Below is the unedited preprint (not a quotable final draft) of:
Mealey, L. (1995). The sociobiology of sociopathy: An integrated evolutionary model. *Behavioral and Brain Sciences* 18 (3): 523-599.
The final published draft of the target article, commentaries and Author's Response are currently available only in paper.

THE SOCIOBIOLOGY OF SOCIOPATHY: AN INTEGRATED EVOLUTIONARY MODEL

Linda Mealey
Department of Psychology
College of St. Benedict
St. Joseph, MN 56374

Keywords

sociobiology, sociopathy, psychopathy, antisocial personality, evolution, criminal behavior, game theory, emotion, moral development, facultative strategies

Abstract

Sociopaths are "outstanding" members of society in two senses: politically, they command

attention because of the inordinate amount of crime they commit, and psychologically, they elicit fascination because most of us cannot fathom the cold, detached way they repeatedly harm and manipulate others. Proximate explanations from behavior genetics, child development, personality theory, learning theory, and social psychology describe a complex interaction of genetic and physiological risk factors with demographic and micro-environmental variables that predispose a portion of the population to chronic antisocial behavior. Recent evolutionary and game theoretic models have tried to present an ultimate explanation of sociopathy as the expression of a frequency-dependent life history strategy which is selected, in dynamic equilibrium, in response to certain varying environmental circumstances. This target article tries to integrate the proximate, developmental models with the ultimate, evolutionary ones. Two developmentally different etiologies of sociopathy emerge from two different evolutionary mechanisms. Social strategies for minimizing the incidence of sociopathic behavior in modern society should consider the two different etiologies and the factors which contribute to them.

Sociopaths, who comprise only 3-4% of the male population and less than 1% of the female population (Strauss & Lahey 1984, Davison and Neale 1994, Robins, Tipp & Przybeck 1991), are thought to account for approximately 20% of the United States' prison population (Hare 1993) and between 33% and 80% of the population of chronic criminal offenders (Mednick, Kirkegaard-Sorensen, Hutchings, Knop, Rosenberg & Schulsinger 1977, Hare 1980, Harpending & Sobus 1987). Furthermore, whereas the "typical" U.S. burglar is estimated to have committed a median five crimes per year before being apprehended, chronic offenders- those most likely to be sociopaths- report committing upward of fifty crimes per annum and sometimes as many as two or three hundred (Blumstein & Cohen 1987). Collectively, these individuals are thought to account for over 50% of all crimes in the U.S. (Loeber 1982; Mednick, Gabrielli & Hutchings 1987, Hare 1993).

Whether criminal or not, sociopaths typically exhibit what is generally considered to be irresponsible and unreliable behavior; their attributes include egocentrism, an inability to form lasting personal commitments and a marked degree of impulsivity. Underlying a superficial veneer of sociability and charm, sociopaths are characterized by a deficit of the social emotions (love, shame, guilt, empathy, and remorse). On the other hand, they are not intellectually handicapped, and are often able to deceive and manipulate others through elaborate scams and ruses including fraud, bigamy, embezzlement, and other crimes which rely on the trust and cooperation of others. The sociopath is "aware of the discrepancy between his behavior and societal expectations, but he seems to be neither guided by the possibility of such a discrepancy, nor disturbed by its occurrence" (Widom 1976a, p 614). This cold- hearted and selfish approach to human interaction at one time garnered for sociopathy the moniker "moral insanity" (McCord 1983, Davison & Neale 1990).

Sociopaths are also sometimes known as psychopaths or antisocial personalities. Unfortunately, the literature reflects varied uses of these three terms (Hare 1970, Feldman 1977, McCord 1983, Wolf 1987, Eysenck 1987). Some authors use one or another term as a categorical label, as in psychiatric diagnosis or in defining distinct personality "types"; an example is the "antisocial personality" disorder described in the Diagnostic and Statistical Manual of the American Psychiatric Association (1987). Other authors use the terms to refer to individuals who exhibit, to a large

degree, a set of behaviors or personality attributes which are found in a continuous, normal distribution among the population at large; an example of such usage is "sociopathy" as defined by high scores on all three scales of the Eysenck Personality Questionnaire- extraversion, neuroticism, and psychoticism (Eysenck 1977, 1987).

Other authors make a distinction between "simple" and "hostile" (Allen, Lindner, Goldman & Dinitz 1971), or "primary" and "secondary" psychopaths or sociopaths (Fagan & Lira 1980), reserving the term "simple" or "primary" for those individuals characterized by a complete lack of the social emotions; individuals who exhibit antisocial behavior in the absence of this emotional deficit are called "hostile" or "secondary" psychopaths or sociopaths, or even "pseudopsychopaths" (McCord 1983). Other authors also make a typological distinction, using the term "psychopath" to refer to anti-social individuals who are of relatively high intelligence and middle to upper socio-economic status and who express their aberrant behavior in impressive and sometimes socially skilled behavior which may or may not be criminal, such as insider trading on the stock market (e.g. Bartol 1984). These authors reserve the term "sociopath" for those antisocial persons who have relatively low intelligence and social skills or who come from the lower socio- economic stratum and express their antisocial nature in the repeated commission of violent crime or crimes of property.

I will begin by using the single term "sociopath" inclusively. However, by the end of the paper I hope to convince the reader that the distinction between primary and secondary sociopaths is an important one because there are two different etiological paths to sociopathy, with differing implications for prevention and treatment.

My basic premise is that sociopaths are designed for the successful execution of social deception and that they are the product of evolutionary pressures which, through a complex interaction of environmental and genetic factors, lead some individuals to pursue a life history strategy of manipulative and predatory social interactions. On the basis of game theoretic models this strategy is to be expected in the population at relatively low frequencies in a demographic pattern consistent with what we see in contemporary societies. It is also expected to appear preferentially under certain social, environmental, and developmental circumstances which I hope to delineate.

In an effort to present an integrated model, I will use a variety of arguments and data from the literature in sociobiology, game theory, behavior genetics, child psychology, personality theory, learning theory, and social psychology. I will argue that: (1) there is a genetic predisposition underlying sociopathy which is normally distributed in the population; (2) as the result of selection to fill a small, frequency-dependent, evolutionary niche, a small, fixed percentage of individuals- those at the extreme of this continuum- will be deemed "morally insane" in any culture; (3) a variable percentage of individuals who are less extreme on the continuum will sometimes, in response to environmental conditions during their early development, pursue a life-history strategy that is similar to that of their "morally insane" colleagues; and (4) a subclinical manifestation of this underlying genetic continuum is evident in many of us, becoming apparent only at those times when immediate environmental circumstances make an antisocial strategy more profitable than a prosocial one.

1. The Model:

1.1 The evolutionary role of emotion

As the presenting, almost defining characteristic of sociopaths is their apparent lack of sincere social emotions in the absence of any other deficit such as mental retardation or autism (Hare 1980), it seems appropriate to begin with an examination of some current models of emotion.

Plutchik (1980) put forth an evolutionary model of emotion in which he posits eight basic or "primary" emotions (such as fear, anger and disgust) which predate human evolution and are clearly related to survival (1). According to the model, everyone (including sociopaths) experiences these primary emotions, which are cross- cultural and instinctively programmed. "Secondary" and "tertiary" emotions, on the other hand, are more complex, specifically human, cognitive interpretations of varying combinations and intensities of the primary emotions (2). Because they are partly dependent upon learning and socialization, secondary emotions, unlike primary emotions, can vary across individuals and cultures. Thus, the social emotions (such as shame, guilt, sympathy, and love), which are secondary emotions, can be expected to exhibit greater variability.

Griffiths (1990) points out that most of the important features of emotion argue for an evolutionary design: emotions are generally involuntary, and are often "intrusive" (p 176); they cause rapid, coordinated changes in the skeletal/muscular system, facial expression, vocalization, and the autonomic nervous system; they are to a large extent innate, or at least "prepared" (see Seligman 1971); and they do not seem as responsive to new information about the environment as do beliefs. Griffiths argues that emotional responses to stimuli (he calls them "affect-programs" after Ekman 1971) are informationally-encapsulated, complex, organized reflexes, which are "adaptive responses to events that have a particular ecological significance for the organism" (p 183). That is, they are likely to be highly specialized reflexive responses elicited spontaneously by the presence of certain critical stimuli, regardless of the presence of possible mediating contextual cues or cognitive assessments.

Nesse (1990) likewise posits an evolutionary model in which emotions are: "specialized modes of operation, shaped by natural selection, to adjust the physiological, psychological, and behavioral parameters of the organism in ways that increase its capacity and tendency to respond to the threats and opportunities characteristic of specific kinds of situations" (p 268). He attributes a particular role to the social emotions, a role he couches in the language of reciprocity and game theory. Presenting a classic Prisoner's Dilemma matrix, he notes which emotions would be likely to be associated with the outcomes of each of the four cells: when both players cooperate, they experience friendship, love, obligation, or pride; when both cheat or defect, they feel rejection and hatred; when one player cooperates and the other defects, the cooperator feels anger while the defector feels anxiety and guilt.

Given that these emotions are experienced AFTER a behavioral choice is made, how could they possibly be adaptive? Nesse's explanation is based on the models of Frank (1988) and Hirshleifer

(1987), which posit that ex post facto feelings lead to behavioral expressions which are read by others and can be used to judge a person's likely future behavior. To the extent that the phenomenological experience of emotion serves to direct a person's future behavior (positive emotions reinforce the preceding behavior while negative emotions punish and, therefore, discourage repetition of the behavior), the outward expression of emotion will serve as a reliable indicator to others as to how a person is likely to behave in the future. Indeed, that there exist reliable, uncontrollable outward expressions of these inner experiences at all suggests that the expressions must be serving a communicative function (Dimberg 1988).

But if, as in the case of the Prisoner's Dilemma, the most rational strategy is to be selfish and defect, why should the positive (reinforcing) emotions follow mutual cooperation rather than the seemingly more adaptive behavior of defection? Here lies the role of reputation. If a player is known, through direct experience or social reputation, always to play the "rational" move and defect, then in a group where repeated interactions occur and individuals are free to form their own associations, no rational player will choose to play with the known defector, who will thus no longer be provided the opportunity for any kind of gain-- cooperative or exploitative. To avoid this social "shunning" based on reputation (3) and hence, to be able to profit at all from long-term social interaction, players must be able to build a reputation for cooperation. To do so, most of them must in fact, reliably cooperate, despite the fact that cooperation is not the "rational" choice for the short-term. Frank and Hirshleifer suggest that the social emotions have thus evolved as "commitment devices" (Frank) or "guarantors of threats and promises" (Hirshleifer)- they cause positive or negative feelings that act as reinforces or punishers, molding our behavior in a way that is not economically rational for the short-term but profitable and adaptive in situations where encounters are frequent and reputation is important.

Frank presents data from a variety of studies suggesting that people do often behave irrationally (emotionally) in many dyadic and triadic interactions- sometimes even when it is clear that there will be no future opportunity to interact again with the same partner. These studies support the suggestion that in social situations, one's emotional response will often prevail over logic, and that the reason is that such behavior is, in the long-term, adaptive under conditions when one's reputation can follow or precede one. (See also Farrington 1982, Caldwell 1986, Anawalt 1986, Axelrod 1986, Alexander 1987, Irons 1991, Dugatkin 1992, and Frank, Gilovich & Regan 1993 for more on the role of reputation.)

According to these models, emotion serves both as a motivator of adaptive behavior and as a type of communication: the phenomenological and physiological experience of emotion rewards, punishes, and motivates the individual toward or away from certain types of stimuli and social interactions, while the outward manifestations of emotion communicate probable intentions to others.

Once such reliable communicative mechanisms have evolved, however, when communication of intent precedes interaction, or when one's reputation precedes one, the conditions of interaction become vulnerable to deception through false signalling or advance deployment of enhanced reputation (e.g. Caldwell 1986). Those who use a deceptive strategy and defect after signalling cooperation are usually referred to as "cheaters" and, as many authors have pointed out (e.g.

Trivers 1971, Alexander 1987, Dennett 1988, Quiatt 1988), the presence of cheaters can lead to a coevolutionary "arms race" in which potential interactors evolve finely tuned sensitivities to likely evidence or cues of deception, while potential cheaters evolve equally fine-tuned abilities to hide those cues (4).

As long as evolutionary pressures for emotions to be reliable communication and commitment devices leading to long-term, cooperative strategies coexist with counter-pressures for cheating, deception, and "rational" short-term selfishness, a mixture of phenotypes will result, such that some sort of statistical equilibrium will be approached. Cheating should thus be expected to be maintained as a low-level, frequency-dependent strategy, in dynamic equilibrium with changes in the environment which exist as counter-pressures against its success. This type of dynamic process has been modelled extensively by evolutionary biologists who use game theory- the topic I turn to next.

1.2 Game theory and evolutionarily stable strategies

Game theory was first introduced into the literature of evolutionary biology by Richard Lewontin (1961), who applied it to the analysis of speciation and extinction events. It was later taken up in earnest by John Maynard Smith and colleagues (eg. Maynard Smith & Price 1973, Maynard Smith 1974, Maynard Smith 1978) who used it to model contests between individuals. Maynard Smith showed that the "evolutionarily stable strategies" (ESSs) that could emerge in such contests included individuals' use of mixed, as well as fixed, strategies. Alexander (1986) writes "It would be the worst of all strategies to enter the competition and cooperativeness of social life, in which others are prepared to alter their responses, with only preprogrammed behaviors" (p 171).

The maintenance of mixed ESSs in a population can theoretically be accomplished in at least four ways (after Buss 1991): (1) through genetically based, individual differences in the use of single strategies (such that each individual, in direct relation to genotype, consistently uses the same strategy in every situation); (2) through statistical use by all individuals of a species-wide, genetically fixed, optimum mix of strategies (whereby every individual uses the same statistical mix of strategies, but does so randomly and unpredictably in relation to the situation); (3) through species-wide use by all individuals of a mix of environmentally-contingent strategies (such that every individual uses every strategy, but predictably uses each according to circumstances); (4) through the developmentally-contingent use of single strategies by individuals (such that each individual has an initial potential to utilize every type of strategy, but, after exposure to certain environmental stimuli in the course of development, is phenotypically canalized from that point on, to use only a fraction of the possible strategies). To Buss's fourth mechanism can be added a differential effect of genotype on developmental response to the environment, thus adding another mechanism: (5) genetically based individual differences in response to the environment, resulting in differential use by individuals of environmentally-contingent strategies (such that individuals of differing genotypes respond differently to environmental stimuli in the course of development and are thus canalized to produce a different set of limited strategies given the same, later conditions).

Following the leads of Kenrick, Dantchik, & MacFarlane (1983), MacMillan & Kofoed (1984), Kofoed

& MacMillan (1986), Harpending & Sobus (1987), and Cohen & Machalek (1988), I would like to suggest an evolutionary model in which sociopaths are a type of cheater- defector in our society of mixed-strategy interactionists. I will be arguing that sociopathy appears in two forms, according to mechanisms 1 and 5 (above), one version that is the outcome of frequency-dependent, genetically based individual differences in use of a single (antisocial) strategy (which I will refer to as "primary sociopathy") and another that is the outcome of individual differences in developmental response to the environment, resulting in the differential use of cooperative or deceptive social strategies (which I will refer to as "secondary sociopathy"). To support this model, I will provide evidence that there are predictable differences in the use of cheating strategies across individuals, across environments, and within individuals across environments; this evidence will integrate findings from the fields of behavior genetics, child psychology, personality theory, learning theory, and social psychology.

2. The Evidence:

2.1 Behavior genetics

For decades, evidence has been accumulating that both criminality and sociopathy have a substantial heritable component, and that this heritable component is to a large extent overlapping; that is, the heritable attributes that contribute to criminal behavior seem to be the same as those which contribute to sociopathy. While there is no one-to-one correspondence between those individuals identified as criminals and those identified as sociopaths, (indeed, the definitions of both vary from study to study), it is clear that these two sets of individuals share a variety of characteristics and that a subset of individuals share both labels (Moffitt 1987, Ellis 1990b, Robins, Tipp & Przybeck 1991, Gottesman & Goldsmith 1993).

2.1.1 Studies of criminal behavior

The behavior-genetic literature on criminal behavior suggests a substantial effect of heredity across several cultures (5). Christiansen (1977a&b), Wilson & Hernnstein (1985), Cloninger & Gottesman (1987), Eysenck & Gudjonsson (1989), and Raine (1993) review studies of twins which, taken as a whole, suggest a heritability of approximately .60 for repeated commission of crimes of property. [Heritability is a measure of the proportion of variance of a trait, within a population, that can be explained by genetic variability within that population; it thus, ranges theoretically from 0.00 to 1.00, with the remaining population variance explained by variance in individuals' environment.] Adoption studies (reviewed in Hutchings & Mednick 1977, Mednick & Finello 1983, Wilson & Hernnstein 1985, Cloninger & Gottesman 1987, Mednick, Gabrielli & Hutchings, 1987, Eysenck & Gudjonsson 1989, and Raine 1993) arrive at a similar conclusion (but see footnote 6).

Several adoption studies were also able to demonstrate significant interactive effects not discriminable using the twin methodology. Crowe (1972, 1974), Cadoret, Cain & Crowe (1983), Mednick & Finello (1983), and Mednick, Gabrielli & Hutchings (1984) report significant gene-environment interactions, such that adoptive children with both a genetic risk (criminal biological parent) and an environmental risk (criminality, psychiatric illness, or other severe behavioral

disturbance in an adoptive parent), have a far greater risk of expressing criminal behavior than do adoptees with no such risk or only one risk factor, and that increased risk is more than simply an additive effect of both risk factors. In addition, Baker, Mack, Moffitt & Mednick (1989) report an interaction based on sex, in which females are more likely to transmit a genetic risk to their offspring than are males.

2.1.2 Studies of sociopathy

The literature on sociopathy suggests a pattern similar to that on criminality: Schulsinger (1972/77), Cadoret (1978), Crowe (1974), Cadoret & Cain (1980), Cadoret, Troughton & O'Gorman (1987), and Cadoret & Stewart (1991) demonstrate a substantial heritability to sociopathy; Cadoret, Troughton, Bagford & Woodworth (1990) found a gene-environment interaction similar to the one found for criminal behavior; and Cadoret & Cain (1980, 1981) found an interaction involving sex, such that male adoptees were more sensitive to the influence of environmental risk factors than were female adoptees.

The similarity of the patterns described in these two domains is to some extent due to the fact that the diagnosis of sociopathy is often based in part upon the existence of criminal activity in a subject's life history. On the other hand, consider the following: (1) criminal behavior and other aspects of sociopathy are correlated (Eysenck 1977, Morrison & Stewart 1971, Cadoret, Cain & Crowe 1983, Wolf 1987, Cloninger & Gottesman 1987, Patterson, DeBaryshe & Ramsey 1989); (2) criminal activity is found with increased frequency among the adopted-away children of sociopaths (Moffitt 1987); and (3) sociopathy is found with increased frequency among the adopted-away children of criminals (Cadoret & Stewart 1991, Cadoret, Troughton, Bagford & Woodworth 1990). This all suggests that the criminality and sociopathy may share some common heritable factors. For this reason, early researchers and clinicians (e.g. Schulsinger 1972/77 and Cadoret 1978) suggested using the term "antisocial spectrum" to incorporate a variety of phenotypes that are considered likely to be manifestations of closely related genotypes (7). The existence of this spectrum suggests a multifactorial, probably polygenic, basis for sociopathy and its related phenotypes. Using an analogy to "g", which is often used to refer to the common factor underlying the positive correlations between various aptitude measures, Rowe (1986) and Rowe and Rodgers (1989) use "d" to refer to the common factor underlying the various expressions of social deviance.

2.1.3 Sex differences and the "two-threshold" model

Cloninger put forth a "two threshold" polygenic model to account for both the sex difference in sociopathy and its spectral nature (Cloninger, Reich & Guze 1975; Cloninger, Christiansen, Reich & Gottesman 1978). According to the model, sociopaths are individuals on the extreme end of a normal distribution whose genetic component is (1) polygenic and (2) to a large degree, sex-limited. [Sex- limited genes, not to be confused with sex-linked genes, are those which are located on the autosomes of both sexes but which are triggered into expression only within the chemical/ hormonal microenvironment of one sex or the other. Common examples include beard and mustache growth in men, and breast and hip development in women.] If a large number of the

many genes underlying sociopathy are triggered by testosterone or some other androgen, many more men than women will pass the threshold of the required number of active genes necessary for its outward expression.

According to the two-threshold model, those females who do express the trait must have a greater overall "dose" or "genetic load" (i.e, they are further out in the extreme of the normal distribution of genotypes) than most of the males who express the trait. This proposition has been supported by data showing that in addition to the greater overall risk for males as opposed to females, there is a also greater risk for the offspring (and other relatives) of female sociopaths as compared to the offspring (and other relatives) of male sociopaths. This phenomenon cannot be accounted for either by sex-linkage or by the differential experiences of the sexes.

Besides providing a proximate explanation for the greater incidence of male sociopathy and crime, the two-threshold model also explains on a proximate level the finding that males are more susceptible to environmental influences than females. Somewhat paradoxically, while a male will express sociopathy at a lower "genetic dose" than is required for expression in a female, the heritability of the trait is greater for females, meaning that the environmental component of the variance is greater for males (8).

The two-threshold model thus explains in a proximate sense what sociobiologists would predict from a more ultimate perspective. The fact that males are more susceptible than females to the environmental conditions of their early years fits well with sociobiological theory, in that the greater variance in male reproductive capacity makes their "choice" of life strategy somewhat more risky and therefore more subject to selective pressures (Symons 1979, Buss 1988, Mealey & Segal 1993). Sociobiological reasoning thus leads to the postulate that males should be more sensitive to environmental cues that (1) trigger environmentally-contingent or developmentally-canalized life history strategies or (2) are stimuli for which genetically based individual differences in response thresholds have evolved. (Recall mechanisms 3, 4 & 5 for the maintenance of mixed-strategy ESSs in a population.)

If the evolutionary models apply then when, specifically, would sociopathy be the best available strategy? and what would be the environmental cues which, especially for boys, would trigger its development? To answer these questions, I turn to the child psychology literature, with a special focus on studies of life history strategies, delinquency, and moral development.

2.2 Child psychology

2.2.1 Life history strategies

Beginning with Draper and Harpending's now-classic 1982 paper on the relationship between father absence and reproductive strategy in adolescents, there has been an increasing effort to view development as the unfolding of a particular life history strategy in response to evolutionarily relevant environmental cues (Draper & Harpending 1982, Surbey 1987, MacDonald 1988, Crawford & Anderson 1989, Draper & Belsky 1990, Gangestad & Simpson 1990, Mealey 1990, Belsky,

Steinberg & Draper 1991, Moffitt, Caspi, Belsky & Silva 1992, Mealey & Segal 1993). These models are based either implicitly or explicitly on the assumption that there are multiple evolutionarily adaptive strategies and that the optimal strategy for particular individuals will depend both upon their genotype and their local environment. To date, most developmental life history models address variance in reproductive strategies (for example, age at menarche or first sexual activity, number of mating partners, and amount of parental investment), but this type of modeling can also be applied to the adoption of social strategies such as cheating versus cooperation.

Perhaps the most oft-mentioned factor suggested as being relevant to the development of a cheating strategy, especially in males, is being competitively disadvantaged with respect to the ability to obtain resources and mating opportunities. Theoretically, those individuals who are the least likely to outcompete other males in a status hierarchy, or to achieve mates through female choice, are the ones most likely to adopt a cheating strategy. (See eg. Thornhill & Alcock 1983, Daly & Wilson 1983 and Gould & Gould 1989 re: non-human animals, and Symons 1979, Kenrick et al 1983, MacMillan & Kofoed 1984, Kofoed & MacMillan 1986, Cohen & Machalek 1988, Tooke & Camire 1991 and Thornhill & Thornhill 1992 re: humans). In humans, competitive disadvantage could be related to a variety of factors, including age, health, physical attractiveness, intelligence, socioeconomic status, and social skills.

Criminal behavior, one kind of cheating strategy, is clearly related to these factors. Of the seven cross-cultural correlates of crime reported by Ellis (1988), three -large number of siblings, low socio-economic status, and urban residency- seem directly related to resource competition; the four others -youth, maleness, being of black racial heritage, and coming from a single parent (or otherwise disrupted) family background- can be plausibly argued to be related to competition as well (see eg., Kenrick et al 1983, Wilson & Hernnstein 1985, Ellis 1988, and Cohen & Machalek 1988). Empirical data suggest that deficits in competitive ability due to psychosis (Hodgins 1992), intellectual handicap (Moffitt & Silva 1988, Quay 1990a, Stattin & Magnusson 1991, Hodgins 1992), or poor social skills (Hogan & Jones 1983, Simonian, Tarnowski & Gibbs 1991, Garmezy 1991, Dishion, Patterson, Stoolmiller & Skinner 1991) are also associated with criminal behavior. Likewise, the competitive advantages conferred by high intelligence (Hirschi & Hindenlang 1977, Wilson & Herrnstein 1985, Silverton 1988, Kandel, Mednick, Kirkegaard-Sorensen, Hutchings, Knop, Rosenberg, & Schulsinger 1988, White, Moffitt & Silva 1989) or consistent external support (Garmezy 1991), can mitigate the development of criminal or delinquent behavior in those who are otherwise at high risk.

Rape and spouse abuse, other forms of cheating strategy, appear to be related to the same life history factors as crime (Ellis 1989 & 1991a, Malamuth, Sockloskie, Koss & Tanaka 1991, Thornhill & Thornhill 1992). In fact, Huesmann, Eron, Lefkowitz & Walder (1984), Rowe and Rodgers (1989) and Rowe, Rodgers, Meseck-Bushey & St. John (1989) present evidence that there is a common genetic component to the expression of sexual and nonsexual antisocial behavior. Given the overlaps between rape, battering, and criminality in terms of life history circumstances, genetics, and apparent inability to empathize with one's victim, it would be parsimonious to postulate that they might be expressions of a single sociopathy spectrum. As such, these antisocial behaviors could be considered to be genetically influenced, developmentally- and environmentally-contingent cheating strategies, utilized when a male finds himself at a competitive disadvantage (see also

Figueredo & McCloskey nd).

Along these lines, MacMillan and Kofoed (1984) presented a model of male sociopathy based on the premise that sexual opportunism and manipulation are the key features driving both the individual sociopath and the evolution of sociopathy. Harpending and Sobus (1987) posited a similar basis for the evolution and behavioral manifestations of Briquet's Hysteria in women, suggesting that this syndrome of promiscuity, fatalistic dependency, and attention- getting, is the female analogue, and homologue, of male sociopathy.

2.2.2 Delinquency

Childhood delinquency is a common precursor of adolescent delinquency and adult criminal and sociopathic behavior (Robins & Wish 1977, Loeber 1982, Loeber & Dishion 1983, Loeber & Stouthamer- Loeber 1987, Patterson et al 1989); in fact, childhood conduct disorder is a prerequisite finding in order to diagnose adult antisocial personality (APA 1987). Importantly, just as in the literature on adults, a distinction is frequently made between two subtypes of conduct disorder in children: Lytton (1990), for example, distinguishes between "solitary aggressive type" and "group type"; Loeber (1990) distinguishes between "versatiles" and "property offenders"; and Strauss & Lahey (1984) distinguish between "unsocialized" and "socialized". I will argue that these subtypes are precursors of two types of adulthood antisociality (with "solitary aggressive", "versatile", or "unsocialized" types leading to primary sociopathy and "group", "property offender", or "socialized" types presaging secondary sociopathy). I will also argue that the differing life history patterns of these two types of delinquents are reflections of two different evolutionary mechanisms for maintaining ESSs in a population- mechanism 1 and mechanism 5, respectively (see Section 1.2).

Although more than half of juvenile delinquents outgrow their behavior (Lytton 1990, Robins, Tipp & Przybeck 1991, Gottesman & Goldsmith 1993), the frequency of juvenile antisocial behaviors is still the best predictor of adult antisocial behavior, and the earlier such behavior appears, the more likely it is to be persistent (Farrington 1986, Loeber & Stouthamer-Loeber 1987, Lytton 1990, Stattin & Magnusson 1991, White, Moffitt, Earls, Robins & 2Silva 1990, and Robins, Tipp & Przybeck 1991). The mean age at which adult sociopaths exhibited their first significant symptom is between eight and nine years; 80% of all sociopaths exhibited their first symptom by age eleven (Robins, Tipp & Przybeck 1991); over two-thirds of eventual chronic offenders are already distinuishable from other children by kindergarten (Loeber & Stouthamer-Loeber 1987). Thus, by evaluating the environments of juvenile delinquents, we can fairly reliably reconstruct the childhood environments of adult sociopaths.

Studies of this sort consistently implicate several relevant environmental factors correlated with boyhood antisocial behavior: inconsistent discipline, parental use of punishment as opposed to rewards, disrupted family life (especially father absence, family violence, alcoholic parent, or mentally ill parent), and low socioeconomic status (Cadoret 1982, Loeber & Dishion 1983, van Dusen, Mednick, Gabrielli & Hutchings 1983, Wilson & Hernnstein 1985, Farrington 1986 & 1989, McCord 1986, Silverton 1988, & Patterson et al 1989, Lytton 1990, Offord, Boyle & Racine 1991).

Besides the fact that all of these variables are more likely to exist when one or the other parent is sociopathic, and the child hence, genetically predisposed to sociopathy, behaviorist and social learning models of the dynamics of early parent-child interactions (to be described in Section 2.4.2) have been fairly convincing in explaining how antisocial behaviors can be reinforced under such living conditions.

Interestingly, in line with the postulate that cheating strategies would be most likely to be used by individuals who are at a competitive disadvantage, McGarvey, Gabrielli, Bentler & Mednick (1981), Loeber & Dishion (1983), Hogan & Jones (1983), Magid & McKelvie (1987), Kandel et al (1988), Hartup (1989), and Patterson et al (1989) all suggest that the common way in which high risk familial and environmental factors contribute to delinquency, is by handicapping children with respect to their peers, in terms of social skills, academic ability, and self-esteem. This noncompetitiveness then leads disadvantaged youths to seek alternative peer groups and social environments in which they can effectively compete (Dishion et al 1991). If they are successful in the estimation of their new peer group, adopting this strategy may lead to "local prestige" (Rowe, personal communication) sufficient to commandeer resources, deter rivals, or gain sexual opportunities within the new referent group (see also Moffitt 1993). In other words, competitively disadvantaged youth may be trying to "make the best of a bad job" (Dawkins 1980, Cohen & Machalek 1988), by seeking a social environment in which they may be less handicapped or even superior.

The correlates of delinquency in girls are essentially the same as those for boys, although delinquency is less common in girls (Robins 1986, Lytton 1990, White, Moffitt, Earls, Robins & Silva 1990). Caspi, Lynam, Moffitt & Silva (1993) found that delinquency in girls, as in boys, is arrived at via two different developmental trajectories. One pattern includes a history of antisocial behavior throughout childhood and a tendency to seek out delinquent peers; based on previous research (White, Moffitt, Earls, Robins & Silva 1990), this life history trajectory is thought to lead to persisten antisocial behavior in adulthood. The second pattern is exhibited by girls who have few behavior problems in childhood, but who, upon reaching menarche, exhibit more and more frequent antisocial behaviors. The antisocial behavior of girls who show this latter pattern is thought to be more a product of environmental influence than that of girls who follow the first trajectory, as this pattern is selectively exhibited by girls who (a) have an early age of menarche and (b) are in coeducational school settings. These girls, upon reaching early sexual maturity, start associating with older male peers and exhibiting some of the antisocial behaviors that are more often displayed by older boys than their younger female peers (see Maccoby 1986); girls who follow this trajectory are expected to "outgrow" their antisocial activites. Although the two subsets of delinquent girls would be difficult to differentiate using a cross- sectional methodology, in accordance with the model presented here, Caspi et al. consider their differing developmental histories to be of theoretical importance for longitudinal studies and of practical importance for early intervention. (See Moffitt 1993 for a similar scenario regarding boys.)

2.2.3 Moral development

Like the tendency to engage in antisocial behavior, an individual's tendency to engage in prosocial behavior seems to be fairly stable from an early age (Rushton 1982). Yet the development of

individual differences in behavior has not been as well studied as the presumably universal stages of cognition that underlie changes in moral reasoning. Kohlberg's (1964) stage model of moral development, for example, ties advances in moral thinking to advances in reasoning ability and attributes individual differences largely to differences in cognitive ability. While it is clear that both moral reasoning and moral behavior covary with age (Rushton 1982) and may do so in a manner consistent with some evolutionists' thinking (e.g. Alexander 1987), cognitive models alone cannot explain the absence of moral behavior in sociopaths, who are not intellectually handicapped with respect to the normal population.

Other developmental models posit the emergence of empathy and the other social emotions as prerequisites for moral behavior (see Zahn- Waxler & Kochanska 1988 for a review). Even very young children, it seems, are in a sense biologically prepared to learn moral behavior, in that they are selectively attentive to emotions- especially distress-

in others (Hoffman 1978, Zahn-Waxler & Radke-Yarrow 1982, Radke- Yarrow & Zahn-Waxler 1986). Hoffman (1975, 1977, 1982), for example, suggests that the observation of distress in others triggers an innate "empathic distress" response in the child, even before the child has the cognitive capacity to differentiate "other" from "self". Accordingly, any instrumental behavior which serves to reduce the distress of the other also serves to relieve the vicarious distress of the child. Thus, very young children might learn to exhibit prosocial behavior long before they are able to conceptualize its effect on others.

In Hoffman's model, the motivation behind early prosocial behavior is the (egocentric) need to reduce one's own aversive feelings of arousal and distress. As the child ages, the range of cues and stimuli which can trigger the vicarious distress increase through both classical and operant conditioning. Eventually, when the child develops the cognitive ability to "role play" or take on another's perspective, empathic distress turns to "sympathetic distress", which motivates prosocial behavior that is more likely to be interpreted as intentional, altruistic, and moral. Hoffman's model of prosocial behavior dovetails nicely with Hirshleifer's (1987) "Guarantor" and Frank's (1988) "Commitment" model of emotion (see section I.A.): the reduction in anxiety which follows cooperative or prosocial behavior reinforces such behavior, while the increase in anxiety which, through stimulus generalization, follows acts or thoughts of antisocial behavior will punish and therefore reduce those acts and thoughts.

Dienstbier (1984) reported an interesting series of studies testing the role of anxiety and emotional arousal on cheating. As expected, high arousal levels were associated with low cheating levels (and vice versa), but the subjects' attribution of the cause of high arousal was also important. When subjects were able to attribute their arousal to a cause other than the temptation to cheat, they found it much easier to cheat than when they had no other explanation for their arousal level. Subjects were also less willing to work to avoid punishment when they were able to attribute their arousal to an external cause rather than to an internal source of anxiety associated with the threat of punishment. Dienstbier concluded that when a situation is perceived to be "detection-free", one's temptation to cheat is either resisted or not, depending on the levels of anxiety perceived to be associated with the temptation.

The ability to act intentionally in either a prosocial or antisocial manner (or in terms of game theory, cooperatively or deceptively), depends upon having reached a certain level of cognitive development at which it is possible to distinguish emotions of the self from emotions of others, i. e., the child must pass from empathic responses to sympathetic responses (Dunn 1982, Hoffman 1975, 1977, 1984, Mitchell 1986, Vasek 1986). This transition begins to occur some time during the second year (Hoffman 1975, 1982, Leslie 1987, Dunn 1987, 1988, and Dunn, Brown, Slomkowski, Tesla & Youngblade 1991) when the child is beginning to develop what has come to be called a "theory of mind" (Premack & Woodruff 1978).

Having a theory of mind allows one to impute mental states (thoughts, perceptions, and feelings) not only to oneself, but also to other individuals. Humphrey (1976, 1983) suggests that this kind of awareness evolved in humans because it was a successful tool for predicting the behavior of others. Humphrey claims that the best strategists in the human social game would be those who could use a theory of mind to empathize accurately with others and thereby be able to predict the most adaptive strategy or play in a social interaction. (Byrne & Whiten 1988 call this aptitude "Machiavellian intelligence".) Humphrey's model is something of a cognitive equivalent of the evolutionary models of emotion discussed in section 1.1; they can probably be considered complementary and mutually reinforcing. With regard to sociopathy, the question is whether a strategist can be successful using only the cognitive tool of a theory of mind, without access to emotional, empathic information which, presumably, sociopaths lack (Mealey 1992). In the next section I will argue that this is exactly what a sociopath does.

2.3 Personality theory

The models of normative moral development presented above are helpful but clearly insufficient to explain sociopathy. Although some adoption studies and most longitudinal studies report significant effects of social and environmental risk factors on delinquency and criminality, the magnitude of that risk as a simple main effect is rather small. Despite repeated exposure to inconsistent and confusing reinforcement and punishment, most children who grow up with these risk factors do not turn out to be sociopathic, whereas some children who do not experience such risk factors, do. Studies have repeatedly shown that the effect of the environment is much more powerful for children at biological risk than for others. What is it that makes "high risk" environmental features particularly salient for those individuals who have a certain predisposing genotype?

2.3.1 The role of gene-environment interactions

Stimulated by the work of Rowe and Plomin (Rowe & Plomin 1981, Rowe 1983a&b, 1990a&b; Plomin & Daniels 1987, Dunn & Plomin 1990), evidence is accumulating that, unlike what has been traditionally assumed, the most important environmental features and events that influence personal development are not those that are shared by siblings within a family (such as parenting style, socioeconomic status, and schooling), but rather, are idiosyncratic events and relationships which are difficult to study systematically with traditional methods. Despite a shared home, individual children will encounter different microenvironments: their individual relationships with their parents will differ, and their experiences on a day to day, minute by minute basis will not

overlap significantly. In addition, there will be some environmental differences which are due to genetic differences; children with different personalities, aptitudes, and body types, will not only seek out different experiences (Scarr & McCartney 1983, Caspi, Elder & Bem 1987, Rowe 1990a), but will also attribute different phenomenological interpretations to the same experiences (Rowe 1983a & 1990b, Dunn 1992). For these reasons, any two children will experience an (objectively) identical environment in different ways; there is, in some sense, no real validity to some of the operational measures we currently use to describe a child's environment (Rowe & Plomin 1981, Plomin & Daniels 1987, Wachs 1992).

Although this may sound discouraging for those who seek to apply psychological research to the prevention of crime and delinquency - and most such efforts have, in fact, been fairly unsuccessful (Feldman 1977, Gottschalk, Davidson, Gensheimer & Mayer 1987, Borowiak 1989 and Patterson et al 1989)- there are reasons for optimism. Palmer (1983) suggests that the "nothing works" conclusion is valid only in the sense that no single intervention technique will be successful across the board, and that targeting different strategies to different individuals should prove more successful. More and more studies are suggesting that there are at least two developmental pathways to delinquency and sociopathy and that we need to address them separately (Quay 1990b, Lytton 1990, White et al 1990, Caspi et al 1993, Moffitt 1993, Dishion & Poe 1993, Patterson 1993, McCord 1993, Simons 1993). The evolutionary model presented here makes specific predictions about the likely differential success of different intervention and prevention strategies for individuals arriving at their anti-social behavior via different paths: while individuals of differing genotypes may end up with similar phenotypes, different environmental elements and experiences may be particularly salient for them. (This is a corollary of mechanism 5 for the maintenance of ESSs presented in Section 1.2).

As will be argued below, primary and secondary sociopathy seem to provide an excellent illustration of the development of similar phenotypes from different genotype-environment interactions. To the extent that we understand it now, primary sociopaths come from one extreme of a polygenic genetic distribution and seem to have a genotype that disposes them "to acquire and be reinforced for displaying antisociality" (Rowe 1990a, p 122). That genotype results in a certain inborn temperament or personality, coupled with a particular pattern of autonomic arousal, that, together, seem to design the individual (1) to be selectively unresponsive to those environmental cues which are necessary for normal socialization and moral development and (2) to actively seek the more deviant and arousing stimuli within the environment. Secondary sociopaths, on the other hand, are not as genetically predisposed to their behavior; rather, they, are more responsive to environmental cues and risk factors, becoming sociopathic "phenocopies" (after Raine 1993) or "mimics" (after Moffitt 1993) when the carrying capacity of the "cheater" niche grows. What are the predisposing constitutional factors that place some individuals at high risk?

2.3.2 The role of temperament

In a twin study, Rushton, Fulker, Neale, Nias & Eysenck (1986) found evidence of substantial heritability of self-reported measures of altruism, nurturance, aggressiveness, and empathy. Across twin pairs, altruism, nurturance, and empathy increased with age, while aggressiveness decreased; sex differences (in the expected direction) were found for nurturance, empathy, and aggression;

for all measures, the environmental contributions were determined to be individual rather than familial. Methodological considerations do not allow full confidence in the numerical heritability estimates of this study, but Eisenberg, Fabes & Miller (1990) conclude that it reports true individual differences which are likely to be a result of genetic differences in temperament, specifically sociability and emotionality.

More recently, two additional twin studies have confirmed the findings of Rushton et al. Emde, Plomin, Robinson, Corley, DeFries, Fulker, Reznick, Campos, Kagan & Zahn-Waxler (1992) reported significant heritabilities for empathy, behavioral inhibition, and expressions of negative affect, while Ghodsian-Carpey & Baker (1987) found significant heritabilities on four measures of aggressiveness in children. Like the Rushton et al study, both of these studies also reported sex differences, and both confirmed the relative importance of nonshared, as opposed to shared, environmental influences.

A fourth twin study (Rowe 1986) used a different set of personality indices but went a step further in establishing the link between temperament and antisocial behavior. Rowe's analysis suggests that, especially for males, the inherited factors correlated with one's genetic risk of delinquency are the same as those that lead to the temperamental attributes of anger, impulsivity, and deceitfulness ("self-serving dishonesty with people with whom a person ordinarily has affectional bonds" p 528). Interestingly, while Rowe found that common genetic factors related temperament and delinquency, it was environmental factors which related academic nonachievement with delinquency. These findings provide evidence for the two-pathway model presented in Section 1.2, in that such a gene-environment interaction (1) would create at least two possible routes to sociopathy or criminality, one primarily heritable and one less so, and (2) in terms of the latter, less heritable pathway, would set the stage for developmentally- and environmentally-contingent individual differences in antisocial behavior. In addition, in line with previously mentioned studies and the proposed model, the environmental factors Rowe found to be statistically significant varied within families and were more significant for males than for females.

Most of the research into the relationship between temperament, personality and sociopathy has been based on the extensive work of Hans Eysenck (summarized in Eysenck 1977 & 1983, Eysenck & Gudjohnsson 1989, and Zuckerman 1989). Eysenck first postulated and then convincingly documented that sociopathy in particular and antisocial behavior in general are correlated with high scores on all three of the major personality dimensions of the Eysenck Personality Questionnaire: 'extraversion' (contra introversion), 'neuroticism' (contra emotional stability), and 'psychoticism' (contra fluid and efficient superego functioning- not synonymous with psychotic mental illness; Zuckerman (1989) suggests that this scale would be better called 'psychopathy'). All three of these dimensions exhibit substantial heritability, and since psychoticism is typically much higher in males than females, it is a likely candidate for one of the relevant sex-limited traits which fits Cloninger's two-threshold risk model explaining the sex difference in expression of sociopathy.

In trying to explain the proximate connections between temperament, delinquency, sociopathy, and criminal behavior, Eysenck and colleagues devised the "General Arousal Theory of Criminality" (summarized in Eysenck & Gudjohnsson 1989), according to which the common

biological condition underlying all of these behavioral predispositions is the inheritance of a nervous system which is relatively insensitive to low levels of stimulation. Individuals with such a physiotype, it is argued, will be extraverted, impulsive, and sensation-seeking, because under conditions of relatively low stimulation they find themselves at a suboptimal level of arousal; to increase their arousal, many will participate in high-risk activities such as crime (see also Farley 1986 and Gove & Wilmoth 1990). In general support of this model, Ellis (1987) performed a meta-analysis which found that both criminality and sociopathy were associated with a variety of indicators of suboptimal arousal, including childhood hyperactivity, recreational drug use, risk-taking, failure to persist on tasks, and preference for wide-ranging sexual activity.

Additional confirmation of the arousal model comes from Zuckerman, who found a similar pattern of behaviors associated with his measure of sensation-seeking. (The following summary is derived from Zuckerman 1979, Zuckerman, Buschbaum & Murphy 1980, Daitzman & Zuckerman 1980, and Zuckerman 1983, 1984, 1985, 1990 & 1991). In addition to seeking thrill and novelty, sensation-seekers describe "a hedonistic pursuit of pleasure through extraverted activities including social drinking, parties, sex, and gambling", "an aversion to routine activities or work and to dull and boring people", and "a restlessness in an unchanging environment" (Zuckerman et al 1980, p 189). In college students, sensation-seeking is correlated with the Pd (Psychopathic Deviate) scale of the Minnesota Multiphasic Personality Inventory, and among prisoners it can be used to distinguish primary psychopaths from secondary psychopaths and non- psychopathic criminals (see also Fagan & Lira 1980). Zuckerman also shows that sensation-seeking as a temperament appears at an early age (3-4 years), exhibits a high degree of heritability, correlates negatively with age in adults, and exhibits sex differences, with higher scores more often in males. Because it shows a relationship with both sex and age, sensation-seeking (and its presumed underlying hypoarousal) may also be a good candidate for a trait which can explain the distribution and expression of sociopathy (see also Baldwin 1990).

Gray (1982, 1987), and Cloninger (Cloninger 1987a, Cloninger, Svrakic & Przybeck 1993) have proposed updated versions of the Eysenck model in which the three personality factors are rotated and renamed so as to more clearly correspond to known neural circuitry. Gray names the three systems: the approach, or, behavioral activation system, the behavioral inhibition system, and the fight/flight system; Cloninger names them "novelty-seeking", "harm- avoidance", and "reward-dependence". The three factors explain the same variance in personality as Eysenck's original factors and have been shown to be independent and highly heritable (Cloninger 1987). In addition to mapping more closely to known neural systems, these three factors are also proposed to correspond to differential activity of three neurochemicals: dopamine for behavioral activation (or novelty-seeking), serotonin for behavioral inhibition (or harm avoidance), and norepinephrine for fight/flight (or reward dependence); see Depue & Spoont 1986, Cloninger 1987, Charney, Woods, Krystal & Heninger 1990, Eysenck 1990, and Raine 1993 for partial reviews.

2.3.3 The role of physiology

Using Cloninger's terminology, sociopaths are individuals who are high on novelty-seeking, low on harm-avoidance, and low on reward- dependence. Thus, we should expect them to be high on measures of dopamine activity, low on measures of serotonin activity, and low on measures of

norepinephrine activity; data suggest that they are.

Zuckerman (1989) reports that sensation-seeking is negatively correlated with levels of dopamine-beta-hydroxylase (DBH), the enzyme which breaks down dopamine, and that extremely low levels of DBH are associated with undersocialized conduct disorder and psychopathy. Importantly, with respect to the two-pathway model, boys with socialized conduct disorder (those with fewer, later-appearing symptoms, and who are posited to be at risk for secondary, as opposed to primary sociopathy), had high levels of DBH.

In addition, extraverts and delinquents are reported to have lower than average levels of adrenaline (epinephrine) and norepinephrine under baseline circumstances; Magnusson (1985 as cited by Zuckerman 1989) reports that urinary epinephrine measures of boys at age 13 significantly predicted criminality at ages 18-25. High sensation- seekers, criminals, and other individuals scoring high on measures of impulsivity and aggression also have significantly lower levels than others of the serotonin metabolite, 5-HIAA (Brown, Goodwin, Ballenger, Goyer & Major 1979, Brown, Ebert, Goyer, Jimerson, Klein, Bunney & Goodwin 1982, Muhlbauer 1985, Depue & Spoont 1986, Zuckerman 1989, 1990, Kruesi, Hibbs, Zahn, Keysor, Hamburger, Bartko & Rapoport 1992, and Raine 1993). These are not small effects: Raine (1993) reports an average effect size (the difference between groups divided by the standard deviation) for serotonin of .75, and for norepinephrine of .41; Brown et al (1979) reported that 80% of the variance in aggression scores of their sample was explained by levels of 5-HIAA alone; and Kruesi et al reported that knowing 5-HIAA levels increased the explained variance of aggression at a two- year follow-up from 65% (using clinical measures only) to 91% (clinical measures plus 5-HIAA measures).

Levels of monoamine oxidase (MAO)- an enzyme which breaks down the neurotransmitters serotonin, dopamine, epinephrine, and norepinephrine-

are also low in antisocial and sensation-seeking individuals (Zuckerman 1989, 1990, Ellis 1991b). Individual differences in platelet MAO appear shortly after birth and are stable (Zuckerman 1989, 1990 and Raine 1993); Zuckerman reports an estimated heritability of .86. Recently, a mutant version of the gene coding for MAO-A, the version of MAO specific to serotonin, has been identified in an extended family in which the males show a history of repeated, unexplained outbursts of aggressive behavior (Brunner, Nelen, Breakefield, Ropers & van Oost 1993, Morrell 1993); urinalysis indicated that the MAO-A is not functioning normally in the affected men.

Results of psychophysiological studies also report significant differences between sociopaths and others. [Reviews of this literature can be found in Mednick, Moffitt & Stack (1987), Trasler (1987), Raine (1989), Eysenck & Gudjohnsson (1989), Raine & Dunkin (1990), Zuckerman (1990), and Raine (1993).] Among the findings are that: high sensation-seekers and sociopaths are more likely than lows and normals to show orienting responses to novel stimuli of moderate intensity, whereas lows and normals are more likely to show defensive or startle responses; criminals and delinquents tend to exhibit a slower alpha (resting) frequency in their electroencephalogram (EEG) than age-matched controls; high sensation-seekers and delinquents differ from lows and nondelinquents in the amplitude and shape of cortical evoked potentials; extraverts and sociopaths show less

physiological arousal than introverts and normals in response to threats of pain or punishment and more tolerance of actual pain or punishment; and delinquents (though not necessarily adult criminals) tend to have lower baseline heart rate than nondelinquents.

The importance of the role of these psychophysiological factors as significant causes, not just correlates, of sociopathy, is strengthened by evidence that (a) these measures of autonomic reactivity are just as heritable as the temperament they are associated with (Zuckerman 1989, Gabbay 1992), and that (b) the same physiological variables which differentiate identified sociopaths, delinquents, and criminals from others can also significantly predict later levels of antisocial behavior in unselected individuals (Loeb & Mednick 1977 using skin conductance; Volavka, Mednick, Gabrielli, Matousek & Pollock 1984 using EEG; Satterfield 1987 using EEG; Raine, Venable & Williams 1990a using EEG, heart rate, and skin conductance; and Raine, Venables & Williams 1990b using evoked potentials). As for the reports on neurochemistry, these are effects are not small; Raine (1993) reports that for heart rate, the average effect size across ten studies was .84.

Another important physiological variable in the distribution of sociopathic behavior is testosterone. Testosterone (or one of its derivatives) is a likely candidate for the role of trigger of the sex-limited activation of genes required by the two-threshold model presented earlier. The mechanism of action of steroid hormones is to enter the nucleus of the cell and interact with the chromosomes, regulating gene expression. This differential activity of the genes leads to some of the individual, age, and sex differences we see in temperament, specifically, psychoticism, aggression, impulsivity, sensation-seeking, nurturance, and empathy (Zuckerman et al 1980, Zuckerman 1984, 1985, 1991 and Ellis 1991b). Variation in testosterone levels also parallels the age variation in the expression of sociopathic behavior and is correlated with such behavior in adolescent and adult males (Daitzman & Zuckerman 1980, Zuckerman 1985, Rubin 1987, Olweus 1986, 1987, Schalling 1987, Susman, Inoff-Germain, Nottelman, Loriaux, Cutler & Chrousos 1987, Ellis & Coontz 1990, Udry 1990, Dabbs & Morris 1990, Gladue 1991 and Archer 1991). Testosterone is thus likely to play a dual role in the development of sociopathy, just as it does in the development of other sex differences: one as an organizer (affecting traits) and one as an activator (affecting states).

Udry (Drigotas & Udry 1993, Halpern, Udry, Campbell & Suchindran 1993), unable to replicate his own 1990 study suggesting an activating effect of testosterone, has suggested that the correlation between testosterone and aggression might be due to a physiosocial feedback loop; he posits that boys with high, early levels of testosterone mature faster, and, being bigger, are more likely to get in fights. Since levels of testosterone, adrenaline, and serotonin have been shown to fluctuate in response to social conditions (McGuire, Raleigh & Johnson 1983, Raleigh, McGuire, Brammer & Yuwiler 1984, Schalling 1987, Olweus 1987, Raleigh, McGuire, Brammer, Pollack & Yuwiler 1991, Archer 1991, Kalat 1992), this sociophysiological interaction creates a positive feedback loop: those who start out with high levels of testosterone and sensation seeking (and low levels of adrenaline, serotonin, and MAO) are (1) more likely than others to initiate aggressive behavior, and (2) more likely to experience success in dominance interactions, leading to (3) an increased probability of experiencing further increases in testosterone, which (4) further increases the likelihood of continued aggressive behavior.

Another example of a sociophysiological feedback loop comes from Dabbs and Morris (1990), who found significant correlations between testosterone levels and antisocial behavior in lower class men but not in upper class men. They explained this by positing that upper class men are more likely, because of differential socialization, to avoid individual confrontations. If this is true, it would mean that upper class men are, because of their socialization, specifically avoiding those types of social encounters which might raise their testosterone (and in turn, their antisocial behavior). This interpretation is supported by the finding (in the same study) that significantly fewer upper class than lower class men had high testosterone levels. Thus, it is possible that upper class socialization may mitigate the influence of testosterone. An alternative explanation- that the aggressive behavior associated with higher testosterone levels leads to downward social mobility- also suggests a recursive sociophysiological interaction.

Raine (1988) has argued that since upper class children are less likely than lower class children to suffer the environmental risks predisposing one toward sociopathic behavior, when such behavior is seen in upper class individuals, it is likely to be the result of a particularly strong genetic predisposition. Evidence supporting this has been reported by three independent studies. Wadsworth (1976) found physiological indicators of hypoarousal amongst upper- class, but not lower-class, boys who subsequently became delinquent. Raine (Raine & Venables 1981, 1984; also reported in Raine 1988 and Raine & Dunkin 1990) found indicators of hypoarousal in his upper-class antisocial subjects, but the reverse in his lower-class subjects. Satterfeld (1987) found that of his lower-class subjects, those in a biological high-risk group were seven times more likely to have been arrested than those in his control group, whereas among his middle- and upper-class subjects, the rate was 25 and 28 times, respectively. This outcome was a result of lower rates of criminal activity in the control groups of the middle- and upper-class subjects as compared to the lower-class controls; i.e., almost all of those who had been arrested from the middle- and upper-class were biologically at high risk, but this was not true for the lower class subjects. The implications of these findings are of tremendous import, as they suggest that (1) the effect of the social environment might be considerably larger than suggested by adoption studies, and (2) there might be different etiological pathways to sociopathy, and therefore different optimal strategies for its prevention or remediation, depending upon what kind of social and environmental background the person has experienced.

2.4 Learning Theory

Adoption studies show that the environment clearly plays an important role in the etiology of sociopathy, but that its effects are different for individuals of different genotype. As mentioned in section 2.3.1, some of this difference is likely to be a result of gene-environment correlations, in that different environments are sought by individuals of different genotypes; some will be a result of differences in interpretation of the same environment by individuals of different genotypes; and some will be a result of differences in environment impinging upon people because of differences in their genotype (e.g. discriminating parental treatment of two children differing in temperament). In nonadoptive families, gene-environment correlations will be even stronger because parents with certain personality types will provide certain environments for their children. These differential effects of environment on individuals of varying genetic risk for sociopathy become readily apparent when we examine the effect of the interaction between physiotype and conditioning on

the process of socialization.

1. Conditioning

There is evidence that individuals with a hypoaroused nervous system are less sensitive than most people to the emotional expression of other individuals, and to social influences in general (Eliasz & Reykowski 1986, Eysenck 1967 as cited in Patterson and Newman 1993). They are also less responsive to levels and types of stimuli that are normally used for reinforcement and punishment (Eliasz 1987); as a result, they are handicapped in learning through autonomic conditioning although they exhibit no general intellectual deficit (e.g. Hare & Quinn 1971, Eysenck 1977, Mednick 1977, Ziskind, Syndulko & Maltzman 1978, Gorenstein & Newman 1980, Newman, Widom & Nathan 1985, Raine 1988, Lytton 1990, Zuckerman 1991).

One of the posited consequences of this learning deficit is a reduced ability to be socialized by the standard techniques of reward and punishment that are used (especially in the lower classes and by uneducated parents) on young children. In particular, hypoaroused individuals have difficulty inhibiting their behavior when both reward and punishment are possible outcomes (Newman, Widom & Nathan 1985, Newman & Kosson 1986, Newman 1987, Zuckerman 1991, Patterson & Newman 1993); in situations when most people would experience an approach-avoidance conflict, sociopaths and extraverts are more likely to approach; (see also Dienstbier 1984). Because of their high levels of sensation-seeking, children with a hypoaroused nervous system will be more likely than other children to get into trouble, and when they do, will be less likely to be affected by, and learn from, the consequences whether those consequences are a direct result of their behavior or an indirect result such as parental punishment.

Despite continuing problems with operational definitions, recent research suggests that there might be distinguishable differences in learning between primary and secondary sociopaths, or children with unsocialized versus socialized conduct disorder (Newman et al 1985, Gray 1987, Quay 1990b, Newman, Kosson & Patterson 1992). Primary sociopaths, with their inability to experience the social emotions, exhibit deficits on tasks which typically induce anxiety in others, specifically, passive avoidance tasks, approach-avoidance tasks, and tasks involving punishment, but they can learn well under other conditions (Raine, Venables & Williams 1990b, Newman et al 1992, Patterson & Newman 1993, Raine 1993). Secondary sociopaths and extraverts, on the other hand, have normal levels of anxiety and responses to punishment, but they may be especially driven by high reward conditions (Boddy, Carver & Rowley 1986, Derryberry 1987, Newman, Patterson, Howland & Nichols 1990).

Primary sociopaths, with diminished ability to experience anxiety and to form conditioned associations between antisocial behavior and the consequent punishment, will be unable to progress through the normal stages of moral development. Unlike most children who are biologically prepared to learn empathy, they are contraprepared to do so, and will remain egoistic-unable to acquire the social emotions of empathy, shame, guilt, and love. They present at an early age with "unsocialized" conduct disorder. Secondary sociopaths, with normal emotional capacities, will present, generally at a later age, with "socialized" conduct disorder (Loeber 1993, Patterson

1993, Simons 1993). What socialization processes contribute to their development?

2.4.2 Social learning

In Section 2.2.1, it was noted that a cheating strategy is predicted to develop when a male (especially) is competitively disadvantaged, and that criminal behavior (especially in males) is clearly related to factors associated with disadvantage. These are: large numbers of siblings, low socio-economic status, urban residency, low intelligence, and poor social skills. How, in a proximate sense, do these variables contribute to the development of secondary sociopathy? Path models suggest a two-stage process involving a variety of cumulative risk factors (McGarvey et al 1981, Snyder, Dishion & Patterson 1986, Snyder & Patterson 1990, Patterson, Capaldi & Bank 1991, Dishion et al 1991, Loeber 1993, Simons 1993, Tremblay 1993, Moffitt 1993) (9).

In the first stage, disrupted family life, associated with parental neglect, abuse, inconsistent discipline, and the use of punishment as opposed to rewards, are critical (Feldman 1977, Wilson & Hernnstein 1985, Snyder et al 1986, McCord 1986, Patterson et al 1989, Luntz & Widom 1993, Conger 1993, Simons 1993). Poor parenting provides the child with inconsistent feedback and poor models of prosocial behavior, handicapping the child in the development of appropriate social, emotional, and problem-solving skills. This pattern is found most frequently in parents who are themselves criminal, mentally disturbed, undereducated, of low intelligence, or socioeconomically deprived (McGarvey et al 1981, McCord 1986, Farrington 1986), leading to a cross-generational cycle of increasing family dysfunction (eg. Jaffe, Suderman & Reitzel 1992, Luntz & Widom 1993).

In the second stage, children with poor social skills find themselves at a disadvantage in interactions with age-mates; rejected by the popular children, they consort with one another (Loeber & Dishion 1983, Snyder et al 1986, Kandel et al 1988, Hartup 1989, and Patterson et al 1989, Dishion et al 1991). In these socially unskilled peer groups, which will also include primary sociopathic, or, unsocialized conduct disorder children, delinquent, antisocial behavior is reinforced and new (antisocial) skills are learned (Maccoby 1986, Moffitt 1993). Antisocial behavior may then escalate in response to, or as prerequisite for, social rewards provided by the group, or as an attempt to obtain the perceived social (and tangible) rewards which often accompany such behavior (Moffitt 1993). As the focus of the socialization process moves outside the home, parental monitoring becomes more important (Snyder et al 1986, Snyder & Patterson 1990, Forgatch 1991, Dishion et al 1991, Conger 1993, Forgatch, Stoolmiller & Patterson 1993, Simons 1993), as does the availability of prosocial alternatives for the socially unskilled adolescent (Farrington 1986, Apter 1992, Moffitt 1993).

The development of secondary sociopathy appears to depend much more upon environmental contributions than does primary sociopathy. Since it is secondary sociopathy which, presumably, has increased so rapidly, so recently in our culture, what can social psychologists contribute to our understanding of the sociocultural factors involved in its development?

2.5 Social Psychology

2.5.1 Machiavellianism

First, the use of antisocial strategies is not restricted to sociopaths. The majority of people who are arrested are not sociopathic, and many people exhibit antisocial behavior that is infrequent enough or inoffensive enough to preclude arrest. Some antisocial behavior is even considered acceptable if it is expressed in socially approved circumstances. Person (1986), for example, relates entrepreneurism to psychopathy, while Christie (1970) notes that people who seek to control and manipulate others often become lawyers, psychiatrists, or behavioral scientists; Jenner (1980), too, claims that "subtle, cynical selfishness with a veneer of social skills is common among scientists" (p 128).

Christie (see Christie & Geis 1970) developed a scale for measuring this subclinical variation in antisocial personality; he called it the "Machiavellianism" or "Mach" scale. One's Mach score is calculated by compiling answers to Likert-format queries of agreement or disagreement with statements like "Humility not only is of no service but is actually harmful," "Nature has so created men that they desire everything but are unable to attain it," and "The most important thing in life is winning". Adults who score high on the Mach scale express "a relative lack of affect in interpersonal relationships," "a lack of concern with conventional morality," "a lack of gross psychopathology," and "low ideological commitment" (Christie & Geis, p 3-4); children who score high on Machiavellianism have lower levels of empathy than age-mates (Barnett & Thompson 1984).

High Machs have an "instrumental cognitive attitude toward others" (Christie & Geis, p 277), and, because they are goal-oriented as opposed to person-oriented, they are more successful in face-to-face bargaining situations than low Machs. High Machs "are especially able communicators, regardless of the veracity of their message" (Kraut & Price 1976). In a related vein, high Machs, like sociopaths, are more resistant to confession after cheating than are low Machs, and they are rated as being more plausible liars (Christie & Geis 1970, Bradley & Klohn 1987); like sociopaths, high Machs are often referred to as "cool". According to Christie, "If Machiavellianism has any behavioral definition ...self-initiated manipulation of others should be at its core" (p 76). One can thus easily think of Machiavellianism as a low-level manifestation of sociopathy. It even shows a sex difference consistent with the two- threshold model (Christie & Geis 1970), an age pattern consistent with age variation in testosterone levels (Christie & Geis 1970), significant positive correlations with Eysenck's psychoticism and neuroticism scales (Allsopp, Eysenck & Eysenck 1991), and a correlation with serotonin levels (Madsen 1985).

In one study, Geis & Levy (1970) found that high Machs (who were thought to use an "impersonal, cognitive, rational, cool" approach with others), were much more accurate than low Machs (who were thought to use a "more personal, empathizing" approach), at assessing how other "target" individuals answered a Machiavellian attitudes questionnaire. Even more interesting is the result (from the same study) that the high Machs achieved their accuracy by using a nomothetic or actuarial strategy: they guessed that everyone was at about the average level, without discriminating between individuals based on differences they had had an opportunity to observe during a previous experimental session. In addition, their errors tended to be random, which would fit with reports by Eliasz & Reykowski (1986) and Damasio, Tranel & Damasio (1990) that

hypoaroused and antisocial individuals are less attentive to social and emotional cues than others. Low Machs, on the other hand, used an idiographic approach, and although they successfully differentiated between high scorers and low scorers, they grossly underestimated the scores of both, guessing at a level that was more reflective of their own scores than those of the population at large.

This study suggests two things: (1) that basing one's playing strategies on an "impersonal, cognitive, rational, cool" approach to others might be more accurate in the long run than using a "personal, empathizing" approach (at least in those situations where cooperative long-term partnerships are not possible); and (2) the errors made by those who use the personal, empathizing approach, are of the kind more likely to result in playing the cooperation strategy when the cheating strategy would be more appropriate (rather than vice versa). Thus, the personal, empathizing approach is likely to make one susceptible to being exploited by others who use the impersonal cognitive approach; indeed, high Machs outcompete low Machs in most experimental competitive situations (Terhune 1970, Christie & Geis 1970).

As I have argued elsewhere (Mealey 1992), the common assumption that an empathy-based approach to predicting the behavior of others is better than a statistical approach is not necessarily correct; this belief may itself be an emotion-based cognitive bias. To have such a bias may be beneficial, however, for the same reason that emotional commitment biases are beneficial: in situations where voluntary, long-term coalitions can be formed, the personal, empathizing (and idealistic) low Machs might outperform the more impersonal, cognitive (and realistic) high Machs, since low Machs would be more successful than high Machs in selecting a cooperator as a partner.

Although two studies (Hare & Craigen 1974 and Widom 1976a) report on the strategy of sociopaths in Prisoner's Dilemma-type settings, in both studies the sociopaths were paired with one another; thus, we do not have a measure of the strategy sociopaths use against partners of their own choosing or in situations with random, rotating partners (10). I would predict that in such settings, sociopaths, (like Geis & Levy's high Mach subjects), would be less proficient than others in distinguishing between high and low Mach partners, and would thus be at a disadvantage in iterated games with a chosen partner; on the other hand (again like high Mach subjects), they should perform at better than average levels when playing with randomly assigned, rotating partners. Widom (1976b) found that when asked to guess how "people in general" would feel about different social situations sociopaths guessed that others would feel essentially the same way that they do, whereas control subjects guessed that others would feel differently. As in the Geis & Levy study, both groups were wrong, but in different ways: the sociopaths underestimated their differences from others, while the control subjects substantially over-estimated their differences from others, suggesting that sociopaths (like high Machs) were using a nomothetic approach to prediction, while controls (like low Machs) were using an idiographic approach.

Machiavellianism and the related propensity to use others in social encounters has generally been looked upon as a trait. An alternative perspective, however, acknowledges both the underlying variation in personality and the situational factors that are relevant to an individual's behavior at any given moment (eg. Barber 1992). In line with mechanism 5 for maintaining ESSs (presented in

Section I.B.), Terhune (1970) says "actors bring to the situation propensities to act in a certain general way, and within the situation their propensities interact with situational characteristics to determine their specific behavior" (p 229) (11). This brings us to the last question: Beyond the constitutional and environmental variables that contribute to the development of individual differences in personality and antisocial behavior, what can social psychology tell us about the within-individual situational factors which encourage or discourage cheating strategies, and how can these be explained?

2.5.2 The role of mood

Although mood and emotion are not identical concepts, they are clearly related (12). Mood might be thought of as a relative of emotion which clearly varies within individuals but is perhaps less an immediate response to concrete events and stimuli and more a generalized, short- to mid-term response to the environment. As such, the role of mood must be addressed by any model that relies so heavily on the concepts of emotion, emotionality, and emotionlessness, as determinants of behavior.

Positive mood and feelings of success have been demonstrated to enhance cooperative behavior (Mussen & Eisenberg-Berg 1977, Cialdini, Kenrick & Baumann 1982, Farrington 1982). If, as Nesse (1991) has argued, positive mood is a reflection not only of past success, but also of anticipation of future success, the facilitation of cooperation by positive mood could be seen as part of a long-term strategy by individuals who feel they can afford to pass up possible short-term gains for the sake of establishing a cooperative reputation.

Sad affect and feelings of failure can also affect strategy in social interactions. To the extent that sadness and feelings of failure follow losses of various sorts, individuals in these circumstances should be expected to be egoistic and selfish. In children, this is typically what is found (Mussen & Eisenberg-Berg 1977, Baumann, Cialdini & Kenrick 1981). In some children, and more consistently in adults, on the other hand, sadness and feelings of failure can facilitate prosocial behavior. Mussen & Eisenberg-Berg (1977) suggest that this is a result of a deliberate effort to enhance one's (diminished) reputation among others; Baumann et al (1981) and Cialdini et al (1982) suggest that it is a result of a deliberate effort to relieve negative affect based on prior experience that prosocial behavior often has a positive, self- gratifying effect.

If sadness is profound, i.e., one is is depressed and experiencing the cognitive biases and selective attention associated with depression (Nesse 1991, Sloman 1992, Mineka & Sutton 1992), one would be expected to desist from all social interaction, being neither antisocial nor prosocial, but asocial (Nesse 1991, Sloman 1992). In this view, the lethargy and anhedonia associated with depression could be considered to be facultative lapses in the emotions or moods which typically motivate a person toward social interaction.

Hostility can also lead to cognitive biases and selective attention to relevant social stimuli. Dodge and Newman (1981) showed that aggressiveness in boys is associated with the over-attribution of hostile intent to others. The authors concluded that such attributions lead to increased "retaliatory"

aggression by the hostile individuals, fueling a cycle of true hostility and retaliation by all parties. It is also abundantly clear that anger and hostility, once expressed, do not lead to catharsis, but to amplified feelings and outward expressions of that anger (Tavris 1982).

Guilt, which often follows selfish behavior, typically results in an increase in subsequent prosocial behavior (Hoffman 1982, Cialdini et al 1982); Hoffman calls this "reparative altruism". Guilt can easily be seen as one of Hirshleifer's (1987) or Frank's (1988) emotional commitment devices, compelling one to perform prosocial behavior as a means of reestablishing one's tarnished reputation.

Interestingly, Cialdini et al (1982) also report that prosocial behavior increases after observing another's transgression. They explain this phenomenon within the context of what they call the "Negative Relief" model: prosocial behavior is performed as a means of alleviating negative feelings in general (including direct or vicarious guilt, sympathy, distress, anxiety, or depression). Like Hoffman's, this model postulates that the reinforcing power of (relief provided by) prosocial behavior is learned during childhood.

Since guilt, anxiety and sympathy are social emotions that primary sociopaths rarely, if ever, experience, there is no reason to expect that they might moderate their behavior so as to avoid them. On the other hand, there is no reason to expect that sociopaths don't experience fluctuations in mood (such as depression, optimism, or anger) in response to their changing evaluation of their prospects of success and failure. To the extent that we can manipulate the sociopath's mood, therefore, we might be able to influence his behavior.

2.5.3 Cultural variables

Competition, in addition to being one of the most important variables in determining long-term life strategy choices, is also one of the more important situational variables influencing the choice of immediate strategy. Competition increases the use of antisocial and Machiavellian strategies (Christie & Geis 1970) and can counteract the increase in prosocial behavior that generally results from feelings of success (Mussen & Eisenberg-Berg 1977). Some cultures encourage competitiveness more than others (Mussen & Eisenberg-Berg 1977, Shweder, Mahapatra & Miller 1987) and these differences in social values vary both temporally and crossculturally. Across both dimensions, high levels of competitiveness are associated with high crime rates (Wilson & Herrnstein 1985, see also Farley 1986) and Machiavellianism (Christie & Geis 1970).

High population density, an indirect form of competition, is also associated with reduced prosocial behavior (Farrington 1982) and increased antisocial behavior (Wilson & Hernnstein 1985, Ellis 1988, Robins, Tipp & Przyeck 1991, U.S. Department of Justice 1992)- especially in males (Wachs 1992; see Section 3.2.1 and references therein for ultimate, game theoretic explanations why this might occur; see Draper 1978, Siegel 1986, Gold 1987, Foster 1991, and Wilson & Daly 1993 for a variety of proximate explanations). Fry (1988) reports large differences in the frequency of prosocial and antisocial behaviors in two Zapotec settlements equated for a variety of socio-ecological variables; the one major difference- thought possibly to be causal- was in land holdings

per capita, with the higher levels of aggression found in the community with the smaller per capita land holdings.

Last, but not least, is the relatedness or similarity of the actors/strategists to their partners in an interaction. Based on models of kin selection and inclusive fitness, individuals should be more cooperative and less deceptive when interacting with relatives who share their genes, or relatives who share investment in common descendents. Segal (1991) reported that identical twins cooperated more than fraternal twins playing the Prisoner's Dilemma. Barber (1992) reported that responses on an altruism questionnaire were more altruistic when the questions were phrased so as to refer to relatives (as opposed to "people" in general), and that Machiavellian responses were thereby reduced. Rushton (Rushton, Russell and Wells 1984, Rushton 1989) presents evidence that people also cooperate more with others who are similar to them even though not genetically related. There are a variety of plausible evolutionary explanations for this behavior (see Pulliam 1982, Mealey 1984, and BBS commentary on Rushton 1989).

3. Integration, Implications, and Conclusions:

3.1 Integration: Sociopathy as an ESS leads to two types of sociopaths

3.1.1 Primary sociopathy

I have thus far argued that some individuals seem to have a genotype that disposes them "to acquire and be reinforced for displaying antisociality" (Rowe 1990a, p 122). That genotype results in a certain inborn temperament or personality, coupled with a particular pattern of autonomic hypoarousal that, together, design the child to be selectively unresponsive to cues necessary for normal socialization and moral development. This scenario is descriptive of mechanism 1 (Section 1.2) of maintaining ESSs in the population; it describes the existence of frequency-dependent, genetically based individual differences in employment of life history strategies. I suggest accordingly, that there will always be a small, cross- culturally similar, and unchanging baseline frequency of sociopaths: a certain percentage of sociopaths- those individuals to whom I have referred as primary sociopaths- will always appear in every culture, no matter what the socio-cultural conditions. Those individuals will display chronic, pathologically emotionless antisocial behavior throughout most of their lifespan and across a variety of situations, a phenotype which is recognized (according to Robins, Tipp & Przybeck 1991) "by every society, no matter what its economic system, and in all eras" (13). Since it is a genetically determined strategy, primary sociopaths should be equally likely to come from all kinds of socio-economic backgrounds; on the other hand, since they constitute that small group of individuals whose physiotype makes them essentially impervious to the social environment almost all sociopaths from the upper-classes will be primary sociopaths (14).

Of course, because they are not intellectually handicapped, these individuals will progress normally in terms of cognitive development and will acquire a theory of mind. Their's however, will be formulated purely in instrumental terms, without access to the empathic understanding that most of us rely on so much of the time. They may become excellent predictors of others' behavior,

unhandicapped by the vagaries and "intrusiveness" of emotion, acting, as do professional gamblers, solely on nomothetic laws and actuarial data rather than on hunches and feelings. In determining how to "play" in the social encounters of everyday life, they will use a pure cost-benefit approach based on immediate personal outcomes, with no "accounting" for the emotional reactions of the others with whom they are dealing. Without love to "commit" them to cooperation, anxiety to prevent "defection", or guilt to inspire repentance, they will remain free to continually play for the short- term benefit in the Prisoner's Dilemma.

3.1.2 Secondary sociopathy

At the same time, because changes in gene-frequencies in the population would not be able to keep pace with the fast-changing parameters of social interactions, an additional, fluctuating proportion of sociopathy should be a result of mechanism 5 for maintaining ESSs, which allows for more flexibility in the ability of the population to track the frequency-dependent nature of the success of the cheating strategy. Mechanism 5 (genetically based individual differences in response to the environment, resulting in differential use by individuals of environmentally-contingent strategies) would explain the development and distribution of what I have referred to as secondary sociopathy. Secondary sociopathy is expressed by individuals who are not extreme on the genetic sociopathy spectrum, but who, because of exposure to environmental risk factors, pursue a life history strategy that involves frequent, but not necessarily emotionless cheating. Unlike primary sociopaths, secondary sociopaths will not necessarily exhibit chronic antisocial behavior, because their strategy choices will be more closely tied to age, fluctuation in hormone levels, their competitive status within their referent group, and changing environmental contingencies. Since secondary sociopathy is more closely tied to environmental factors than to genetic factors, secondary sociopaths will almost always come from lower class backgrounds and their numbers could vary substantially across cultures and time, tracking environmental conditions favoring or disfavoring the use of cheating strategies.

The existence of this second etiological pathway to sociopathy explains the fact that cultural differences are correlated with differences in the overall incidence of antisocial behavior (Wilson & Hernnstein 1985, Farley 1986, Gold 1987, Ellis 1988, Robins, Tipp & Przybeck 1991). It also explains why, as the overall incidence of sociopathy increases, the discrepancy in the ratio of male to female sociopaths decreases (Robins, Tipp & Przybeck, 1991): since secondary sociopathy is less heritable than primary sociopathy (according to this model), the effect of sex-limited genes (like that of all the genes contributing to the spectrum) should be less important for the development of secondary sociopathy, resulting in less of a sex difference. Based on this model, I would predict that, unlike what we find for primary sociopathy (see Section 2.1.3), we should find no differential heritability between the sexes for secondary sociopathy (even though there will still be a sex difference in prevalence).

3.2 Implications of the two-pathways model

Terhune (1970) suggests that choice of strategy in experimental game situations (and, presumably, real-life settings as well) depends upon two things: (1) cognitive expectations

regarding others (i.e., a theory of mind), and (2) motivational/emotional elements such as hopes and fears. Since primary sociopaths have a deficit in the realm of emotional motivation, they presumably act primarily upon their cognitive expectations of others; to the extent that they do act upon emotions, it is most likely to be upon mood and the primary emotions (like anger and fear) rather than upon the social and secondary emotions (like love and anxiety). Thus, the extent to which a society will be able to diminish the antisocial behavior of primary sociopaths will depend upon two things: (1) its influence on the sociopath's cognitive evaluation of its own reputation as a player in the Prisoner's Dilemma, and (2) the primary emotion- or mood-inducing capacity of the stimuli it utilizes in establishing the costs and benefits of prosocial versus antisocial behavior.

Manipulations of these two variables will also influence the numbers of secondary sociopaths by changing the size of the adaptive niche associated with antisocial behavior. In addition, since the development of secondary sociopathy is more influenced by the social environment than is the development of primary sociopathy, and since secondary sociopaths are not devoid of social emotions, changing patterns in the nurturing and socialization of children and in the socialization and rehabilitation of delinquents and adult criminals is an additional, viable possibility for reducing the overall prevalence of antisocial behavior.

3.2.1 Minimizing the impact of primary sociopaths: society as a player in the Prisoner's Dilemma

Sociopaths' immediate decisions are based partly on their ability to form a theory of mind, and to use those expectations of others' behavior in a cost-benefit analysis to assess what actions are likely to be in their own self-interest. (This is true for both primary and secondary sociopaths.) The outcome of such analyses is therefore partially dependent on the sociopath's expectations of the behavior of other players in the game. I would argue that an entire society can be seen as a player, and that the past behavior of that society will be used by the sociopath in forming the equivalent of a theory of mind, to predict the future behavior of that society.

Like an individual player, a society will have a certain probability of detecting deception, a more-or-less accurate memory of who has cheated in the past, and a certain proclivity to retaliate or not, based upon a cheater's past reputation and current behavior. Since the sociopath is using a rational and actuarial approach to assess the costs and benefits of different behaviors, it is the actual past behavior of the society which will go into his calculations, rather than risk assessments inflated from the exaggerated fears or anxieties that most people feel in anticipation of being caught or punished. Thus, to reduce antisocial behavior, a society must establish and enforce a reputation for high rates of detection of deception and identification of cheaters, and a willingness to retaliate. In other words, it must establish a successful strategy of deterrence.

Game theory models by Axelrod and others have shown that the emergence, frequency, and stability of social cooperation is subject to an abundance of potential deterrent factors (Axelrod & Hamilton 1981, Axelrod 1984, Feldman & Thomas 1987, Axelrod & Dion 1988, Heckathorn 1988, Hirshleifer & Coll 1988, Boyd 1988, Dugatkin & Wilson 1991, Boyd & Richerson 1992, Nowak & Sigmund 1993 and Vila & Cohen 1993). Among these are: group size (as it decreases, cooperation increases); nonrandom association of individuals within the population (as it increases, cooperation

increases); the probability of error in memory or recognition of an individual (as it decreases, cooperation increases); the effect of a loss on a cooperator (as it decreases, cooperation increases); the effect of a gain on a defector (as it decreases, cooperation increases); the frequency of punishment against defectors (as it increases, cooperation increases); the cost of punishment for the punished (as it increases, cooperation increases); and the cost of punishment for the punishers (as it decreases, cooperation increases) (15).

Recent game-theoretic models are coming closer and closer to the complexity of real-world, human social interactions on a large scale by examining the role of culture and technology in: expanding society's collective memory of individual players' past behavior; broadcasting the costs and benefits of cooperation and defection, and; the development and application of new socialization, deception-detection, and punishment techniques (see esp. Hirshleifer & Rasmusen 1989, Machalek & Cohen 1991, Dugatkin 1992). These models begin to provide useful strategies for the real-world prediction and reduction of cheating strategies and antisocial behavior. (See also Feldman 1977, Farrington 1979, Bartol 1984, Wilson & Herrnstein 1985, Axelrod 1986, Eysenck & Gudjonsson 1989, Ellis 1990a, and Machalek & Cohen 1991 for some nonquantitative models and tests which incorporate some of these variables in their explanation of the socialization, punishment, and deterrence of crime.)

Since neither secondary nor primary sociopaths have a deficit in the ability to perform accurate cost-benefit analyses, increasing the probabilities of criminal detection, identification, and punishment, can also reduce crime; a society must therefore establish a reputation for willingness to retaliate. [The National Research Council (1993) reports that a 50% increase in the probability of incarceration for any single crime reduces subsequent crime twice as much as does doubling incarceration duration (p 294).] Harsher penalties can also be deterring, but only if they are reliably meted out.

Another key is in making the costs of cheating salient. Generally speaking, antisocial and uncooperative behaviors increase as the costs become more diffuse or removed in time, and prosocial and cooperative behaviors decrease as the benefits become more diffuse or removed in time (Bartol 1984, Ostrom 1990, Low 1993). For primary sociopaths, this is even moreso, since their sensation- seeking physiotype makes them particularly unable to make decisions based on nonimmediate consequences. Although able to focus attention on interesting tasks for short periods, the sociopath cannot perform well under conditions of delayed gratification (Pulkkinen 1986) and is more motivated avoid immediate costs than by threats or avoidance of future punishments (Christie & Geis 1970, McCord 1983, Raine 1988, 1989, Forth & Hare 1989). Costs associated with social retaliation must therefore not only be predictable, but be swift- and the swiftness itself, must also be predictable.

Another factor the sociopath will use to "compute" the potential value of an antisocial action is the cost-benefit ratio of the alternatives (Piliavin, Thornton, Gartner & Matsueda (1986). For the sociopath, money and other immediate tangible rewards are more motivating than social reinforcers (such as praise) or promises of future payoff, and visual stimuli are more salient than auditory stimuli (Chesno & Kilmann 1975, Raine & Venables 1987, Forth & Hare 1989, Raine 1989, Raine et al 1990b, Zuckerman 1990). Thus, alternatives to crime must be stimulating enough and

rewarding enough to preferentially engage the chronically hypoaroused sensation-seeker. This will be a difficult task to achieve, but it will be more successful if we can effectively distinguish primary from secondary sociopaths. Primary sociopaths, with their emotional, but not intellectual deficit, will be competent on some tasks on which secondary sociopaths, with deficits in social skills, emotion-regulation and problem-solving, will not. Possibilities might include: novelist, screen play writer, stunt man, talk show host, disk jockey, explorer, race car driver, or skydiving exhibitionist. Given that primary sociopaths will always be with us in low numbers, it would be a wise social investment to create- even on an individual basis, if necessary- a number of exciting, high- payoff alternatives for them, in order to minimize the number who may otherwise cause pain and destruction.

Distinguishing between primary and secondary sociopaths is also critical for decisions about confinement and rehabilitation. Quinsey & Walker (1992) cite examples where recidivism rates went up for psychopaths, but down for nonpsychopaths, after they were exposed to the same kind of "treatment". Recidivism is much greater in primary sociopaths than in secondary sociopaths (Hare, Forth & Strachan 1992), and sometimes the only response is prolongued incapacitation (until they literally "grow out of it"). A recent international meeting of experts concluded that "treatment" programs dealing with primary sociopaths should be "less concerned with attempts to develop empathy or conscience than with intensive efforts to convince them that their current attitudes and behavior (simply) are not in their own self-interest" (Hare 1993, p 204).

3.2.2 Minimizing the prevalence of secondary sociopathy: society as a socializing agent and mood setter

Given that secondary sociopaths have a different life history and are more responsive to environmental influences than primary sociopaths, social changes can be designed to minimize not only their impact, but their incidence. Loeber (1990) argues that each generation in our society is being raised with an increasing number of environmental risk factors, leading to increasing generation-wide deficits in impulse control. He makes specific suggestions to screen for high-risk children and institute early intervention, noting that different interventions are likely to be more or less effective given different risk factors in the child's or adolescent's life history. (See also U.S. Department of Justice 1993.)

One possible intervention is parent training (see Magid & McKelvie, 1987 and Dumas, Blechman & Prinz 1992, for reviews and programmatic suggestions). Laboratory experiments show that antisocial behaviors can be reduced and prosocial behaviors reinforced by appropriate use of modelling, induction, and behavioral modification techniques (Feldman 1977, Mussen & Eisenberg-Berg 1977, Grusec 1982, Rushton 1982, Gelfand & Hartmann 1982, Radke-Yarrow & Zahn-Waxler 1986, Kochanska 1992 & 1993). Recent longitudinal studies in natural settings suggest that the positive effects of good parenting, especially parental warmth and predictability, may be long-lasting (McCord 1986, Kochanska 1992 & 1993, Kochanska & Murray 1992).

The cause and effect relationship between parental behavior and child behavior, however, is not likely to be one-way. Children of different gender, temperaments, and even social classes, respond

differentially to different socialization techniques (Dienstbier 1984, Radke-Yarrow & Zahn-Waxler 1986, Lytton 1990, Kochanska 1991 & 1993, Kochanska & Murray 1992, McCord 1993), and to some extent, difficult children elicit poor parenting (Buss 1981, Lee & Bates 1985, Bell & Chapman 1986, Snyder & Patterson 1987, Lytton 1990, Eron, Huesmann & Zelli 1991). It is easy for parents of difficult children to lose heart, and in so doing, become even less effective (Patterson 1992). For example, studies cited in Landy & Peters (1992) found that mothers of aggressive children, like other mothers with a low sense of personal power, tend to give weak, ineffectual commands to their children.

This lack of "goodness of fit" between parental style and the needs of the child is probably an important factor in the exacerbation of conduct disorder (Lee & Bates 1985, Landy & Peters 1992, Wachs 1992, Moffitt 1993). Parents need help in identifying high-risk children and they need instruction in how to take a practical, assertive approach with them (see Magid & McKelvie 1987, Garmezy 1991), while using a more inductive, empathic approach with their other children (see Kochanska 1991, Kochanska & Murray 1992, and Kochanska 1993).

Social workers, health care providers, and employees of the criminal justice system also need to be able to distinguish between children with different risk factors and life histories and to respond accordingly. Palmer (1983) argues that agents should be individually matched with each client/ offender based on style and personality characteristics, to prevent high Mach and sociopathic offenders from taking advantage of low Mach employees.

At a broader level, many sociocultural aspects of modern society seem to contribute to antisocial behaviors and attitudes (National Research Council 1993, Moffitt 1993). As a society gets larger and more competitive, both theoretical models (Section 3.2.1) and empirical research (Section 2.4.2) show that individuals become more anonymous and more Machiavellian, leading to reductions in altruism and increases in crime. Social stratification and segregation can also lead to feelings of inferiority, pessimism, and depression among the less privileged, which can in turn promote the use of alternative competitive strategies, including antisocial behavior (Sanchez 1986, Magid & McKelvey 1987, Wilson & Daly 1993).

Crime may be one response to the acquisition of an external locus of control (Raine, Roger & Venables 1982) or learned helplessness. Learned helplessness and other forms of depression have been associated with reduced levels of serotonin (Traskman, Asberg, Bertilsson & Sjostrand 1981); since reduced levels of serotonin have also been shown to be related to increased aggression, it is likely that physiological changes mediate these psychological and behavioral changes. The neurochemical pathway involved in learned helplessness (identified by Petty & Arnold 1982) appears to be the same one identified by Gray (1982, 1987) and Cloninger (1987a) with mediation of behavioral inhibition/harm avoidance, and by Charney et al (1990) with anxiety-mediated inhibition.

Crime may also function to obtain desirable resources, increase an individual's status in a local referent group, or provide the stimulation that the more privileged find in more socially acceptable physical and intellectual challenges (eg. Farrington 1986, Farley 1986, Lyng 1990, Apter 1992,

Moffitt 1993). According to Apter, "the vandal is a failed creative artist," a bored and frustrated sensation-seeker who "does not have the intellectual or other skills and capacities to amuse or occupy himself" (1992, p 198). Thus, in addition to making the costs of antisocial behavior greater, strong arguments can be made for providing early social support for those at risk, and for developing alternative, nonexploitative, sensation-seeking ventures that can meet the psychological needs of disadvantaged and low-skill individuals.

3.3 Conclusions

A review of the literature in several areas supports the concept of two pathways to sociopathy:

(1) "Primary sociopaths" are individuals of a certain genotype, physiotype, and personality who are incapable of experiencing the secondary, "social" emotions that normally contribute to behavioral motivation and inhibition; they fill the ecological niche described by game theorists as the "cheater strategy" and, as the result of frequency-dependent selection, will be found in low frequency in every society.

(1b) To minimize the damage caused by primary sociopaths, the appropriate social response is to modify the criminal justice system in ways that obviously reduce the benefits and increase the costs of antisocial behavior, while simultaneously creating alternatives to crime which could satisfy the psychophysiological arousal needs of the sociopath.

(2) "Secondary sociopaths" are individuals who use an environmentally-contingent, facultative cheating strategy not as clearly tied to genotype; this strategy develops in response to social and environmental conditions related to disadvantage in social competition and will thus covary (across cultures, generations, and even within an individual lifetime) with variation in immediate social circumstances.

(2b) To reduce the frequency of secondary sociopathy, the appropriate social response is to implement programs which reduce social stratification, anonymity, and competition, intervene in high-risk settings with specialized parent education and support; and increase the availability of rewarding, prosocial opportunities for at-risk youth.

Since the genetics and life histories of primary and secondary sociopaths are so different, successful intervention will require differential treatment of different cases; we thus need to encourage the widespread adoption of common terminology and diagnostic criteria. FOOTNOTES

1. Plutchik's eight primary emotions are: anger, fear, sadness, disgust, surprise, joy, acceptance, and anticipation. Others posit a few more (Izard 1977, 1991) or fewer (Ekman 1971, Panskepp 1982) but what is basically agreed is that primary emotions are those which can be found in other mammals, are hard-wired in the brain, are reflexively produced in response to certain stimuli, are associated with certain, sometimes species-specific, physiological responses (e.g., piloerection, changes in heart rate, facial expressions), and, in humans, are found cross-culturally and at an early age. (See Ortony & Turner 1990 for a dissenting opinion.)

Note that the "social emotions", including love, guilt, shame, and remorse, do not meet the above criteria, and are not considered to be primary emotions by most authors (see Izard 1991 for another perspective). Although distinctly human, the social emotions seem to involve a critical element of learning, and, central to the argument I will be making, are not panhuman.

2. According to Plutchik, cognitive processes themselves evolved "in the service of emotions... in order to make the evaluations of stimulus events more correct and the predictions more precise so that the emotional behavior that finally resulted would be adaptively related to the stimulus event" (p 303). This model of the relationship between emotion and cognition is somewhat similar to Bigelow's (1972), which postulates that intelligence evolved as a result of the need to control the emotions (especially the aggressive emotions), in the service of sociality, and Humphrey's (1976, 1983), which claims that self-awareness evolved because it was a successful tool for predicting the behavior of others.

3. See Draper (1978) and the 1986 special issue of Ethology and Sociobiology (vol. 7 #3/4) on ostracism for further discussion of the role of shunning with specific reference to human societies; see Hirshleifer & Rasmusen (1989) for a game theoretic model of shunning; and see Nathanson (1992) for the importance of the social emotion, shame.

4. The wealth of literature on strategies that people use to detect deception in interpersonal interactions, as well as the technologies that have been developed in order to further enhance that ability in less-personal social interactions, are indicators of the importance we bestow on such ability. (See Zuckerman, DePaulo & Rosenthal 1981, Mitchell & Thompson 1986, and especially, Ekman 1992.)

5. Although the data are overwhelming, the particular articles cited in this section should not be considered to be independent reports, since most of the reviews cited overlap substantially in their coverage, and many authors or teams report their findings more than once in a series of updates. While interested readers should direct themselves to the most recent publications, older publications do contain some information not presented in the updates, and thus are included for thoroughness and ease of reference.

6. Twin study methods yield estimates of what is termed "broad heritability", which includes both "additive" genetic factors (i.e., the summed effect of individual genes on the phenotype) and "non-additive" genetic factors (i.e., the phenotypic effects of dominance interactions between homologous alleles on paired chromosomes, and the epistatic interactions between non-homologous genes throughout the genome). Adoption study methods, on the other hand, yield estimates of what is termed "narrow heritability" which is only the additive genetic component. The additive component is that which can be selected for (or against) as it is transmitted from generation to generation, while the nonadditive effect is unique to each individual genotype and is broken and reshuffled with every episode of sexual recombination. Because of this difference, twin studies typically yield higher heritability estimates than adoption studies.

Another difference between the twin methodology and the adoption methodology, is that twin

studies generally provide heritability coefficients which estimate the proportion of the total explained variance accounted for by genetic factors, whereas adoption studies provide heritability coefficients which estimate the proportion of the total variance (including measurement error) that is accounted for by additive genetic factors. Since measurement error is so large when assessing criminality, adoption studies tend to yield both smaller and more varied heritability estimates than do twin studies.

A third difference is that twin studies yield heritability estimates for members of a particular generational cohort, usually tested at the same age, whereas adoption studies necessarily regress measures from one generation to another. This leads to two problems in interpreting of heritability estimates derived from adoption studies which are not germane to twin studies. The first is that heritability can change across generations- even in the absence of genetic change- due to changes in the environment; this effect cannot be assessed in either twin or adoption studies, but is only a limitation of generalizability for the former, whereas it is conflated in the latter. The second is that heritability can also be different at different ages. Huesmann et al (1984), for example, report that the correlation between children's aggression level and their parents' aggression level when measured at the same age, is greater than the correlation between the child's own aggression level at one age and at a later age. This phenomenon, too, results simply in limited generalizability of heritability estimates derived from twin studies, but yields conflated estimates from adoption studies.

The heritability of .6 reported herein is an estimate of broad heritability as derived directly from twin studies; similar estimates can also be calculated indirectly from adoption study data after accounting for measurement error, but cohort effects cannot be separated out. See Loehlin (1992) for a general discussion of twin and adoption methodologies and Emde et al (1992) and Raine (1993) for further discussions of the relevance of methodological considerations as they pertain to interpretation of the specific studies summarized herein.

7. There is also evidence that at least one form of alcoholism belongs to the sociopathy spectrum: Type II alcoholism, which is also much more prevalent in men than women and seems to be transmitted in the same way (Cloninger, Christiansen, Reich & Gottesman 1978, Bohman, Sigvardsson & Cloninger 1981, Cloninger, Bohman & Sigvardsson 1981, Stabenau 1985, Cadoret 1986, Zucker & Gomberg 1986, and McGue, Pickens & Svikis 1992). Type II alcoholism is characterized by early onset, frequent violent outbursts, EEG abnormalities, and several of the personality attributes that are often seen in sociopathy- impulsivity, extraversion, sensation-seeking, aggressiveness, and lack of concern for others (Cloninger 1987b, Tarter 1988).

8. The interesting phenomenon of differential heritability of traits across the sexes can occur, as in this case, as a result of differential (sex-limited) expression of the same genes, or, as it does with Type I alcoholism (a milder, nonviolent form), as a result of differential environmental experiences of the sexes (Cloninger, Christiansen, Reich & Gottesman 1978). Since heritability is measured as a proportion, the value of a heritability estimate can be changed by changes in either the numerator (variance in a trait due to genetic variance) or the denominator (total variance in the trait). Since the denominator (total variance) is composed of both genetic and environmental variance, changes

in either will change the heritability. This method of defining heritability also explains some other apparent paradoxes, such as how two populations (eg., racial groups or two successive generations of a single group) could have exactly the same genotypic variation with respect to a trait, but because of differences in their environments, exhibit differential phenotypes and differential heritability of the trait.

9. Like the behavior genetic studies cited in Section 2.1, these studies provide overwhelming data, but should not be considered as independent reports, because many overlap or update earlier work. Methodologically, while path models and the longitudinal studies from which they are derived have excellent ecological validity, they are correlational, and while they improve upon cross-sectional designs by noting which factors precede others developmentally, they cannot completely sort out cause and effect- especially in the earliest stages of parent-child interactions.

10. The strategy of sociopaths against one another, although not a test of the current model, is still interesting in its own right. In the Hare & Craigen (1974) modified Prisoner's Dilemma, the majority of sociopaths, on their turn, chose from amongst five "plays", that choice which minimized their own pain (an electric shock) for that trial, but which maximized their partner's. Since partners took turns in selecting from the same five "plays", this strategy actually maximized pain over the long-run. The alternative, pain-minimizing strategy, involved giving both oneself and one's partner a small shock- a choice that most subjects declined to use. This result seems to confirm the sociopath's inability to consider anything other than the immediate consequences of an act, as well as the ineffectiveness of delayed punishment or threat of punishment as a deterrent. In the Widom (1976a) study, sociopaths did not, in general, "defect" more often than the controls, but in the condition when subjects were informed of their partner's move on the previous trial, sociopaths were much more likely than controls to "defect" after a mutual cooperation. On this measure, at least, the sociopaths seemed to demonstrate an inability to "commit" to an ongoing cooperative relationship.

11. Terhune reports that personality is the most important factor for strategy choice within the setting of single-trial Prisoner's Dilemma interactions. In multiple-trial interactions, however, when players have the opportunity to learn one another's dispositions, situational factors are more important for determining play (see Frank, Gilovich & Regan 1993). This is consistent with the idea that the establishment of reputation is a key goal, even for players who on a single trial would choose not to cooperate. For more on the idea that establishing a certain reputation within one's referent group is a conscious goal, and how that might play a role in the development of antisocial behavior, see Hogan & Jones (1983) and Irons (1991).

12. For some of the debate on this issue see the series of comments and replies following Nesse (1991) in the electronic journal Psycoloquy. The comments specifically addressing the relationship between mood and emotion are: Morris (1992), Nesse (1992a), Plutchik (1992), and Nesse (1992b).

13. While searching for data to test this prediction, I came across only the Robins et al (1991) reference in support of it, and one reference in an introductory psychology text (Wade & Tavris

1993) against it. The latter stated that antisocial personality disorder "is rare or unknown in small, tight-knit, cooperative communities, such as the Inuit, religious Hutterites, and Israelis raised on the communal plan of the kibbutz" (p 584). Contact with Dr. Tavris allowed me to follow up on the sources from which the latter statement was derived (Eaton & Weil 1953, Montagu 1978, and Altrocchi 1980). My conclusion, (which is shared by Dr. Tavris in a personal communication), is that the absence or rarity of sociopathy in these small, tightly knit societies, is not a result of the creation of a social system in which sociopaths never develop; rather, it is that secondary sociopaths do not develop (keeping total numbers at the low baseline), and that primary sociopaths emigrate.

Small, closely knit societies have all the properties that game theoretic models indicate will reduce (but not eliminate) the incidence of the cheater strategy (see Section 3.2.1). One of the most important of these features is size per se; the cheater strategy cannot be used repeatedly against the same interactionists and remain successful (see section 1.2). Thus, in small societies, sociopaths are likely to do their damage, acquire a reputation, and leave- to avoid punishment and move on to greener pastures. This "roving strategist" model (Harpending & Sobus 1987, Dugatkin & Wilson 1991, Dugatkin 1992) allows for both the evolution and the maintenance of a low baseline of successful sociopaths even in small groups (like those in which we presumably evolved).

14. Despite being a genetically based strategy, because primary sociopathy is the end product of the additive and interactive effects of many genes, we will not be able to predict or identify individual sociopaths by knowledge of their genotype. We will, however, be able to predict which children will be at risk, given their genetic background, the same way we predict which children will be at risk given their familial and sociocultural background. We will also be alerted to differentiate between diagnoses of primary sociopathy and secondary sociopathy (and our consequent approaches to them) based upon knowledge of an already identified sociopath's genetic and environmental background.

15. Axelrod (1986) and Boyd and Richerson (1992) also consider the extension of punishment not only to cheaters, but to those cooperators who do not, themselves, punish cheaters. The presence of this strategy can lead to an ESS of practically any behavior, regardless of whether there is any group benefit derived from such cooperation. Clearly this extension of the model has some analogues with totalitarian regimes and in-groups of a variety of sorts.

ACKNOWLEDGEMENTS

I would like to thank Mr. Rainer Link, who helped me get started on this project, and who collaborated with me on the first version and first public presentation of the model (Link & Mealey 1992). I would also like to extend thanks to the many individuals who provided useful comments during the revision process: J.D. Baldwin, David Buss, Patricia Draper, Lee Dugatkin, Lee Ellis, Hans Eysenck, David Farrington, Hill Goldsmith, Henry Harpending, James Kalat, John Loehlin, Michael McGuire, Randy Nesse, Jaak Panskepp, David Rowe, Sandra Scarr, Nancy Segal, Chuck Watson, David S. Wilson, and four anonymous BBS reviewers.