enormous mass of half-digested observations, a not inconsiderable body of empirical generalizations, and a contradictory stew of ungrounded, middle-level theories expressed in a babel of incommensurate technical lexicons. (Tooby & Cosmides, 1992, p. 23)

Anyone familiar with the broad field of psychology knows that it is in theoretical disarray. The different branches—such as cognitive, social, personality, and developmental—proceed in relative isolation from one another, at most occasionally borrowing like a cup of sugar a concept here and a method there from a neighbor. Within each branch, psychologists also fail to reach consensus. Mini-theories proliferate unconnected, each conceived to account for a particular set of phenomena, such as obedience to authority, children's concepts of mind, or the effects of priming on categorization tasks. Although psychologists assume that the human mind is a whole and integrated unity, no metatheory subsumes, integrates, unites, or connects the disparate pieces that psychologists gauge with their differing calipers.

An important new theoretical paradigm called *evolutionary psychology* is emerging that offers to provide this metatheory. This target article describes the basic features of evolutionary psychology and draws out several key implications for psychological science. It covers recent empirical work conducted using the principles of evolutionary psychology in the areas of jealousy, reasoning abilities, social exchange, decision rules, language, mate preferences, status, aggression, and sex. It considers the consequences for branches of psychology such as social, personality, cognitive, developmental, and cultural. It concludes by looking to the future of evolutionary psychology—its promises, its pitfalls, its illuminations, its limitations.

Fundamental Principles of the New Paradigm

All Psychological Theories Imply Evolved Mechanisms

It does not seem to be generally known among psychologists that all manifest behavior depends on underlying psychological mechanisms—information-processing devices, decision rules, and so on—in conjunction with contextual input into those mechanisms. No behavior can be produced without them. If dogs and cats respond to the same stimuli with different responses, it is because the psychological mechanisms of dogs and cats differ. If a child and an adolescent respond differently to the same stimulus, it is because they differ in their psychological mechanisms. If a man and a woman differ in their behavior in response to identical input, it is because they possess somewhat different psychological mechanisms. The reasons that a person obeys au-

thority, conforms to the group, values particular mates, and responds with rage when provoked in particular ways—and a blank slate does not—is because the person possesses a particular set of psychological mechanisms absent in the blank slate.

All psychological theories, even the most ardently environmental ones, imply the existence of psychological mechanisms (Quine, 1981; Symons, 1987). Skinner's theory of operant learning, for example, implies the existence of domain-general mechanisms that cause organisms to alter their behavioral output in accordance with the history of reinforcement they have experienced. The mechanisms Skinner implies are among the most domain general ever proposed—they are presumed to operate in the same manner across different domains such as feeding and mating and, remarkably, also are presumed to be the same across different species. Festinger's (1957) theory of cognitive dissonance, to take another example, implies the existence of internal psychological mechanisms that cause discrepant thoughts or behaviors to feel uncomfortable and that cause people to alter one of those thoughts or behaviors to make the two more consistent. Latané's (1981) theory of social loafing implies the existence of human psychological mechanisms that cause people to diminish effort at a project as a function of the presence of others.

All psychological theories—be they cognitive, social, developmental, personality, or clinical—imply the existence of internal psychological mechanisms. Unfortunately, the precise nature of these mechanisms is often left implicit. Despite the lack of explicitness, it is clear that no behavior can be produced in the absence of psychological mechanisms. Because all psychological theories imply underlying mechanisms, they also imply a human nature. What are the origins of basic psychological mechanisms that comprise human nature?

Evolution by Natural Selection Is the Only Known Causal Process Capable of Producing Complex Physiological and Psychological Mechanisms

Only a few causal processes have been proposed over the past two centuries to account for the origins of these complex organic mechanisms known as adaptations (Dawkins, 1986; Mayr, 1982). Several of these, such as orthogenesis and lamarkism, have been shown to be false and are no longer considered viable possibilities. Three remaining possibilities have some adherents. The first is *evolution by natural selection* (Darwin, 1859, 1871; Hamilton, 1964). The second is *creationism.* The third is *seeding theory*—the idea that extraterrestrial organisms visited Earth many years ago and planted the seeds of life. Creationism is largely incapable of being verified or disproved by observation or experiment and is not a scientific theory. Seeding theory, although it cannot be excluded as a possibility, is not an explanation in itself but, rather, pushes the problem back a step to the causal process that created the origins of the seeds and the extraterrestrial beings that planted them. Evolution by natural selection, in contrast, is a powerful and well-articulated theory that has successfully organized and explained thousands of diverse facts in a principled way (Mayr, 1982).

Because all behavior depends on complex psychological mechanisms, and all psychological mechanisms, at some basic level of description, are the result of evolution by selection, then all psychological theories are implicitly evolutionary psychological theories.[1] No psychological theories imply basic psychological mechanisms that were created by some other causal process. As Symons (1987) phrased it, "we're all Darwinians" in the sense that all (or nearly all) psychologists believe that evolution is responsible for who we are today. If another causal process exists that is capable of producing complex mechanisms, it has not been made generally known to the scientific community.

Levels of Analysis in Evolutionary Psychology

When I give colloquia about my evolution-based research on human mating strategies, I am sometimes asked questions such as "What evidence would falsify 'the theory'?" or "Doesn't the existence of people helping total strangers falsify 'the theory'?" In order to answer these questions, one must first distinguish between at least four levels of analysis (see Figure 1). The first level is *general evolutionary theory—evolution by natural selection,* as understood in its modern form as *inclusive-fitness theory.* Now, at this level, even though general evolutionary theory is called a *theory,* it is widely regarded by biologists as so well established that it is simply assumed to be correct in its general outlines, and then work proceeds from that assumption but does not test the assumption, at least not directly. There have been thousands of tests of the general theory. New species can be created in the laboratory using its principles. Evolution by natural selection is the guiding metatheory for the entire field of biology. There are phenomena that could falsify the general

[1] Of course, evolutionary processes other than selection—including mutation, drift, and pleiotropic effects—can affect physiological and psychological mechanisms, but they are extremely unlikely to fashion complex, precise, efficient, well-sculpted mechanisms. Of all evolutionary processes, only selection has the causal power to produce such complex mechanisms.

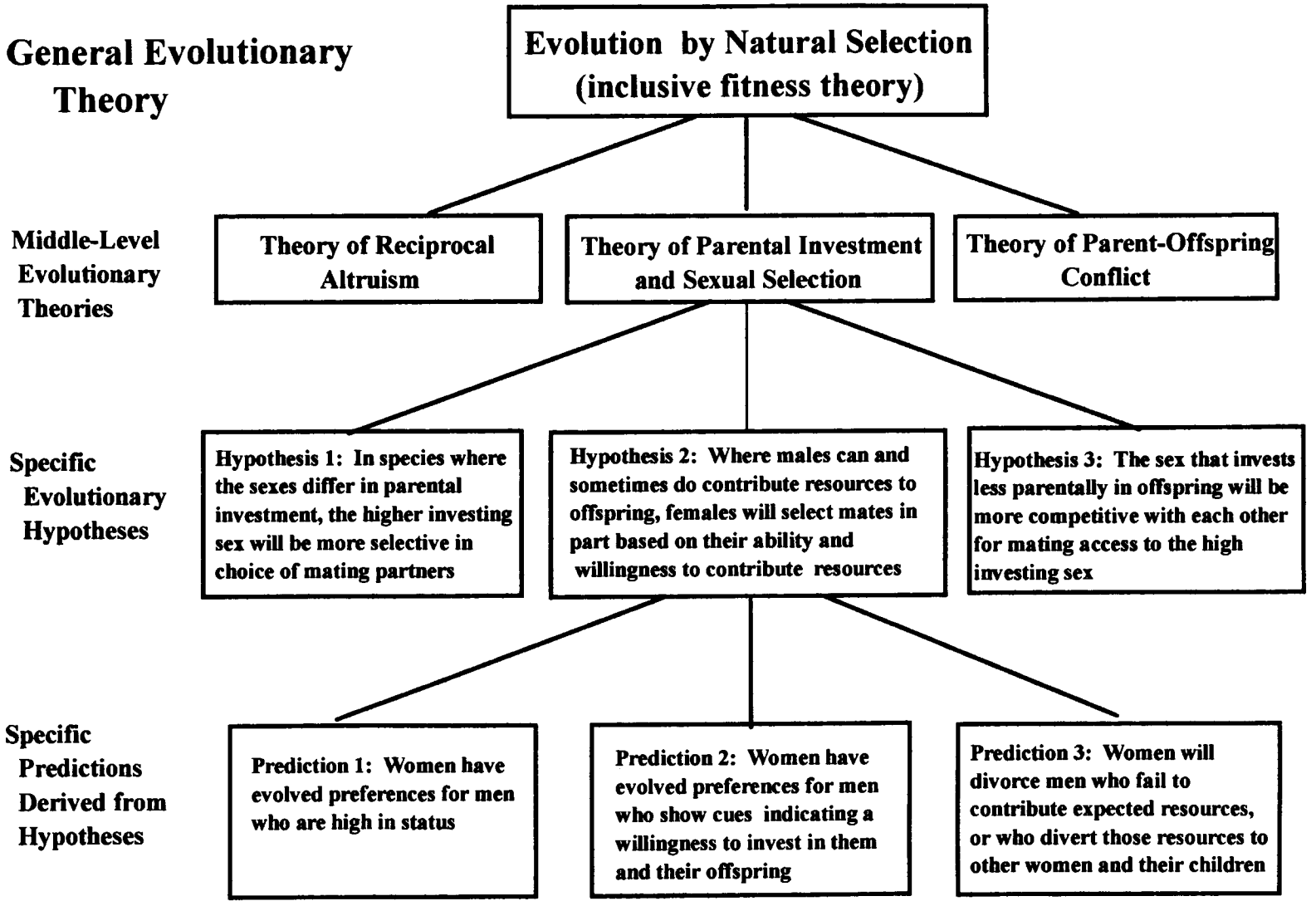

Figure 1. *Simplified depiction of a hierarchy of levels of analysis in evolutionary psychology. Each middle-level theory must be consistent with general evolutionary theory and is subsumed by general evolutionary theory but cannot be logically deduced from general evolutionary theory. A variety of specific evolutionary hypotheses can be derived from each middle-level theory, just as a variety of specific empirical predictions can be generated from each evolutionary hypothesis. Standards of "normal paradigm science" hold for testing each level in the hierarchy.*

theory—if complex life forms were found to be created in time periods too short for natural selection to have operated (e.g., in 7 days) or if adaptations of organisms were found that evolved for the benefit of intrasexual competitors or for the benefit of other species (Darwin, 1859; Mayr, 1982; Williams, 1966). But no such phenomena have ever been observed or documented.

So, when an evolutionary psychologist tests an evolutionary proposition, she or he is not testing "general evolutionary theory," just as, when an astronomer tests a particular hypothesis (e.g., about the amount of critical mass in the universe), she or he is not testing "general relativity theory" with each experiment. That theory is assumed to be true, just as evolution by natural selection is assumed to be true for the present purposes. Because no compelling alternatives have been proposed over the past 130 years, and because there is overwhelming evidence supporting general evolutionary theory, these assumptions are reasonable.

Moving one level down, we find *middle-level evolutionary theories,* such as the theory of reciprocal altruism (Trivers, 1971), the theory of parental investment and sexual selection (Trivers, 1972), and the theory of parasite–host coevolution (Hamilton & Zuk, 1982). These middle-level theories are still fairly broad in that they are theories about entire domains of functioning—for example, the conditions under which parents and their offspring will conflict with one another. These theories are fair game for testing and possible falsification. I'll examine just one to illustrate this point—Trivers's theory of parental investment and sexual selection (see Figure 1).

This theory, which is itself an elaboration of Darwin's (1871) theory of sexual selection, provided one of the key theoretical ingredients for predicting the operation of mate choice and the operation of intrasexual competition. Leaving aside the logical and reproductive underpinnings of Trivers's theory (which would require a major treatise to spell out), he essentially argued that the sex that invests more in offspring (often, but not always, the female) will evolve to be more choosy about mating, whereas the sex that invests less in offspring will evolve to be more competitive with members of their own sex for sexual access to the valuable high-investing opposite sex. Women, whose minimum parental investment includes a 9-month gestation period, for example, are predicted to have evolved mechanisms that lead to greater choosiness than men, whose minimum parental investment is the contribution of his sperm. The asymmetries between the sexes, in fitness currencies, of the costs of making a poor mate-choice and the benefits of making a wise mate-choice would have created selection pressure for sex-differentiated psychological mate preferences. Trivers and others have developed additional hypotheses about the precise content of mate choice—various forms of resources, for example, when certain contextual conditions were met such as resource defensibility, variance in resource holdings among potential mates, or whether a long-term or short-term mate is being pursued (Buss & Schmitt, 1993). Some of the *specific hypotheses* derived from Trivers's theory are shown in Figure 1. And *specific predictions* can be derived from each of these hypotheses—predictions about evolved psychological mechanisms or behavioral strategies in a particular species.

In testing these predictions, all the conditions of "normal paradigm science" hold. If the predictions do not pan out empirically, then the hypothesis on which they were based is called into question. If key hypotheses are called into question by several predictive failures, then the truth or value (depending on one's philosophy of science) of the middle-level theory that generated the hypotheses is doubted. Theories that are consistently supported—as, for example, Trivers's theory of parental investment and sexual selection has been in hundreds of empirical studies—are hailed as major middle-level theories, especially if they prove highly generative of interesting and fruitful avenues of research. Theories that are not generative or that produce a series of predictive failures are abandoned or replaced by better theories.

This is a highly oversimplified account, of course, and several additional levels of analysis are often involved. Evolutionary psychologists, for example, develop hypotheses about the psychological mechanisms that have evolved in humans to solve particular adaptive problems that humans have faced under ancestral conditions. This often involves a detailed task-analysis of the sorts of information-processing mechanisms needed to solve particular adaptive problems, conjoined with an analysis of the relevant ancestral cues that would have been available to organisms in those environments. In my work, for example, I have developed hypotheses about psychological mate preferences of men and women, based in part on Trivers's theory of parental investment, but also based on a task analysis of the adaptive problems that men and women would be required to solve if they were pursuing a short-term or a long-term sexual strategy (Buss & Schmitt, 1993). Some have been supported by dozens of studies; a few have not. But, for the present purposes, the key point is that when one asks "What evidence could falsify the theory?" one must locate the question in the hierarchy of levels. My particular hypothesis about a psychological mechanism could be wrong, even if the theory one level up, which led me to the hypothesis, is entirely correct. As in the rest of science, all levels are evaluated by the cumulative weight of the evidence—rarely is a single study definitive one way or the other.

Thus, the empirical methods used by an evolutionary psychologist to evaluate hypotheses and predictions are

exactly the same as those used by other psychologists. They include experimental methods (e.g., Sadalla, Kenrick, & Vershure, 1987), questionnaire methods (e.g., Buss, 1989a, 1989b; Kenrick, Sadalla, Groth, & Trost, 1990), analysis of public documents such as homicide statistics or divorce statistics (e.g., Betzig, 1989; Daly & Wilson, 1988), observational methods (e.g., Buss, 1988a, 1988b; Hill & Kaplan, 1988), psychophysiological techniques (Buss, Larsen, Westen, & Semmelroth, 1992; McGuire & Troisi, 1987), and many others. Empirical methods, as in other areas of psychology, are tailored to the specific hypothesis being tested. As always, results that transcend several methods are seen as stronger than results limited to a single method. And results found across different populations and cultures are seen as stronger than results limited to a single population or culture.

Before leaving the level-of-analysis issue, it should be noted that some evolutionary investigations take as their starting point a phenomenon or an observation and then try to test hypotheses about its function or about why it evolved. The fact of sexual reproduction itself, for example, remains a major enigma to evolutionary biologists, and there are several competing theories about why sex evolved (e.g., Hamilton, 1980; Tooby, 1982). No previous evolutionary theory "predicted" in advance that sex would exist, but the fact of its existence is fair game for subsequent evolutionary analysis, just as observations in other fields (e.g., the observation of galaxies moving away from one another in astronomy) are fair game for subsequent theoretical scrutiny.

To take another example, the existence of the orgasm among women has provoked substantial theoretical interest among evolutionists (e.g., Baker & Bellis, 1989; Gould, 1987; Rancour-Laferriere, 1985; Symons, 1979). Several competing evolutionary hypotheses have been advanced, including hypotheses of (a) paternity confidence, (b) cue to selecting the right male, (c) "sealing the pair-bond," and (d) sperm upsuck. At least two prominent evolutionists, in contrast, have argued that the female orgasm is not in itself an adaptation, but rather an incidental by-product of male orgasm, much like male nipples apparently have no function and are incidental by-roducts of the fact that females have nipples (Gould, 1987; Symons, 1979). The key point is that it is rare that one can refer to *the* evolutionary hypothesis. Just as there are competing theories in other areas of science, so there are often competing evolutionary hypotheses about the same set of observations. Testing among competing hypotheses involves generating additional predictions about phenomena as yet unobserved and proceeds in the same fashion as "normal paradigm science." The value of evolutionary theories and hypotheses, like the value of all theories and hypotheses, must be gauged by their conceptual and empirical harvest.

The Nature of Psychological Mechanisms

Symons (1987) asked: If we are all Darwinians, what is the fuss about? If all behavior depends on mechanisms, and evolutionary processes are the only ones capable of producing basic mechanisms, then the key question cannot be "Is evolution relevant to human behavior?" The answer to that question must necessarily be "Yes," and hence it is an uninteresting question. Instead, the key questions become: What is the nature of the psychological mechanisms that evolution by selection has fashioned? Why do these mechanisms exist in the form that they do—what adaptive problems did they arise to solve, or what are their functions?

At the core of the debate between evolutionary and nonevolutionary psychologists are their answers to these questions. The key issues of this debate have been obscured by false dichotomies that must be jettisoned before we can think clearly about the issues—false dichotomies such as "nature versus nurture," "genetic versus environmental," "cultural versus biological," and "innate versus learned." These dichotomies imply the existence of two separate classes of causes, the relative importance of which can be evaluated quantitatively. Evolutionary psychology rejects these false dichotomies.[2] All humans have a nature—a human nature that differs from cat nature, rat nature, and bat nature. That nature requires particular forms of environmental input for its development. Once developed, all mechanisms require particular forms of input to be activated and to function properly. The mechanisms of learning that make humans responsive to immediate and developmental contingencies owe their existence to evolution by natural selection. The evolved mechanisms and the input that they were designed to be activated by both owe their existence to causal evolutionary processes (Tooby & Cosmides, 1990a). They are not two separate causal processes, but rather part and parcel of the same evolved package. In order to see why these previous dichotomies are false, it is first necessary to provide a provisional definition of *psychological mechanisms* and to discuss several key conceptual issues about their nature.

An *evolved psychological mechanism* is a set of processes inside an organism that:

[2]The exception to this statement, or course, occurs when one is interested in partitioning variance among individuals at a sample or population level, in which case behavioral genetic methods can be used to generate quantitative estimates of the relative size of the genetic and environmental variance components (see Plomin, DeFries, & Loehlin, 1977, for a useful discussion of this issue). This is a different level of analysis, however, than the individual level that is the focus of the present discussion.

1. Exists in the form it does because it (or other mechanisms that reliably produce it) solved a specific problem of individual survival or reproduction recurrently over human evolutionary history.

2. Takes only certain classes of information or input, where input (a) can be either external or internal, (b) can be actively extracted from the environment or passively received from the environment, and (c) specifies to the organism the particular adaptive problem it is facing.

3. Transforms that information into output through a procedure (e.g., decision rule) in which output (a) regulates physiological activity, provides information to other psychological mechanisms, or produces manifest action and (b) solves a particular adaptive problem.

Species have evolved psychologies to the degree that they possess mechanisms of this sort (modified from Buss, 1991, p. 464, but see Fodor, 1968; Marr, 1982; Newell & Simon, 1961; Pylyshyn, 1980).

Because all behavior owes its existence to underlying psychological mechanisms, the central task according to evolutionary psychologists is to discover, describe, and explain the nature of those mechanisms. Many mainstream psychologists implicitly set this as their agenda already. The difference between evolutionary and nonevolutionary psychologists is not so much the agenda they set—although there are some key differences, noted later—but rather in the conceptual tools they bring to bear on pursuing that agenda.

A central premise of evolutionary psychology is that the main nonarbitrary way to identify, describe, and understand psychological mechanisms is to articulate their functions—the specific adaptive problems they were designed by selection to solve. Consider the human body. In principle, the mechanisms of the body could be described and parsed in an infinite number of ways. Why do anatomists identify as separate mechanisms the liver, the heart, the larynx, the hand, the nose, the eyes, and the ears? What makes these divisions nonarbitrary compared with alternative ways of parsing the body, such as those based solely on physical proximity? The answer is function. The liver is recognized as a mechanism that performs functions different from those performed by the heart and the larynx. The eyes and the nose, although spatially proximate, perform different functions and operate according to different input and different principles. A partition that failed to be based on function would be seen by anatomists and physiologists as failing to cleave nature at its natural joints. Evolutionary psychologists argue that similar principles should be applied to analyzing the mechanisms of the human mind. Although an infinite number of descriptions may be used to describe and parse the mind, a powerful and nonarbitrary description identifies mechanisms by function.

Although, at this incipient stage of development in evolutionary psychology, no psychological mechanism has been fully or completely described—in terms of all its procedures or decision rules, the precise range of events that trigger its activation, and the events that affect its development—several illustrations of potential candidates for evolved psychological mechanisms are shown in Table 1, along with their hypothesized functions. An evolved disposition to fear snakes, for example, exists in the form that it does because it solved a specific problem of survival in human ancestral environments. The fear is triggered only by a narrow range of inputs, such as long, slithering, organisms perceived to be within striking distance. Once a snake is perceived to be dangerous and within striking range, this information is transformed via decision rules that activate phys-

Table 1. *Evolved Psychological Mechanisms: 10 Illustrations*

Psychological Mechanism	Function	Author(s)
1. Fear of Snakes	Avoid poison	Marks (1987)
2. Superior Female Spatial-Location Memory	Increase success at foraging/gathering	Silverman and Eals (1992)
3. Male Sexual Jealousy	Increase paternity certainty	Buss, Larsen, Westen, and Semmelroth (1992) Daly, Wilson, and Weghorst (1982) Symons (1979)
4. Preference for Foods Rich in Fats and Sugar	Increase caloric intake	Rozin (1976)
5. Female Mate Preference for Economic Resources	Provisioning for children	Buss (1989a, 1989b)
6. Male Mate Preferences for Youth, Attractiveness, and Waist-to-Hip Ratio	Select mates of high fertility	Buss (1989a, 1989b) Singh (1993)
7. Landscape Preferences for Savanna-Like Environments	Motivate individuals to select habitats that provide resources and offer protection	Kaplan (1992) Orians and Heerwagen (1992)
8. Natural Language	Communication/manipulation	Pinker and Bloom (1990)
9. Cheater-Detection Procedure	Prevent being exploited in social contracts	Cosmides (1989)
10. Male Desire for Sexual Variety	Motivate access to more sexual partners	Symons (1979)

iological activity, such as autonomic arousal. The eventual output is manifest action—such as freezing or fleeing—that in ancestral environments would have solved an adaptive survival problem by reducing the risk of a potentially deadly snake-bite. That human phobias tend to be concentrated heavily in the domains of snakes, spiders, heights, darkness, and strangers provides a window for viewing the survival hazards that our ancestors faced (Marks, 1987).

Preferences are evolved psychological mechanisms of a sort different from fears. Preferences motivate the organism to seek things rich in the "resource-providing potential" needed for survival or reproduction (Orians & Heerwagen, 1992). Landscape preferences provide an illustration. Research has shown that savanna-like environments are consistently preferred to other environments. In particular, landscapes are liked that provide food, water, safety, protection from hazards (e.g., bad weather or landslides), and relative freedom from predators, parasites, toxic foods, and unfriendly humans (Orians & Heerwagen, 1992). Furthermore, people prefer places where they can see without being seen—places providing multiple views for surveillance and multiple ways of moving through space for escape. As a human ambulates through a variety of potential habitats, some particular landscape constellations fail to activate, fulfill, or embody these evolved preferences. Those that do embody the preferences presumably trigger a set of cognitive procedures or decision rules, depending in part on other contextual input, such as one's state of hunger or thirst, the size of one's group, and knowledge about the presence of hostile humans in the vicinity. Eventually, these procedures produce output in the form of a behavioral decision to remain in the habitat or to continue one's search for a better habitat. These behavioral decisions presumably led the possessors of landscape preferences to survive and reproduce better than those lacking landscape preferences or those who possessed alternative preferences that were less effective at securing resources and reducing risk.

Although psychological mechanisms such as landscape preferences clearly differ in important ways from mechanisms such as snake fears, they share critical ingredients that qualify them as evolved psychological mechanisms—they solved specific adaptive problems in human ancestral environments; they are triggered only by a narrow range of information; they are characterized by a particular set of procedures or decision rules; and they produce behavioral output that presumably solved the adaptive problem in ancestral times.

Given the infinite courses of action a human could pursue in principle, evolved psychological mechanisms are necessary for channeling action into the narrow pockets of adaptive choices: "Animals subsist on information. The single most limiting resource to reproduction is not food or safety or access to mates, but what makes them each possible: the information required for making adaptive behavioral choices" (Tooby & Cosmides, 1990b, p. 408). Psychological mechanisms are necessary for seeking and extracting particular forms of information; decision rules are necessary for producing action based on that information.

Evolved psychological mechanisms are likely to be large in number and complex in nature, and many will be domain specific. There are several rationales for these premises, but I mention only two—one conceptual and one empirical. Conceptually, the adaptive problems that humans had to solve in their environment of evolutionary adaptedness were many, complex, and different from one another. A fear of snakes may solve the adaptive problem of avoiding a dangerous environmental hazard but does nothing to solve the adaptive problem of which foods to consume (e.g., berries and nuts, not twigs or gravel). Similarly, solutions to the problem of "how to attract a mate" do little to solve the problem of "how to socialize children." Different adaptive problems typically select for different adaptive solutions. As Symons (1992) put it, there is no such thing as a "general solution" because there is no such thing as a "general problem."

Mechanisms vary, of course, along many dimensions—some more domain general, others more domain specific; some more cognitively penetrable, others less cognitively penetrable; some easily overridden by other mechanisms, others more difficult to override. What constitutes a successful solution to an adaptive problem, however, differs across adaptive domains (e.g., avoiding a snake vs. selecting a mate), individual circumstances (e.g., presence of powerful kin and alliances vs. absence of social resources), different species (humans vs. spiders), different ages (prepubescent vs. adolescent), and different sexes (male vs. female).

There can in principle, therefore, be no fully domain-general solution mechanism—one that can be used across all adaptive domains, by all ages, by all sexes, and under all individual circumstances. A carpenter's flexibility comes not from having a single, domain-general, "all-purpose tool" for cutting, poking, sawing, screwing, twisting, wrenching, planing, balancing, and hammering, but rather from having many, more specialized, tools. It is the number and specificity of the tools in the entire toolkit that give the carpenter great flexibility, not a single, highly "plastic" tool. Similarly, we display great flexibility in dealing with our social environments not because we have just a few domain-general psychological mechanisms, but rather because we possess a large number of complex and specific ones, which can be deployed singly and in complex combinations depending on circumstances.

On conceptual grounds, therefore, evolutionary psychologists assume that—because (a) adaptive problems are many and distinct, (b) successful solutions to one problem are different from the solutions needed for other problems, and (c) what will be successful depends heavily on species, age, sex, context, and individual circumstances—the solution mechanisms will be numerous and complex. Evolutionary psychology offers a powerful heuristic for identifying some of these human adaptive problems (Buss, 1991).

The second rationale for the complexity–numerosity premise is empirical. In the past 30 years, psychologists have demonstrated again and again violations of proposed principles of domain generality. In learning theory, for example, violations of equipotentiality have been demonstrated by Garcia and others. Indeed, Garcia's findings at first were so startling to editors and reviewers of the major journals—mainly because the findings violated domain-general learning principles—that they refused to believe or to publish them until they were replicated many times (Garcia, 1981). We now know that some things are extraordinarily difficult to learn, requiring thousands of trials; others can be learned in a single trial. We now know that humans are predisposed to learn some things more readily and rapidly than other things (Seligman & Hagar, 1972). More people learn fears of snakes, heights, spiders, and darkness, for example, than fears of cars or electrical outlets, which are currently more hazardous.

The existence of many domain-specific mechanisms, of course, does not rule out the possibility that some mechanisms will be relatively more domain general than others—mechanisms such as the capacity for induction, the ability to perceive means–ends relations, and perhaps the perception of certain forms of covariation (Holland, Holyoak, Nisbett, & Thagard, 1986; Nisbett, 1990; but see Pinker, 1994, for a discussion of the need for domain-specific similarity metrics to guide generalizations). An evolutionary psychological perspective, however, suggests that the human mind cannot be solely composed of domain-general mechanisms—most adaptive problems require more complex and specialized psychological machinery to successfully solve. Moreover, the relatively more domain-general mechanisms will not be deployed randomly. Instead, these mechanisms are co-opted for very specific goals, such as forming reciprocal alliances or friendships, selecting mates, achieving or maintaining position within social hierarchies, helping family members, and building coalitions.

Many empirical findings that point to domain specificity have been discovered, and I list just 20 samples now for illustrative purposes:

1. A highly patterned distribution of fears and phobias that corresponds to hazards faced by humans in ancestral environments—the "fear of strangers" that emerges reliably between 8 and 24 months of age and fear of snakes, spiders, heights, open spaces, and darkness (Marks, 1987).
2. Particular mechanisms of color vision (Shepard, 1992).
3. Universal psychological adaptations to terrestrial living (Shepard, 1987).
4. Perceptual adaptations for entraining, tracking, and predicting animate motion (Freyd & Miller, 1993).
5. Children imitate high-status models much more than they do low-status models (Bandura, 1977).
6. Preschoolers reliably develop a specific theory of mind that entails the use of inferences about the beliefs and desires of others to predict their behavior (Wellman, 1990).
7. Autism results in a highly domain-specific psychological impairment—namely, the inability to formulate a concept of mind involving inferences about the beliefs and desires of others (Leslie, 1991).
8. Child abuse is 40 times greater among preschoolers in stepfamilies than in "intact" families in which there are two genetic parents—not implying dedicated mechanisms for child abuse, but rather mechanisms for the preferential allocation of resources and imposition of costs (Wilson & Daly, 1987).
9. The causes of marital dissolution across cultures are highly predictable on evolutionary psychological grounds, centering heavily on infidelity and infertility (Betzig, 1989).
10. Male sexual jealousy occurs in all known cultures and is the leading cause of spousal homicide across cultures—not suggesting dedicated mechanisms for spousal homicide, but rather male mechanisms designed to increase paternity certainty (Daly & Wilson, 1988).
11. Men and women worldwide show preferences for mates who are kind, intelligent, and dependable (Buss et al., 1990).
12. Men and women show consistent differences in what qualities they desire in potential mates (e.g., cues to resource investment potential, cues to reproductive value); these differences are closely linked with the social adaptive problems that men and women have confronted in mating contexts and are highly consistent across cultures (Buss, 1989a).
13. Women and men show predictable shifts in mate preferences when moving from brief sexual encounters to committed mating relationships (Buss & Schmitt, 1993).
14. Men and women differ dramatically in the frequency and content of sexual fantasy in ways predicted by evolutionary psychologists (Ellis & Symons, 1990).
15. Men inseminate more sperm after a separation from their wives in which an opportunity for infidelity might occur—a possible solution to the adaptive prob-

lem of lowered paternity certainty (Baker & Bellis, 1989).

16. Women of high reproductive value are more intensely guarded, sequestered, veiled, cloistered, and restrained than women of lower reproductive value (Dickemann, 1981).

17. Men engage in more risk-taking activity than women do, particularly between the ages of 16 and 24, when men are entering the arena of mate competition (Wilson & Daly, 1985).

18. Morning sickness shows a degree of design specificity such that one can reasonably infer that it represents an adaptation to prevent the ingestion of teratogens (Profet, 1992).

19. Women show superior spatial-location memory compared with men—a possible adaptation to gathering (Silverman & Eals, 1992).

20. Men show greater spatial-rotation ability compared with women—a possible adaptation to hunting (Silverman & Eals, 1992).

Although no one of these findings tells a definitive story, in the aggregate they point strongly to the existence of a large number of specialized psychological mechanisms. A mushrooming body of empirical evidence, in other words, supports the conceptual expectations of evolutionary psychologists—numerous mechanisms have evolved because of the large number and extreme diversity of adaptive problems that humans needed to solve in our evolutionary environments.

Many Important Adaptive Problems for Humans Are Social

The social group constituted at least one of the crucial "selection environments" for humans. Brewer and Caporael (1990), for example, argued that the cooperative group may have been the primary survival strategy of humans, and this would have selected for adaptations suited for cooperative group-living—adaptations such as cooperativeness, loyalty, and fear of social exclusion (see also Alexander, 1987; Baumeister & Tice, 1990; Buss, 1990b). Individuals whose mechanisms led them to be uncooperative, deviant from group norms, or disloyal presumably would have had more trouble surviving than those with the opposite set of mechanisms, and hence their mechanisms would have been selected against. This does not rule out mechanisms that lead people to be selectively disloyal or uncooperative, depending on particular circumstances. Indeed, analyses of the evolution of cooperation anticipate the existence of precisely such discriminative mechanisms (Axelrod, 1984; Cosmides, 1989).

But survival is only the beginning. Because natural selection operates by a process of differential reproductive success (not differential survival success), there are many reproductive problems that we had to solve, and many of these are inherently social in nature. Examples include successful intrasexual competition, mate selection, mate attraction, sexual intercourse, mate retention, reciprocal dyadic alliance formation, coalition building and maintenance, prestige and reputation maintenance, hierarchy negotiation, parental care and socialization, and extraparental kin investment (Buss, 1986, 1991).

Within each of these large classes of social adaptive problems lie dozens of subproblems. Forming a successful dyadic alliance, for example, may require identifying key resources possessed by potential friends, assessing which individuals possess these resources, modeling the values of those individuals, gauging potential sources of strategic interference, initiating sequential and incremental chains of reciprocity, and detecting signs of "cheating" or nonreciprocity (see Cosmides & Tooby, 1989). All these subproblems require solutions for the formation of a successful friendship.

Humans are probably unique in the duration and complexity of the social relationships they form. Humans sometimes form lifelong mating relationships, develop friendships that last for decades, and maintain contact with their brothers, sisters, and other relatives over great expanses of time and distance. Because social adaptive problems were so crucial for human survival and reproduction, many of the most important features of our evolved psychological mechanisms will necessarily be social in nature. Social adaptive problems have been so important over human evolutionary history that many of the dedicated psychological mechanisms currently studied by cognitive, personality, and developmental psychologists, in addition to those studied by social psychologists, are inherently social.

Why I Am Not a Sociobiologist

To psychologists unfamiliar with thinking about selection pressures, adaptive problems, and evolved psychological mechanisms, these claims may seem similar to those of sociobiologists. Although sociobiologists and evolutionary psychologists do share the same basic evolutionary theory in its modern instantiation as inclusive-fitness theory (Hamilton, 1964), they depart in ways that are crucial for psychology. One difference hinges on the nature of evolved psychological mechanisms. Although this is not true of all sociobiologists, many advocate a view of humans as "fitness maximizers" or "fitness strivers" or that humans act "as if" they were inclusive-fitness maximizers (e.g., Alexander, 1979; Betzig, Borgerhoff Mulder, & Turke, 1987;

Lopreato, 1984; Turke, 1990). They imply, and sometimes explicitly state, that humans possess mechanisms with the goal of maximizing their inclusive fitness—that is, maximizing their gene representation in subsequent generations relative to other people. To quote one well-known sociobiologist, "Humans are inclusive fitness maximizing blobs" (Alexander, 1991).

I have labeled this view the *sociobiological fallacy* (Buss, 1991) because it conflates a theory of the origins of mechanisms (inclusive-fitness theory) with a theory of the nature of those mechanisms. If men had as a goal the maximization of fitness, then why aren't they all lined up to give donations to sperm banks, and why do some individuals decide to forgo reproduction entirely? Humans clearly have evolved a specific preference for fatty foods, but, given the abundance of such foods in modern environments, our evolved preferences now lead to the overconsumption of fat, which may be detrimental to survival and reproductive success. Men do not look at erotic photographs to maximize their fitness, but rather evolved mechanisms of attraction exist in men, and they can be exploited by evolutionarily novel simulations of ancestral stimuli. Food preferences and mechanisms of sexual attraction are merely the end products of a causal process of evolution by selection. Once those mechanisms are in place, they can be activated or executed in ways that may or may not lead to fitness in current environments. After all, evolutionary theory is a theory about origins and change, and there is no guarantee that selection pressures remain invariant over time. The nature of mechanisms as end products should not be confused with the causal process that created them. The sociobiological fallacy has led to some dubious speculating about how, if one really looks closely enough, one will see that person X really is maximizing fitness, even though the behavior seems anomalous with respect to this goal (e.g., suicidal, schizophrenic, dysfunctional). Evolutionary psychologists see humans as "adaptation executors" or "mechanism activators" rather than as "fitness strivers" (Tooby & Cosmides, 1990b).

The reasons are several. First, fitness is not something that can be tracked within an individual's lifetime, much less action by action. That is, even assuming that individuals had the cognitive capacity to calculate correlations between alternative courses of action and differential inclusive-fitness over the appropriate sample space (which itself is highly questionable), the relevant fitness information only becomes known generations later and hence is not accessible to individual actors.

Second, what contributes to fitness varies across species, sexes, ages, ecologies, and adaptive domains. Successful solutions to the problem of mate selection differ from those for food selection. Successful solutions for females may differ from those for males. Successful solutions in the tropics differ from those in polar-ice regions. Selection cannot produce mechanisms of the domain-general form of "fitness maximizers" for the simple reason that there has never existed any domain-general way to maximize fitness (Symons, 1992).

An implication of the sociobiological fallacy is that many sociobiologists have skipped or neglected the "psychological level" of analysis. Many go directly from principles of evolution to patterns of social organization—such as the nature of the mating system (e.g., polygyny vs. monogamy), the social system (e.g., the avunculate), or the legal system—without a description and account of the psychological mechanisms on which these aggregate end products are presumably founded. In contrast, evolutionary psychologists see psychological mechanisms as central to the analysis, not something that can be skipped, passed over, or omitted.

These are not trivial distinctions, but rather call for entirely different programs of research and conceptual analysis. If humans are really fitness maximizers, then the task becomes how to prove that individuals are maximizing fitness by performing a given behavior or engaging in a certain cultural practice. Counting offspring becomes a key empirical criterion (Betzig et al., 1987). In contrast, counting offspring is not directly relevant to evolutionary psychologists because, to them, it is only a gauge of current directional selection, not a promising method for illuminating adaptation in the form of psychological mechanisms.

In sum, evolutionary psychologists see their central task as being similar to that of other psychologists—to study psychological mechanisms. These mechanisms include specific goals or motives, such as desires for particular foods, desires for particular landscapes, and desires for particular mates. These mechanisms are activated by current manifestations of ancestral cues, such as the smell of cooked meat, the sight of a particular landscape painting, or a conversation with a person showing healthy skin and cues to kindness. These adaptations are executed in real time in current environments, regardless of whether or not they currently lead to fitness or reproductive success. Humans are living fossils—collections of mechanisms produced by prior selection pressures operating on a long and unbroken line of ancestors. Today we activate and execute these specific mechanisms, but we do not have some domain-general goal, either consciously or unconsciously, to maximize the replication of our genes relative to others.

The Centrality of Context in Evolutionary Psychology

A common misconception of evolutionary approaches is that they postulate "instincts"—rigid, ge-

netically inflexible behavior patterns that are invariantly expressed and unmodifiable by the environment. Although this view may have characterized some evolutionary approaches in the past and in some cases is erroneously thought to characterize contemporary evolutionary approaches, nothing could be farther from the current views in evolutionary psychology.

Indeed, there are few other perspectives within psychology that place greater importance on a detailed and complex treatment of environmental, situational, and contextual factors. Contextual evolutionary analysis takes place at several levels in the causal sequence. One is the *historical selective context*—the selection pressures that humans and their ancestors have faced over thousands of generations. Because we share part of our evolutionary history with other species—humans and chimps share common ancestors—we share some mechanisms with those species, such as our mechanisms of vision, which are similar. But, because human evolutionary history differs from that of all other species, and the selection pressures we have experienced are unique in many ways, some of our evolved psychological mechanisms are unique to us and are not shared by any other forms of life. Evolutionary psychology requires an analysis of these shared and unique features of our historical context.

A second context for evolutionary psychological analysis is the *ontogenetic context.* Evolutionary analyses of ontogenetic context have taken two forms, although these by no means exhaust the possibilities. One is analysis of the experiences during development that can shunt individuals toward different strategies (Buss, 1991; Tooby & Cosmides, 1990a). There is some evidence that father absence during childhood shunts individuals toward a more promiscuous mating strategy, whereas the presence of an investing father during childhood shunts individuals toward a more monogamous mating strategy (Belsky, Steinberg, & Draper, 1991; Draper & Belsky, 1990). The environmental input during development—presence versus absence of investing fathers and the reliability or unpredictability of resources—presumably provides information about the probability of securing a high-investing, committed mate and hence whether or not the pursuit of a series of short-term mates might be more advantageous. Second, developmental experiences set differing thresholds on species-typical psychological mechanisms. The threshold for responding to a threat with extreme violence, for example, may be lowered in some cultures, such as the Yanomamo Indians of Brazil (Chagnon, 1983), and raised in others, such as the !Kung San of Botswana (Shostack, 1981). Ontogenetic context includes, of course, variations by sex (due to sex-differentiated socialization) as well as variations due to culture (Low, 1989).

The third form of contextual analysis entails an analysis of the *immediate situational inputs* that activate the operation of particular psychological mechanisms. Just as callous-producing mechanisms are activated only if an individual experiences repeated friction to the skin, so psychological mechanisms such as sexual jealousy (Buss et al, 1992), cheater detection (Cosmides, 1989), and discriminative parental solicitude (Daly & Wilson, 1988) are activated only by particular contextual input such as cues to infidelity, nonreciprocation, and the simultaneous presence of biological children and stepchildren. A central goal of evolutionary psychology is to explicate all these forms of contextual input—historical, ontogenetic, and experiential.

The Core of Human Nature: Why Our Basic Psychological Mechanisms Are Likely to Be Species Typical

There are compelling reasons for the view that our basic psychological mechanisms are likely to be species typical, shared by most or all humans (Tooby & Cosmides, 1990a). Essentially, all complex mechanisms require dozens, hundreds, or thousands of genes for their development. Sexual recombination, by shuffling genes with each new generation, makes it exceedingly unlikely that complex mechanisms could be maintained if genes coding for complex adaptations varied substantially between individuals. Selection and sexual recombination tend to impose relative uniformity in complex adaptive designs. This is readily apparent at the level of physiology and anatomy—all people have two eyes, a heart, a larynx, and a liver. Individuals can vary quantitatively in the strength of their hearts or in the efficiency of their livers but do not vary in their possession of the basic physiological mechanisms themselves (except by unusual genetic or environmental accident). This suggests that individual differences, including heritable individual differences, are unlikely to represent differences in the presence or absence of complex adaptive mechanisms—that is, mechanisms containing many elements that are functionally integrated and likely to be polygenic (Dawkins, 1986). Individual differences cannot be understood apart from human nature mechanisms any more than differences in the turning radius and stopping ability of cars can be understood apart from the basic car-nature mechanisms such as steering wheels and brakes.

Discovering Evolved Psychological Mechanisms

Psychological mechanisms are usefully regarded as evolved solutions to adaptive problems. Analogy to the

human body is useful. We have sweat glands and shivering mechanisms that solve problems of thermal regulation; callous-producing mechanisms that solve the problem of repeated friction to the skin; taste preferences that solve the problem of what substances to ingest. Standards for inferring that these mechanisms are solutions to adaptive problems include economy, efficiency, complexity, precision, specialization, and reliability (Tooby & Cosmides, 1992; Williams, 1966). Mechanisms that solve adaptive problems are like keys that fit particular locks. The efficiency, detail, and complex structure of the key must mesh precisely with the inner "problem" posed by the lock.

Evolutionary analysis of psychological mechanisms proceeds in two directions—form-to-function and function-to-form (Tooby & Cosmides, 1992). Imagine finding a key but not knowing which of the thousands of possible locks it might fit. Its size, its shape, its details might suggest tentative hypotheses and rule out others. It might be too large to fit some locks, yet too small to fit others. The shape of its tines must have a corresponding mirror-image shape in the internal workings of the lock. Eventually, through an iterated process of hypothesis generation and empirical testing, we might eventually discover the exact lock that the key was designed to fit. The precision, reliability, and specialization with which a particular key fits a particular lock provide the researcher with reasonable standards for inferring that a particular key was designed to fit a particular lock.

Alternatively, one might identify a lock (adaptive problem) and then search for a key that might fit it. Here, the same standards would apply—precision, efficiency, complexity of design. The "bottom line" is whether the key one discovers (adaptive mechanism proposed) actually fits the lock (solves the adaptive problem with reasonable precision, efficiency, and reliability) and whether alternative hypotheses about its origin (e.g., incidental by-product of some other adaptation) and function (other adaptive problems the mechanism might solve or other mechanisms capable of solving the adaptive problem) can be reasonably ruled out.

Evolutionary psychologists proceed in both directions, form-to-function and function-to-form. Sometimes a phenomenon or form is discovered—fever, fear of snakes, male sexual jealousy, mate preferences for "kindness"—and researchers generate and test hypotheses about its function. Often, there are competing functional theories about the same phenomenon, and these may be pitted against one another in critical empirical tests. This method is sometimes erroneously derided as telling "just-so stories," but it is an essential process of science. The discovery of three-degree black-body radiation sent astronomers scrambling for cosmological theories or "stories" to explain it. The discovery of continental drift sent geologists scrambling for a theory, such as plate tectonics, that could explain it. The power of a theory rests with its ability to explain known facts and to generate new predictions, which are then subjected to empirical test. Specific evolutionary psychological theories should be evaluated by these rigorous scientific standards. Some will pan out. Others will be jettisoned on conceptual or empirical grounds.

Evolutionary analysis provides psychologists with a powerful heuristic, guiding them to important domains of adaptive problems and guiding the development of hypotheses about adaptive mechanisms heretofore unobserved. Because fertilization and gestation occur internally within women, for example, an adaptive problem for ancestral men would have been ensuring confidence in their paternity as a condition for heavy investment. Men who were indifferent to this adaptive problem are not our ancestors. Such men would have devoted valuable effort to children who possessed copies of other men's genes rather than their own. Identifying this adaptive problem has led evolutionary psychologists to search for adaptive solutions in psychological mechanisms such as mate preferences for chastity, fidelity, and faithfulness (Buss, 1989a; Buss & Schmitt, 1993) and mechanisms involved in male sexual proprietariness such as sexual jealousy (Buss et al., 1992; Daly, Wilson, & Weghorst, 1982; Symons, 1979). Function-to-form and form-to-function are both viable methods for discovering our evolved psychological mechanisms.

Culture

When I give colloquia on my cross-cultural research on human mating strategies, at least one member of the audience will raise the following issue, phrased variously as "I have an alternative explanation for your findings—culture" or "Doesn't the existence of cross-cultural variability undermine your explanatory account?" When asked to elaborate on precisely what causal mechanisms are being invoked by culture as an alternative explanation, the questioner typically cannot supply additional details. Is "culture" really an alternative explanation? And how can evolutionary psychologists deal with cultural variability?

Let us start with a common observation: "Humans everywhere show striking patterns of local within-group similarity in their behavior and thought, accompanied by profound intergroup differences" (Tooby & Cosmides, 1992, p. 6). These local within-group similarities and between-group differences can be of any sort—physical, psychological, behavioral, attitudinal, and so on. How can we understand and explain these cultural differences? It is useful to start with a physical

example—callouses. The number and thickness of callouses that individuals have certainly show patterns of local within-group similarity and between-group differences. The warring Yanomamö have thicker and more numerous callouses than the missionaries who proselytize them.

The cultural differences can often be traced to environmental differences—Yanomamö experience more repeated friction on certain parts of their skin than do the missionaries. These differences, in turn, may be traced to other differences, such as the ways that the two groups secure food, the nature of the protective garments they use, and perhaps even the performance of certain rituals and leisure activities.

A causal explanation of these "cultural differences" requires the following ingredients: (a) evolved callous-producing mechanisms that were "designed" to receive as input only certain forms of external information (repeated friction), (b) local within-group similarities and between-group differences in exposure to these forms of external information, and (c) an account of why some groups of individuals receive this exposure more than others. In this example, it is clear that any reasonably complete causal explanation requires a description of the evolved callous-producing mechanisms. Without these mechanisms, the "cultural differences" literally could not occur. There are two profound implications that follow: (a) Cultural variability, far from constituting evidence against evolved psychological mechanisms, depends on a foundation of evolved mechanisms for its very existence; and (b) cultural variability is not explained merely by invoking "culture" (which merely mystifies the actual causal processes involved) but rather represents phenomena that require explanation.

Cultural differences in the number and thickness of callouses represent physical differences, but the logic applies with equal force to psychological, attitudinal, ideational, and behavioral differences. Certain Yanomamö groups display high levels of aggression, whereas the !Kung are notably peaceable (Chagnon, 1983; Shostack, 1981). The Ache of Paraguay are highly promiscuous, whereas the Hiwi show high levels of monogamy—a difference perhaps attributable to the high ratio of men to women among the Hiwi and the low ratio of men to women among the Ache, providing input into mechanisms that are sensitive to the relative availability of mates (Buss, 1994; Hill & Hurtado, 1989; Pedersen, 1991). These cultural differences are real and important, but explanatory accounts of them cannot ignore evolved psychological mechanisms underlying aggression and sexuality—mechanisms that are differentially activated in some contexts more than in others. Explanations require a specification of precisely what those context differences are and, ideally, a historical account of how they came to pass. Recognizing the role of evolved mechanisms provides a necessary foundation for cultural analyses of this sort.

Evolutionary psychology advocates integration and consistency of different levels of analysis, not psychological or biological reductionism: "By themselves, psychological theories do not, and cannot, constitute theories of culture. They only provide the foundations for theories of culture" (Tooby & Cosmides, 1992, p. 88). But those foundations are critical and the *sine qua non* of cultural phenomena:

> It is especially important ... to recognize that the environmental factors that cause contentful mental and behavioral organization to be expressed are not necessarily the processes that constructed the organization. ... The claim that some phenomena are "socially constructed" only means that the social environment provided some of the inputs used by the psychological mechanisms of the individuals involved. (Tooby & Cosmides, 1992, pp. 89–90)

Not all cultural phenomena can be explained as "evoked culture" in the manner in which callous differences are explained. A different subset of cultural phenomena may be restricted to:

> (1) those representations or regulatory elements that exist originally in at least one mind that (2) come to exist in other minds because (3) observation and interaction between the source and the observer cause inferential mechanisms in the observer to recreate the representations or regulatory elements in his or her own psychological architecture. In this case, their representations and elements inferred are contingent: They could be otherwise, and in other human minds, they commonly are otherwise. (Tooby & Cosmides, 1992, p. 91)

Tooby and Cosmides referred to these cultural phenomena as "adopted culture."

But phenomena described by adopted culture, like all other human behavioral phenomena, require an account of what psychological mechanisms underlie them and why such mechanisms have evolved. Tooby and Cosmides (1992) argued:

> The advantage of such mechanisms is straightforward. Information about adaptive courses of action in local conditions is difficult and costly to obtain by individual experience alone. Those who have preceded an individual in a habitat and social environment have built up in their minds a rich store of useful information. The existence of such information in other minds selected for specialized psychological adaptations that were able to use social observations to reconstruct some of this information within one's own mind. ... By such inferential reconstruction, one individual was able to profit from deducing what another already knew ... this task of reconstruction would be unsolvable if the

> child did not come equipped with a rich battery of domain-specific inferential mechanisms, a faculty of social cognition, a large set of frames about humans and the world drawn from the common stock of metaculture, and other specialized adaptations designed to solve the problems involved in this task ... [thus] culture is also shaped by the details of our evolved psychological organization ... there is no radical discontinuity inherent in the evolution of "culture" that removes humans into an autonomous realm. (p. 91)

"Culture," "learning," and "socialization" do not constitute explanations, let alone alternative explanations to those anchored in evolutionary psychology. Instead, they represent human phenomena that require explanation. The required explanation must have a description of the underlying evolved psychological mechanisms at its core.

The Evolutionary Psychology of Jealousy: An Illustration

No evolved psychological mechanism has been explored comprehensively in all its facets—the historical selection pressures that forged it, its development, the inputs that activate it, its species-typical nature, and its sex-differentiated, age-differentiated, culturally differentiated, and individually differentiated features. In this sense, evolutionary psychology offers a promissory note, and it is reasonable to hold it to a rigorous theoretical standard—what new insights are gained by adopting this perspective? Its value, like the value of all theoretical perspectives, must be gauged by its conceptual and empirical harvest.

Here I explicate one case I believe illustrates the potential payoff of evolutionary psychology—the case of jealousy. Jealousy is neither a peripheral nor a trivial emotion, for it is experienced in all known cultures and is the leading cause of spousal battering and homicide worldwide (Daly & Wilson, 1988). Why do humans experience jealousy? Do the sexes differ in its expression? What contexts activate jealousy? And of what value is evolutionary psychology in shedding light on this pervasive and pernicious mechanism?

Jealousy is a cognitive–emotional–motivational complex activated by threat to a valued relationship. It is considered "sexual jealousy" if the relevant threatened relationship is a sexual one, but there are types of jealousy that do not involve sex. Jealousy presumably is activated by cues to the loss of key resources provided by the relationship—cues such as eye contact between one's mate and a rival, decreased sexual interest, and a mate's increase in flirting with same-sex competitors. Jealousy channels attention, calls up relevant memories, and channels thought in particular directions. Ultimately, it motivates actions designed to reduce or eliminate the threat and retain the valuable relationship and the resources it provides.

Because both men and women over human evolutionary history have been damaged by relationship loss, both sexes have faced adaptive problems to which jealousy may have evolved as a solution. There are no evolutionary grounds for predicting that one sex will be more jealous than the other, and, indeed, almost all studies have shown that the sexes are equally jealous (G. L. White & Mullen, 1989). Jealousy appears to be a species-typical mechanism in both men and women in all known cultures (Daly & Wilson, 1988).

But evolutionary psychologists have long predicted that the sexes will differ in the events that activate jealousy (Daly et al., 1982; Symons, 1979). Specifically, because fertilization and gestation occur internally within women and not men, men over evolutionary history have faced an adaptive problem simply not faced by women—less than 100% certainty of parenthood. The reproductive threat for the man comes from the possibility of sexual infidelity by his mate. In species such as ours, in which the male sometimes invests heavily in a female and children, the female's certainty of genetic parenthood is not compromised if the male has sex with other females. The woman may risk the loss of her mate's time, attention, commitment, involvement, protection, and resources—resources that can be diverted from her and her children toward another woman. For these reasons, evolutionary psychologists have predicted that the inputs that activate jealousy for men will focus heavily on the sex act per se, whereas for women they will focus on cues to the loss of the men's commitment and investment.

A recent series of studies provided powerful confirmation. Consider this question: What would upset or distress you more: (a) imagining your mate having sexual intercourse with someone else or (b) imagining your mate forming a deep emotional attachment to someone else? The overwhelming majority of women endorsed emotional attachment; most men endorsed sexual intercourse. These sex differences were also observed in physiological arousal to imagining the two different scenarios. In measures of heart rate, electrodermal activity, and frowning, men showed greater physiological arousal and distress to imagined sexual infidelity than to emotional infidelity (Buss et al., 1992). Women tended to be more distressed by emotional than by sexual infidelity.

Individuals also vary within sex in jealous responses. For example, in the study just described, although some 60% of the men reported that they would be more distressed by their partner's sexual infidelity, the other 40% reported that they would be more distressed by their partner's emotional infidelity. These individual differences provide an important avenue for testing evolutionary psychological hypotheses. One such hy-

pothesis is that the relevant ontogenetic experiences must occur before the mechanism is activated. In the case of men, the relevant experience might be whether or not the man had experienced a committed sexual relationship. We found that the majority of men who had not experienced such a relationship reported that they would be more upset by emotional, rather than sexual, infidelity (Buss et al., 1992). In contrast, most men who had experienced a committed sexual relationship reported that they would be more upset by sexual infidelity. So, individual differences within sex may be due, in part, to differing developmental experiences—in this case, whether or not the relevant activating context had been experienced—although obviously the opposite causal arrow (i.e., men upset by infidelity preferentially seek committed relationships) and other alternative explanations (e.g., men lower in mate value have more difficulty securing committed sexual relationships and so may not be able to insist on sexual fidelity) cannot be ruled out.

What about cross-cultural evidence? Sex differences in jealousy are not limited to American samples. Gottschalk (1936) found that 80% of the central European men in his sample expressed fears of sexual threat, such as fantasies about the man's mate having sexual intercourse with another man or fears about his own sexual adequacy. Only 22% of the women in this sample expressed sexual concerns, focusing instead on relationship themes such as emotional closeness between the woman's mate and other women. A study of Dutch, English, and American divorce cases found that men more frequently cited infidelity by their spouses as a cause of divorce, even though such men were less likely to encounter infidelity than their female counterparts (Buunk, 1987; see also Kinsey, Pomeroy, & Martin, 1953). Betzig (1989) found similar results in a massive study of 89 cultures from around the world.

Cross-culturally, a wife's infidelity is viewed as a provocation so extreme that a "reasonable man" may respond with lethal violence (Daly & Wilson, 1988, p. 196). In Texas up until 1974, for example, it was legal for a husband to kill his wife and her lover if he did so while the adulterers were caught *flagrante delicto* (in the actual act). It was considered a reasonable response to a powerful provocation. Laws exonerating men from killing adulterous wives are found worldwide and throughout human history, despite myths propagated by some anthropologists that there are cultures in which men are not sexually jealous. Consider this description of Greek culture:

> The wife's infidelity ... brings disgrace to the husband who is then a Keratas—the worst insult for a Greek man—a shameful epithet with connotations of weakness and inadequacy. ... While for the wife it is socially acceptable to tolerate her unfaithful husband, it is not socially acceptable for a man to tolerate his unfaithful wife and if he does so, he is ridiculed as behaving in an unmanly manner. (Safilios-Rothschild, 1969, pp. 78–79)

Daly and Wilson (1988) scrutinized in detail the ethnographies for cultures that scholars such as Margaret Mead, Frank Beach, Marvin Whyte, and others have asserted have no bars to sexual conduct other than the universal incest taboo. Daly and Wilson found evidence for sexual jealousy in every one of these supposedly "nonjealousy" cultures. Among the Marquesa Islanders, for example, in which anthropologists have asserted that there are no bars to adultery other than the incest prohibition, we find this striking contradiction: "When a women undertook to live with a man, she placed herself under his authority. If she cohabited with another man without his permission, she was beaten, or, if her husband's jealousy was sufficiently aroused, killed" (Handy, 1923, p. 100; cited in Daly & Wilson, 1988, p. 204).

Another example of the supposed absence of sexual jealousy involved the practices of wife sharing by Eskimo men. Contrary to popular myths, however, male sexual jealousy is the leading cause of spouse homicide among the Eskimos—homicides that occur at an alarmingly high rate. Eskimo men share their wives only under highly circumscribed conditions—when there is the reciprocal expectation that the favor is to be returned in kind. Nowhere are wives shared freely. Paradises populated with sexually liberated people who share mates and do not get jealous apparently exist only in the minds of optimistic anthropologists and their unsuspecting readers. Sexual jealousy has been found to be a leading motive behind homicide in Sudan (Lobban, 1972), Uganda (Tanner, 1970), and India (Bohannan, 1960). Daly et al. (1982) concluded that "the majority of cases in each society was precipitated either by male accusations of adultery or by the woman's leaving or rejecting the husband" (p. 16).

These studies are clearly just the start of the exploration of this important psychological mechanism. Additional evolutionary psychological questions being explored currently include: Does male sexual jealousy vary in intensity across cultures according to the magnitude of male parental investment? Does female jealousy decrease as a function of decreases in a mate's resources? Does male sexual jealousy decrease as the reproductive value of his mate decreases? Is the partner who is relatively lower in mate value more jealous than the partner who is higher in mate value? All these questions were guided by evolutionary psychological thinking, and answers to them over the next few years should provide an even greater understanding of the workings of this complex mechanism—its species-typical features, its sex-differentiated features, and its individually different features.

There are several important theoretical points that can be drawn from this case example. First, evolved mechanisms do not determine behavior invariantly or rigidly but rather require relevant contextual information for their activation. Second, not all individuals respond to the same input in the same manner; just as men and women weight differing signs of infidelity somewhat differently, so different individuals within sex also weight cues differently (e.g., based on different developmental experiences, different assets such as mate value). Third, different cultures are likely to provide somewhat different input into evolved mechanisms—highlighting phenomena that require explanation rather than invoking "culture" as an alternative explanation. Fourth, mechanisms such as those subsumed by the concept of "jealousy" cut across traditional disciplinary boundaries within psychology. It is clearly a social phenomenon, because it involves mates and intrasexual rivals; it is clearly a cognitive phenomenon, because its mechanisms process informational input; it clearly has important developmental features, because varying ontogenetic experiences appear to affect the operation of the mechanisms; and, because individuals differ in consistent ways over time in the manner in which their jealousy mechanisms are activated, it is clearly a personality phenomenon as well. This implies that the traditional disciplinary boundaries within psychology do not cleave nature at its functional joints.

Implications for the Key Branches of Psychology

If the arguments for evolutionary psychology presented here have any merit, then profound and revolutionary implications follow for the conceptual foundations of the core of each branch of psychology. I cannot hope to enumerate all these foundational implications in this article. Nonetheless, it may be useful to give a glimpse of what these implications are for several of the major branches of psychology.

Evolutionary Social Psychology

Why form relationships that endure over time? Why compete with others? Over what resources do people compete and under what conditions? Which individuals come into conflict and why? Why interact with members of your own species at all? Why live in groups? Why not go off into the forest and contemplate the universe alone? The field of social psychology must come to grips with these core questions. Not all species live in groups. Some come together only briefly for breeding and otherwise live a solitary existence. Why are humans different?

Currently practiced social psychology tends to be "phenomenon" oriented. Typically, some interesting, counterintuitive, or anomalous observation is noticed and empirically documented. Examples are the "social loafing effect," the tendency for individuals to perform less work toward a joint outcome as the group size increases (Latané, 1981); the "bystander intervention effect," the tendency not to help someone in distress as the number of others present increases (Darley & Latané, 1968); the "fundamental attribution error," the hypothesized tendency for observers to underestimate situational influences on behavior, instead attributing causality to internal dispositional properties of the actor (Ross, 1981); the "male misperception of female friendliness" phenomenon, in which male observers tend to perceive sexual interest on the part of a woman, whereas female observers perceive mere friendliness (Abbey, 1982).

Explanations for these phenomena take the form of hypothesized situational, cognitive, or developmental antecedents. The fundamental attribution error, for example, is explained by invoking the attention structure: Observers presumably focus attention on the actor and so attribute causality to internal properties of the actor, whereas actors presumably focus attention on the external conditions as they are acting and so attribute causality to the situation rather than to themselves. The theory is that causal attribution is attributed to whatever events one's attention happens to be drawn toward—a tendency presumed to produce systematic errors in causal understanding. It might be noted that this pseudo-explanation requires a suspension of disbelief. That is, in any context other than "explaining" the attribution error, the suggestion that we attribute causality to whatever attracts our attention would be dismissed as preposterous. Do we attribute causality to accidentally triggered car alarms or to Day-Glo streamers at used-car lots?

The male misperception phenomenon, to take another example, is explained by ontogenetic exposure to media images and to male adoption of the "male sex role" of the parent during socialization. But do kids really follow their parents as role models in general? Why don't they follow the "roles" of eating spinach or sitting quietly on airplanes? Social loafing and the bystander intervention effect are explained by invoking the concept of "diffusion of responsibility," whereby, as the number of people present increases, the less each individual feels responsible to take action to intervene or to work to the maximum of his or her capacity—little more than a redescription of the phenomenon itself.

This phenomenon-oriented approach—identifying sometimes interesting and frequently counterintuitive patterns in thought or behavior and explaining them solely by reference to proximate causes—is vividly

illustrated by the organizational structure of most social psychology textbooks. The typical organization follows the phenomena that have received the most study. There are separate chapters on aggression, conformity, attraction, attitude change, attribution, persuasion, and so on. Within each chapter are summaries of the phenomena that have been documented. An occasional text will try to be more theoretical. For example, Deaux and Wrightsman (1988) presented three theories they believe have received the greatest support in social psychology: role theory, learning theory, and cognitive theory.

A full consideration of each of these theories is beyond the scope of this article. It is sufficient at this point to note:

1. All these theories implicitly assume a domain-general mind (e.g., in role theory, behavior is simply the product of whatever "role" one happens to adopt; in observational learning theory, people presumably imitate or adopt whatever behavior is modeled, largely unaffected by content).
2. None of the theories addresses the crucial question of origins—why are those roles adopted, why are particular things learned, why are cognitive mechanisms structured in particular ways?
3. None of the theories invokes the concept of function or adaptation—none specifies what problems the organism was designed to solve or what strategic solutions have evolved that historically gave humans a selective advantage at solving those problems.

These explanations do not invoke function. They do not describe evolved psychological mechanisms. They do not define the adaptive problem—or a modern instantiation of an ancestral adaptive problem—that the phenomenon was designed by selection to solve. They do not account for what the organism is trying to do. They implicitly assume a domain-general mind upon which the media and agents of socialization impress their stamp. In short, they avoid entirely the key questions of the origins and functions of the social phenomenon documented.

Once people are social, a logical next question is "Who should people be social with?" This question constitutes a major topic in traditional social psychology—attraction. The goal of this section is not to provide an exhaustive or comprehensive answer to this question. Instead, this section is designed to illustrate the differences between traditional social-psychological explanations and evolutionary psychological explanations of the same set of phenomena.

Let me now turn to three specific examples in which evolutionary psychological thinking has been applied to the analysis of social relationships.

Reciprocal alliance formation or friendship. Theoretical analyses have shown that tremendous benefits can accrue to individuals who form cooperative reciprocal relationships (Trivers, 1971). Costs are incurred that provide a larger benefit to someone else; at some later time, the recipient of the initial benefit bestows a benefit on the initial giver. Both individuals can gain by this process above and beyond what they could have gained by acting alone. Indeed, humans seem to have reached something of a pinnacle of reciprocal alliance formation—something that has not escaped the attention of social psychologists, judging by the importance of social exchange and equity theories (Clark & Reis, 1988).

One major condition limiting the evolution of reciprocal relationships, however, is the possibility of "cheating"—failing to reciprocate once a benefit has been received from the other person in the relationship (Cosmides & Tooby, 1989). Indiscriminate cooperation under conditions that allow cheating would be selected against; such a strategy is vulnerable to exploitation by noncooperators (Axelrod, 1984). It would suffer ultimately in the currency of reproductive success and hence would not evolve. Therefore, a prerequisite for the evolution of enduring reciprocal relationships is solving the adaptive problem of preventing cheating. Cosmides (1989) presented experimental evidence that people may possess something like a specialized "look for cheaters" cognitive algorithm that governs the manner in which they reason about social exchange. Humans seem especially sensitive to detecting people who violate social contracts by taking benefits without reciprocating by paying the appropriate costs. This is just one of the many social adaptation problems that must be solved in order to form complex reciprocal alliances—others include evolved capacities to recognize different individuals, to remember the histories of one's interactions with different individuals, to communicate one's values to others, and to model the values of other individuals (Cosmides & Tooby, 1989). Forming reciprocal alliances requires a number of complex psychological mechanisms that are uniquely designed for specialized adaptive problems.

Parent–child relationships. Parents and children share 50% of their genes, and so one expects, on theoretical grounds, that acts of altruism will flow from one to the other without the necessary expectation of reciprocity. What constitutes a "violation" in friendships (e.g., failure to reciprocate) does not constitute a violation in parent–child relationships. Evolutionary psychologists expect that specialized psychological mechanisms will have evolved that are attendant upon the unique adaptive problems that parents have confronted when interacting with their children. One class

of solutions to these problems is subsumed by what Daly and Wilson (1988) called *discriminative parental solicitude.*

The tremendous surge of love that parents feel toward their children seems to be mitigated by a highly predictable set of conditions that is difficult to account for on any grounds but evolutionary: (a) when the parent is not the biological parent, (b) when paternity is uncertain, (c) when the child is deformed or otherwise of poor phenotypic quality, and (d) when circumstances such as poverty, lack of food, or maternal overburdening from too many children render prospects for surviving and flourishing poor (Daly, 1989). It is precisely under these circumstances that infanticide instigated by parents is carried out, at least in traditional societies (Daly & Wilson, 1988; Dickemann, 1975; Minturn & Stashak, 1982). Without these mitigating circumstances, parents typically invest time, energy, effort, and love that is probably unparalleled in any other type of human relationship.

Mating relationships. In sexually reproducing species such as ours, reproduction cannot occur without mating. In most cultures, the vast majority of individuals do form mating relationships of more than a brief duration (more than 90% of all people get married at some point in their lives). This special social relationship, however, carries unique adaptive problems that are not shared by other forms of social relationships.

One adaptive problem is the selection of a suitable mate, such as one who is cooperative, dependable, resourceful, and reproductively capable. In our evolutionary past, men who selected mates who were low in reproductive capacity, for example, experienced lower reproductive success than did men who selected mates peaking in reproductive value. In our evolutionary past, 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. The sex differences in mate preferences for youth and physical appearance, on the one hand, and for resources, ambition, industry, and commitment, on the other, reflect sex differences in the adaptive problems that ancestral men and women faced when selecting a mate (Buss, 1989a, 1989b).

Both men and women faced different adaptive problems when pursuing short-term as opposed to long-term mates. The premium that both sexes place on sexual fidelity in a marriage partner, for example, would hamper gaining sexual access to desirable short-term mates. The shifts in men's and women's desires across these two contexts correspond precisely to shifts in the adaptive problems that men and women must solve in the two mating contexts (Buss, 1994; Buss & Schmitt, 1993).

The possibility of sexual infidelity, at least historically, posed distinctive adaptive problems for men and women. Men whose mates were unfaithful risked investing in children who were not their own. Women whose mates were unfaithful, although not risking analogous maternity uncertainty, nonetheless risked the diversion of a man's resources to other women and their children. There is compelling evidence that "sexual jealousy" evolved as a complex psychological solution to these problems (see earlier discussion of jealousy; Buss et al., 1992; Daly et al., 1982; Symons, 1979).

Note that this mechanism is irrelevant to solving the adaptive problems associated with friendships or kinships. What constitutes a "violation" in a long-term mateship—having sex with someone else—would not constitute a violation of a friendship (unless it is sex with the mate of one's friend), just as failure to reciprocate would constitute a violation of a friendship but not of a parent–child relationship. Different relationships pose different adaptive problems. People secure different sorts of resources from different types of relationships. What constitutes a successful relationship differs across relationship types. Thus, evolutionary psychologists expect that humans have evolved distinct psychological mechanisms to solve the unique adaptive problems associated with these different types of relationships. Some mechanisms, of course, may operate across contexts—successful status attainment, for example, may simultaneously attract mates and help with the provisioning of children. Selection of a good cooperator might be good for friendships as well as for mateships. Mechanism specificity will occur to the degree that there are specific adaptive demands linked with particular types of relationships.

In sum, humans form many intense, long-duration relationships that differ in their adaptive demands. Long-term relationships undoubtedly constituted human solutions to many of the survival and reproductive problems our ancestors faced. Therefore, the psychology of relationships rightly should occupy a central place in the evolutionary social psychology of humans. This focus coincides with the recent surge of interest in close relationships (Hazan & Shaver, 1991; Hendrick & Hendrick, 1991; Kelley et al., 1983; Rusbult, 1987). Because the adaptive problems posed by different types of relationships were at least partially distinct from one another, solutions to one often do little for solutions to the others. Evolutionary psychologists anticipate that there will be numerous social psychological mechanisms identified that have evolved to deal with these numerous unique complexities.

Evolutionary Personality Psychology

Personality psychology may be the broadest and most encompassing branch of psychology. Histori-

cally, all "grand" theories of personality have hypotheses about the contents of human nature at their core—be they motives for sex and aggression (Freud), self-actualization (Maslow), effectance (R. White), striving for superiority (Adler), or striving for status, power, popularity, or intimacy (Hogan, McAdams, McClelland, Wiggins). Hypothesized features of human nature have provided much of the "core" around which personality theories are constructed.

On the other hand, personality psychology has also been centrally concerned with the enduring ways in which individuals differ from one another (Wiggins, 1979). Much of current personality research explores questions such as: What are the most important ways in which individuals differ? What are the origins of individual differences? What are the psychological and physiological concomitants of individual-difference dimensions? What are the consequences of particular dimensions of difference for social interaction, psychopathology, well-being, and the life course?

Most work in evolutionary psychology has focused on species-typical psychological mechanisms. Because these evolved mechanisms form the core of human nature, from the perspective of evolutionary psychology, they are more or less synonymous with the first central issue of interest to personality psychologists. In contrast, the derivation of individual differences is considerably more problematic and has only recently received focused attention by evolutionary psychologists (e.g., Buss, 1991; Gangestad & Simpson, 1990; Tooby & Cosmides, 1990a).

Sex differences as one class of strategic individual differences. To get from human-nature psychological mechanisms to the analysis of individual differences, it is useful to go through an intermediate step—the analysis of sex differences, which may be regarded as one class of individual differences. Evolutionary psychology provides a unique metatheory for predicting when we should and should not expect sex differences: Men and women are expected to differ only in the delimited domains in which they have faced recurrently different adaptive problems (a) over human evolutionary history, (b) during their development, or (c) over different current environments inhabited. In domains in which the sexes have faced the same adaptive problems, no sex differences are expected. Alternative theories of sex differences typically cannot specify in advance the domains in which sex differences will be found, in which direction they will be found, and why they will be found in these domains and directions.

Men and women historically have faced many adaptive problems that are highly similar. Both sexes needed to maintain body temperature, so both sexes have sweat glands and shivering mechanisms. Repeated friction to certain areas of the skin was a "hostile force of nature" to both sexes in ancestral environments, so men and women have callous-producing mechanisms. Both sexes needed to solve the adaptive problem of identifying a good cooperator for strategic confluence when seeking a long-term mate, and this may be one reason why both sexes value "kindness" in a partner so highly across all cultures whose partner preferences have been studied (Buss, 1989a).

In several domains, however, the sexes have faced different adaptive problems. For 99% of human evolutionary history, men faced the adaptive problem of hunting and women of gathering—possible selective reasons for men's greater upper-body strength and spatial-rotation ability and for women's greater spatial-location memory (Silverman & Eals, 1992). Internal female fertilization and gestation created the adaptive problem of uncertainty of parenthood for men but not for women. Cryptic ovulation created the adaptive problem for men of knowing when a women was ovulating—a possible causal force in the origins of sexual activity through the entire cycle and the emergence of long-term, committed mating bonds between a man and a woman (Alexander & Noonan, 1979). The dual male mating strategy of seeking both short-term sexual partners and long-term marriage partners created an adaptive problem for women of having to discern whether particular men saw them as temporary sex partners or as potential spouses (Buss & Schmitt, 1993). Sex differences in mate preferences (Buss, 1989a), courting strategies (Buss, 1988a, 1988b; Tooke & Camire, 1991), jealousy (Buss et al., 1992), mate-guarding tactics (Buss, 1988b; Flinn, 1988), sexual fantasies (Ellis & Symons, 1990), and sexual desires (Buss, 1994) correspond remarkably well to these sex-linked adaptive problems. Evolutionary psychology offers the promise of providing a coherent theory of strategic sexual differences as well as strategic sexual similarities.

Strategic individual differences caused by individuals confronting different "environmentally induced" adaptive problems. The construction workers laboring on the building next door have thick callouses on their hands. My academic colleagues down the hall do not. These individual differences in callous thickness are highly stable over time. At one level of analysis, the variance can be traced solely to variance in the reliably recurring experiences of the two groups. At another level of analysis, the existence of the species-typical callous-producing mechanism is a central and necessary element in the causal explanation of observed individual differences. Just as men and women differ in the adaptive problems they confront, different individuals within each sex face different adaptive problems over time. Some manifest individual

differences are the strategic products of species-typical mechanisms responding to recurrently different adaptive problems across individuals.

In this callous example, the individual differences in skin-friction experiences are in some sense "environmental." If my academic colleagues were to trade places with the construction workers, then the manifest individual differences would reverse. Nonetheless, we cannot rule out the genotype–environment correlation processes proposed by Plomin, DeFries, and Loehlin (1977) and Scarr and McCartney (1983). Some individuals, because of heritable skills, interests, or proclivities, may preferentially select academic work or construction work as occupations. These selections, in turn, may create repeated exposure to friction-free versus friction-prevalent environments, which then differentially activate the species-typical callous-producing mechanism.

There are three central points in my argument thus far:

1. Stable manifest individual differences can be caused by differences in the recurrent adaptive problems to which different individuals are exposed.
2. The complex species-typical mechanisms are necessary and central ingredients in the causal explanation of individual differences because, without them, the observed individual differences could not occur.
3. The manifest individual differences are strategic outcomes of recurrently different input into species-typical mechanisms.

There are undoubtedly many recurrent environmental individual differences of precisely this sort. Firstborn children probably face recurrently different adaptive problems than those faced by laterborn children. These apparently trigger in firstborns greater identification with the status quo, the parents, and the established power structure. This tendency may be responsible for the fact that firstborns typically oppose revolutionary scientific theories (Sulloway, 1994). Laterborns, who confront a niche already filled by an older sibling, tend to rebel more against established traditions, which may lead them to a greater identification with revolutionary scientific theories (Sulloway, 1994).

Individuals who grow up in environments in which resources are unpredictable, such as among Hungarian Gipsies, may adopt a more impulsive personality style, and even mating style, where it would be adaptively foolish to delay gratification (Bereczkei, 1993). In contrast, those growing up in environments in which resources and future prospects are more predictable may adopt a personality strategy involving greater delay of gratification, including sexual gratification. 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.

Strategic individual differences caused by individuals confronting different "heritably induced" adaptive problems. Recurrently different input into species-typical psychological mechanisms, of course, may come from heritable individual differences, whatever their ultimate origin (i.e., whether they originated from selection for alternative genetically based strategies, frequency-dependent selection, genetic noise, pathogen-driven selection for genetic uniqueness, or assortative mating). Individuals with an ectomorphic body type, for example, confront different adaptive problems than those with an mesomorphic body type. Ectomorphs may risk being at the receiving end of greater aggression than their more muscular peers—an adaptive problem that typically must be solved by means other than physical aggression. Genetic differences, in other words, pose different adaptive problems for different individuals.

In addition to facing different adaptive problems, some individuals experience greater success at pursuing certain strategies rather than others:

> Selection operates through the achievement of adaptive goal states, and any feature of the world—either of the environment, *or of one's own individual characteristics*—that influences the achievement of the relevant goal state may be assessed by an adaptively designed system. (Tooby & Cosmides, 1990a, p. 59, italics added)

Individuals who are mesomorphic, for example, typically will experience far greater success at enacting an aggressive strategy than individuals who are ectomorphic (Tooby & Cosmides, 1990a, called this phenomenon *reactive heritability*).

Consider individual differences in physical attractiveness. There is evidence that physically attractive men are more successful at pursuing a "short-term" mating strategy involving many sexual partners (Gangestad & Simpson, 1990). Physically attractive women are better able to pursue a long-term strategy of seeking and actually obtaining higher status, higher income marriage partners (Taylor & Glenn, 1976). Heritable differences in physical attractiveness affect the success of pursuing different mating strategies. The manifest strategy differences are in some sense "heritable" but only indirectly and reactively. Relative physical attractiveness functions as "input" into species-typical or sex-typical psychological mechanisms, which then canalize the strategies of different individuals in different directions.

Heritable dimensions of individuals—such as differences in body type, keenness of vision, oratory skills, physical attractiveness, and spatial ability—provide important input into species-typical mechanisms. These individually different inputs tell the organism about the adaptive problem it is facing and the strategic solutions likely to be successful. The resulting product consists of strategic individual differences that are stable over time. The observed strategic differences are correlated with genetic variance but cannot be understood apart from the central role played by our species-typical psychological mechanisms that were "designed" to receive input—both environmentally and heritably based—about the adaptive problems confronted and the strategic solutions likely to be successful.

Evolutionary approaches to goals, tasks, projects, and strivings. The focus of evolutionary psychology on strategic individual difference coincides and converges with the recent trend in personality psychology toward a focus on goals (Pervin, 1989), life tasks (Cantor, 1990), personal projects (Little, 1989), and personal strivings (Emmons, in press). The goal-based research programs pursued by different investigators often identify similar fundamental goals. Consider these examples: "to make attractive women [men] notice me more" (personal striving), "to have sex" (personal project), "to get a boyfriend" (life task), "to attract mates" (evolutionary life task), and "to maintain my marital relationship" (current concern). From an evolutionary perspective, all these forms of effort constitute mating effort and are thematically related to reproduction. Successful mating is a task that must be accomplished for successful reproduction. Individuals whose psychological properties led them to succeed at this task are our ancestors. That the theme of successful mating emerges repeatedly from goal-based personality research suggests that these methods provide powerful tools for exploring functionally significant life tasks.

Two other themes of major evolutionary significance are negotiating hierarchies and forming reciprocal alliances. Concrete examples of personal goals that emerge from goal-based research programs are getting a promotion (current concern), graduating from university (personal project), being more productive at work (personal project), and dominating people in certain situations (personal striving) (Emmons, in press). Because position within social hierarchies historically bestowed on the successful a host of reproductively relevant resources (e.g., better and more food, better and more mating opportunities), rising in hierarchies, or status striving, should constitute a major species-typical goal of humans (Betzig, 1986; Buss, 1986; Hogan, 1983). Because the effective formation of cooperative reciprocal alliances represents an extremely effective form of reproductive competition (Axelrod, 1984; Trivers, 1971), this also should comprise a major motive of humans.

It is probably not by chance that the most frequently studied human motives are achievement (McClelland, 1951), power (Winter, 1973), and intimacy (McAdams, 1988). It is also not by chance that power and love emerge consistently and cross-culturally as the two most important dimensions of interpersonal behavior (Carson, 1990; G. M. White, 1980; Wiggins, 1979). Although these goals may be framed in somewhat different ways for different individuals, and the strategies used to attain them certainly vary widely, evolutionary psychology suggests that these will be based on powerful underlying human commonalties. Individual uniqueness should not blind investigators to these underlying features of our evolved human nature.

Evolutionary psychology leads investigators to the hypothesis that much human effort and, hence, strivings, projects, tasks, concerns, and their attendant strategies will be directed toward accomplishing those goals that historically have been linked with fitness. Goal-directed strategic effort arises from psychological mechanisms that owe their existence and form to evolution by natural selection. Among humans, these include successful mate competition, mate attraction, hierarchy negotiation, reciprocal alliance formation, coalition building, and so on. Although most goal-based research has focused on consciously articulated tasks, nothing in evolutionary psychology requires that humans be aware of either the underlying psychological mechanisms or the ultimate functions of goal pursuit. The crucial issue is whether these strivings and their attendant psychological mechanisms show evidence of function and meet rigorous standards of evidence for adaptation—efficiency, economy, precision, and complexity of design—that is uniquely tailored to solving a particular adaptive problem.

The next decade of psychological research should witness a sharp increase in attention paid to strategies, tactics, and goals as new units of analysis in personality psychology. The discovery of an underlying, species-typical goal structure to these strategies will constitute a major and lasting scientific advance. Research informed by evolutionary psychology will facilitate this important scientific advance.

The five-factor model in evolutionary perspective—personality as the adaptive landscape. One need not believe that there are only five important personality dimensions (see, e.g., DeRaad & Hoskens, 1990; Tellegen, 1985) to reach the conclusion that the five discovered so repeatedly—Surgency (dominance, power, extraversion vs. submissiveness, weakness, introversion), Agreeableness (cooperative, trustworthy

vs. aggressive, suspicious), Conscientiousness (industrious, responsible vs. lazy, irresponsible), Emotional Stability (secure, stable vs. insecure, anxious), and Intellect-Openness (intelligent, perspicacious, creative vs. stupid, boorish, unimaginative)—must surely be included in some form within any major personality taxonomy. Descriptive work documents the robustness of these factors but does not elucidate why they are so frequently found.

From an evolutionary perspective, there are three ways to approach this crucial question. The first approach, discussed earlier, is that these individual differences may represent strategic differences, based on either heritable or environmental differences. Second, they may signify mere "noise" in the system—variations that were neutral with respect to natural and sexual selection. The third approach, entirely compatible with the first, is that these five dimensions of individual differences summarize the most important features of the social landscape that humans have had to adapt to (Buss, 1989b). From this perspective, "to know others is an adaptive necessity" (Symons, 1979, p. 310).

The core of the "personality as adaptive landscape" view is that perceiving, attending to, and acting upon differences in others has been (and likely still is) crucial for solving adaptive problems. The first piece of evidence in favor of this view is that trait terms are inherently evaluative. Peabody (1985) found that fewer than than 3% of trait terms were evaluatively neutral, the remaining 97% having definite evaluative (as well as descriptive) aspects (see also Hofstee, 1990). Hogan (1983) argued that trait terms reflect observer evaluations of others as potential contributors to, or exploiters of, the group's resources. Borkenau (1990) argued that traits are evaluative, goal-based social categories. For example, the Intellect of others (Factor V) must be evaluated so that a person knows to whom to go for advice. Conscientiousness (Factor III) must be evaluated to know whom to trust with tasks. Borkenau argued that a selective advantage would accrue to those persons who have the ability to perceive and act upon these major individual differences in others. Graziano and Eisenberg (in press) placed Agreeableness (Factor II) in evolutionary perspective. They argued that coordinated group action is best accomplished when individuals are willing to cooperate and conform to group norms and to suspend their individual concerns for the good of the group (see Wiggins, 1991, for a similar account).

Humans are an intensely group-living species. Groups afford protection from predators, protection from other groups of aggressive males, the possibility of cooperative hunting of large game, and a population of potential mates. But groups also carry costs. With group living comes an intensification of competition, risks of communicable diseases, and aggression from other group members. Other humans can cripple our survival and reproductive success. Other humans are our primary sources of strategic interference. Other humans are our primary "hostile force of nature" (Alexander, 1987). In a phrase, other humans define our primary adaptive landscape and are capable of facilitating or interfering with our reproductive strategies (see also Byrne & Whiten, 1988).

I have argued that personality traits summarize the most important features of that adaptive landscape (Buss, 1989b). They provide a source of information for answering important life questions: Who is high or low in the social hierarchy? Who is likely to rise in the future? Who will make a good member of my coalition? Who possesses the resources that I need? With whom should I share my resources? Who will share their resources with me? On whom can I depend when in need? With whom should I mate? Whom should I befriend? Who might do me harm? Whom can I trust? To whom can I go for sage advice? The hypothesis is that people have evolved psychological mechanisms sensitive to individual differences in others that are relevant to answering these critical adaptive questions.

Two of the most important features of human groups are (a) that they are intensely hierarchical, with important reproductive resources closely linked with position in the hierarchy (e.g., Hogan, 1983; Lopreato, 1984), and (b) that they are characterized by elevated forms of cooperation and reciprocal alliance formation (Axelrod, 1984; Cosmides & Tooby, 1989; Trivers, 1971). The importance of hierarchy suggests that location of others in the hierarchy and proclivities to ascend in the hierarchy are extremely important features of the human adaptive landscape. The prevalence of reciprocal alliance formation suggests that a second critical feature of the human adaptive landscape is the differential proclivity of others to "cooperate" or to "defect."

The persistent emergence of Surgency (dominance vs. submissiveness) and Agreeableness (cooperative vs. aggressive) as the two major axes in interpersonal taxonomies (e.g., Wiggins, 1979) and as the first two factors in personality-descriptive taxonomies (McCrae & Costa, 1989; Trapnell & Wiggins, 1990) represents the adaptive significance to all humans of discerning in others their hierarchical position and proclivity and their willingness to form reciprocal alliances (Buss, 1989b). In human evolutionary history, those individuals able to accurately discern and act upon these individual differences likely enjoyed a considerable reproductive advantage over those who were oblivious to these consequential individual differences. Evidence from studies of competition and mating supports specific predictions from an evolutionary analysis of these features of the human adaptive landscape. For example, kindness (Factor II), dependability (Factor III), emotional stability (Factor IV), and intelligence (Factor V)

are among the most valued characteristics in potential mates (Buss et al., 1990).

Historically, evolutionary approaches have ignored individual differences. Recent work has shown that models can gain increased sophistication and precision by incorporating an analysis of individual differences. The integration of basic human-nature psychological mechanisms with evolved strategic individual differences may provide the most compelling theoretical bridge to close the current chasm between the branches of psychology that deal with typical human mechanisms and those that focus on individual differences.

Evolutionary Developmental Psychology

Developmental psychology is not a branch of psychology with a particular content attached to it, but rather an approach to psychological phenomena of any sort that incorporates a temporal, life-span, or ontogenetic perspective. Thus, one can study personality development, social development, moral development, perceptual development, or cognitive development. Can evolutionary psychology shed any novel light on the ontogeny of human life spans? Although only the future will reveal how far and deep evolutionary psychological insights will be, there are several promising directions already apparent.

One new perspective provides an evolutionary approach to socialization practices. Why do parents devote the tremendous effort that they do to shaping their children in particular directions? Can we understand and predict these directions? Low (1989) provided a start by examining socialization practices in 93 cultures. Low showed striking support for three evolution-based predictions about childhood training:

1. Boys, across cultures, are trained to show greater fortitude, aggression, and self-reliance than girls are trained to show.
2. Girls, across cultures, are trained to be more responsible, obedient, and restrained than boys are trained to be (especially sexually restrained).
3. The more polygynous the society, the more intensely boys are trained to be competitive strivers.

These findings highlight the heuristic value of evolutionary thinking in identifying important variation, as well as uniformity, across cultures. They also highlight the fact that parental socialization practices are important developmental phenomena requiring explanation.

Evolutionary work on attachment (Bowlby, 1969; Hazan & Shaver, 1991) and the role of warmth (McDonald, 1992) has flourished over the past decade. McDonald (1992), for example, made a compelling case for viewing warmth as a reward system that evolved to facilitate cohesive family relationships in general and parental investment in children in particular. McDonald assembled empirical evidence for the modularity of mechanisms. Contrary to what some developmental perspectives predict, for example, the data show that the same individuals can behave in affectionate, intimate, and empathic ways with some people while acting brutally and aggressively toward others. McDonald's evolutionary analysis of warmth and attachment shows much promise.

Another promising direction has come from an evolutionary developmental theory of family environment proposed by Belsky et al. (1991). Following Draper and Harpending (1982), Belsky et al. proposed that critical events during childhood shunt individuals into different developmental paths. Early father presence shunts children into a mating strategy marked by long-term monogamous relationships with high parental investment; early father absence shunts children into a mating strategy marked by early sexual maturation, early sexual intercourse, more numerous short-term sexual encounters, and a generally more promiscuous mating strategy. Although this theory is still in the early stages of testing, it offers the promise of accounting for individual differences in the development of alternative sexual strategies in males and females.

Puberty and adolescence are obvious areas ripe for evolutionizing (Savin-Williams, 1987; Weisfeld, 1979). Although many physical changes that occur with puberty are fairly apparent—such as fat deposition on hips, buttocks, breasts, and thighs in females and growth of facial hair, deepening of voice, and increase in stature in males—the psychological transformations that accompany the physical changes have been far less explored. Increased interest in sexual activity (especially with the opposite sex), increased frequency of sexual fantasy, onset of acute self-consciousness, increased concern with conforming to peer norms, increased risk-taking among males, and increased intrasexual competition for position and status are just a few of the many topics that deserve evolutionary psychological analysis.

The shift in effort from mating to parenting represents another key life-span issue. What psychological mechanisms get triggered by the birth of a child? Are these the same for fathers and mothers? Why do many women experience a postbirth period of 10 or more months in which they show a decreased interest in sex? Are the same psychological mechanisms in parents activated by girl and boy babies, or are some of the mechanisms different? Is the shift in effort from mating to parenting the same for men and women, and does it depend on particular circumstances, such as extramarital mating?

Menopause and becoming a grandparent represent other key milestones that are yielding to evolutionary psychological analysis (Alexander, 1991; Hill & Hurtado, 1991). After women cease reproduction, do they channel their efforts increasingly toward parenting and grandparenting? Is the asymmetry between the sexes in capacity for reproduction after age 50 accompanied by sex differences in effort allocation and psychological activation? Do older men capable of attracting younger mates continue to channel resources toward mating, whereas women more reliably channel resources toward kin?

Any reasonably comprehensive theory of human ontogeny must include an account of where people come from, where they are going, and how long they live. A branch of evolutionary thinking called *senescence theory* deals with the fundamental question of why individuals die, why they die at the rates they do, and why men die sooner than women, on average, worldwide (Williams, 1957). One key reason that men die 6 years earlier than women, for example, is because they tend to take greater risks in achieving the status and resources that make them successful in competing for mates (see Trivers, 1985, for a summary of this evidence). Evolutionary senescence theory provides a powerful beginning of an account of life's end.

These are just a few of the important issues that evolutionary developmental psychologists can be expected to tackle in the coming decade of research. Ultimately, a comprehensive evolutionary developmental psychology will include an account of the species-typical, sex-differentiated, and individually different transformations over the life span in the adaptive problems faced and the psychological mechanisms activated.

Evolutionary Cognitive Psychology

Like developmental psychology, cognitive psychology does not so much describe a particular content area as a level of analysis and description (Pylyshyn, 1980). Natural selection forges mechanisms that are designed to take in certain particular classes of information and transform that information through a series of decision rules into adaptive output of various sorts (see earlier definition of *psychological mechanism*).

Information-processing mechanisms presumably underlie all psychological and behavioral phenomena, not just those traditionally referred to as *cognitive.* Thus, the strategies earlier described under various branches of psychology all presumably have dedicated information-processing mechanisms attending them. These mechanisms are just as needed for social exchange, mate selection, and parenting as they are for vision, audition, and categorization. This means that the historical divisions within the field of psychology do not map onto the natural ways in which the human mind is organized.

When the term *biological* is used, many people believe that one is referring to the "wetware" of the mind—the neurons, the synapses, the biochemical processes in the brain. In contrast, the cognitive level of description used by many evolutionary psychologists refers to an entirely different type of description (Cosmides & Tooby, 1987). Consider a word-processing program such as MicroSoft Word. This program can run on a wide variety of different computers or hardware. Analogously, evolved cognitive mechanisms are usefully described in information-processing terms, regardless of the underlying wetware in which they are instantiated. Although understanding the actual brain mechanisms in which evolved cognitive programs are instantiated may in some cases shed light on their nature and functioning, the cognitive level of description will likely remain an extraordinarily useful one, just as knowledge of the computer hardware and machine language in which a computer program is instantiated will never negate the usefulness of describing a word-processing program in information-processing terms (Fodor, 1975; Marr, 1982; Newell & Simon, 1961; Pylyshyn, 1980).

Several important programs of cognitive research have emerged within the past 5 years using evolutionary psychology as the central metatheoretical framework. These span topics such as natural language, perceptual organization of colors, spatial skills, human-reasoning algorithms, and the perception of landscapes. This section briefly highlights a few of these programs to illustrate the promise of evolutionary cognitive psychology.

One program of research has provided an evolutionary psychological analysis of how humans reason—a topic that has played a central role in cognitive science (Cosmides, 1989; Cosmides & Tooby, 1992). Cosmides and Tooby (1992) argued that the universal existence of social exchange among human groups requires the evolution of several specific cognitive mechanisms, without which social exchange could not occur. Using the classic Wason selection task, they pit predictions from evolutionary social exchange theory against predictions from other theories such as availability theory and permission schema theory. The results suggest that humans do not possess a general-purpose ability to detect violations of conditional rules. On the contrary, humans seem well designed for detecting violations of conditional rules that are framed specifically in the format of social contracts (Cosmides & Tooby, 1992). The results support the evolutionary predictions that we possess specialized cheater-detection procedures; that these procedures operate even in unfamiliar situations, suggesting some

degree of generality across content domains; that the perspective of the individual is critical to the definition of cheating (e.g., what constitutes cheating from a worker's perspective differs from that of a boss's perspective); and that people carry cost–benefit representations of social contracts (Cosmides & Tooby, 1992).

Another line of research has tackled sex differences in cognitive abilities, focusing on the spatial domain (Silverman & Eals, 1992). It has long been known that men show superior performance, on average, on tasks of spatial ability that entail mental rotation, map reading, and maze learning. Silverman and Eals (1992) argued that these particular forms of spatial ability are precisely those that would have facilitated skill at hunting—a task performed mainly by men over human evolutionary history (Tooby & DeVore, 1987).

Women, in contrast, have specialized in gathering, and so Silverman and Eals (1992) proposed the radical hypothesis that, contrary to all published studies on spatial ability, women will display superiority in particular forms of spatial tasks—those that would have facilitated gathering, such as object memory and location memory. They conducted four empirical studies using both contrived and naturalistic stimuli. The results were consistent across studies—women outperform men on spatial tasks involving location memory and object memory.

Although more research is clearly required, the implications of these studies are far-reaching. First, they imply that there may be several distinct abilities that are included within the domain of "spatial" and that these are far more modular in nature than previously believed. Second, they suggest that studies of sex differences in cognitive abilities benefit by examining the nature of the adaptive problems that men and women have faced over human evolutionary history. Moreover, sex differences cannot be explained by global and hence inaccurate characterizations of spatial abilities that ignore the more modular processes.

Another branch of cognitive science being informed by evolutionary theory is language and language use. Pinker and Bloom (1990) argued that language is designed by natural selection for the communication of propositional structures over a serial channel. Point by point, Pinker and Bloom dismantled alternative nonselectionist explanations that suggest that language may be merely an incidental by-product of big brains. The deep structure of human grammar, they argued, is too well designed for function, including elements such as major lexical categories (noun, verb, adjective, preposition), major phrasal categories, phrase structure rules, rules of linear order, case affixes on nouns and adjectives, verb affixes that signal the temporal distribution of the event, and mechanisms of complementation and control that govern the expression of propositions. Pinker and Bloom concluded by delineating the heuristic and synthesizing value of viewing language as a product of natural selection, built specifically for the communication of propositional structures, including causal relations entailed by the behavior of other people involving beliefs and desires.

This is just a small sampling of cognitive research programs currently being informed by evolutionary psychology. Others include the psychology of aesthetics, with a special focus on landscape preferences (Kaplan, 1992; Orians & Heerwagen, 1992); the perceptual organization of colors (Shepard, 1992); spatial representation (Shepard, 1984); generalization (Shepard, 1987); cognitive biases and heuristics (Gigerenzer, 1991); concepts of mind (e.g., Leslie, 1991; Wellman, 1990); and many others. A central thrust of all these new programs of research is that the study of human cognition is greatly informed by attempts to identify the adaptive problems that humans had to solve over thousands of years of evolutionary history. Perhaps this was most succinctly put by Williams (1966): "Is it not reasonable to anticipate that our understanding of the human mind would be aided greatly by knowing the purpose for which it was designed?" (p. 16)

Ultimately, all evolved psychological mechanisms will be usefully described at the cognitive level, including descriptions of the informational cues the mechanisms were designed to take as input; the decision rules and processes upon which the information is transformed; the outputs in the form of action, physiological responses, or information to other mechanisms; and the nature of the adaptive problem that is solved by strategic output.

The Future of Evolutionary Psychology

Scientific success in uncovering the mysteries of life has been based on three critical foundations—mechanism, natural selection, and historicity (Williams, 1992). Since the cognitive revolution, psychologists have moved away from behaviorism's unworkable antimentalism, making it respectable to study information-processing mechanisms inside the head. Nonetheless, we have been handicapped in failing to consider the profound importance of natural selection and historicity in the creation of those mechanisms. The neglect of natural selection has led psychologists to ignore the adaptive functions of mechanisms and hence has hindered the quest to unravel the mystery of why these mechanisms exist at all and more specifically why they exist in the particular forms that they do.

Currently, evolutionary psychology is viewed from the mainstream as a relatively new theoretical perspective within psychology—a perspective that generates some novel insights perhaps, and that includes a lot of promise perhaps, but is just one perspective among

many. A prominent, open-minded psychologist I know said, "At some point in the future, every psychology department will need to have at least one evolutionary psychologist on its rosters."

At the other extreme, a well-known evolutionary psychologist once remarked that, at some point in the future, the term *evolutionary* would be dropped entirely from *evolutionary psychology* because the entire field of psychology will be evolutionary, and the qualifier would be superfluous. Although I do not share the latter view, I do believe that evolutionary psychology provides a coherent metatheory for the different branches of psychological science, and it is unlikely to be supplanted by another unless some radically new causal process, heretofore entirely unknown and unobserved, is discovered to account for the origins and particulars of the complex adaptations that characterize humans and other species.

Most of us are aware that the field of psychology is currently in woeful disarray. Disciplinary boundaries are strange, unnatural, misleading, and distorting. A plethora of mini-theories within each discipline clamors like a babble of incommensurate tongues. Experimentalists use stimuli that are convenient, but often arbitrary—many only marginally more meaningful than the nonsense syllables used in hundreds of memory drum experiments in earlier decades. Furthermore, many psychologists assume a high degree of domain generality of psychological mechanisms—an unfortunate assumption carried over from behaviorism. When I recently asked a distinguished categorization researcher whether he thought that the cognitive mechanisms that humans use to categorize kinship relationships (e.g., father, mother, daughter, brother) were the same as those used to categorize plants or foods (e.g., edible vs. nonedible, fruit vs. meat), he answered in the affirmative. To an evolutionary psychologist, however, it would be astonishing to find that degree of domain generality with no specialized procedures for dealing with radically different adaptive domains such as kinship categories and consumption categories. Despite the mainstream assumptions, cutting-edge cognitive psychologists are making great strides in the evolutionary analysis of perception (Shepard, 1992), language (Pinker, 1994), reasoning (Cosmides, 1989), cognitive heuristics (Gigerenzer & Hug, in press), and cognitive neuroscience (Gazzaniga, 1992).

Social psychologists have mapped out reaction times to trait words shown to college sophomores on cathode ray tubes, but the mainstream seems to have lost sight of the social interactions and social relationships that properly form the core content for the field. Recently, however, there are signs of increasing commitment to the study of social relationships (e.g., Berscheid & Snyder, 1989; Hazan & Shaver, 1991; Hendrick & Hendrick, 1991; Rusbult, 1987; Snyder, Gangestad, & Simpson, 1987). A veritable cottage industry has sprung up around the evolutionary psychology of human mating (Baily, Gaulin, Agyei, & Gladue, 1994; Buss, 1994; Gangestad & Simpson, 1990; Kenrick, Groth, Trost, & Sadalla, 1993). And the evolutionary psychologies of friendships (Lusk, MacDonald, & Newman, 1993), kinships (DeKay, 1991), and coalitions (Cosmides & Tooby, 1993) are starting to receive increasing attention.

Personality psychologists historically have endlessly created scale after scale to measure yet more dimensions of investigator-defined and often arbitrary individual differences. Taxonomic efforts at individual differences remain atheoretical and isolated from the basic species-typical psychological functioning that occupies much of the rest of the field. Individual differences too, however, are starting to yield to an evolutionary psychological analysis (e.g., Belsky et al., 1991; Buss, 1993; Gangestad & Simpson, 1990; Hogan, 1983; Kenrick et al., 1993; McDonald, 1992; Nesse & Lloyd, 1992; Waller, in press).

Explanations advanced as causal (e.g., "culture," "learning," and "socialization") are at best descriptions of phenomena awaiting explanation and at worst empty names given to ignorance of actual causal processes that give the illusion of having explained something—and hence have the pernicious effect of halting the causal investigation (D. Symons, personal communication, 1991). Cultural and socialization phenomena, too, are starting to yield to evolutionary psychological analysis (Belsky et al., 1991; Brown, 1991; Low, 1989; Tooby & Cosmides, 1992).

Despite these important advances, the program advocated by evolutionary psychology would dissolve the traditional disciplinary boundaries. Human beings cannot be neatly partitioned into discrete contents such as personality, social, developmental, or cognitive. Stable individual differences have been relegated traditionally to the personality branch, but they often involve social orientations, have particular developmental antecedents, and are undergirded by particular cognitive mechanisms. Social exchange and reciprocity have traditionally been regarded as quintessentially belonging to social psychology, but the mechanisms that underlie them are information-processing devices that have developmental trajectories. The rapid changes occurring at puberty have traditionally been the province of developmental psychologists, yet individuals differ in onset of puberty, many of the most important changes are social, and all are undergirded by evolved psychological mechanisms that get suddenly activated. From the perspective of evolutionary psychology, many traditional disciplinary boundaries are not merely arbitrary but are misleading and detrimental to progress. They imply boundaries that cleave mechanisms in

arbitrary and unnatural ways. Studying human psychology via adaptive problems and their solutions provides a natural means of "cleaving nature at its joints" and hence crossing current disciplinary boundaries.

A critical task in this new psychological science will be the identification of the key adaptive problems that humans confronted repeatedly over our evolutionary history. We have barely scratched the surface by identifying some of the problems most obviously and plausibly linked with survival and reproduction. Most adaptive problems remain unexplored, most psychological solutions undiscovered. It is not unreasonable to expect that the first scientists to explore these uncharted territories will come away with a great bounty.

Evolutionary psychology provides the conceptual tools for emerging from the fragmented state of current psychological science. It provides the key to unlocking the mystery of where we came from, how we arrived at our current state, and the mechanisms of mind that define who we are.

Notes

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