

Risk Taking, Antisocial Behavior, and Life Histories

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In this chapter we examine the ultimate causes of risk taking and antisocial behavior. We discuss risk taking and antisocial behavior together because they have much in common; both often involve impulsive, reckless, immediately-rewarding, and self-serving behavior. We do so for ease of exposition, but also for empirical reasons: Many forms of risk taking (e.g., speeding while driving, promiscuous sex) are tightly associated with antisocial behavior, at both the individual and aggregate levels (reviewed in Mishra & Lalumière, 2009). This observation has led some to propose such broad-spectrum constructs as “taste for risk” (Daly & Wilson, 2001), “generality of deviance” (Osgood, Johnston, O’Malley, & Bachman, 1988), “problem behavior syndrome” (Jessor, 1991), and “low self-control” (Gottfredson & Hirschi, 1990) that reflect the connection between general risk taking and antisocial behavior. Just as most criminologists have realized the futility of crime-specific etiological explanations, it is becoming clear that the correct target of explanation is something more biologically relevant than legally-defined actions or even socially undesirable behaviors.

Longitudinal studies have uncovered reliable developmental trends in antisocial behavior. This research has been mostly descriptive, and explanatory questions have focused mostly on proximal factors. In this chapter, we begin by describing three general developmental pathways to antisocial tendencies. We then introduce life history analysis to provide a framework for ultimate explanatory questions about the development of both general risk taking and antisocial tendencies. In particular, we explore the notion of risky and antisocial behaviors as adapted responses to particular conditions encountered by individuals during their lifetimes; by “adapted”, we mean selected over generations because of positive impact on fitness, regardless of current fitness effects. We describe fundamental crossroads all organisms must face—those having to do with growth, maintenance, and reproduction—and examine how these choices are

linked to the three developmental pathways. We end with an application of life history analysis to a contemporary criminological phenomenon, the sudden drop in rates of risk taking and criminal behavior in the 1990s.

The Development of Antisocial Tendencies: Three Pathways

Quinsey, Skilling, Lalumière, and Craig (2004) proposed that there are three key developmental pathways that describe different patterns of antisocial and risky behavior over the life course. A pattern of delinquent behaviors concentrated in adolescence and early adulthood is termed *adolescence-limited delinquency* (after Moffitt, 1993). Antisocial behavior associated with neuropathology and social adversity beginning early in life and persisting over the life span is termed *life-course persistent offending* (Moffitt, 1993). A third pattern of antisocial behavior is similar to life-course persistent offending, in that it is characterized by early onset of antisocial behavior and persistence throughout the lifespan, but individuals do not show any evidence of early neuropathology or social adversity. This pattern is termed *psychopathy* (Harris, Rice & Quinsey, 2003; Harris, Skilling & Rice, 2001). There are surely other, less common or more specific pathways (e.g., White, Bates, & Buyske, 2001), but here we concentrate our discussion on these three general pathways.

Delinquent behavior limited to adolescence and early adulthood period is normative, and data suggest that it is somewhat anomalous to refrain from any antisocial behavior during this period (reviewed in Moffitt, 1993). Late adolescence and early adulthood is also rife with other high risk behaviors, such as speeding, drug use, and promiscuous sexual activity (Gottfredson & Hirschi, 1990). Developmental scientists typically invoke learning theory to explain the ubiquity of adolescence-limited delinquency. For example, adolescents mimic life-course persistent peers, because risky and antisocial behavior in adolescence often leads to desirable outcomes (money, reputation, sex) that cannot be obtained as easily through prosocial means (Moffitt, 1993).

Adolescent-limited delinquents desist from antisocial conduct in early adulthood as the benefits of engaging in such behavior diminish relative to rising costs.

Life-course persistent offending represents a vastly different pattern of antisocial behavior. Life-course persistent offenders begin engaging in problem behavior early in childhood (e.g., they are hyperactive, aggressive), and display antisocial behavior throughout adulthood. Life-course persistent offenders often exhibit evidence of neurodevelopmental perturbations experienced early in life, along with being raised in disadvantaged environments. A number of factors possibly causing neurodevelopmental perturbations have been linked with antisocial behaviors, such as brain injury, malnutrition, maternal smoking during pregnancy, and obstetrical complications (reviewed in Anderson, 2007; Harris, Rice, & Lalumière, 2001). These factors typically interact with other social factors related to delinquency, such as a single-parent upbringing, low socioeconomic status, or parental abuse (Rutter, 1997). Together, neurodevelopmental problems and poor social environments are suggested to decrease intellectual (especially verbal) abilities leading to increased impulsivity, decreased sensitivity to punishment, and impaired development of prosocial skills, all of which lead to snowballing adjustment problems.

The third pattern of antisocial behavior is psychopathy. Psychopaths exhibit chronic and extreme antisocial behavior throughout their lifetime and across various contexts. They are similar to life-course persistent offenders, in that they experience early onset of antisocial behavior that perseveres throughout the lifespan, but exhibit important differences in severity of offending, affect and physiology, interpersonal relations, and lack of neurodevelopmental pathology (reviewed in Harris et al., 2001; Lalumière, Harris, Quinsey, & Rice, 2005; Quinsey et al., 2004). Research suggests that psychopaths do not exhibit signs of neurodevelopmental perturbations experienced by life-course persistent offenders, and social factors do not seem to

have any influence on the development of their persistent antisociality. Compared to other life-course persistent offenders, psychopaths tend to have broader and more extensive criminal histories, exhibit increased likelihood of reoffending after incarceration, commit more violent crimes, are more likely to engage in instrumental (goal-directed) violence, and are more likely to select strangers as victims. Affectively and physiologically, psychopaths also show differences: They exhibit shorter delay of gratification, less sensitivity to punishment, and are less physiologically reactive when exposed to cues of distress, fear, or other aversive cues.

The risk taking and antisocial behaviors described above for the three pathways are typically seen as a pathological aberration from normal prosocial behavior. Implicit in this view is the assumption that engaging in risky and antisocial behavior is irrational or counter-productive, and self-destructive. This assumption stems from the perception that risky or antisocial behavior conflicts with an individual's best interests due to its high cost (e.g., physical injuries, jail time). Risky and antisocial behavior, however, may represent an adapted response to particular environmental or situational conditions, an optimal behavioral option in some circumstances, maximizing the likelihood of certain outcomes that were statistically related to fitness in ancestral environments. Although risky behavior may lead to costly outcomes (e.g., foreshortening one's life expectancy), it may also have benefits (e.g., increased mating opportunities): all gains and losses are in the currency of reproductive success, and those individuals who sacrificed their lifespan in exchange for reproduction under some circumstances may have done better genetically than their rivals who did not. In the context of adaptive decision making in humans and in light of evolutionary theorizing, when is it beneficial to engage in risky and antisocial behaviors when other alternatives are available? Why are there three general developmental patterns of risky and antisocial tendencies?

Life History Analysis: A Brief Introduction

The central tenet of evolution by natural selection is differential reproductive success, or fitness, of individuals possessing certain heritable characteristics. There is enormous variability in the ways that organisms can maximize reproductive success. Life history analysis represents a way of conceptualizing the evolution of allocation of effort or energy toward such fitness-relevant characteristics as age of first reproduction, number of offspring, size of offspring, or length of reproductive lifespan. Life history analysis seeks to understand the selective pressures that influence both the timing and expenditure of limited energy resources under different conditions.

A key concept in life history analysis is tradeoff: Organisms must allocate a finite amount of effort or energy to endeavors that constrain each other, such as number and size of offspring (Stearns, 1992). Natural selection favors an allocation of effort or energy that optimally maximizes fitness given the features of a particular environment (Kaplan & Gangestad, 2005). A number of tradeoffs have been documented in animals, including tradeoffs between size and number of offspring, mating and parenting, and growth and early reproduction. These tradeoffs are relevant in the evolution of a diversity of life histories both between species and within species. Some important tradeoffs will be discussed in the context of risk taking and antisocial behavior, particularly in how they affect potentially adaptive risk acceptance in different environmental and situational contexts. We also discuss the relevance of life history analysis for the three general developmental patterns of antisocial behavior.

Survival, the Present, and the Future

Organisms have limited effort and energetic resources to allocate to different essential reproductive activities. This limitation forces tradeoffs, such as that between current and future reproduction. Current reproduction incurs costs such as compromised immune function, reduced chance of survival, and lowered expected future reproduction. Delaying current reproduction

incurs the risk of not reproducing at all because of potential mortality before other reproductive opportunity (Kaplan & Gangestad, 2005). Organisms “decide” on a schedule of reproduction based on optimality of allocation of resources in a particular environment. If the mortality rate due to extrinsic factors (e.g., predation, accidents) is high, it makes little sense for an organism to delay reproduction given the potentially severe costs of not reproducing at all in a dangerous environment. Consequently, effort and energy in this particular environment should be allocated toward earlier reproduction, minimizing the chances of death without reproducing.

The time horizon of an organism, determined from environmental cues to life expectancy, has a powerful influence on life history. Under the eye of selection, organisms that most accurately assess their time horizons based on internal and external mortality cues and exhibit an appropriate behavioral response would obtain higher fitness and pass this ability on to future generations. In the context of decision making, a limited time horizon leads organisms to value immediate, short-term rewards more highly than larger distal future rewards, a pattern known as future discounting. Discounting of the future may appear on the surface to be a brash strategy, but choosing such a strategy when faced with certain environmental conditions may represent an optimal decision. Harvey and Zammuto (1985) showed that age of first reproduction in females is related to life expectancy at birth, both within and across various species of wild mammals.

Humans appear to exhibit similar sensitivity to time horizons by discounting the future if time horizons appear to be short, or if the projected quality of one’s future is perceived to be poor. In an interesting study, Phillips, Ruth, and Wagner (1993) examined the death rates of Chinese-Americans who believed that certain years of birth are associated with susceptibility for certain diseases (e.g., fire years are associated with the heart and therefore heart diseases). Results showed that Chinese-Americans died significantly earlier if they contracted a disease associated with their birth year compared to Chinese-Americans who contracted a disease not

associated with their birth year. Chinese-American who were less likely to hold traditional beliefs (e.g., not born in China) showed fewer years of life lost if there was a match between disease and year of birth. White-Americans, who were not expected to hold such belief, did not show an association between year of birth and death rates for any diseases. The findings for Chinese-Americans held for all major causes of death, and could not be explained by cohort effects, marital status, or changes in the explicit outward behavior of patients, doctors, or other healers. One interpretation of these findings, in light of sensitivity to time horizons, is that certain beliefs about future outcomes implicitly affect physiology and behavior.

Returning to antisocial and risky behavior, the decision to engage in such behavior may be contingent on an individual's assessment (not necessarily conscious) of his own need and how the available present and future behavioral options might meet that need. For example, individuals experiencing economic hardship, poor health, or low social status, may rightly perceive that their expected outcome (e.g., a minimum wage job) will be poor. Such people often appear to engage in behaviors reflective of future discounting, such as competitive risk taking or interpersonal violence, perhaps because their perceived need for social, reproductive, or financial advancement exceeds the mean advancement resulting from lower risk behaviors. Engaging in such behaviors may lead to at least short-term gains in reputation, reproductive opportunities, or material resources. Potentially costly risky or antisocial behavior becomes an appealing option, as the benefits may far outweigh the costs for an individual with poor future prospects and a shortened time horizon.

Following this logic, age-specific risk rates reflect different valuations in short versus long-term rewards. The relative valuation of safety and survival changes in reference to life stages, particularly in comparison to other potential immediate rewards such as mating access (Daly & Wilson, 2001; Hill & Chow, 2002; Rogers, 1994). Young males aged 18 to 24 are particularly

likely to engage in antisocial and risk-accepting behavior, because competition for status, mates, and resources in that period of time reaches its peak (Wilson & Daly, 1985). Young males not only compete with each other, but also compete with older males who have had more time to accumulate skills, resources, and status, features important to female mate choice. This period of time allows for the potential of high variance in gains, as the costs of not obtaining resources and a mate are significant in a fitness sense, and risk taking may be necessary in order to obtain favorable outcomes (Hill & Chow, 2002).

There are also situations in which the future is less discounted, and behavior is focused on maximizing long-term outcomes. Other aspects of life history have been associated with decreases in risky behavior, such as obtaining status, gaining a long-term mate, and parenthood in children (Hill & Chow, 2002). For individuals who have already obtained a mate through competition and are the progenitors of offspring, effort and energy may shift from competition and mating effort to parental effort, facilitating a decrease in risky behavior.

Interpersonal conflict can be thought of as an outcome of steep future discounting and a risk-accepting response to social competition, and many homicides occur as a direct result of male-male competition over status, or mates (e.g., Daly & Wilson, 1998, 1990; Wilson & Daly, 1985, 1982, 1997). Wilson and Daly examined homicide rates and reproductive timing as a function of economic inequality and local life expectancy. In the context of limited life expectancy, it is likely that males would escalate competition, and indeed, Wilson and Daly found that the homicide rate increased as local life expectancy decreased, even after statistically removing the effects of homicide on life expectancy. Similarly, a shift toward immediate reproduction trading off with later reproduction should be observed in situations of short time horizons, because the likelihood of successfully reproducing in the future is diminished in such a situation. Wilson and Daly found support for this hypothesis, demonstrating that

disproportionately high birth rates among younger mothers were observed in neighborhoods with the lowest life expectancies.

The predictability of environmental cues should also play an important role in the modulation of risky behavior. Risk acceptance may constitute a more effective strategy when future prospects are unknown. If an individual was to utilize a 'safe', risk-averse strategy in the face of uncertainty, he may not survive to reproduce again if conditions become particularly bad. In the face of unpredictability, a risky strategy, although paradoxical, may have been associated with greater reproductive success in an ancestral environment. Following from this prediction, Hill, Ross, and Low (1997) found that reported risk taking behavior in various domains (e.g., sexual, health, financial) was higher in college students who exhibited higher future unpredictability beliefs and shorter lifespan estimates. Further research demonstrated that early cues of unpredictability, such as parental divorce or family unreliability, are associated with a risk-accepting life history strategy (Ross & Hill, 2002). It is also possible that divorced or unreliable parents genetically passed on traits that predispose their offspring toward risky behavior, and previous research has shown that there is some genetic transmission of antisocial tendencies from parents to offspring (e.g., Cadoret, Yates, Troughton, Woodworth, & Stewart, 1995). Behavioral genetic studies have also shown, however, that the environment accounts for a large proportion of variance in phenotypes, suggesting that features of the environment may calibrate or activate evolved mechanisms (e.g., sensitivity to predictability cues) associated with risk taking.

In sum, similar tradeoffs are seen in humans that are seen in other animals, wherein short time horizons and unpredictable environments may lead to discounting of the future, as evidenced by greater risky and antisocial behavior in individuals with shorter or less favorable future prospects.

Mating and Parenting Effort

In most species, males have a higher potential reproductive rate than females, and so can produce more offspring in a given period of time (Clutton-Brock & Vincent, 1991). One mechanism through which this sex difference can manifest is an imbalance in minimal parental investment (Trivers, 1972). Females incur greater time and energy costs than males in order to produce offspring. In humans, women must invest at least nine months of time for gestation, and must go through parturition. Except under exceptional circumstances, energy costs are also incurred in having to provide nourishment for the neonate. In contrast, men need only contribute a single ejaculate to successfully produce offspring with a fertile woman.

The sex difference in potential reproductive rates creates a situation in which the “slower” sex, usually female, becomes a valuable resource which members of the opposite sex, usually males, compete for (Clutton-Brock & Vincent, 1991). Because a pregnant or lactating female is effectively removed from a pool of potential mates, the effective (or operational) sex ratio is male-biased, facilitating the evolution of intense male-male competition for the limited number of available females. That certain males can monopolize the available pool of females more than others increases male variance in reproductive success, fuelling competition (Clutton-Brock & Vincent, 1991).

Over evolutionary time, there may have been stronger selection pressure on men relative to women to seek sexual opportunities, given that an increase in sexual partners likely increased the reproductive success of men more than women over time. A tendency for men to invest more energy in mating effort than women has been well established (reviewed in Low, 2000; see also Schmitt, 2005). Although men are more likely than women to invest in mating relative to parenting effort, there is variation within the sexes. Some men may be monogamous and invest copious amounts of time and energy in their offspring; others may attempt to have as many

sexual encounters as possible, never investing in offspring. Similar, but smaller variation in allocation of energy to mating and parental effort is seen in women. In both men and women, a tendency toward early reproduction and high mating effort is generally associated with greater risk taking and antisocial behavior (reviewed in Lalumière et al., 2005).

In both sexes, risk taking is highly associated with being or getting someone pregnant in adolescence (Bingham & Crockett, 1996; Jessor, Costa, Jessor & Donovan, 1983). Teenage fathers are more likely to have committed serious crimes (Stouthamer-Loeber & Wei, 1998), and to have encountered risk factors associated with antisocial behavior, such as low socioeconomic status or parental antisociality (Fagot, Pears, Capaldi, Cosby, Leve, 1998). Early pregnancy in females has also been associated with antisocial behavior, with childhood aggression predicting early motherhood (Serbin et al., 1998). Other studies have investigated mating effort more generally in relationship to antisocial conduct. Lalumière and Quinsey (1996) found that variables measuring antisocial tendencies were also related, in men, to a history of multiple uncommitted sexual relationships. Antisocial men are also more likely to utilize sexual coercion, aggression, or deception in the pursuit of mating opportunities. In many studies, age at first intercourse is strongly related to indicators of antisocial tendencies (e.g., Quinsey, Book, & Lalumière, 2001).

Why are antisocial individuals more likely to engage in potentially costly mating behaviors, exhibiting high mating effort and low parental effort? Adolescence-limited delinquents exhibit a peak in antisocial behavior, including increased sexually coercive behavior, after puberty, with a systematic decline occurring sometime thereafter. As mentioned before, this peak during adolescence may be due to escalated intra-sex competition for mates (Campbell, 1995; Daly & Wilson, 1988; Wilson & Daly, 1985). Because of sex differences in potential reproductive rate,

there is greater variability in male than in female reproductive success, and thus there are greater fitness benefits bestowed upon males that succeed, and greater costs for males that do not.

It should be noted that behaviors that are considered risky may also reflect hard to fake displays of prowess or social status, such as willingness to fight, fearlessness, or independence. Adolescent risky and antisocial behavior may thus serve as an “honest signal” of qualities desirable to females (e.g., health, attractiveness; Lalumière & Quinsey, 2000; Zahavi & Zahavi, 1997). This notion is supported by the findings that gang leaders and dominant males enjoy increased access to sexual partners, and young males are more likely to engage in risky behavior when in the presence of peers (reviewed in Daly & Wilson, 2001).

Desistance from criminal and risky behavior for most individuals occurs after adolescence, likely as a function of a shift in allocation of energy from mating to parenting effort. Marriage, stable work, and aging are all reliable correlates of desistance from risky behavior. A shift from mating to parenting effort (or vice versa) should be observed when the cost-benefit ratio favors one type of effort over the other. Investing in a committed relationship with a high quality mate, for example, may offer greater fitness benefits in the long-term. The costs of attempting to gain multiple mating opportunities—such as time and effort allocated to courting, risks associated with sexual aggression, or retaliatory violence from partner’s relatives—may exceed the benefits of investing in a long-term relationship with a single partner, and allocating effort and energy to children borne of that partnership. Interestingly, little research has been done to investigate the actual effect of having children on the shift from mating to parental effort. We expect that adolescent-limited delinquents are likely to exhibit diminished risky and antisocial behavior after having children, whereas life-course persistent offenders would not necessarily do so. Lowered testosterone following the onset of fatherhood has been suggested as a proximal mechanism for this shift (e.g., Gray, Kahlenberg, Barrett, Lipson & Ellison, 2002). Only adolescence-limited

delinquents exhibit a decrease in antisocial behavior with age, and so are likely more sensitive to situational or environmental changes, such as having children. Because life-course persistent offenders do not desist from antisocial behavior with age, different mechanisms are required to explain the persistence of antisocial behavior in life-course persistent offenders and psychopaths.

In sum, individuals must “decide” to invest energy in mating or parenting. Males and younger individuals have more to gain and less to lose from engaging in risky behavior. With age, greater social status, a long-term relationship, and children, however, the relative valuation of benefits and costs from risky antisocial behavior changes significantly, and a shift from mating to parenting effort is observed.

Growth, Reproduction, and Competitive Disadvantage

Life-course persistent offenders do not exhibit desistance from antisocial or criminal behavior with age, suggesting that a different mechanism is required to explain the consistently high valuation of antisocial behavior, relative to its costs. The construct of embodied capital, used in human behavioral ecology, is particularly illuminating of life-course persistent offending.

Embodied capital refers to intrinsic attributes, such as health, skills, or attractiveness, that allow for successful competition for resources, mates, and status (Lalumière et al., 2005). Individuals with low embodied capital may experience an early and consistent competitive disadvantage, such that a conditional strategy of persistently risky and antisocial behavior may represent the best chance for obtaining resources, status, or mates. Individuals with low embodied capital would likely project their future prospects to be poor, thus affecting the cost-benefit ratio of adopting risky antisocial behavior. The strategy is conditional, in the sense that it facultatively responds to cues of low embodied capital.

Life-course persistent offenders indeed appear to be at competitive disadvantage relative to others, suffering from neurodevelopmental problems, poor academic success, and poor social

support. As a consequence, antisocial behaviors such as the acquisition of resources through criminal means, establishment of dominance or higher status through violence, or coercion in attempting to gain mating opportunities, may represent the most beneficial behavioral option. Competitive disadvantage has been empirically shown to influence rates of antisocial and criminal behavior. Wilson and Daly (1997) demonstrated that Chicago neighborhoods with higher local income disparities also experienced higher homicide rates. If one is able to legitimately compete for resources, status, or mates, it is not beneficial to engage in costly risky or criminal behavior. Low embodied capital individuals, however, have much to gain and often little to lose from discounting the future and engaging in antisocial conduct. The constraints of low embodied capital shift the cost-benefit ratio of risky and antisocial behaviors, making such behaviors a more beneficial option. Because low embodied capital may not be easy to remedy, this option remains optimal throughout the lifespan.

Cues of present or future embodied capital may influence growth trajectories and the adoption of life-course persistent antisocial behavior, and these outcomes may represent consequences of a life history tradeoff between investment in long-term growth and earlier reproduction. Infants exhibit a predictable growth trajectory when they experience typical prenatal conditions. Low birth weight caused by poor maternal nutrition (Godfrey, Robinson, Barker, Osmond, & Cox, 1996), however, can often lead to rapid compensatory growth during the early years of a child's life, in addition to health problems later in life (Gluckman, Hanson, & Spencer, 2004; Lummaa, 2003). The experience of poor maternal nutrition in utero may serve as a cue to the developing fetus that conditions experienced during development (in this case, limited resource availability), are likely to continue after birth and in the future. Thus, compensatory growth and accelerated development in the early part of a child's life may occur as

a pre-emptive physiological adapted response that is likely to confer benefits in anticipation of specific future conditions.

Individuals who exhibit compensatory growth may reproduce earlier in life, but their lack of investment in long-term growth results in an earlier onset of senescence. Such a mechanism may represent an attempt to mature and reproduce earlier than other potential competitors in a cohort, albeit at the cost of not being able to reproduce later. Empirical evidence supports a short-term versus long-term growth life history tradeoff, in that individuals experiencing early compensatory growth senesce faster and suffer negative reproductive consequences later in life (Lummaa, 2003; Phillips et al., 2001; Eriksson et al., 2001).

Several factors have been implicated in the development of life-course persistent offending, including parental abuse, poor nutrition (in utero or during childhood), neurodevelopmental perturbations, and general developmental instability (Harris et al., 2001; Lalumière et al., 2001). Although these factors are typically seen as disrupting normal developmental processes, another interpretation is possible. Neurodevelopmental perturbations and poor nutrition may serve as cues of developmental disadvantage to a mother and her fetus, thus facilitating the development of psychological mechanisms calibrated to produce risk-accepting strategies. Early parental abuse and the subsequent development of persistent antisocial behavior may also reflect the same mechanism, as parental abuse may suggest (analogous to poor nutrition) low embodied capital and a difficult future. Persistent antisocial behavior has also been associated with lower life expectancy, consistent with a life history strategy oriented toward short-term, immediate gains at the cost of long term survival (Laub & Vaillant, 2000).

An interesting natural experiment provides information relevant to the suggested tradeoff between growth (or embodied capital more generally) and reproduction. During World War II, food supplies were limited by the German army in some parts of the Netherlands, leading to a

severe food shortage. Males whose mothers experienced food scarcity during pregnancy had lower birth weight and experienced lower reproductive success over their lifetime (Lumey & Stein, 1997). These males also exhibited much higher frequencies of antisocial behavior in early adulthood compared to males whose mothers did not experience food scarcity (Neugebauer, Hoek, & Susser, 1999).

In sum, persistent antisocial behavior may develop as a conditional life history strategy based on environmental cues predictive of negative future prospects and competitive disadvantage (or low embodied capital), with short-term benefits of immediate reproduction and long-term costs of decreased life span. The lack of desistence of antisocial behavior in life-course persistent offenders can be explained by low embodied capital and other consequences of compensatory growth (or similar mechanisms) in response to early predictive environmental cues. In both cases, an individual has little prospect of improving competitive standing relative to others in the population, and experiences little ability to legitimately acquire a stable job, a long-term relationship partner, or good social standing—all factors that have been shown to be associated with the desistence of antisocial behavior in adolescent-limited delinquents. This framework leads to new expectations regarding the development of antisocial and risky behavior. For example, fast growth during childhood should be associated with life-course persistent offending, but not adolescence-limited delinquency, unless intense remedial measures are put into place.

Life History Strategies as Personalities

Personality describes an individual's consistent pattern of emotional, cognitive, and behavioral responses in multiple contexts (Funder, 2001). Individual differences manifesting as unique personalities may represent different, consistent patterns of solving life history problems. Psychopathy may represent an extreme example of a personality type, in that it is indicative of a

consistent pattern of affect, cognition, and behavior that reflects constant risk-acceptance and future discounting. At the other extreme, exceptionally risk-averse individuals may always choose the “safest” avenue, whereby risk is avoided, and the future is always considered, not discounted. Some studies have identified other personality traits closely associated with criminality and antisocial behavior, such as negative emotionality and weak constraint (Agnew, Brezina, Wright, & Cullen, 2002; Caspi et al., 1994), as well as sensitivity to rewards (Fonseca & Yule, 1995), and low self-control (Gottfredson & Hirschi, 1990).

Although psychopaths share features with life-course persistent offenders—early onset and persistence of antisocial tendencies, for example—there are important differences to consider. In particular, psychopaths generally do not seem to have experienced the same cues of competitive disadvantage as life-course persistent offenders. They do not exhibit the same neurodevelopmental pathologies, and they appear to have higher embodied capital. For example, Lalumière, Harris, and Rice (2001) found that adult psychopaths, compared to other adult offenders, had experienced fewer obstetrical complications, exhibited lower fluctuating asymmetry (based on 10 features of the head and body), were less likely to be left-handed (a sign of early neurodevelopmental perturbations), and were rated as more physically attractive. Other studies have investigated the underlying structure of persistent violence, suggesting that a factor associated with psychopathy, and a factor associated with early developmental problems (consisting of obstetrical complications, low IQ, problems in infancy, and so on) were unrelated to each other (Harris et al., 2001). This and other evidence (reviewed in Barr & Quinsey, 2004; Harris et al., 1993; Skilling, Quinsey, & Craig, 2001) suggests that psychopathy represents a separate sub-group of persistent offenders (Lalumière, Mishra, & Harris, chapter 10 of this volume).

Although engaging in risky behavior is often contingent on fluid environmental or situational conditions, stable patterns of personality may represent attempts to establish “niches” in variable environments. Individuals of average embodied capital that do not suffer from extreme competitive advantage, for example, may engage in consistently low-risk behavior. Investment in low variance outcomes, such as commitment to education throughout early childhood, a stable job, and a long-term relationship in life may reflect a long-term, stable risk-averse personality.

The introversion-extraversion personality dimension may represent behavioral patterns that arise from this scenario. Investment in high mating effort and taking risks that require certain skills may reflect a personality type that is outgoing, risk-accepting, and extroverted. Nettle (2005) has suggested that the introversion-extraversion personality dimension reflects different benefits and costs. Extraversion, for example, was found to be associated with higher mating effort; male extraverts were more likely to have extra-pair partners and female extraverts more likely to leave existing relationships. Costs of extraversion were also hypothesized and found, with increases in the likelihood of involvement in an accident or illness. In addition, extraverted women were more likely to expose their children to step-parenting, a known risk factor for child abuse and murder (Daly & Wilson, 1988).

Some support for the development of different personality “types” that partially incorporate risk-acceptance and risk-propensity comes from Sulloway’s (1997) investigation of birth order and personality. Sulloway suggested that first-borns tend to identify more with their parents, adopting a risk-averse, more conservative strategy over the course of the life span, while later and middle-borns tend to take more risks. Sulloway’s characterization of birth order and personality is consistent with the notion that risky or antisocial behavior is an adaptive response contingent on early cues of future prospects and projected time horizons. First-borns may

develop a conservative, risk-averse personality because of the greater certainty of their future resource or status potential derived from parental inheritance. For later-born individuals, certainty of future resources or status is not guaranteed, and a riskier strategy may be required to gain resources, status, and mates. Some empirical evidence supports different personalities and risk propensity based on birth order, suggesting that middle and later-born offspring are more likely to engage in adolescent antisocial behavior such as substance use, precocious sexual activity, and criminal behavior (Argys, Rees, Averett, & Witoonchart, 2006). Other studies have linked birth order to personality differences in various domains (e.g., Buunk, 1997; Saroglou & Fiase, 2002).

Evidence for animal “personalities” has been accumulating, and has been a recent topic of great interest for behavioral ecologists. Wolf et al. (2007) conducted computer simulations that suggest that life-history tradeoffs favor the evolution of different personalities (e.g., risk-proneness, aggressiveness, boldness). Wolf and colleagues argued that intra-species variation in the valuation of current versus future fitness returns may lead to polymorphic populations that vary in their propensity toward short-term and long-term oriented life history strategies. Animal “personalities” may reflect an attempt to establish behavioral “niches” in a variable environment. Future research using animal models may shed light on the evolution of personalities in humans.

Life Histories and Heritability

In this chapter, we suggest that people’s life histories vary with conditions encountered throughout their lifetimes, especially those encountered early in life. Thus, many life histories, including those involving life-course persistent offending, are likely developmentally conditional (see Lalumière et al., 2005, for a thorough discussion of conditional and obligate strategies associated with antisocial behavior in humans and other species). It is well accepted, however, that personality in general and antisocial tendencies in particular show significant heritability in

behavior genetic studies (e.g., Mason & Frick, 1994). There are at least three ways to resolve this apparent inconsistency. First, psychopathy is likely part of a heritable and obligate life history (Lalumière, Mishra, & Harris, chapter 10 of this volume), and psychopathy has not been considered in behavior genetic studies of antisocial behavior. Thus, the number of psychopaths in a given behavioral genetic study of antisocial behavior would directly inflate heritability estimates. Second, some factors associated with resistance to developmental perturbations must be heritable. Because neurodevelopmental factors are cues to future competitive disadvantage in our hypothetical model of life-course persistence offending, behavioral genetic studies of persistent offending will inevitably obtain non-zero heritability. Finally, non-zero heritability does not necessarily provide evidence against the existence of condition-dependent life histories.

For instance, the experience of maltreatment is reliably associated with the development of antisocial tendencies (there is now good evidence that this is an environmental effect, not simply a genetic transmission effect). Childhood maltreatment may provide a cue to the quality of current and future environments, and people may “adjust” their development accordingly. Caspi et al. (2002), however, found that a genetic polymorphism on the X chromosome associated with the monoamine oxidase A enzyme (which breaks down some neurotransmitters) moderates this relationship: Maltreated individuals with a genotype associated with low expression of the gene are much more likely to engage in antisocial behavior as adults than maltreated individuals with a genotype associated with high expression of the gene. Other gene-environment interactions have been detected using large samples and sensitive measures (e.g., a serotonin transporter gene and stressful life events on risk for adult depression; Caspi et al., 2003). Thus, is it likely that the “decision” to adopt a particular life history is dependent on both the conditions encountered and the genotype of the individual. For some people, difficult social conditions may not provide a cue to impending competitive disadvantage because they have the ability to overcome them.

An Application of Life History Analysis: Understanding the 1990s Crime Drop

We now turn our attention to the application of life history analysis to understanding a contemporary criminological issue. In the early 1990s, rates for all types of crimes fell sharply in both Canada and the United States (Blumstein & Wallman, 2005; Lalumière et al., 2005; Levitt, 2004; Mishra & Lalumière, 2009). A number of explanations have been offered for the crime drop, including an aging population, increases in the number of police officers, a stronger economy, and changes in abortion laws in the 1970s (Levitt, 2004). Although each explanation can account for a small portion of the decline in crime, none appear to explain a significant amount of the variation in rates of criminal behavior. In addition, many explanations involve U.S.-specific phenomena, such as increased incarceration, and ignore the parallelism between the Canadian and American crime data (Ouimet, 2002). It is quite possible that criminological hypotheses for the decline in crime may be focusing on too narrow a target of explanation.

Our research suggests that existing explanations of the crime drop have not considered the broader category of behavior to which most crimes belong, specifically antisocial behavior and risk taking (Mishra & Lalumière, 2009). Archival data from the United States and Canada were used to show that since the early 1990s, antisocial and risky behaviors in the domains of violence, some types of drug use, accidents, and sexual behavior have dropped significantly, and in a manner that closely parallels the drop in crime. Our results confirm a strong link between crime, antisocial behavior, and risky behavior, and suggest that what requires explanation is not simply the drop in crime, but a more general drop in risk taking and antisocial behavior.

What facilitated a decrease in criminal and risky behavior in general in the 1990s? We propose in this chapter that antisocial and risk taking tendencies are affected by people's time horizons. Here we apply the life history framework presented in this chapter to suggest potential causes of the crime and risk drop, in the hope that these suggestions may represent fruitful

avenues of research. We identify what may be indicators of a shift from a focus on short-term gains to a focus on long-term gains in the early 1990s, and suggest environmental cues that may have influenced such a shift.

The significant drop in antisocial behavior that was observed for the entire population of the United States and Canada in the early 1990s suggests that time horizons were perceived to be longer, and future prospects were perceived as more positive. Therefore, we expect to find *indicators* of investment in long-term, future outcomes, instead of short-term outcomes, and an increase in behaviors suggestive of an optimistic view of the future. In addition, if risk and antisocial behavior is affected by time horizons and the quality of one's future, then environmental *cues* predictive or indicative of a benevolent future should be observed to precede or accompany the drop in antisocial behavior in the 1990s.

Preliminary data provide some support for the notion that a shift toward positive future orientation was observed over the course of the 1990s. For example, according to the Youth Risk Behavior Surveillance Survey, teenagers have lived healthier lives by exercising more and eating more fruits and vegetables since the early 1990s. Doctor's visits for tests diagnostic of long-term chronic diseases such as cancer and diabetes have also increased during that time span despite a drop in the incidence of many diseases, suggesting that people are investing time in physical maintenance. Depression rates, which may be reflective of pessimism about future prospects, decreased over 25 percent in Canada since the early 1990s (Patten, 2002). It is important to interpret such data with caution, because many other factors could be responsible for these changes, such as increased antidepressant prescriptions affecting depression rates. Together, however, these indicators suggest that as of the early 1990s, people may have exhibited a greater and more optimistic interest in long-term, future-oriented behaviors rather than behaviors reflective of short-term, immediate rewards focused on the present.

Reproductive and parenting behaviors have also changed since the early 1990s. Investment in high mating effort and attempts at immediate reproduction are associated with a shorter time horizon and more negative future prospects, whereas greater investment in parenting and one's offspring suggests a longer-term and more future oriented perspective. Therefore, we should expect that indicators of parenting effort should have increased, and indicators of high mating effort should have decreased since the early 1990s. Since that time, such a shift has appeared to have occurred; mothers have delayed reproduction, with decreases in birth rates observed for all ages, except for those aged 30 to 44, women whose reproductive future is short (data from the U.S. National Center for Health Statistics, NCHS). There are significantly fewer teen pregnancies (down more than 20% in both the United States and Canada since 1991), in addition to fewer live births among teens (NCHS). It would also be expected that parents allocate more resources to fewer offspring. Even divorce rates have decreased since the early 1990s, suggesting that people may be investing more in long-term relationships (NCHS). Collection of more data relevant to reproductive outcomes and investment in children will provide further tests as to whether there has been a shift toward long-term strategies involving investing in children, as opposed to more short-term, mating effort oriented strategies since the early 1990s. One potentially productive avenue of research would be to examine changes in intensity of parental supervision over the last 20 years (certainly an indicator of parental effort); parental monitoring is one of the best protective factors for antisocial behavior (Donovan & Jessor, 1985).

The dramatic increase in obesity rates since the early 1990s is particularly interesting in the context of the life history trade-off between investment in long-term growth and short-term reproduction (Mokdad et al., 1999). If the decline in crime and risk taking since the early 1990s is the result of situational cues signaling favorable future conditions, we hypothesize that people would invest more in maintenance and growth than in immediate reproduction. We are currently

analyzing data at the state level investigating the relationship of reproductive outcomes and obesity rates since the 1990s. Preliminary results suggest that there is indeed an inverse relationship between indicators of immediate reproduction, such as teenage pregnancy, and long-term investment in growth, such as body mass index. We do not suggest that obesity is adaptive, but rather investment in growth and long-term health means saving calories rather than spending them. In a modern environment with easy access to calorie-rich foods, this process leads to obesity. Such results must obviously be interpreted with caution at present, and further data must be collected, but these preliminary results suggest that a tradeoff between immediate reproduction and long-term growth may have occurred in concert with the drop in antisocial and risky behavior in the 1990s. The question still remains, however: What caused this shift from short-term to long-term strategies?

We described several environmental and situational variables associated with increases in antisocial behavior and short-term life history strategies in this chapter, including perceived length of time horizons, projected quality of future prospects, unpredictability of environments, quality of early environment, intensity of competition, and competitive disadvantage. Changes in each of these variables may have preceded or accompanied the drop in antisocial behavior in the early 1990s, and would represent important avenues of investigation.

Life expectancy has been increasing for some time in North America. People perceive the length of their time horizon in more ecologically relevant ways than simply looking at a calculated national average life expectancy, and so cues such as the presence of older relatives (parents, grandparents), as well as the presence of older individuals within smaller local populations (e.g., neighborhoods within a city) would be indicative of a lengthier expected future. In communities where there are many sources of extrinsic mortality, such as homicide or accidents, antisocial behaviors are more often observed (Wilson & Daly, 1997). The recent

increase in body mass index may itself provide a cue to the health of others, generating positive estimates of one's (or one's children's) future health. A recent study reported that having an overweight spouse, friends or siblings increases the odds of obesity (Christakis & Fowler, 2007). Thus, it is possible that, at the community level, sources of extrinsic mortality have decreased, and cues to future health have increased, leading to more future-oriented and less antisocial behavior.

Other cues relevant to time horizons and future prospects may include decreases in perceived inequality, leading to less interpersonal competition and less potential for individuals to suffer competitive disadvantage. Although inequality between the richest and the poorest has actually been increasing at the national level since the early 1990s, it may be possible that communities at a lower level, such as neighborhoods, may have experienced a more egalitarian distribution of wealth, leading to less inequality and fewer costly antisocial behaviors as a response to lesser competition. Comparison of different communities since the early 1990s would shed light on what time horizon-relevant cues may influence life history strategies.

Conclusion

The application of life history analysis to the development of risky and antisocial behavior may provide a useful framework for thinking about both ultimate and proximal causes, especially hypothetical causes that may not have been postulated under standard development and learning theories. A consideration of ultimate causes, in particular, forces us to think differently about the meaning of pathology, the function of risk and antisocial behavior, the causes of health problems, and how people respond to difficult early conditions. We hope we have shown that a research program informed by life history analysis is a program that may lead to the discovery of proximal—and thus likely modifiable and preventable—causes.

REFERENCES

- Agnew, R., Brezina, T., Wright, J. P., & Cullen, F. T. (2002). Strain, personality traits, and delinquency: Extending general strain theory. *Criminology*, *40*, 43-72.
- Anderson, G. S. (2007). *Biological influences on criminal behavior*. London: CRC Press.
- Argys, L. M., Rees, D. I., Averett, S. L., & Witoonchart, B. (2006). Birth order and risky adolescent behavior. *Economic Inquiry*, *44*, 215-233.
- Barr, K. N. & Quinsey, V. L. (2004). Is psychopathy a pathology or a life strategy? Implications for social policy. In C. Crawford & C. Salmon (Eds.), *Evolutionary psychology, public policy, and personal decisions* (pp. 293-317). Hillsdale, N.J.: Erlbaum.
- Bingham, C. R. & Crockett, L. J. (1996). Longitudinal adjustment patterns of boys and girls experiencing early, middle, and late sexual intercourse. *Developmental Psychology*, *32*, 647-658.
- Buunk, B. P. (1997). Personality, birth order and attachment styles as related to various types of jealousy. *Personality and Individual Differences*, *23*, 997-1006.
- Blumstein, A., & Wallman, J. (2005). *The Crime Drop in America*. New York: Cambridge University Press.
- Cadoret, R. J., Yates, W. R., Troughton, E., Woodworth, G., & Steward, M. A. (1995). Genetic-environmental interaction in the genesis of aggressivity and conduct disorders. *Archives of General Psychiatry*, *52*, 916-924.
- Campbell, A. (1995). A few good men: Evolutionary psychology and female adolescent aggression. *Ethology and Sociobiology*, *16*, 99-123.
- Caspi, A., McClay, J., Moffitt, T. E., Mill, J., Martin, J., Craig, I. W., Taylor, A., Poulton, R. (2002). Role of genotype in the cycle of violence in maltreated children. *Science*, *297*, 851-854.

- Caspi, A., Sugden, K., Moffitt, T.E., Mill, J., Taylor, A., Craig, I.W., Harrington, H.L., McClay, J., Martin, J., Braithwaite, A., & Poulton, R. (2003). Influence of life stress on depression: moderation by a polymorphism in the 5-HTT gene. *Science*, 301, 386-389.
- Caspi, A., Moffitt, T. E., Silva, P. A., Stouthamer-Loeber, M., Krueger, R. F., & Schmutte, P. S. (1994). Are some people crime-prone? *Criminology*, 32, 163-196.
- Christakis, N. A., & Fowler, J. H. (2007). The spread of obesity in a large social network over 32 years. *The New England Journal of Medicine*, 357, 370-379.
- Clutton-Brock, T. H., & Vincent, A. C. J. (1991). Sexual selection and the potential reproductive rate of males and females. *Nature*, 351, 58-60.
- Daly, M., & Wilson, M. (1988). *Homicide*. Hawthorne, NY: Aldine de Gruyter.
- Daly, M., & Wilson, M. (1990). Killing the competition. *Human Nature*, 1, 83-109.
- Daly, M., & Wilson, M. (2001). Risk taking, intrasexual competition, and homicide. *Nebraska Symposium on Motivation*, 47, 1-36.
- Donovan, J. E., & Jessor, R. (1985). Structure of problem behavior in adolescence and young adulthood. *Journal of Consulting and Clinical Psychology*, 53, 890-904.
- Fonseca, A. C., & Yule, W. (1995). Personality and antisocial behavior in children and adolescents: An enquiry into Eysenck's and Gray's theories. *Journal of Abnormal Child Psychology*, 23, 767-781.
- Gluckman, P. D., & Hanson, M. A. (2004). Living with the past: Evolution, development, and patterns of disease. *Science*, 305, 1733-1736.
- Godfrey, K., Robinson, S., Barker, D. J. P., Osmond, C., & Cox, V. (1996). Maternal nutrition in early and late pregnancy in relation to placental and fetal growth. *British Medical Journal*, 312, 410.

- Gottfredson, M. R., & Hirschi, T. (1990). *A General Theory of Crime*. Stanford: Stanford University Press.
- Eriksson, J. G., Forsen, T., Tuomilehto, J., Osmond, C., Fraser, R. B., & Barker, D. J. P. (2001). Early growth and coronary heart disease in later life: Longitudinal study. *British Medical Journal*, *322*, 949–954.
- Fagot, B. I., Pears, K. C., Capaldi, D. M., Crosby, L., & Leve, C. S. (1998). Becoming an adolescent father: Precursors and parenting. *Developmental Psychology*, *34*, 1209-1219.
- Fonseca, A. C., & Yule, W. (1995). Personality and antisocial behavior in children and adolescents: An enquiry into Eysenck's and Gray's theories. *Journal of Abnormal Child Psychology*, *23*, 767-781.
- Funder, D. C. (2001). *The personality puzzle*. New York: W. W. Norton & Company.
- Gluckman, P. D., Hanson, M. A., & Spencer, H. G. (2004). Living with the past: Evolution, development, and patterns of disease. *Science*, *305*, 1733–1736.
- Godfrey, K., Robinson, S., Barker, D. J. P., Osmond, C., & Cox, V. (1996). Maternal nutrition in early and late pregnancy in relation to placental and fetal growth. *British Medical Journal*, *312*, 410.
- Gray, P. B., Kahlenberg, S. M., Barrett, E. S., Lipson, S. F., & Ellison, P. T. (2002). Marriage and fatherhood are associated with lower testosterone in males. *Evolution and Human Behavior*, *23*, 193-201.
- Harris, G. T., Rice, M. E., & Lalumière, M. L. (2001). Criminal violence: The roles of neurodevelopmental insults, psychopathy, and antisocial parenting. *Criminal Justice and Behavior*, *28*, 402-426.

- Harris, G. T., Rice, M. E., & Quinsey, V. L. (1993). Psychopathy as a taxon: Evidence that psychopaths are a discrete class. *Journal of Consulting and Clinical Psychology, 62*, 387-397.
- Harris, G. T., Skilling, T. A., & Rice, M. E. (2001). The construct of psychopathy. *Crime and Justice: A Review of Research, 28*, 197-264.
- Harvey, P. H., & Zammuto, R. M. Patterns of mortality and age at first reproduction in natural populations of mammals. *Nature, 315*, 319-320.
- Hill, M. H., & Chow, K. (2002). Life-history theory and risky driving. *Addiction, 97*, 401-413.
- Hill, E. M., Ross, L. T., & Low, B. S. (1997). The role of future unpredictability in human risk taking. *Human Nature, 8*, 287-325.
- Jessor, R. (1991). Risk behavior in adolescence: A psychosocial framework for understanding and action. *Journal of Adolescent Health, 12*, 597-605.
- Jessor, R., Costa, F., Jessor, L., & Donovan, J. E. (1983). Time of first intercourse: A prospective study. *Journal of Personality and Social Psychology, 44*, 618-626.
- Kaplan, H., & Gangestad, S. (2005). Life history theory and evolutionary psychology. In D. M. Buss (Ed.), *The Handbook of Evolutionary Psychology* (pp. 68-95). Hoboken, NJ: John Wiley & Sons.
- Lalumière, M. L., Harris, G. T., Quinsey, V. L., & Rice, M. E. (2005). *The causes of rape: Understanding individual differences in male propensity of sexual aggression*. Washington, D.C.: American Psychological Association.
- Lalumière, M. L., Harris, G. T., & Rice, M. E. (2001). Psychopathy and developmental instability. *Evolution and Human Behavior, 22*, 75-92.
- Lalumière, M. L., & Quinsey, V.L. (1996). Sexual deviance, antisociality, mating effort, and the use of sexually coercive behaviors. *Personality and Individual Differences, 21*, 150-175.

- Lalumière, M. L., & Quinsey, V. L. (2000). Good genes, mating effort, and delinquency. *Behavioral and Brain Sciences*, *23*, 608.
- Laub, J. H., & Vaillant, G. E. (2000). Delinquency and mortality: A 50-year follow-up study of 1,000 delinquent and non-delinquent boys. *The American Journal of Psychiatry*, *157*, 96-102.
- Levitt, S. D. (2004). Understanding why crime fell in the 1990s: Four factors that explain the decline and six that do not. *Journal of Economic Perspectives*, *18*, 163-190.
- Low, B. S. (2000). *Why sex matters: A Darwinian look at human behavior*. New Haven, CT: Princeton University Press.
- Lumey, L. H., & Stein, Z. A. (1997). In utero exposure to famine and subsequent fertility: The Dutch famine cohort study. *American Journal of Public Health*, *87*, 1962–1966.
- Lummaa, V. (2003). Early developmental conditions and reproductive success in humans: Downstream effects of prenatal famine, birthweight, and timing of birth. *American Journal of Human Biology*, *15*, 370–379.
- Mason, D. A., & Frick, P. J. (1994). The heritability of antisocial behavior: A meta-analysis of twin and adoption studies. *Journal of Psychopathology and Behavioral Assessment*, *16*, 301-323.
- Mishra, S., & Lalumiere, M. L. (2009). Is the crime drop of the 1990s in Canada and the USA associated with a general decline in risky and health-related behaviors? *Social Science and Medicine*, *68*, 39-48.
- Moffitt, T. E. (1993). Adolescence-limited and life-course-persistent antisocial behavior: A developmental taxonomy. *Psychological Bulletin*, *100*, 674-701.
- Mokdad, A. H., Serdula, M. K., Dietz, W. H., Bowman, B. A., Marks, J. S., Koplan, J. P. (1999). The spread of the obesity epidemic in the United States, 1991-1998. *The Journal of the American Medical Association*, *282*, 1519-1522.

- Nettle, D. (2005). An evolutionary approach to the extraversion continuum. *Evolution and Human Behavior*, 26, 363-373.
- Neugebauer, R., Hoek, H. W., & Susser, E. (1999). Prenatal exposure to wartime famine and development of antisocial personality disorder in early adulthood. *Journal of the American Medical Association*, 282, 455-462.
- Osgood, D. W., Johnston, L. D., O'Malley, P. M., & Bachman, J. G. (1988). The generality of deviance in late adolescence and early adulthood. *American Sociological Review*, 53, 81-93.
- Quimet, M. (2002). Explaining the American and Canadian crime "drop" in the 1990's. *Canadian Journal of Criminology*, 33, 33-50.
- Patten, S. B. (2002). Progress against major depression in Canada. *Canadian Journal of Psychiatry*, 47, 775-780.
- Phillips, D. I. W., Handelsman, D. I., Eriksson, J. G., Forsen, T., Osmond, C., Barker, D. J. P., et al. (2001). Prenatal growth and subsequent marital status: Longitudinal study. *British Medical Journal*, 322, 771.
- Phillips, D. P., Ruth, T. E., & Wagner, L. M. (1993). Psychology and survival. *The Lancet*, 342, 1142-1145.
- Quinsey, V. L., Book, A., & Lalumière, M. L. (2001). A factor analysis of traits related to individual differences in antisocial behavior. *Criminal Justice and Behavior*, 28, 522-536.
- Quinsey, V. L., Skilling, T. A., Lalumière, M. L., & Craig, W. (2004). *Juvenile delinquency: Understanding individual differences*. Washington, DC: American Psychological Association.
- Rogers, A. R. (1994). Evolution of time preference by natural selection. *American Economic Review*, 84, 460-481.

- Ross, L., & Hill, E. M. (2002). Childhood unpredictability, schemas for future unpredictability, and risk taking. *Social Behavior and Personality, 30*, 453-474.
- Rutter, M. (1997). Antisocial behavior: Developmental psychopathology perspectives. In D. Stoff, J. Breiling, & J. Maser (Eds.), *Handbook of antisocial behavior*. New York: Wiley.
- Saroglou, V., & Fiase, L. (2003). Birth order, personality, and religion: A study among adults from a three-sibling family. *Personality and Individual Differences, 35*, 19-29.
- Serbin, L. A., Cooperman, J. M., Peters, P. L., Lehoux, P. M., Stack, D. M., & Schwartzman, A. E. (1998). Intergenerational transfer of psychosocial risk in women with childhood histories of aggression, withdrawal, or aggression and withdrawal. *Developmental Psychology, 34*, 1246-1262.
- Schmitt, D. P. (2005). Sociosexuality from Argentina to Zimbabwe: A 48-nation study of sex, culture, and strategies of human mating. *Behavioral and Brain Sciences, 28*, 247-311.
- Skilling, T. A., Quinsey, V. L., & Craig, W. (2001). Evidence of a taxon underlying serious antisocial behavior in boys. *Criminal Justice and Behavior, 28*, 450-470.
- Stearns, S. C. (1992). *The evolution of life histories*. Oxford: Oxford University Press.
- Stouthamer-Loeber, M., & Wei, E. H. (1998). The precursors of young fatherhood and its effect on delinquency of teenage males. *Journal of Adolescent Health, 22*, 56-65.
- Suloway, F. J. (1997). *Born to rebel: Birth order, family dynamics, and creative lives*. New York: Pantheon Books.
- Trivers, R. L. (1972). Parental investment and sexual selection. In B. Campbell (Ed.), *Sexual selection and the descent of man, 1871-1971* (pp. 136-179). Chicago, IL: Aldine.
- White, H. R., Bates, M. E., & Buyske, S. (2001). Adolescence-limited versus persistent delinquency: Extending Moffitt's hypothesis into adulthood. *Journal of Abnormal Psychology, 110*, 600-609.

- Wilson, M., & Daly, M. (1985). Competitiveness, risk taking, and violence: The young male syndrome. *Ethology and Sociobiology*, 6, 59–73.
- Wilson, M., & Daly, M. (1992). Who kills whom in spouse killings? On the exceptional sex ratio of spousal homicides in the United States. *Criminology*, 30, 189–215.
- Wilson, M., & Daly, M. (1997). Life expectancy, economic inequality, homicide and reproductive timing in Chicago neighbourhoods. *British Medical Journal*, 314, 1271–1274.
- Wolf, M., Sander van Doorn, G., Leimar, O., Weissing, F. J. (2007). Life history trade-offs favour the evolution of animal personalities. *Nature*, 447, 581-585.
- Zahavi, A., & Zahavi, A. (1997). *The handicap principle: A missing piece of Darwin's puzzle*. New York: Oxford University Press.