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CHAPTER 24

EVOLUTIONARY THEORY AND CRIMINOLOGY

ANTHONY WALSH AND CODY JORGENSEN

INTRODUCTION: CRIMINOLOGY NEEDS AN ORGANIZING PRINCIPLE

IN this chapter, we (a) demonstrate the relevance of evolutionary theory to criminology, (b) discuss the evolutionary origins of both prosocial and antisocial traits, and (c) show that evolutionary theory is invaluable to understanding two key issues that have been impervious to solution using the standard social science model—the sex ratio in criminal offending and the age–crime curve.

Evolutionary criminology is part of a broader biosocial approach to criminology that includes genetics and neurobiology in addition to evolutionary theory (Walsh & Beaver, 2009). Whereas genetic and neurobiological approaches are finding relatively widespread acceptance (Cooper, Walsh, & Ellis, 2010), with many books devoted to them, the evolutionary approach to criminology is barely acknowledged, currently with only two books devoted exclusively to it (Durrant & Ward, 2015; Roach & Pease, 2013). This is unfortunate because evolutionary theory can serve as a meta-theory for criminology and all other social sciences because of "its potential to tie together the forest of hypotheses about human behavior now out there" (de Waal, 2002, p. 187). Tooby and Cosmides (2005) agree, arguing that evolutionary psychology can coherently integrate all the human sciences:

> Evolutionary psychology is the long-forestalled scientific attempt to assemble out of the disjointed, fragmentary, and mutually contradictory human disciplines a single, logically integrated research framework for the psychological, social, and behavioral sciences—a framework that not only incorporates the evolutionary sciences on a full and equal basis, but that systematically works out all of the revisions in existing belief and research practice that such a synthesis requires. The long-term scientific goal

> toward which evolutionary psychologists are working is the mapping of our universal human nature. (p. 5)

Criminology is certainly in need of an organizing principle to bundle its stew of contradictory theories into a relatively orderly package. Cooper and colleagues' (2010) study asking criminologists to identify the theory they believed accounted for the most variance in serious criminal behavior identified no less than 24 (and there are many others), with self-identified political ideology (conservative, moderate, liberal, and radical) being far the best predictor of the theories they chose. We do not claim that accepting an evolutionary approach (one not limited only to evolutionary psychology) will lead to an explosion of new criminological evidence as did, for example, the acceptance of atomic theory for chemistry in the 19th century (Knight, 1992). Rather, evolutionary analyses will add layers of new understanding to what we already know and will open up avenues to explore novel vistas.

Evolutionary criminology utilizes a Darwinian framework to animate its research agenda. Its vocabulary contains many biological terms, but it is "environmentally friendly" because it recognizes that pressures from the social environment formed a good part of the human genome. Evolutionary explanations of behavior differ from genetic explanations: Geneticists focus on differences among people and ask proximate-level "how" questions, whereas evolutionists focus on human similarities and ask ultimate-level "why" questions. For instance, a proximal explanation for sex difference in aggression may appeal to different testosterone levels, whereas evolutionary scientists would explore the adaptive rational for why sex differences in testosterone levels exist in the first place. Because evolved adaptations apply to all members of a species, unlike geneticists, evolutionary criminologists search for *environmental* sources of variation in criminal behavior. However, they readily acknowledge variation in human traits distributed around adaptive means, but their concern is central tendency rather than variation.

Many criminologists have an aversion to evolutionary thinking because it engages their naive fear of biology. Cooper et al. (2010) found that the modal number of biology classes taken by the 770 criminologists they surveyed was zero. This apparently reflects a belief that human behavior can be understood by appealing only to the environmental portion of the biosocial whole and that culture puts humans above biology. Such an attitude is scientifically indefensible. Humans are certainly unique in many ways, but so is every other animal species in one way or another. The attitude that humans are so special that they are set above nature and require a different set of ontological principles to understand their behavior delays progress in the human sciences. Human nature is the sum of human adaptations forged by the mechanisms of evolution—natural selection, sexual selection, mutation, genetic drift, and gene flow. An understanding of the adaptive significance of human nature's component parts forged by these processes should be fundamental to all branches of human science; models of human behavior without such information are incomplete.

Criminologists may also discount evolutionary theory because it is not shy about revealing the "dark" side of human nature, and in this sense it is "politically incorrect." It talks about reproductive success as the ultimate goal of all sexually reproducing animals and lays bare the aggression, deceptiveness, and egoism that have evolved as aids in pursuing it (mating effort). But other more positive human characteristics, such as altruism, nurturance, and empathy, have also evolved because they equipped us with parental skills (parenting effort) and valuable social skills as well. In *The Descent of Man*, Charles Darwin wrote about cooperation three times more often than he wrote about competition (Barrett, 2016; Levine, 2006). But it is negative traits that most interest criminologists, whose stock in trade is vice, not virtue.

EVOLUTION AND BEHAVIOR

We can think of the difference between mainstream criminology and evolutionary criminology as analogous to the difference between geography and geology. Geography *describes* the shape and location of the land (topography) as it presently exists, whereas geology looks beneath the surface to *explain* the processes that shaped it (plate tectonics and so forth). Evolution has likewise shaped the behavior and psychology of humans in adaptive (purpose-serving) ways, so biosocial criminologists hold it evident that it is crucial to look below the surface of behavior. Social scientists acknowledge that human anatomical and physiological features were selected over alternate designs because it best served some function that assisted the proliferation of genes underlying those features, and they are thus geologists of the body. However, most social scientists would probably dismiss the idea that behavior is also the product of the same evolutionary processes, and they are thus content to be geographers of the mind.

We are not disparaging geography while endorsing geology; there is much overlap in the two disciplines. Geology focuses on the physical features of the earth and is more closely aligned with physics. Geography has a broader perspective (What is the social, political, and economic impact of a specific environmental policy?), combines the natural and social sciences, and is more closely aligned with biology. Geography departments offer courses in evolutionary geography—how geography has shaped things such as human culture. In this sense, we would very much like to see criminologists become "geographers of the mind."

Commenting on mainstream social science's refusal to examine the adaptive significance of human behavior, Kenrick and Simpson (1997) state that "to study any animal species while refusing to consider the evolved adaptive significance of their behavior would be considered pure folly . . . unless the species in question is *Homo sapiens*" (p. 1). Alcock (2001) makes a similar point: "To say that human behavior and our other attributes cannot be analyzed in evolutionary terms requires the acceptance of a genuinely bizarre position, namely, that we alone among animal species have somehow managed to achieve independence from our evolutionary history" (p. 223). In addition, Plomin, DeFries, Craig, and McGuffin (2003) assert that "the behavioral genomic level of analysis may be the most appropriate level of understanding for evolution because the functioning of the whole organism drives evolution. That is, behavior is often the cutting edge of natural selection" (p. 533). Without an evolutionary understanding, there is no scientific way to determine how a particular behavioral trait might have served the goal of enhancing survival and/or reproductive success over the course of time and how it can be coopted to serve other purposes, including criminal purposes (Durrant & Ward, 2012).

Some social scientists might take the position that although the human behavioral repertoire must have been designed by natural selection, evolved behaviors lost their relevance once we developed culture: "The beginning of mankind's psychosocial development represents the end of biological evolution" (Ruffie, 1986, p. 297). Ruffie does not specify what environmental pressures resulting from our "psychosocial development" might have led to the elimination of alleles underlying evolved behavioral traits that have supposedly been rendered irrelevant. Unless evolved traits become detrimental to survival and reproductive success, the genes underlying them will remain in the human gene pool. This does not mean that evolutionary criminologists consider culture unimportant in explaining human behavior, although they do not view it as a realm decoupled from biology. Evolutionists simply ask us to remember that "psychology underlies culture and society, and biological evolution underlies psychology" (Barkow, 1992, p. 635). It is true that the fine nuances of life are edited out as we move from proximate-level to ultimate-level explanations, but ultimate-level explanations complement proximate explanations; they do not compete with them.

Contrary to Ruffie's (1986) puzzling contention that culture ended biological evolution, culture actually gave it a gigantic boost. Sophisticated gene technology has revealed that the rate of genomic change has been approximately 100 times greater during the past 40,000 years than it was during most of the Pleistocene due largely to the greater challenges posed by living in ever larger social groups: "The rapid cultural evolution during the Late Pleistocene created vastly more opportunities for further genetic changes, not fewer, as new avenues emerged for communication, social interaction, and creativity" (Hawks, Wang, Cochran, Harpending, & Moyzis, 2007, p. 20757).

Culture drives selection not only for psychological and behavioral traits but also for morphological changes. A number of studies of hominid crania dating as far back as 1.9 million years show more robust increases in cranial capacity in areas with greater population density and in colder and most northerly areas of the world in which food procurement was most problematic (Ash & Gallup, 2007; Kanazawa, 2008). Bailey and Geary (2009) found that latitude was strongly related to cranial capacity (*r* = .61), but population density was more strongly related (*r* = .79), and concluded that the burden of evolutionary selection has moved from "climactic and ecological to social" (p. 77). In many ways, the human brain is an artifact of culture because culturally created environments have influenced both the anatomy and the physiology of the human brain above and beyond the influences posed by the challenges of the physical environment (Mithen & Parsons, 2008). Even today, new genetic variations affecting the brain's structure and function have been discovered as it continues to evolve in response to new ecological and social conditions (Evans et al., 2005; Mekel-Bobrove et al., 2005; Zhang, Landback, Vibranovski, & Long, 2011).

It must be stressed that we are adapted to seek the immediate means of achieving specific goals, not ultimate ends. As Daly and Wilson (1988) state, "Fitness consequences are invoked not as goals in themselves, but rather to explain why certain goals have come to control behavior at all, and why they are calibrated in one particular way rather than another" (p. 7). Humans are designed to satisfy proximate goals, which is why we use the phrase *adaptation executors* (acting in ways that would have maximized fitness in ancestral environments but not necessarily today) rather than *fitness maximizers* to refer to the evolved behavioral goals of modern humans.

When we have sex, for instance, we seek the pleasurable means by which reproductive success may be achieved, not reproductive success per se. In pre-contraceptive times, there was a tighter fit between means of satisfying proximate goals (sexual pleasure) and means of satisfying ultimate evolutionary goals (reproduction). Similarly, parents nurture and love their children because ancestral parents who did so saw more of them grow to reproductive age and pass on the genes underlying the traits than did parents practicing less solicitude. The neurohormonal substrates of nurturing behavior are adaptations because they solved a recurring adaptive problem—the survival of offspring. Parents who neglected or abused their children compromised their viability and thus the probability of their genes being represented in future generations. The love and nurturance of offspring increase the probability that parental genes will survive across the generations, but in no sense can this distal consequence be construed as parents' proximal motivation for lavishing love and care on their children.

THE EVOLUTION OF CRIMINAL TRAITS

The probability of survival and reproductive success of individuals increases in proportion to the degree to which they are able to harmoniously adjust themselves to their fellow humans and to their environment by developing appropriate approach–avoidance behaviors. But as the classic (and evolutionary) view of human nature has it, humans are designed to maximize their pleasure and to minimize their pain. This design feature of human nature can disrupt relationships with others when we place immediate concerns for gratification above the maintenance of social harmony and seek "money without work, sex without courtship, and revenge without court delays," to use Gottfredson and Hirschi's (1990, p. 89) words. Seeking needs and wants this way is what we call criminal. The traits that lead people down such dark roads are not traits that criminals possess and the rest of us lack; they are part of a universal human repertoire (wouldn't we all like "money without work," etc.?). We are all at risk for crossing the line from pro- to antisocial behavior given adequate provocation; it is simply that criminals routinely cross the threshold at lower levels of instigation. Criminals discount the delicate balance of the approach–avoidance imperative for a variety of reasons, such as being low on self-control, empathy, and fear and/or being high on aggression, callousness, and lust.

Criminal behavior is normal behavior engaged in by normal individuals. If this is so, the potential for it is in us all, and it must have conferred some evolutionary advantage. It is the traits underlying criminal behavior, not the specifics of criminal behavior (or of any other social behavior for that matter), that are the alleged adaptations. These traits are typically used illegitimately by individuals who, for whatever reason, cannot attain status and the resources that come with it legitimately. In other words, like all behavior linked to survival and reproductive success, the same traits can be used legitimately or illegitimately contingent upon many factors both internal and external to the actor.

Criminologists are increasingly finding that all traits associated with criminal behavior are substantially heritable (Barnes, Beaver, & Boutwell, 2011; Bentley et al., 2013) and are even zeroing in on specific genes associated with those traits (Beaver, Wright, & Walsh, 2008; Ferguson, 2010). Given this, we have to ask why genes promoting such traits exist. The human genome is the chemical archive of accumulated wisdom that has survived millions of years of ruthless selective retention and elimination of genes. Genes exist in the gene pool of any species because they somehow conferred an adaptive advantage on ancestral organisms, suggesting that genes underlying traits associated with criminal behavior have survived because they served some evolutionary purpose. Behaviors motivated by a particular trait may be morally repulsive, but the trait is nevertheless "natural" (the product of nature) rather than pathological.

These traits may lead to certain behavioral strategies that may be either pro- or antisocial depending on how they were shaped in the past by cues in an individual's environment (Wiebe, 2012). There is also considerable heritable variation in these traits that place individuals at risk for criminal behavior, which is likely preserved by balancing selection processes such as heterozygote advantage and negative frequency-dependent selection. Balancing processes maintain rare alleles in a population's gene pool when they have higher adaptive value than alternatives (Boutwell et al., 2015; Penke, Dennisen, & Miller, 2007). Heterozygote advantage occurs in situations in which the fitness value of a person with two different alleles (Aa) is greater than the fitness value of an individual with homozygous alleles (either AA or aa). This causes the retention of the alleles in the population regardless of differing fitness values of AA and aa alleles. In negative frequency-dependent selection, the fitness of a phenotype increases when it is rare and decreases when it becomes more common (Andrés et al., 2009).

Judith Harris (1998) speculates about the evolutionarily relevant advantages of certain traits in ancient hunter–gatherer leaders that are also useful for criminals:

> Almost all the characteristics of the "born criminal" would be, in watered-down form, useful to a male in a hunter–gatherer society and useful in his group. His lack of fear, desire for excitement, and impulsiveness made him a formidable weapon against rival groups. His aggressiveness, strength, and lack of compassion enable him to dominate his groupmates and give him first shot at hunter–gatherer perks. (pp. 299–300)

These perks were those most pertinent to survival and reproductive success—resources and women. Females would have been attracted to such men, not because they were sensitive "nice guys" but because they had high status and resources within the group and were good protectors and women who mated with such men would have enjoyed increased fitness (Buss, 2005). The traits described by Harris can overshoot their optimum and become liabilities, which is often the case when exercised too freely in modern evolutionarily novel societies.

These traits may also have been liabilities in small ancestral groups roaming the savanna if they led to exploitation because counteracting human competitive and status-striving motives is a powerful egalitarian instinct (Gavrilets, 2012; Rogers, Deshpande, & Feldman, 2011). When Hominids branched off from the ancestral primate line during the Plio-Pleistocene Epoch, they faced an ecology that exerted pressure for strong norms of reciprocal altruism. The nomadic lifestyle characterized by dangerous and uncertain prospects of obtaining survival resources probably kick-started the evolution of our species' powerful egalitarian instincts balancing out, but not eliminating, the evolutionarily more ancient primate behavioral patterns rooted in status competitions and dominance (Adkins & Guo, 2008; Charlton, 1997).

Foraging and hunting and gathering demanded strict group-wide cooperation, and scarce resources would have been distributed according to egalitarian principles lest the group fall into fractious disputes. In small hunter–gatherer groups, resource sharing would have taken place under the vigilant eyes of all in immediate time (as opposed to a delayed-time share of society's resources in agrarian and industrial societies). All band members would have demanded an equal share of the pie, leaving little, if any, room for exploitation, and perceptions of unequal distribution would have produced immediately adverse emotional reactions. It would still be the case that certain skills—hunter, speaker, fighter, peacemaker, strategist, and so on—would have conferred status on a person, and thus increased the person's fitness, but status would have been freely conferred based on meritocratic principles and subject to withdrawal if the person took what group members considered to be unfair advantage (Adkins & Guo, 2008).

Nevertheless, the traits Harris (1998) alludes to as advantageous in securing resources and mates legitimately can be put to illegitimate use. Even criminals are constrained to cooperate with their conspecifics most of the time, but due to other traits they may possess, such as low self-control, low empathy, and low fear, they may default on the norms of reciprocity when opportunities arise. Although there are far more opportunities to exploit fellow humans today, there have always been individuals we refer to as psychopaths, perhaps genetically maintained by one of the balancing selection processes referred to previously. Those who have commented on the trademark behavior of such people in classical, biblical, and medieval works recognized the same traits (impulsively self-serving and callous yet charming) in them as we do today (Hare, 1996). Aristotle wrote of men with a "brutish nature" arising from "reasons of injuries to the system, by reason of acquired habits, and by reason of originally bad nature" (as quoted in McKeon, 1947, p. 453). Even in cultures resembling ancient hunter–gatherer groups such as the Inuit that demand strong norms of cooperation, people recognize psychopathic individuals, whom the Inuit call *kunlangeta*, who repeatedly lie, steal, freeload, and "take advantage of many women" (Murphy, 1976, p. 1026).

ALTRUISM AND CRIMINALITY

Altruism is an active regard for the well-being of another and is the epitome of prosocial behavior. In many ways, it is the polar opposite of criminality—an active concern only for the self at the expense of others. Social life, as Plato and Freud as well as other lesser known luminaries have told us, is often a hedonic tug-of-war when the desire to expeditiously meet our wants and needs conflicts with the norms of cooperation. We desire both our pleasures and the good will of others, so most of us seek our pleasures in socially approved ways: "money from work, sex through courtship, and revenge delivered by the courts." Although criminal activity is not uncommon, *H. sapiens* is a species with "minds [that] are exquisitely crafted by evolution to form cooperative relationships built on trust and kindness" (Allman, 1994, p.14). These relationships lead to altruistic behavior, and from an evolutionary standpoint, we have to understand altruism in order to understand criminality.

A requisite condition for tit-for-tat reciprocity to be a stable strategy is frequent association and the ability to recognize reciprocators and non-reciprocators. Because of the mutual benefits of reciprocal altruism that accrue to all socially interacting species, altruism and cooperation have been strongly favored by natural selection. Although individual organisms are adapted to act in ways that tend to maximize their own fitness, not necessarily for the good of the group, their fitness goals are best realized by adhering to the rules of cooperation and altruism—by "being nice"—and that is for the good of the group. Altruists recoup the costs of extending benefits and cooperation to others many times over, so altruism is thus ultimately self-serving, but this observation does not diminish the value of altruism to its beneficiaries.

However, reciprocal altruism cannot explain situations in which individuals confer some benefit on strangers with no expectation of reciprocity. The phrase "psychological altruism" has been coined to distinguish this kind of altruism (Kruger, 2003). If reciprocal altruism is a gene-based adaptation, perhaps psychological altruism is an exaptation seized upon by natural selection to improve upon the operation of reciprocal altruism by infusing it with additional neurohormonal mediators. Psychological altruism is motivated by internal rewards such as guilt reduction or the joy experienced when beneficiaries express their gratitude for the benefactor's largesse (Brunero, 2002). Brain imaging studies consistently show that our pleasure centers "light up" when giving or receiving something valued, but brain areas associated with the pleasures of social attachments only fire when giving (Moll et al., 2006). We act altruistically because we tend to feel good when we do so and because such behavior confers social status on us by identifying us as persons who are kind, reliable, and trustworthy. In the ultimate sense, we do so because our distant ancestors who were altruistic and cooperative enjoyed greater reproductive success than those who were not. Possessing the neural architecture that produces rewarding feelings when we do good deeds for others is part and parcel of that adaptation (Barkow, 1997).

Selfishness in the evolutionary sense is morally neutral because biologists recognize that all sexually reproducing organisms have evolved to be concerned with their own survival and reproduction and will do what they must to realize those concerns (Tang, 2010). Selfishness as understood in the vernacular means a crabbed, spiteful, egoism stripped of any concern for the well-being of others. Such selfishness is ultimately maladaptive, which is hardly self-serving. Selfishness properly understood is the most adaptive of traits because it is precisely by cooperating and being actively concerned for others that we best serve our own interests. As Edward O. Wilson (1978) stated,

> Human beings appear to be sufficiently selfish and calculating to be capable of infinitely greater harmony and social homeostasis. This statement is not self-contradictory. True selfishness, if obedient to the other constraints of mammalian biology, is the key to a nearly perfect social contract. (p. 157)

If you help another person in need, it is altruism regardless of whether it lights up your pleasure center, gains you brownie points with God, puffs up your chest, or enhances your status in the group. If one insists that psychological altruism is not "real" altruism because it is not entirely selfless, one is unwittingly asserting that "real" behaviors are ineffable, biology-free, and cannot evolve.

All nontrivial behavior has to be animated by something, and altruistic acts are typically animated by experiencing empathy. Empathy channels altruism in social species without undue reliance being placed on cognitive ruminations about such things as reciprocity concerns. Empathy is the cognitive and emotional ability to understand the feelings and distress of others as if they were our own. The cognitive component allows us to understand the distress of others and why they are feeling it, and the emotional component allows us to "feel" that distress. To the extent that we feel empathy for others, we have an evolved visceral motivation to take some action to alleviate the distress of others if we are able. Altruism can thus be thought of as the co-evolved action component of empathy. The basis of empathy is the distress we feel personally when witnessing the distress of others, and if we can alleviate the distress of others, we thereby alleviate our own. Thus, empathy also has a selfish component, which is very good because if we were lacking in emotional connectedness to others, we would be callously indifferent to their needs and suffering.

Frans de Waal (2008) posits that empathy is an ancient phylogenetic capacity predating the emergence of *H. sapiens* and evolved rapidly in the context of parental care. Empathy is an integral component of the love and nurturing of offspring. Caregivers must quickly and automatically relate to the distress signals of their offspring. Parents who were not alerted to or who were unaffected by their offspring's distress signals or by their smiles and cooing are surely not among our ancestors. Like the diffusion of adaptive love and care of offspring to the non-adaptive love and care of the children of others and to pets, the capacity for empathetic responses, once locked into the human repertoire, diffused to a wider network of social relationships. It is the relative lack of empathy that allows criminals to exploit others for their own ends (Keysers & Gazzola, 2014; Walsh & Vaske, 2015).

COOPERATION CREATES NICHES FOR CHEATS

Because cooperation occurs among groups of reciprocal altruists, it creates niches for cheats, who typically have low levels of empathy and altruism, to exploit (Durrant & Ward, 2015). It has been proposed that the stronger the selection for altruism in a species, the more vulnerable it becomes to "Machiavellian intelligence" (Runciman, 2005, p. 132). Cheats are individuals in a population of cooperators who signal cooperation but fail to reciprocate. If there are no deterrents against cheating, it is in an individual's fitness interests to obtain resources from others under the assumption of reciprocity and then to default, thus gaining resources at zero cost. "Social parasitism" of this sort has been observed among a variety of nonhuman animal species, and its ubiquity across species implies that it has had positive fitness consequences (Alcock, 2005). Cheating comes at a cost, however, so before deciding to default, the individual must weigh the costs and benefits of cooperating versus defaulting, as illustrated in the familiar prisoner's dilemma of game theory (Axelrod, 1984).

By cheating, each player in the game is behaving rationally—defined as a positive fit between ends and the means used to achieve them. However, cheating is only rational in circumstances of limited interaction and communication. In the prisoner's dilemma game, the participants were acquaintances who might never see each other again and thus need not fear any repercussions arising from their cheating. Had they been brothers, good friends, or members of a long-standing gang, they most likely would not have defaulted on their promise to cooperate, and each would have benefited rather than one benefitting at the expense of the other. Frequent interaction and communication breed trust among organisms with sufficient intelligence to recognize one another. Under such circumstances, cheating becomes less rational because cooperators remember and retaliate against those who have cheated them. Cheating ruins reputations, costs cheaters future cooperation, and can result in punishment, which is why most career street criminals either die early or end up destitute (Shover, 1985).

Cheats can only prosper in a population of unconditional altruists that game theorists call suckers. Suckers are individuals who continue to extend benefits to those who have cheated them. Any sucker genotype would soon be driven to extinction by cheats, leaving only cheats to interact with other cheats. Evolutionary logic predicts that a population of cheats could not thrive any more than could a population of suckers, and selection for cooperation would occur rapidly (Machalek, 1996). Pure suckers and cheats are thus unlikely to exist in large numbers in any social species. The vast majority of social animals, including human beings, are grudgers. Grudgers are susceptible to being cheated because they conform to the norms of mutual trust and cooperation and expect the same from others. But if cheated, they retaliate by not cooperating with perpetrator in the future, and perhaps repaying the cheat in kind. Cheaters interact with grudgers in a *repeated* game of prisoner's dilemma in which players adjust their strategies according to their experience with other players. Cooperation rather than cheating becomes the rational strategy under such circumstances because each player reaps in the future what he or she has sown in the past (Roach & Pease, 2013).

As predicted by evolutionary logic, in computer simulations of interactions between populations of cheats, suckers, and grudgers, cheats are always driven to extinction (Allman, 1994). Yet we continue to see cheating behavior despite threats of exposure and retaliation. The problem with computer simulations is that players are constrained to operate within the same environment in which their reputations quickly become known. Real-life strategies are not automated binary strategies (cheat/don't cheat) based on the behavior of a laboratory opponent. Although computer simulations are invaluable for fleshing out the basic logic of evolutionary processes, we should not form an overly simplistic view of cooperating and cheating from them (Raine, 1993). Cheats are not constrained to remain in one environment in the real world; they can move from location to location, meeting and cheating a series of grudgers who are unaware of their reputation. This is exactly what many career criminals do. They move from place to place, job to job, relationship to relationship, leaving a trail of misery behind them before their reputation catches up to them (Ellis, 2005). Cheats are much more likely to prosper in large cities in modern societies than in small traditional communities in which, as in evolutionary environments, the threat of exposure and retaliation is great (Ellis & Walsh, 1997; Sampson & Laub, 2005). However, factors such as the stability of the group and cultural dynamics must also be considered. For instance, criminologists know that there are communities in which a "badass" reputation is valued by males more than anything else, but even in these communities there must be a certain level of group cooperation (Anderson, 1999).

We have evolved psychological mechanisms that lead us to repay cooperation and defection in kind—any other strategy would be counterproductive. Among these mechanisms are the social emotions of empathy, guilt, shame, and the primary emotion of anger. Empathy moves us toward helping behavior, and shame and guilt preclude most of us from defecting in our social obligations and motivate us to engage in reparative behavior to restore our good name if we do so. Anger motivates us to retaliate if we are victimized by defection, and experiencing our anger may motivate the defector not to repeat. Punishing defectors is a valuable adaptive strategy as long as it does not exceed reasonable limits and is not imposed on unintentional defection because it is unlikely that cooperation would have evolved without it. As Buckholtz and Marois (2012) state, punishment "seems crucial for the evolutionary stability of cooperation and is the cornerstone of modern models of criminal justice" (p. 655).

THE SEX RATIO ISSUE: PARENTING VERSUS MATING EFFORT

Bernard, Snipes, and Gerould (2010) claim that the issue of why always and everywhere males commit more crime than females is the "single most important fact that criminology theories must be able to explain" (p. 299). Criminologists have been trying to come to grips with the issue armed only with the theoretical tools of sociology. Gottfredson and Hirschi (1990) have concluded that an explanation of sex differences in crime is "beyond the scope of any available set of empirical data" (p. 149). They mean, of course, any available data set from within the standard social science model, which attributes any behavioral or trait sex difference to socialization. The notion that the sex difference in criminal behavior is attributable to differential socialization is not even logically sustainable. If this were so, there would be *some* culture in *some* historical period in which female rates equaled, or even exceeded, male rates, but there is no such culture to be found (for a book-length treatment, see Walsh and Vaske, 2015). We maintain that the concept of mating versus parenting effort provides the only scientifically viable explanation at an ultimate level for sex differences in crime and that the only viable scientific explanation at a proximate level is sex differences in the neuroarchitecture and neurochemistry forged by sexual selection (de Vries & Sodersten, 2009; Del Giudice, 2009; Pezeshki Rad et al., 2014).

If everything in evolution, even survival, is subservient to reproductive success, we need to know how adaptive fitness traits are useful for either promoting or discouraging criminal activity. There are two ways that members of any animal species can maximize reproductive success: parenting effort and mating effort. Parenting effort is the proportion of reproductive effort invested in rearing offspring, and mating effort is that proportion allotted to acquiring sexual partners. Because acquiring sexual partners would have required overcoming the reticence of a careful female or vanquishing competitors vying for the same partner, traits such as aggression and a high need for status would be among those most useful. David Rowe (2002) provides a thumbnail sketch of some other traits useful to mating effort that can clearly be co-opted to support criminal behavior:

> A strong sexual drive and attraction to novelty of new sexual partners is clearly one component of mating effort. An ability to appear charming and superficially interested in women while courting them would be useful. The emotional attachment, however, must be an insincere one, to prevent emotional bonding to a girlfriend or spouse. The cad may be aggressive, to coerce sex from partly willing partners and to deter rival men. He feels little remorse about lying or cheating. Impulsivity could be advantageous in a cad because mating decisions must be make quickly and without prolonged deliberation; the unconscious aim is many partners, not a high-quality partner. (pp. 62–63)

Probably almost all heterosexual males have falsely proclaimed love or used some other kind of mildly coercive/manipulative tactics in pursuit of sexual satisfaction, but most know to place limits on their behavior. Nevertheless, it is plain that high levels of the traits associated with mating effort coupled with the lack of constraint are serious risk factors for criminality.

The reverse is also true—traits that facilitate parenting effort underlie other forms of prosocial activity: "Crime can be identified with the behaviors that tend to promote mating effort and noncrime with those that tend to promote parenting effort" (Rowe, 1996, p. 270). Because female reproductive success hinges more on parenting effort than on mating effort, females have evolved higher levels of the traits that facilitate it (e.g., empathy and altruism) and lower levels of traits unfavorable to it (e.g., aggressiveness) compared to males. Of course, both sexes engage in mating and parenting strategies, and both follow a mixed mating strategy. It is only claimed that mating behavior is far more typical of males and parenting effort is far more typical of females and that the traits underlying those strategies have been forged by eons of sexual selection pressures (Campbell, 2009).

Because humans are born more dependent than any other animal, parenting effort is particularly important, and we have thus evolved to invest heavily in parenting. However, there is considerable variation within the species. Gender constitutes the largest division due to different levels of obligatory parental investment between the sexes. Female parental investment necessarily requires an enormous expenditure of time and energy, but the only *obligatory* investment of males is the time and energy spent copulating. Reproductive success for males increases in proportion to the number of females to whom they have sexual access, and thus males have an evolved propensity to seek multiple partners.

Reproductive success among our ancestral females rested primarily on their ability to secure mates to assist them in raising offspring in exchange for exclusive sexual access, and thus human females evolved a much more discriminating attitude about sexual behavior (Geary, 2000; Nedelec & Beaver, 2012). The inherent conflict between the reckless and indiscriminate male mating strategy and the careful and discriminating female mating strategy drove the evolution of traits such as aggressiveness in males and the lowering levels (relative to female levels) of empathy and constraint that help males overcome both male competitors and female reluctance. It is important to remember, however, that although these traits were designed by natural and sexual selection to facilitate mating effort, they are also useful in gaining nonsexual resources via illegitimate means (Quinsey, 2002; Walsh, 2006).

Empirical research supports the notion that an excessive concentration on mating effort is linked to criminal behavior. A review of 51 studies relating number of sex partners to criminal behavior found 50 of them to be positive, and in another review of 31 studies, it was found that age of onset of sexual behavior was negatively related to criminal behavior in all 31 (Ellis & Walsh, 2000). A British cohort study found that the most antisocial 10% of males in the cohort fathered 27% of the children (Jaffee, Moffitt, Caspi, & Taylor, 2003), and anthropologists tell us that there are striking differences in behavior between members of cultures that emphasize either parenting or mating strategies. Cultures emphasizing mating effort the world over exhibit behaviors (low-level parental care, hypermasculinity, and transient bonding) considered antisocial in Western societies (Ember & Ember, 1998).

Molecular genetic studies have also found significant relationships between sexual behavior and criminal behavior. Beaver et al. (2008) tested the evolutionary claim that the most antisocial males should have the most sex partners and found the same polymorphism of the dopamine transporter gene (*DAT1* 10-repeat) that was significantly related to both number of sexual partners and antisocial behavior. Another study found that males homozygous for the *DAT1* polymorphism had significantly more sex partners (an average of 5.66) compared to males who had only one or no copies (an average of 2.94), as well as significantly higher scores on delinquency and on other kinds of risky behaviors (Guo, Tong, & Cai, 2008). The 10-repeat allele of the *DAT1* gene is exceptionally efficient at clearing dopamine from the synaptic gap after it signals other neurons. Because dopamine gives us pleasure when we engage in activities such as sex, if it is cleared too fast, we are moved to seek more of the activity to get more pleasure (more dopamine). This constant seeking of activities to raise dopamine levels is the chemical basis of addiction to all sorts of things besides sex, such as drugs, smoking, food, gambling, and alcohol (Walsh, Johnson, & Bolen, 2012).

The fact that criminals are consistently found to have more sexual partners compared to members of the general population is at odds with historical data, which indicate that high-status males have always enjoyed greater reproductive success. Rosemary Hopcroft (2015a, 2015b) produces evidence from the National Longitudinal Study of Youth that greater reproductive success accrues to males who have achieved high status (defined in terms of personal rather than household income) legitimately. It is the opposite for women, however: "Annual personal income is negatively correlated with number of offspring for women, and positively correlated with number of offspring for men" (Hopcroft, 2015a, p. 148). She also provides evidence that high-status males today still enjoy greater copulatory opportunities, but in these times of effective birth control, this does not translate into the same high rate of reproductive success that it once did. Her findings, in conjunction with others from developed countries, suggest that "the demographic transition has attenuated, but not entirely broken, the link between social status and reproductive success in modern industrial societies" (2015a, p. 150). The same relationship between status and reproductive success obtains among criminals. "Badass" males in subcultures of violence are the big fish in that particular reproductive pool that attract women swimming in the same pool, even if they are low status in the legitimate pool.

"STAYING ALIVE": FEAR AND EMPATHY

Anne Campbell's (1999) *staying alive/low-fear hypothesis* is an evolutionary approach to the gender ratio issue, and it has been described as "perhaps the best attempt to account for gender differences in criminality" (Roach & Pease, 2013, p. 66). Campbell's hypothesis features the selection pressures faced by ancestral females with regard to parental investment and status striving. The obligatory parental investment of females is enormously greater than that of males. Only after months of gestation and months or years of lactation can a woman contemplate further children, which means that her reproductive success is far more tied to children she has than is that of a male. The greater dependence of the infant on its mother renders a mother's presence more critical to offspring survival, and hence to the mother's reproductive success, than the presence of a father. In ancestral environments, the care of nursing infants meant that females always kept them in close proximity, and this posed an elevated risk of injury to the child as well as the mother if the mother placed herself in risky situations. Because female survival is critical to infant survival, it is critical to female reproductive success. Campbell therefore avers that females have evolved a propensity to avoid engaging in behaviors that pose survival risks.

Campbell (2009) proposes that the evolved mechanism underlying this propensity is a physiology that responds to risky situations in ways that are subjectively experienced as fear. There are essentially no sex differences in fearfulness across a number of contexts *unless* a situation contains a significant risk of physical injury. Greater fear responses account for the greater tendency of females to avoid potentially violent situations and also to employ indirect and low-risk strategies in competition and dispute resolution relative to males. The most fearful ancestral females who avoided or removed themselves from situations containing a high risk of physical injury or death were those most likely to survive, and their survival increased the probability of the survival of their offspring and also the probability of the perpetuation of their genetic lineage.

The staying alive/low-fear hypothesis also has implications for sex differences in status seeking. Because males have greater variance in reproductive success compared to females but less parental certainty, they stand to gain greater fitness benefits by engaging in intrasexual competition for mating opportunities. High-status and dominant males always attract more females compared to low-status subservient males. Status and dominance striving is often risky business, and because attaining status is less reproductively consequential for females than for males, there has been less pressure for the selection of mechanisms useful in that endeavor for females. In evolutionary environments, a male's reproductive success often rested on involving himself in risky situations in which high fear would have been a definite handicap.

Campbell (1999) notes that there is female competition for mates, but it is mostly low key, low risk, and chronic as opposed to the high-key, high-risk, and acute nature of male competition. Females cannot compete for the assets most pertinent to attracting a committed mate, such as youth and beauty; a woman either possesses them or she does not. Male assets that attract females, unlike youth and beauty, can be achieved in competition with other males. Males are generally willing to incur risks to achieve status and dominance to gain the resources that come with it, and thus potentially gain access to more females.

Women do commit crimes, of course, but rarely do they involve risk of physical injury and are almost always committed for instrumental reasons. Campbell (1999) notes that although robbery and larceny/theft both involve expropriating resources from others, females constitute approximately 43% of arrests for larceny/theft and only approximately 7% of arrests for robbery, a crime carrying a relatively high risk for personal injury. Campbell notes that although women do aggress and do steal, "they rarely do both at the same time because the equation of resources and status reflects a particularly masculine logic" (p. 210). Robbery, and flaunting the material trappings signaling its successful pursuit, is seen ultimately as a campaign for respect and status in the street culture from which most robbers come (Jacobs & Wright, 1999). Studies of female robbers provide no mention that female robbers crave the additional payoffs of dominance that male robbers do, or seek reputations as "hard-asses" (Messerschmidt, 1993). A woman with a reputation as a "hard-ass" would be most unattractive as a long-term partner.

If pressed to boil down to a basic level the evolved traits that best account for the wide gender gap in criminal behavior, it would have to be the gender differences in empathy and fear fashioned by the respective reproductive roles of the sexes. Empathy and fear are the natural enemies of crime for the obvious reasons stated by Walsh and Vaske (2015):

> Empathy is other oriented and prevents one from committing acts injurious to others because one has an emotional and cognitive investment in the well-being of others. Fear is self-oriented and prevents one from committing acts injurious to others out of fear of the consequences to one's self. Many other prosocial tendencies flow from these two basic foundations, such as a strong conscience, altruism, self-control, and agreeableness. (p. 168)

MATING EFFORT AND THE AGE–CRIME CURVE

The age–crime curve has been described as "the most important regularity in criminology" (Nagin & Land, 1993, p. 330). The age–crime curve is the statistical count of the number of known criminal/delinquent offenses committed in a population during a given period and mapped according to age categories. The curve shows a sharp increase in offending beginning in early adolescence, a peak in mid-adolescence, a steep decline in early adulthood, followed by a steady decline thereafter. The peak may be higher or lower at different periods, and the peak age may vary by a year or two, but the peak remains. This pattern has been noted in all cultures for which statistics are gathered and at all times. Charles Goring noted the constancy of the age–crime curve across times and culture and concluded that it was "a law of nature" (as quoted in Gottfredson & Hirschi, 1990, p. 124).

Laws of nature describe regularities of nature; they do not explain why the regularities occur. As with the gender ratio issue, the age–crime curve has long puzzled criminologists laboring under the illusion that biology is irrelevant for their discipline. Hirschi and Gottfredson (1983) have even stated that "the age distribution of crime cannot be accounted for by any variable or combination of variables currently available to criminology" (p. 554), and Shavit and Rattner (1988) write that the age peak in delinquency remains "unexplained by any known set of sociological variables" (p. 1457). To try to explain it, sociological criminologists often invoke peer influences, but they do not inform us *why* these peer influences become more salient during adolescence and why these influences are typically antisocial. To do so, Spear (2013) states that an evolutionary perspective may be what we need:

> Common behavioral proclivities seen in human adolescents and their counterparts in other species include elevations in peer-directed social interactions along with occasional increases in fighting with parents, increases in novelty seeking, sensation seeking, and risk taking. . . . These across-species similarities support the suggestion that certain neurobehavioral characteristics of adolescence may be tethered in part by biological roots embedded in the evolutionary past. (p. S8)

Mating effort entails a certain element of risk, and mating is particularly prevalent among adolescents and young adults (Ellis et al., 2012). Risky behavior among adolescents is frequently pathologized, which is understandable when we witness them engaging in reckless driving, binge drinking, and drug-taking. However, these things are all evolutionarily novel acts, and the costs of engaging in them heavily outweigh the benefits, but we rarely pause to consider what may be evolutionarily adaptive about risk-taking per se during adolescence (Ellis et al., 2012). Studies of a number of primate species have shown that their adolescents share with human adolescents the tendency to become very sensitive to rewards, risk-taking, sensation-seeking, and novelty. From an evolutionary perspective, the purpose of these tendencies is to compel the animal to leave the nest to find a mate from another troop. Mid-adolescence and early adulthood is a period of intense competition among males for dominance and status among many primate species, including *H. sapiens,* aimed ultimately at securing more mating opportunities than the next male. As Martin Daly (1996) states, "There are many reasons to think that we've been designed to be maximally competitive and conflictual in young adulthood" (p. 193).

Puberty is initiated with the activation of the hypothalamic–pituitary–gonadal axis, which dramatically increases the level of sex hormones signaling readiness for reproduction. At this time, many sex differences emerge or increase as the genes turned on by hormones activate brain areas organized along sexually dimorphic lines in utero. Ernst, Pine, and Hardin (2006) explain that at a proximal level, risk-taking is the result of the developmentally normal lack of balance between brain areas associated with approach/avoidance behaviors: "The propensity during adolescence for reward/novelty seeking in the face of uncertainly or potential harm might be explained by a strong reward system (nucleus accumbens), a weak harm-avoidance system (amygdala), and/or an inefficient supervisory system (medial/ventral prefrontal cortex)" (p. 299). Aaron White (2004) augments this with his summation of key messages from a New York Academy of Sciences neuroscience conference. The main points stressed are that much of adolescent behavior is rooted in the lack of synchrony between a physically mature body and a still maturing nervous system. One of the consequences of this is that adolescents have higher sensitivity to reward, meaning that they require higher levels of stimulation to obtain the same rewards as mature adults. This leads them to seek higher levels of novelty and stimulation to achieve the same feeling of pleasure. In short, biological changes in the body and brain, intermingling with environmental factors, result in adolescents being prone to risk-taking and experiencing wide emotional swings.

Adolescence can be an emotionally trying time when both sexes are experiencing many physical and social changes. Males are juiced up by the huge pubertal surge of testosterone while at the same time experiencing profound changes in their neurobiology. Functional magnetic resonance imaging studies show that adolescents have exaggerated nucleus accumbens (NAcc) activity relative to activity in regions of the prefrontal cortex (PFC) compared to children and adults (Eshel, Nelson, Blair, Pine, & Ernst, 2007; Galvan et al., 2006). Because the NAcc is implicated in reward-seeking behaviors and the PFC is an inhibitor of impulse, findings such as these reveal mechanisms behind the adolescent propensity to favor short-term hedonism over more reasoned long-term goals. This suggests that adolescence is accompanied by changes in the ratios of excitatory to inhibitory neurotransmitters, fiber architecture, and tissue composition; the excitatory transmitters dopamine and glutamate peak while the inhibitory transmitters γ-aminobutyric acid and serotonin are reduced (Bava & Tapert, 2010; Collins, 2004; Walker, 2002). The biological tools needed to increase novelty-seeking, sensation-seeking, status-seeking, and competitiveness are adaptations forged by natural selection in the service of reproductive success (Bava & Tapert, 2010; Spear, 2000; White, 2004).

In addition to the previously mentioned chemical changes, the adolescent brain is also going through an intense period of tissue resculpting. It shows a decrease in gray matter in prefrontal regions as unused synapses are pruned, increased myelination of the PFC, and changes in the density and distribution of dopamine receptors in pathways that connect the limbic system to the PFC (Steinberg, 2005). The pubertal hormonal surges prompt the increase of gene expression in the brain, and the genes then play their parts in slowly refining the neural circuitry to its adult form (Walker, 2002). Brain imaging studies reveal that the PFC (the modulator of emotions from the limbic system) undergoes a wave of synaptic overproduction just prior to puberty, which is followed by a period of pruning during adolescence and early adulthood (Giedd, 2004; Sowell, Thompson, & Toga, 2004). The selective retention and elimination of synapses relies crucially on experience-dependent input from the environment because the developing brain physically "captures" these inputs in somatic time the way that natural selection seizes on advantageous alleles in evolutionary time.

Because the adolescent PFC is also less completely myelinated than the adult PFC (Sowell et al., 2004), there is a larger "time lapse" between the onset of an emotional event in the limbic system and a person's rational judgment of it in the PFC. Diffusion tensor imaging studies demonstrate increasing fractional anisotropy (FA) and decreasing mean diffusivity (MD) as the brain matures from childhood to adulthood. FA is linked to increased axon myelination and is a scalar used to measure the integrity of white matter fiber (axons) tracts; the higher the FA, the greater the integrity of the connectivity between brain areas. MD is a measure reflecting water content and density throughout brain white matter. In short, increased FA and decreased MD indicate that the areas of the brain such as the "rational" PFC and the "emotional" limbic system are better able to communicate with each other as the brain matures (Lebel & Beaulieu, 2011).

These brain imaging studies show that there are physical reasons for the greater ratio of emotional to rational responses evidenced by teens. The physical immaturity of the adolescent brain combined with a "supercharged" physiology facilitates the tendency to assign faulty attributions to situations and the intentions of others, and this can lead to antisocial responses. In other words, "a brain on 'go slow' superimposed on a physiology on 'fast forward' explains why many teenagers find it difficult to accurately gauge the meanings and intentions of others and to experience more stimuli as aversive during adolescence than they did as children and will do so when they are adults" (Walsh, 2002, p. 143). As Richard Restak (2001) states, "The immaturity of the adolescent's behavior is perfectly mirrored by the immaturity of the adolescent's brain" (p. 76). Although parents may decry such behavior, it is how natural selection has designed human adolescents to be prepared to leave the nest and produce the next generation.

The human brain is evolution's masterpiece. It is the most complex and capable organ known. It is humanity's central processing unit and the great mediator to all human behavior. It processes the information we collect through our senses and makes sense of that information. Without such a complex brain, what it means to be human would be uninteresting; that is, the human condition would be nothing more than a monotonous routine in survival. Instead, our complex brains give us art, science, and morality (Pinker, 2002). Understanding the brain's structure, function, and evolutionary development is paramount to a more complete understanding of criminal behavior. As such, evolutionary theory and neurocriminology add significant explanatory power to the criminologist's toolkit. Understanding brain development can help explain the age–crime curve, but understanding abnormalities in brain structure and function can also help explain a variety of antisocial behaviors. Abnormalities in brain structures, such as the amygdala and PFC, and/or their functioning (e.g., metabolic activity) are routinely associated with violence, sex offenses, psychopathy, and addiction (Jorgensen & Barnes, 2016; Raine, 1993).

CONCLUSION

This chapter argues for nothing more nor less than the evolution of criminology through the integration of the theories, methods, and technological instruments gifted to it by the more robust sciences. In their disciplines' adolescence, chemistry borrowed shamelessly from physics, biology from chemistry, and psychology from biology, and all progressed by leaps and bounds when they did so. To insist on trying to explain human behavior without an evolutionary framework is akin to modern chemistry going about its business ignoring the very causal foundations of the discipline—atoms and the other basic forces governing the behavior of matter—as it was once urged to do by many of its leading luminaries (Walsh, 1997). This does not imply the colonization of criminology;

criminologists can go about their work in their areas of expertise just as do biologists in their numerous areas of research without invoking evolution. However, biologists realize that evolution draws all their sub-areas together because "nothing in biology makes sense except in the light of evolution," as the grandfather of the neo-Darwinian synthesis of genetics and evolution, Theodosius Dobzhansky (1973, p. 125), maintained long ago. Darwin himself (1859) predicted that one day, "psychology will be based on a new foundation, that of the necessary acquirement of each mental power and capacity by gradation. Much light will be thrown on the origin of man and his history" (p. 428). Much the same claim could be made of any behavioral discipline, including criminology.

An evolutionary approach can aid criminology in many ways in addition to providing the benefits outlined in this chapter. It can help explain why some people victimize others while simultaneously explaining why most of us do not. Another major benefit is that it can reconcile the tension between the two major criminological traditions whose assumptions about criminal behavior are radically at odds—social learning and social control theories (Pratt, Gau, & Franklin, 2011). The former views humans as naturally good (or at least a blank slate) until corrupted by bad neighborhoods, peers, families, and societies (how the sum of naturally good individuals equals bad groups is a question never asked), whereas the latter views individuals as naturally selfish and requiring social controls to get them to respect the rights of others. For the social learning tradition, crime is an aberration, so it asks, "What causes crime?" The control tradition views crime as the default option in the absence of controls, and it asks, "Since crime is a way to acquire valued resources immediately and at minimal costs, why don't we all commit it?" The problem with this tension is each tradition's strictly dichotomized assumptions about human nature: It is either naturally good or naturally selfish (the social learning tradition's assumption is implicit rather than explicit, whereas the assumption of the control tradition is explicit). However, viewed through an evolutionary lens, this is a false dichotomy.

Evolutionary criminology maintains that criminal behavior is normal and to be expected on a large scale when social cohesion breaks down, as the social control tradition (exemplified by Durkheimian anomie, social disorganization, social bond, self-control, and age-graded theories) avers. Evolutionary criminology also avers that the desire for peaceful coexistence by conforming to social norms and supporting their enforcement is also normal, as the social learning tradition maintains. Which of these features of human nature prevail—either at the social level or at the individual level—depends on the coalescence of a large number of contingent factors because, as Aristotle stated many centuries ago, we have both beast and angel in our nature. Humans have a set of evolved motivations and regulatory mechanisms that they can display in reckless ways or in adherence to social norms.

We have evolved to be reciprocal altruists who can realize our self-interests best by following rules than by not following them. The apparent paradox of social beings committing antisocial acts is resolved when we realize that our desire to cooperate with our fellows provides opportunities for non-cooperators to victimize us. The individuals most likely to do so are those who are disadvantaged in the competition for wealth, power, and status, which is what most mainstream criminological theories express. Adding evolutionary explanatory concepts to criminology theories would not only enrich and broaden their repertoire of concepts but also ground them in the one existing theory that has the potential to add unity and coherence across all disciplines that study the behavior of living things. Evolutionary theory highlights the types of environments in which the kinds of behaviors that trouble us most are likely to emerge, and it is the only extant meta-theory that is capable of uniting, integrating, and making sense of the disparate data on human behavior coming to us from many theories and many disciplines.

In summary, it is worth noting that less than 100 years ago, biology, like criminology today, was so fragmented that most biologists considered its unity "to be nearly an impossible task" (Smocovitis, 1992, p. 2). Biologists worried then about its autonomy as a science and about the intrusion of physics and chemistry into their discipline, just as many criminologists worry about the intrusion of biology today. Smocovitis quotes Joseph Woodger in his 1929 book *Biological Principles* on this fragmentation:

> If we make a general survey of biological science we find that it suffers from cleavages unknown [in unified sciences such as chemistry]. Long ago it [chemistry] has undergone that inevitable process of sub-division into special branches which we find in other sciences, but in biology this has been accompanied by a characteristic diversion of method and outlook between the exponents of the several branches which has tended to exaggerate their differences and has even led to certain traditional feuds between them . . . [instead of a unified science we have] a medley of ad hoc hypotheses. (pp. 4–5)

By substituting "criminology" for "biology" in the previous quotation, criminologists will recognize the present state of their disciple. Smocovitis (1992) concludes his history of the process from fragmentation to the paradigm shift inspired by the synthesis of Darwinian natural selection and Mendelian genetics (neo-Darwinism) by stating, "What the architects had worked to construct [the unity of biology], had by 1982 become a matter of fact" (p. 62). It will be a happy day when in the not too distant future another historian of science writes a similar conclusion with regard to the unity of criminology.

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