

SEX RATIOS AND THE r/K CONTINUUM

by

Courtney E. Ballard

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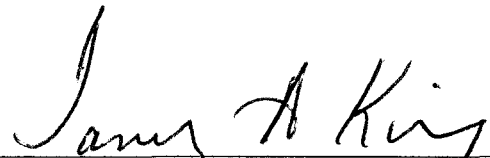
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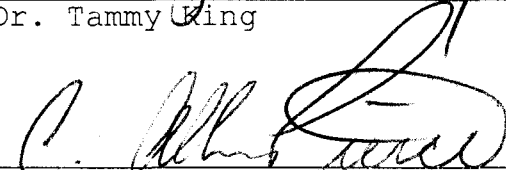
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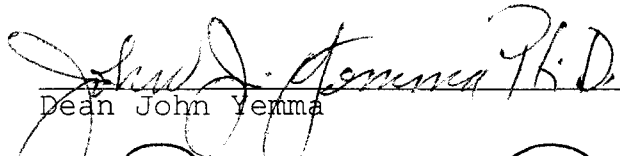
Signature:

  
\_\_\_\_\_  
Courtney Ballard Date 7/30/99

Approvals:

  
\_\_\_\_\_  
Dr. Tammy King Date 7/30/99

  
\_\_\_\_\_  
Dr. C. Allen Pierce Date 7/30/99

  
\_\_\_\_\_  
Dean John Verma Date 7-30-99

  
\_\_\_\_\_  
Dean Peter Kasvinsky Date 8/4/99

## ABSTRACT

An analysis of existing U.S. Census, Uniform Crime Report and Vital Statistics data was undertaken to determine whether a relationship exists between environmental factors, specifically sex ratios, and population behavior. Nine U.S. states were examined for their ratios of men to women, and then compared to existing data concerning marriage rates, birth rates, rates of birth to un-wed mothers, and violent crime rates. The theoretical framework for this research was based on the r/K continuum, a biological theory focused on reproductive strategy and resource allocation of individuals within a population.

Pearson's Correlation coefficients were calculated in order to find the strength, direction, and significance of any linear relationship between the variables. Four hypotheses were tested in this way:

*Hypothesis One: Since high birth rates are more indicative of the r end of the continuum and low sex ratios represent an r-selected population, there should be a statistically significant ( $\alpha < .05$ ) negative correlation between birth rates and sex ratios;*

*Hypothesis Two: Since r-selected populations exhibit higher rates of birth to un-wed mothers, and low sex*

*ratios represent an r-selected population, there should be a statistically significant ( $\alpha < .05$ ) negative correlation between rates of birth to un-wed mothers and sex ratios;*

*Hypothesis Three: Since higher ratios of married to un-married people suggest a K-selected population, and higher sex ratios represent a population at the K end of the continuum, there should be a statistically significant ( $\alpha < .05$ ) positive relationship between marriage ratios and sex ratio; and*

*Hypothesis Four: Since high violent crime rates are associated with an r-selected population, and low sex ratios represent a population at the r end of the continuum, there should be a statistically significant ( $\alpha < .05$ ) negative correlation between violent crime rates and sex ratios.*

The results of the statistical analysis supported only Hypothesis Two; there was a statistically significant inverse relationship between sex ratios and rates of birth to un-wed mothers. The results of the study showed general support for

the evolutionary theory of human behavior, as the trends revealed by the correlation coefficients demonstrated the expected outcome. However, the trends were not statistically significant and, therefore, the remaining hypotheses were rejected.

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## CHAPTER I

### STATEMENT OF PROBLEM

For the past few decades, biological theories of criminal behavior have been avoided and even ostracized by American criminologists (Fishbein, 1998). Perhaps due to the political and social implications, many researchers have avoided theories which include terms such as "crime gene" or "somatotype." Most researchers have instead emphasized social learning theories or theories of self-control to explain criminal or deviant behavior. It is the fear of concrete biological theory that has, in effect, halted its development and/or expansion, however this fear is not without justification. The possible implications of these theoretical perspectives, in the minds of many criminologists, could be overwhelming. For example, if a certain set of nucleotides on the human genome is found to be responsible for criminal behavior, it would then be possible to amend this gene sequence, block enzymes produced by these genes, or at the other extreme, eradicate those individuals marked by the "crime gene."

For reasons based in "human privacy" and "sanctity of life" legislation, these alternative correctional treatments would probably never see implementation in the United States criminal justice system, but the undermining theory would add a new, substantial element to our system of law and

punishment. If biological theories did indeed gain credit with criminologists, it would replace many of the fundamental contentions of our system of justice; specifically, the notion of free will which has been adopted by the government and criminal justice system would dissipate in the face of a new deterministic, biological explanation of human behavior. The implications of such a change in our system would wipe out all of our current treatment programs and uproot the primary principle of blame in our society. If an individual's actions are biologically predetermined, then that individual cannot be held accountable for criminal behavior. In that light, how could we as a society punish a rapist or a murderer if that individual could not control those actions?

It is questions like these that have led criminologists toward different theoretical perspectives, toward theories that integrate social interaction with individual behavior. Veering away from theories that include radical policy changes and/or scientific treatment programs, many criminologists have planted their work in sociological theory and conventional treatment; they have remained on "safer" ground.

One of the most unfortunate aspects of this aversion to biological theory is that many well-formed theories based in the biological functioning of human beings have gone unnoticed, or been discounted without much theoretical discourse. It is safe to say that Cesare Lombroso's theories

of atavism<sup>1</sup> (Lombroso-Ferrero, 1972), Lavater's work with physiognomy<sup>2</sup>, and Gall's work with phrenology<sup>3</sup> (Vold, 1958), can be discounted as viable explanations or indicators of criminal behavior; their work had many problems with validity and reliability and showed little respect for the scientific method<sup>4</sup>. These statements concerning early biological theories, however, are merely criticisms made in light of modern knowledge of deoxyribonucleic acid (DNA) and the functioning of heredity. The fact remains that these contributions were the first of their kind and a milestone for biological theories to come.

It is ironic that these fundamental perspectives have actually worked against modern biological theory. Many criminologists today mention Lombroso and his contemporaries with a little chuckle, as the idea that a person's physical type or facial structure could identify propensities for criminal behavior seems a bit ludicrous. And unfortunately, many more recent biological theories have fallen under the same light as the earlier, less probable, work of biological and physiological theorists without much further

<sup>1</sup> Lombroso claimed that criminals were atavistic types, or evolutionary throw-backs.

<sup>2</sup> Physiognomy is the practice of judging a person's criminal tendencies by examining facial features and outward appearances.

<sup>3</sup> Phrenology is the study of the conformation of the skull in order to determine criminality of an individual.

<sup>4</sup> Using the scientific method, a researcher begins with a theory, develops a hypothesis and tests it.

consideration. The fact remains, however, that the hard sciences have progressed at an exponential rate in the past few decades, in terms of scientific evidence of animal and human behavior. It is unfortunate, therefore, that many biological theories of criminal behavior (and more generally, behavior as an adaptation) have been dismissed as improbable or unsupported without further analysis. As such, many people rely heavily on environmental theories to explain human behavior.

It is important to note here that the major argument of most modern criminologists against biological theories of deviant behavior is that the environment is the primary factor operating on human behavior. However, the theory of the r/K continuum (and many other theories based on biology and evolution) does not negate that contention. The environment does play the primary role in determining human behavior; without the environment, evolution does not work. Behavior is merely an *adaptation* to the environment, a biological reaction to the circumstances surrounding an organism. It is therefore important at this time to accept the work of the biological sciences and biological criminologists, and consider their explanations of human behavior possible, if not probable.

### Need

In the field of criminology, as in any other discipline, it is important to examine all possible theories for human behavior and more specifically, human deviance. If we aim to find the best or most viable explanation, it is necessary to set aside our political and/or personal biases in search of answers. It is through this process that solutions will be found and instituted.

The objective of this thesis is to examine the behavioral variation between groups of individuals in terms of *adaptation* to different social and/or environmental circumstances.

### Purpose

The purpose of this study is to establish a connection between environmental factors and human adaptations and behaviors in response to those factors. Through the analysis of data related to group behavior and dynamics, it is possible to study correlations between social and/or physical conditions and human reactions to them. This study is intended to support the theory that humans react and adapt to their surroundings in order to survive in the broader scheme of evolution.

## Hypothesis

A direct linear relationship exists between environmental circumstances surrounding a population and the individuals' adaptation to them, viewed in terms of behavioral patterns in that social group.

## Overview

The following chapters of this thesis will examine the above stated hypothesis in great detail. In Chapter Two, the theoretical perspective of the research and a comprehensive review of pertinent literature will be introduced. The methodology of this study will be detailed in Chapter Three, and the results of the study and statistical procedures will be presented in Chapter Four. However, before the study design and execution are described, it is important to explain the premises behind the theory of the r/K continuum and introduce this theory into the discipline of criminology.

## CHAPTER II

### THEORETICAL PERSPECTIVE AND REVIEW OF LITERATURE

It has long been accepted that the behavior of animals in the wild can be explained in terms of biological theory. Charles Darwin's (1859) ground breaking work on adaptation and natural selection laid the foundation for experts in the field of animal science. His principles are now commonly accepted as a means of explaining animal behavior. In essence, Darwin argued that animals in the wild are influenced by their immediate surroundings; they adapt to their environment, and more advantageous or disadvantageous adaptations are selected for or against in a dynamic system of evolution.

Although Darwin's work predated any knowledge of the function of genetics, this field has served only to strengthen his contentions. Modern studies of plant and animal genetics have far exceeded Mendel's pea plant experiments from the 1850s and 1860s, and there is little argument about the causes and mechanisms surrounding animal behavior. Most scientists agree that organisms adapt to long-term changes in their surroundings over very long periods of time through complex alterations in the configurations of base-pairs in their DNA sequencing. (Short-term adaptation is usually behavioral rather than genetic, whereas long-term adaptation reflects generations of genetic mutation and alteration. Only drastic changes in the environment will cause the process of long-term

adaptation/genetic alteration to occur more rapidly.) The ever-changing genetic make-up of an organism, therefore, represents the mechanical aspect of behavioral change, while adaptation represents the over-riding reason *why* organisms go through that change.

With that in mind, many scientists have explained the specific behaviors of animals in terms of adaptation to their particular environments. The factors they have identified vary with every species and the circumstances surrounding those species, but the major contributors seem to fall under the following categories: resource availability, population size, population birth and death rates, and male to female ratios within that species (MacArthur & Wilson, 1967). All of these factors seem to have some effect on the methods and strategies of animal adaptation.

If it is generally agreed that these environmental factors influence genetic and behavioral changes in animals, then it seems logical that the same would be true of humans (if one supports Darwin's work). The physical and socially constructed environment should incite humans to adapt to the conditions surrounding their existence. In order to ensure their survival in the "gene pool," humans adapt to long-term changes through activation of particular base-pair sequences or actual mutations in their DNA sequencing. This process



could occur over several generations of offspring before the alteration is manifest. In the end, however, those who are well-adapted (and their offspring) will be more likely to withstand the constant change and selection associated with evolution.

*But, humans do not fall into the same category as wild animals;* at least that is the presumption of many modern sociologists, psychologists and behaviorists (Wilson & Herrnstein, 1985; Jeffery, 1990). Humans have the ability to think critically, make choices based on available options, however limited; we do not function on instinct alone. Since this is thought to be true, many social scientists are unwilling to view human behavior in the same light as animal behavior, and this is why more modern biological theories of human behavior have been ignored by the sociological and criminological communities (Fishbein, 1998).

It is the conviction of this researcher, however, that sociologists and criminologists must venture away from this anthropocentric viewpoint. We have reached the point in the scientific community where we can fully accept that we too, as humans, are made up of the same genetic material as the "less cognizant" animal kingdom. Our DNA might contain many more base pairs (in most cases) and function in a much more complex manner, but the fact remains that we are not above the

theories and principles we have assigned to our cohabitants of this planet. In order to more fully understand our own behavior, we must accept our modern theories of adaptation and examine more closely the reason why we exhibit certain behaviors. We must seek to understand our environment, our physical and social surroundings, in order to gain a clearer picture of our own actions, criminal and non-criminal.

For the past two decades, scientists in the field of animal biology have used a concept known as the r/K continuum to describe animal behavior (Daly & Wilson, 1978; Gadgil & Solbrig, 1972; MacArthur & Wilson, 1967; McNaughton, 1975; Pianka, 1970). It is referred to as a continuum because r and K strategies represent the two extremes or reproductive activity and resource allocation. Most organisms fall somewhere between these two extremes. "The position of a population on the evolutionary r/K continuum should depend upon both the properties of the ecosystem and the ecological role of the population in that ecosystem" (McNaughton, 1975, p.251).

In essence, organisms which lie closer to the r end of the continuum invest more time and energy into rapid reproduction/procreation and the colonization of all possible available resources without investing much time in caring for their offspring. In contrast, organisms which are categorized

as lying closer to the K end of the continuum tend to invest more energy into survival and the rearing of few viable offspring with high competitive availability. However, it is important to note that in the field of biology, organisms are rarely classified as either r-selected or K-selected, as this continuum is meaningful only as a basis for comparison. No classification system currently exists for r- or K-selection; they merely represent differing ends of one spectrum upon which many species can be placed (Gadgil & Solbrig, 1972)

In the scheme of evolutionary theory, the underlying principle of r- and K-strategies is based on reproduction and the allocation of resources as the purpose of adaptation. In the barest sense, it centers around assuring the survival of individual genetic material. There are, however, several behavioral traits associated with these differing strategies that have been observed in the wild and go beyond simple reproduction.

As stated above, the principle object of the K strategy is the investment of resources to ensure the survival of a few young who will stand a greater chance of reaching reproductive maturity to pass on genetic material to future generations. As it requires quite a lot of time and energy to successfully rear young to the age of reproductive maturity even in a moderately saturated environment, both male and female adults must assist this process. Therefore, a dual parent effort is

typically indicative of the K reproductive strategy.

In a *highly* saturated environment, however, it is often necessary for organisms to band together and share the responsibilities involved with caring for and/or providing for offspring (Daly & Wilson, 1978; McNaughton, 1975). This altruistic pattern of behavior is evident when closely-related adults of a species seem to protect and feed all offspring, direct progeny or not. Therefore, organisms that have adopted the K strategy of reproduction tend to exhibit more pronounced patterns of social charity and more complex schemes of social organization.

Conversely, those organisms associated with r strategies of reproduction exhibit behavior that manifests itself in selfish motivation. In this system of rapid reproduction (and consequently, rapid genetic mutation and adaptation), very few resources are directed toward the actual care for young, while most energy is consumed in the reproductive process. Those organisms that reach reproductive maturity copulate with as many mates as possible in order to maximize the number of viable offspring in the environment. Dual parent care for young is almost non-existent in this strategy of behavior, as competition for many mates is prevalent. Therefore, the r strategy is characterized by a high rate of reproduction, a high rate of genetic mutation and adaptation, a higher rate of

violent activity and fewer cooperative efforts.

In addition to behavioral characteristics, there are indicators that manifest themselves as physical traits associated with r and K strategies of reproduction. Animal biologists have found that those species which have adopted a reproductive strategy closer to the r end of the continuum tend to have progeny in rapid succession, frequently giving birth prematurely (Chisholm, 1988). In addition, the progeny often exhibit low birth rates and high rates of twinning. The logical relationship between r strategies and these physiological characteristics of offspring lies in the underlying object of this reproductive strategy. If the purpose of this strategy is to produce as many offspring as possible while investing the least amount of energy to the actual survival of the offspring, then it follows that low birth weights and high rates of premature birthing would be a product of this strategy of reproduction.

Closer to the K end of the spectrum, the reverse is true. The intended outcome of the K reproductive strategy is to rear a few viable offspring and allocate all resources and energy to this process. Therefore, it is not surprising to see females wait until the appropriate time, or the appropriate circumstances, to find a mate and bear young. They will usually carry their young to full term and give birth to young that fall within the normal range of birth weights.

It is important to note here that, in addition to high inter-species variability along the r/K continuum, there is significant intra-species variability as well (Rushton, 1988). Obviously, female fish who lay hundreds of thousands of eggs to be fertilized by one or many males can be easily contrasted with higher primates which spend years raising very few young. However, animal biologists have noted that placement along the continuum can vary greatly with age, sex, resource availability, and sex ratios within a particular species as well (Ellis, 1987; Gadgil & Solbrig, 1972). Younger members of a species lean toward the r end of the spectrum. Males of any age tend to exhibit r selected traits as well. In addition, a high availability of resources in a low density population provides for greater reproductive opportunities (r strategy), as well as greater numbers of female mates available to fewer males. It is these environmental circumstances that dictate the optimum strategy of reproduction within and between species in the animal kingdom (Ellis, 1987; Pianka, 1970).

*So can this classification system extend beyond the animal kingdom into the domain of Homo sapiens? Recently, a select number of criminologists and sociologists have attempted to integrate the r/K model into modern behavioral theory (Ellis & Walsh, 1997; Ellis 1989a; Ellis 1987; Rushton*

& Bogaert, 1988; Rushton & Bogaert, 1987). Although controversial, recent studies have demonstrated how it is possible to place differing sub-groups of humans along the spectrum of reproductive strategies. If these sub-groups were to be placed closer to the r or K extremes on the continuum, they would thereby exhibit traits particular to the associated categories. Those demonstrating selfish motivation of reproduction and violent competition for mates and resources would fall closer to the r end of the spectrum, and those groups demonstrating greater resource allocation to a few young and a more altruistic behavior pattern would fall closer to the K end of the spectrum.

In order to test the theoretical placements of humans along the r/K continuum, Lee Ellis, a major figure in facilitating the convergence of r/K selection and human behavior, outlined seven hypotheses which would support his arguments (Ellis & Walsh, 1997). It was the purpose of this research to examine, through additional research, and amend (where necessary) certain aspects of this preliminary theoretical perspective.

*Hypothesis 1: Since r-selected strategies provoke greater violence and selfish motivation, and these traits are found more often in male members of an animal population than female members, violent criminality should be more prevalent in male*

*humans than female humans.* The first component of this hypothesis is that males fall toward the r end of the spectrum, and females tend toward the K end of the spectrum (Buss & Schmitt, 1993). It is logical to state that females would tend toward the K end of the reproductive spectrum as it is the female that carries the offspring in her body. Most females do not give birth to more than one child at a time, so it is therefore less probable that her reproductive strategy would fall closer to the r end of the spectrum. In addition, it is usually the mother of the offspring who cares for the child once it is born. Since raising a child is a time and energy consuming venture, the mother will usually prefer assistance in the provision of food and shelter for her young. It is evolutionarily advantageous, therefore, that females adopt a K strategy of reproduction and resource allocation.

Males, on the other hand, do not carry offspring in their bodies, and they cannot be certain that the offspring are actually genetically related to them. It is much more beneficial for males, therefore, to adopt a reproductive strategy more closely situated to the r end of the spectrum. Since the ultimate goal of animal behavior, in terms of evolution, is reproduction, then it is much more advantageous for males to attempt to impregnate as many females as possible. It follows, that males, exhibiting r-selected



reproductive traits, would exhibit many other behavioral traits associated with that strategy: selfish motivation and violent tendencies.

That assertion is apparently supported by our national crime statistics. It is difficult to refute the fact that the vast majority of our prison inmates are male, and most of our violent crimes are perpetrated by males. Some people might argue that these statistics reflect the sexism inherent in our criminal justice system, but it would be hard for any person to argue that males are not more violent than females (even with the growing number of incidents of female violence). While male violent tendencies may well be explained in other terms, this hypothesis does indeed support the r/K theory of reproduction.

*Hypothesis 2: Since the groups that demonstrate r strategies of reproduction tend to produce offspring with certain physiological traits, violent criminal offenders should also exhibit high rates of twinning, low birth weights, and high rates of premature birthing.* This somewhat controversial element of Ellis's r/K theory of criminal behavior, makes the assumption that individual propensities for r- or K-selected behavior are passed down through specific genetic material. He argues that there are sub-groups of the human population which have evolved, through generations of

genetic alteration, and adapted to the environment through the adoption of either r or K strategies of reproduction and resource allocation. Therefore, individuals born and raised under different strategies would exhibit the characteristics of these strategies passed down to them through the generations.

It is the belief of this researcher, however, that individuals are not born with a propensity for one strategy or another; those individuals raised in an r-selected sub-group will not necessarily adopt those strategies unless the environment dictates the necessity. All individuals that are able to adapt to their environment have the ability to select reproductive strategies appropriate to their immediate environment. If the immediate surroundings of individuals warrant r or K strategies, then those who are able to adapt to that environment will adopt the strategy best suited to the circumstances. If this is true, the physiological traits associated with particular strategies will not necessarily be apparent in those who adopt the r strategy, only their progeny. Therefore, this hypothesis remains unsupported until future research undertakes the endeavor to test it.

*Hypothesis 3: Since those individuals that lie closer to the r end of the continuum tend to have children earlier in life and in larger numbers, criminals and psychopaths should*

*have many siblings and be born to younger parents.* Again, this hypothesis is based upon the idea that those groups which demonstrate r-selected traits will genetically pass these traits to their offspring, and those offspring will have a genetic predisposition for criminal or violent behavior. Ellis and Walsh (1997) have stated that this hypothesis can be supported by statistical correlations between criminal behavior and large family sizes, but there are some major exceptions to these findings. Some religious groups such as the Amish and the Mormons tend to have exceptionally large families, but they also have some of the lowest reported crime rates. This could be due to internal control and sanctioning of criminal behavior within the family or religious group. Ellis, on the other hand, has proposed that religion might be an over-riding factor in the r/K theory, and he uses this to explain this contradiction.

If, however, all individuals have the ability to adapt to their immediate surroundings, then a reproductive strategy is not genetically predetermined. Those individuals reared in households with many children may not themselves adopt the r strategy; conversely, those individuals reared in households with few children may not adopt the K strategy. This adaptation would be a product of the many forces operating and interacting in an individual's environment. It could be

argued, therefore, that one's family size would not indicate (or predetermine) the strategy selection for that individual. Family size could only be correlated with the reproductive strategy of the parents, and again, these theoretical correlations have not been explored to test this hypothesis.

*Hypothesis 4: There should be a correlation between criminality in parents and the criminality in their children; the biological parents of criminals should have children who are also criminal.* Here, Ellis argues that traits associated with r strategies of reproduction (i.e. violent behavior and criminality) are passed from one generation to the next; individuals have a greater predisposition to learn r-selected activities if their parents pass that genetic information to them. He states that this hypothesis is heavily supported by crime statistics, but he also admits that there are many other theories that could explain this correlation.

One of these other explanations could center around social learning theory and a greater opportunity for certain individuals to learn and adopt particular strategies of behavior. If not a genetic predisposition, perhaps individuals raised in an environment in which it is conducive to employ an r strategy, can learn to employ that strategy with more ease than others raised under the K strategy. It is also possible that this correlation merely reflects a static

environment between generations. If the biological parent adapts to his/her environment using the r strategy of reproduction, and the environment does not change, then the offspring of that parent will probably find it advantageous to adopt that same strategy. The data would seem to support this hypothesis (Nagin & Farrington, 1992).

*Hypothesis 5: The racial and ethnic differences that exist in regard to the r/K continuum should be correlated with the associated behaviors of certain strategy selections; those exhibiting r-selected strategies should also demonstrate the highest rates of violence and criminal behavior.* Although controversial, evolutionary theorists have proposed that there are differences in reproductive strategy between differing racial and ethnic groups (Ellis, 1987; Rushton & Bogaert, 1988). The preliminary data seem to suggest that blacks are more r-selected than whites who, in turn, are more r-selected than Asians. This is supported by rates of birth, rates of prematurity, low birth weights, larger family sizes, and the earlier onset of sexual activity. This theory is also supported by crime statistics which state that blacks have higher crime rates than whites who, in turn, have higher rates of crime than Asians.

Obviously, this is a sensitive subject, one which no one wants to approach for fear of appearing racist or entering

into a realm of continued attack by the scientific community. However, it is important to fully examine these statistics provided and attempt to understand exactly why the numbers appear the way they do as there are many hypotheses regarding this subject. Some scientists argue that the differences in reproductive behaviors between racial groups are related to the varying climates in which each group resides (Miller, 1994). Ellis (1987, 1997) argues that certain races have genetic differences, and it is natural to assume that the genetic differences extend all the way to reproductive strategy selection. This researcher argues, however, that sexual strategies are not passed from one generation to the next through genetic material; they are merely adaptations to the immediate environment.

It is the environment, therefore, which will determine the sexual strategy of an individual. As in nature, available resources, population size, birth rates, death rates and male to female ratios in a population will usually influence sexual strategy. Those individuals which are well-adapted to their environments will survive. It seems logical, therefore, to argue that races of humans are not genetically programmed to behave a certain way; differing behavior strategies are merely adaptations to the surrounding environment.

For humans, this surrounding environment is composed of many different factors which are similar to those surrounding

animals in nature; their sexual strategies will depend on available resources such as socioeconomic level, education level, availability of food and shelter, and job status. These strategies also depend on population size and density, birth and death rates, and sex ratios in the population. These aspects of society are the major predictors of social behavior, and it is likely that the strategies associated with them may be associated with groups *because* of their race, not genetically determined by their race.

According to Guttentag and Secord (1983), the ratio of men to women in a social setting has profound effects on the behavior of that society. Not only do sex ratios determine the predominant sexual strategy of that population, but these ratios affect the roles that men and women take in a social hierarchy. Ratios of men to women can be high or low based on a number of factors such as: high male or female mortality rates, high rates of male or female imprisonment or banishment, high rates of male or female immigration or emigration, etc. When these ratios change, the very nature of that society changes. These changes are noticeable even in very small sub-groups (racial and socio-economic groups) in a population.

The black component of American society is an especially interesting study, as the ratio of males to females in this

sub-group is relatively low (Guttentag & Secord, 1983; South & Trent, 1988). (That is, there are more females than males.) In areas of high concentration, this low male to female ratio is more pronounced. For example, according to the 1990 U.S. Census, the ratio of black males to females in St. Louis, Missouri, was 80 males to every 100 females between the ages of 15 and 49 (U. S. Census Bureau, 1991). This substantial difference in numbers of black males and females is due to several circumstances surrounding black Americans. The mortality rate of black males is unusually high, and the rate of imprisonment of young black males is also high. Guttentag and Secord (1983) suggest that the forces operating on the sex ratios in black populations in the United States could be based on behavior particular to that group or discrimination against that group. For example, gang-related homicide is a social circumstance somewhat unique to young black males. In addition, discrimination against young black males may land a larger percent of them in prison or jail than members of other racial sub-groups (South & Trent, 1988). Factors like these operating in predominantly black populations will skew the ratio of males to females in favor of females.

If this is true, then it could provide an explanation for the findings of several studies that support racial correlations with strategies on the r/K continuum. Since r-selected traits are associated with higher violent and



criminal behavior, and black Americans seem to be linked with these traits, it may be possible to explain the reason why this is so. Perhaps at the root of perceived racial differences lie explanations based more in environmental adaptation than vastly different genetic programming. If low sex ratios can account for sexual strategy and the accompanying social behavior patterns, then it may be found that racial differences are based on environmental conditions, not intrinsic tendencies for violent or passive behavior.

*Hypothesis 6: Since violent and criminal behavior is associated with a strategy closer to the r end of the spectrum, whichever social class (or stratum) exhibits the most r-selected traits should also demonstrate the highest degree of violent and criminal behavior. Low social status is typically linked with high criminal activity, but there seems to be little evidence regarding the differences in criminal behavior between the middle- and upper-classes (Ellis, 1988). It can be inferred, therefore, that lower socioeconomic classes will be associated with the r end of the continuum. There exists no current research, however, which associates any of the other behavioral characteristics (such as premature birthing, high rates of illegitimacy, low birth weights, and earlier sexual maturity, etc.) with the lower social stratum; therefore, this hypothesis only serves to tentatively link*

social status with particular reproductive strategies.

*Hypothesis 7: Since males tend to be more r-selected than females, populations with low sex ratios (more females than males) will have a greater propensity for an r strategy of reproduction and behavior than those populations with balanced or high sex ratios.* Based on the work of Guttentag and Secord mentioned previously (1983), imbalanced ratios of males to females will change the very nature of reproduction and social behavior. That sex which is in high demand (low numbers) generally has what is known as "dyadic power" in that population. "Dyadic power" refers to an inherent influence over sexual strategy based on the low supply and high demand for members of that particular sex. In essence, the strategy preference for males (r) or females (K) will become prevalent if one of those two sexes falls into short supply.

As stated above, males tend to be more r-selected than females; it is more advantageous for males to demonstrate high promiscuity, create transient ties with their female counterparts, and invest more time and energy in the reproductive process, and less time in the actual rearing of his offspring (Buss & Schmitt, 1993). Conversely, females are more K-selected than males. Since females cannot rapidly give birth to many progeny and it takes a lot of energy to raise a few young, it is not befitting a female to mate promiscuously.

They will look for long, lasting relationships with a male who will assist in the rearing of offspring, and they will invest most of their energy into assuring the survival of the few offspring they have.

Guttentag and Secord (1983) explained that if this ratio of males to females is low, males will be in high demand and, therefore, control the social behavior of that society. If, however, the ratio of males to females is high (more males than females), then females will have control over reproductive and social strategies. Therefore, it is ultimately this social factor that has great influence over the behavior of a population, and sex ratios play a major role in the selection of strategies on the r/K continuum. This hypothesis seems to be generally supported by the preliminary research (Ellis and Walsh, 1997).

Aside from the preliminary work of Ellis (1997; 1988; 1989a) and Walsh (1997) and the supporting social theories of Guttentag and Secord (1983), there has been very little research involved in testing the relationship between sex ratios and human behavior, specifically criminal behavior. Occasionally, a fragment of philosophical banter will initiate a short-lived argument of the principles behind the theory (Rowe, 1996), but very little actual research exists in the area of evolutionary theories of human behavior.

A study by South and Trent (1988) was conducted across

117 nations in order to assess the differences in gender roles in society based on ratios of men to women. While the study was not intended to examine criminal behavior, it did focus on many of the other variables involved in this theory. The study itself was intended to examine female roles in society and the value placed on them in areas of differing sex ratios. South and Trent believed that female dyadic power, or lower numbers of females in the population (Guttentag & Secord, 1983), would constitute a society in which women were more valued. Conversely, higher numbers of women in a population would provide men with dyadic power, and women in those societies would be de-valued.

In order to test their hypothesis, South and Trent examined rates of female suicide, female literacy rates, average age of marriage for females, marriage rates, and labor-force participation rates. While the results of their study did not support each research hypothesis presented, the results generally demonstrated the expected relationships between the variables. Although this study was not specifically examining the effect of sex ratios on criminal behavior, it did provide support for the notion that population behavior in a general sense is affected by these ratios.

Another study conducted by Bereczkei (1993) focused on the behavioral differences between the Gipsies of Eastern

Europe and the Hungarians in terms of r/K selection, but little or no attention was paid to the explanation of cause. That is, the two social groups were compared for differences in behavior and environmental circumstances, and it was established that the Gipsies were more r-selected than the Hungarians; however, very little information or conjecture was offered in the way of explaining why these differences exist. Berezkei did include quantitative measures of the variables involved (fertility, birth spacing, mortality, age distribution, and physical parameters). The results did concur with the hypothesis that the "un-settled" Gipsies showed higher rates of fertility, birth rates, mortality, and female surplus, which is consistent with an r-selected reproductive strategy. The Hungarians demonstrated lower rates of fertility, lower birth rates and mortality, and a more balanced ratio of males to females. It can be inferred, therefore, that the research tentatively supports the hypothesis that sex ratios affect human behavior and/or sexual strategies.

#### Discussion and Summary

While the theory of the r/K continuum is not new to the field of biology, it is certainly a revolutionary idea in the realm of criminology. In fact, a few experts are finally examining the possibility of biological and/or evolutionary

theories to describe human deviant and non-deviant behavior. The works of Ellis (1987; 1988; 1989a) and Walsh (1997) have broken new ground in criminological theory, but there remains much research to be done in the way of support for their theories.

The seven hypotheses of this theory are currently the most logical avenues of exploration in this theoretical perspective, and they may now be considered the stepping stones for future research. These hypotheses are:

*Hypothesis One: Since r-selected strategies provoke greater violence and selfish motivation, and these traits are found more often in male members of an animal population than female members, violent criminality should be more prevalent in male humans than female humans;*

*Hypothesis Two: Since the groups that demonstrate r strategies of reproduction tend to produce offspring with certain physiological traits, violent criminal offenders should also exhibit high rates of twinning, low birth weights, and high rates of premature birthing;*

*Hypothesis Three: Since those individuals that lie closer to the r end of the continuum tend to have*

*children earlier in life and in larger numbers, criminals and psychopaths should have many siblings and be born to younger parents;*

*Hypothesis Four: There should be a correlation between criminality in parents and the criminality in their children; the biological parents of criminals should have children who are also criminal;*

*Hypothesis Five: The racial and ethnic differences that exist in regard to the r/K continuum should be correlated with the associated behaviors of certain strategy selections; those exhibiting r-selected strategies should also demonstrate the highest rates of violence and criminal behavior;*

*Hypothesis Six: Since violent and criminal behavior is associated with a strategy closer to the r end of the spectrum, whichever social class (or stratum) exhibits the most r-selected traits should also demonstrate the highest degree of violent and criminal behavior; and*

*Hypothesis Seven: Since males tend to be more r-selected*

*than females, populations with low sex ratios (more females than males) will have a greater propensity for an r strategy of reproduction and behavior than those populations with balanced or high sex ratios.*

Through the use of some of these hypotheses and consideration of research designs employed in other studies, it is possible to test the validity of the theory of the r/K continuum as it applies to human reproductive and/or social behavior. It is the goal of this research to further examine this theory and test some principles found in the presented hypotheses, more specifically the effects of sex ratios on behavioral categories such as marriage rates, birth rates, rates of birth to un-wed mothers, poverty levels, and violent crime rates. In the following chapter, the methodology for this research project is outlined, and justification for the research design and application are presented.



## CHAPTER III

### METHODOLOGY

The method of research employed for this study was an analysis of existing U.S. Census data in order to establish a correlation between sex ratios and social/behavioral variables. With that established, it was possible to infer whether the associated behavioral characteristics of r and K strategies were associated with ratios of men to women. In order to do this, it was appropriate to isolate particular geographic locations that represent particularly high or particularly low sex ratios. Once several geographic areas with varying ratios of males to females were located, a statistical evaluation of violent crime rates and behavioral attributes provided quantitative information about how sex ratios affect a population.

#### Variables

The key independent variable in this study was the sex ratio of given geographical areas expressed as "x" number of males per 100 females, between the ages of 15 and 49. This age bracket was established by South and Trent (1988) as the best grouping for measures of sex ratios in relation to corresponding behavioral patterns due to the fact that this distribution represents the years of most probable fertility for adult females and most adult males. Since reproduction

lies at the foundation of the theory of the r/K continuum, it is befitting to exclude members of a population who are not reproductively viable and could not affect this social dynamic.

The dependent variables in this study were identified as characteristics associated with r- and K-selection, or social and behavioral reactions to the environment, such as: birth rates, rates of birth to un-wed mothers, marital status figures and rates of violent criminal activity. These indicators place particular groups closer to either the r or the K end of the spectrum, and once classified, it was possible to test for correlations between r and K strategies and the sex ratios of particular areas. It should be noted here that socio-economic status figures are included in the dependent variables to be studied. While no current theory exists as to how material wealth factors into the theory of r/K selection, it was deemed a topic of interest due to the close association between crime and socio-economic status, and therefore, included in the study.

The birth rates (expressed as "x" number of live births per 1,000 women) and rates of birth to un-wed mothers (expressed as "x" number of live births to un-wed mothers per 1,000 live births) were provided by the Vital Statistics of the United States (National Center for Health Statistics, 1990; 1991). Due to the method of reporting birth rates and

rates of birth to un-wed mothers by the National Center for Health Statistics, both variables are examined for the years 1990 and 1991. Because these variables are merely indicators of sexual activity, it was necessary to collect data from both of these years in order to fully encompass the "window" in which children conceived in 1990 were born.

Marital status figures (expressed as "x" number of currently married persons per 100 never married, separated, widowed or divorced) and socio-economic status information (expressed as "x" number of persons above the poverty level per 100 persons below the poverty level) were calculated from data provided by the U.S. Census Bureau (1990). The analysis of crime statistics was based primarily on violent crimes, as those are the crimes associated with the r-strategy of reproduction and resource allocation. Those data (expressed as "x" number of violent crimes<sup>1</sup> per 100,000 people in a given area) were collected from the Uniform Crime Reports (Federal Bureau of Investigation, 1990).

### Sample

The sample group came from the population of U.S. states (including the District of Columbia), and the selection criterion was based on the ratio of men to women (expressed as "x" number of men ages 15-49 to every 100 women ages 15-49).

<sup>1</sup>Violent crime includes murder, forcible rape, robbery and aggravated assault as defined by the Uniform Crime Reports.

States were chosen as the unit of analysis because state-level data was the most reliable in terms of geographical consistency for all data sources employed. Once the sex ratios for each state were established, a mean sex ratio and standard deviation were calculated. The theoretical perspective of this research implies variations at the more extreme ends of the spectrum; therefore, the sample included only those states that represented significantly higher or lower sex ratios from the mean. For that reason, only nine states were selected to be part of the sample. These nine states fell outside of one standard deviation above or below the mean.

Table 1

Summary of Sample Group Sex Ratios: Male to Female

STATE	SEX RATIO
Alaska	114.63
Hawaii	109.05
Nevada	107.31
California	106.71
North Dakota	106.07
Alabama	96.59
Louisiana	96.06
Mississippi	95.27
District of Columbia	92.07

The mean sex ratio for the United States was 1.0031 with

a standard deviation of 0.0375. The states included in the sample were Alabama, Alaska, California, District of Columbia, Hawaii, Louisiana, Mississippi, Nevada and North Dakota (See Table 1). The sample was based purely on statistical procedure, and no geographical or social bias entered into the selection process.

### Measures

The measures used for this study were based on existing data from national databases published by various government agencies. The primary resources were the 1990 U.S. Census Bureau's report on population statistics, the National Center for Health Statistics' 1990 and 1991 Vital Statistics of the United States, and the 1990 Uniform Crime Reports published by the Federal Bureau of Investigation. All of the sources employed for the purpose of this study comes from the year 1990 in order to remain consistent across all data sources, as the most current source of U.S. Census data was published in that year. The reliability of these sources is directly related to the method of data collection employed by these agencies.

### Design

The design of this study was exploratory in nature; as very little research currently exists regarding the

relationship between sex ratios and social/adaptive behavior, it was necessary to approach the topic in its broader sense and provide the foundation for future research. The aim of this endeavor was to find a relationship between sex ratios, ratios of men to women, and other social behaviors associated with the r/K continuum.

The theory associated with the r/K continuum states that increased numbers of males in a particular population will produce certain characteristics within that population based on adaptation to those surroundings. Some of these characteristics would be decreased birth rates, decreased rates of birth to un-wed mothers, increased marriage rates, and lower violent crime rates. This is based on the high demand for women in the population and the subsequent dyadic power that women hold. Conversely, decreased numbers of males in a population will produce increased birth rates, increased rates of birth to un-wed mothers, decreased marriage rates, and higher violent crime rates.

Using existing data published by the aforementioned sources, it was then possible to look for a descriptive statistical correlation between the independent and dependent variables for the most extreme cases of high and low sex ratios in the population. These correlations provided evidence for the theory of criminal behavior and the r/K continuum.

### Testable Hypotheses

*Hypothesis One: Since high birth rates are more indicative of the r end of the continuum and low sex ratios represent an r-selected population, there should be a statistically significant ( $\alpha < .05$ ) negative correlation between birth rates and sex ratios;*

*Hypothesis Two: Since r-selected populations exhibit higher rates of birth to un-wed mothers, and low sex ratios represent an r-selected population, there should be a statistically significant ( $\alpha < .05$ ) negative correlation between rates of birth to un-wed mothers and sex ratios;*

*Hypothesis Three: Since higher ratios of married to unmarried people suggest a K-selected population, and higher sex ratios represent a population at the K end of the continuum, there should be a statistically significant ( $\alpha < .05$ ) positive relationship between marriage ratios and sex ratio; and*

*Hypothesis Four: Since high violent crime rates are associated with an r-selected population, and low sex*

*ratios represent a population at the r end of the continuum, there should be a statistically significant ( $\alpha < .05$ ) negative correlation between violent crime rates and sex ratios.*

### Analysis

After the preliminary estimates of sex ratios for the 50 states and the District of Columbia were calculated and selections for inclusion in the sample determined, the data were compiled for each state in the sample. The method of statistical analysis for this data was the calculation of Pearson's Correlation Coefficient ( $r$ ) as this statistic demonstrates the strength, direction and significance of the relationship between the variables<sup>2</sup> (Kiess, 1996). This procedure was selected as the most appropriate in order to provide the answer to whether sex ratios have any effect on indicators of behavioral patterns of human behavior. This was preformed using a computer software program known as "Statistical Procedures for the Social Sciences" or SPSS.

### Summary

In this chapter, the research method and design was discussed. Due to the exploratory nature of this study, it

<sup>2</sup> This statistical procedure operates under the assumption that both the independent and dependent variable scores are normally distributed in the population sampled.



was necessary to establish a research design in which all data are consistent in year of publication and geography. For this reason, nine U.S. states were selected based on significantly high or low ratios of men to women between the ages of 15 and 49 (independent variable), and data regarding birth rates, rates of birth to un-wed mothers, marriages ratios, violent crime rates, and socio-economic status data (dependent variables) within those States were compiled from existing government data sources. It was expected that the data would provide support for the theory that human social and/or adaptive behavior is related to the ratio of men to women in society, and therefore, the r/K continuum. In the following chapter, the comprehensive outlines of the statistical procedures employed and results of this study are presented.

## CHAPTER IV

### RESULTS, ANALYSIS AND DISCUSSION

The results of this study show general support for the theory of r/K selection in human behavior. Although the general trends identified by Pearson's Correlation Coefficients are in general accordance with the contentions of the theory of the r/K continuum, many of these trends are not statistically significant at the  $\alpha < .05$  level. The results of the statistical analyses performed on the sample group ( $n = 9$ ), however, did not stray far from those anticipated (See Appendix A for complete summary of results). The statistics are presented in the following section of this chapter, and the implications of these statistics are examined below in the Discussion section of this chapter.

#### Results

Sex Ratios and Birth Rates      *Hypothesis One: Since high birth rates are more indicative of the r end of the continuum, and low sex ratios represent an r-selected population, there should be a statistically significant ( $\alpha < .05$ ) negative correlation between birth rates and sex ratios.* In order to accurately assess the birth rate as a result of sex ratios during a given year, the ratios of live births per 1,000 people were examined for the years 1990 and 1991. Because the

gestation period for a human child is approximately 9 months, an inclusion of birth rates during both 1990 and 1991 was necessary in order to fully account for any pregnancies that occurred as a result of the circumstances surrounding the population during 1990.

Although there exist obvious problems with the validity of this consolidation, the fact that the data were collected on an annual basis made it impossible to specify the birth rates for the particular times during which births would have occurred as a result of the environmental factors present only in 1990. Certainly, births that occurred during the first eight months of 1990 and the final four months of 1991 were unlikely to have been conceived during the year 1990. However, the nature of the existing data made it impossible to isolate the pertinent months during those years in order to accurately measure the births that resulted from sexual activity solely in 1990. Therefore, it was decided that an examination of birth rates for both years would provide the most accurate figure possible under the given circumstances.

The coefficient yielded by Pearson's Correlation between the variables Sex Ratio and Birth Rate for 1990 suggested a *moderate positive* relationship ( $r = .402$ ); however, this correlation was not significant at the  $\alpha < .05$  level. For the year 1991, the Pearson's Correlation coefficient for the

variables Sex Ratio and Birth Rate was even lower ( $r = .239$ ) suggesting a *weak positive* relationship between the variables, but again this relationship was not found to be statistically significant at the  $\alpha < .05$  level. Therefore, it is necessary to reject the above stated hypothesis regarding the variables. There is not a statistically significant ( $\alpha < .05$ ) negative relationship between sex ratios and birth rates for the populations under study.

Sex ratios and Rates of Birth to Un-Wed Mothers Hypothesis

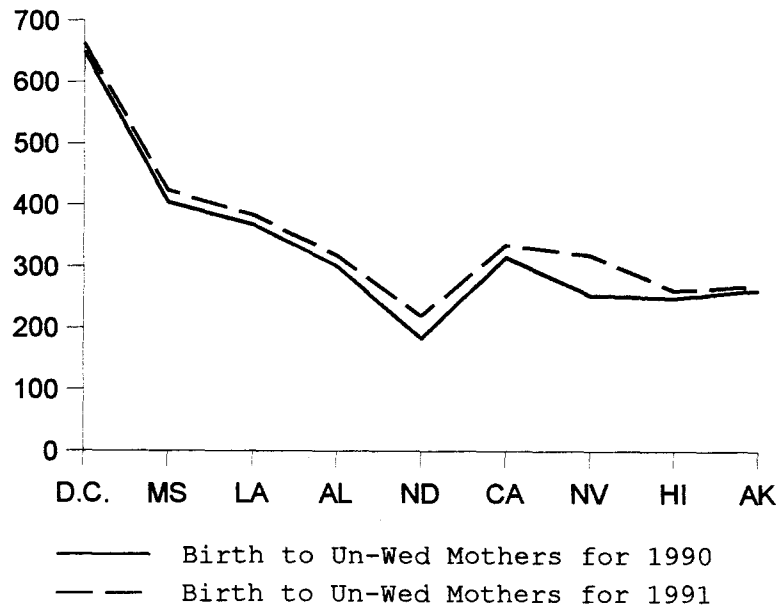
*Two: Since r-selected populations exhibit higher rates of birth to un-wed mothers, and low sex ratios represent an r-selected population, there should be a statistically significant ( $\alpha < .05$ ) negative correlation between rates of birth to un-wed mothers and sex ratios. As stated above, birth rates are merely an expression of sexual activity rates during a given time period, but the births themselves are a delayed indicator of population circumstances due to the gestation period of a human child. Therefore, in order to examine rates of birth to un-wed mothers as a result of activities and other environmental factors during 1990, it was again necessary to include figures from both 1990 and 1991.*

The results of the Pearson's Correlation between the variables Sex Ratio and Rate of Birth to Un-Wed Mothers for

1990 revealed strong negative relationship ( $r = -.741$ ) which was statistically significant at the  $\alpha < .05$  level. In addition, the correlation between the variables Sex Ratio and Rate of Birth to Un-Wed Mothers for 1991 demonstrated a strong negative relationship ( $r = -.746$ ) which is also statistically significant at the  $\alpha < .05$  level. These statistics, therefore,

Figure 1

Summary of Relationship between Sex Ratios and Rates of Birth to Un-Wed Mothers (States listed from lowest to highest sex ratio, left to right)



support the research hypothesis. There is a statistically significant ( $\alpha < .05$ ) negative relationship between sex ratios

and rates of birth to un-wed mothers (See Figure 1).

Sex Ratios and Marriage Ratios      *Hypothesis Three: Since higher ratios of married to un-married people suggest a K-selected population, and higher sex ratios represent a population at the K end of the continuum, there should be a statistically significant ( $\alpha < .05$ ) positive relationship between marriage ratios and sex ratios. The coefficient produced by Pearson's Correlation suggested a moderate positive ( $r = .556$ ) relationship between the variables Sex Ratio and Marriage Ratio, but this relationship was not statistically significant at the  $\alpha < .05$  level. It is necessary, therefore, to reject the above-stated hypothesis. There is not a statistically significant ( $\alpha < .05$ ) positive relationship between the variables Sex Ratio and Marriage Ratio for the populations under study.*

Sex Ratios and Violent Crime Rates      *Hypothesis Four: Since high violent crime rates are associated with an r-selected population, and low sex ratios represent a population at the r end of the continuum, there should be a statistically significant ( $\alpha < .05$ ) negative correlation between violent crime rates and sex ratios. The result of the Pearson's*

Correlation procedure produced a coefficient which implied a moderate negative relationship between the variables ( $r = -.420$ ); however, this relationship was not found to be statistically significant at the  $\alpha < .05$  level. The research hypothesis, therefore, must be rejected. There is not a statistically significant ( $\alpha < .05$ ) negative relationship between the variables Sex Ratio and Violent Crime Rate for the populations under study.

Sex Ratios and Economic Status Although there was no research hypothesis at the start of this study regarding the relationship between sex ratios and socio-economic status, the variable was included in the study as a matter of interest to the researcher. While socio-economic status is not necessarily a variable directly related to the r/K continuum (socio-economic status is not an indicator of placement on the continuum), it is closely related to environmental conditions which might dictate either r- or K-selection. The variable was included in the study as a possible correlate to the other variables under examination.

The Socio-Economic Status variable, which was determined by measuring the ratio of people above the poverty level to every 100 people below the poverty level, was measured against all of the variables mentioned in the study, and only one was

found to be statistically significant. The coefficient produced by Pearson's Correlation confirmed a strong positive relationship ( $r = .874$ ) between the variables Sex Ratio and Socio-Economic Status statistically significant at the  $\alpha < .01$  level. The implications of this relationship are examined below in the discussion section of this chapter.

Incidental Correlations Since the calculation of Pearson's Correlation coefficients included the construction of a correlation matrix between the variables, it was possible to look at relationships between all of the variables under study. The matrix revealed some expected and a few unexpected significant correlations that are worth mention in this section of the report. (Only correlations significant at the  $\alpha < .05$  and  $\alpha < .01$  level are discussed here.)

According to the Pearson's Correlation matrix, there is a strong statistically significant ( $\alpha < .05$ ) positive relationship between the birth rate in 1991 and the violent crime rate ( $r = .703$ ). In addition, there is a strong positive relationship between violent crime and rates of birth to un-wed mothers in 1990 and 1991 statistically significant at the  $\alpha < .01$  level ( $r = .841$  and  $r = .833$ , respectively). The data also indicate that violent crime rates and marriage ratios have a very strong negative correlation ( $r = -.902$ ;  $\alpha$



<.01). Finally, the correlation matrix revealed that there is a very strong negative relationship ( $r = -.941$  and  $r = -.950$ , respectively) between marriage ratios and rates of birth to un-wed mothers for both 1990 and 1991 statistically significant at the  $\alpha < .01$  level. Possible explanations for these correlations are presented below in the Discussion section of this chapter.

### Discussion

Sex Ratios and Birth Rates      *Hypothesis One: Since high birth rates are more indicative of the r end of the continuum and low sex ratios represent an r-selected population, there should be a statistically significant ( $\alpha < .05$ ) negative correlation between birth rates and sex ratios. The relationship between birth rates and sex ratios was not statistically significant at the  $\alpha < .05$  level, and therefore, the research hypothesis was not supported. Inclusion of all the states may have demonstrated a stronger linear relationship. However, aside from a lack of significance, it is interesting to note that the relationship between the variables was found to be positive rather than negative as predicted ( $r = .402$ ;  $r = .239$ ). This means that the findings in this area of the study are contrary to those predicted; a*

positive relationship means that as ratios of men to women increase (more men in a population), birth rates increase as well.

While this finding seems to contradict the general theory of the r/K continuum, it is possible that the explanation lies just under the surface. The original prediction is based on the idea that lower numbers of males in society will give males the dyadic power, or control over the reproductive strategy. This would lead to a more r-selected population which is, of course, oriented toward greater time and energy spent on reproduction/procreation; herein lies the premise behind Hypothesis One.

As the numbers of men in a population increase, however, the dyadic power shifts to those in higher demand (women). This would lead to a more K-selected population which centers around rearing a few viable young until they reach reproductive maturity. Perhaps due to the accessibility of birth control methods in these modern populations, pregnancy can be more easily controlled. Women who bear children and seek the aid of a male partner/husband would probably only do so after marriage. Since marriage is a phenomenon characteristic of K-selection, higher numbers of women would bear children when the conditions of the population are oriented toward that end of the continuum. Therefore, the general birth rates might actually be higher in a population

where women control the dyadic power (high sex ratios).

It should be noted here that due to a lack of statistical significance, the relationship between these variables, either positive or negative, still remains without support. There may not exist any relationship at all between the variables Sex Ratios and Birth Rates, and any number produced during the statistical procedure lacks credibility without statistical significance. Therefore, neither hypothesis can be substantiated without further research efforts.

Sex Ratios and Rates of Birth to Un-Wed Mothers Hypothesis

*Two: Since r-selected populations exhibit higher rates of birth to un-wed mothers, and low sex ratios represent an r-selected population, there should be a statistically significant ( $\alpha < .05$ ) negative correlation between rates of birth to un-wed mothers and sex ratios.* The data support this particular hypothesis, as there is a strong negative statistically significant relationship ( $r = -.741$ ;  $r = -.746$ ;  $\alpha < .05$ ) between the variables Sex Ratio and Rate of Birth to Un-Wed Mothers for both 1990 and 1991. This means that lower sex ratios (fewer males) will produce higher numbers of births to un-wed mothers, and this supports the theory of r/K selection. Lower sex ratios will encourage r-selected traits in a population; less value is placed on marriage and dual

parenting, and therefore, many more births will occur out of wedlock.

As stated previously, it is possible that the prevalence of birth control methods could lower the number of un-planned pregnancies and, consequently, birth rates. However, unplanned pregnancies are obviously not totally eliminated by birth control in any population, and therefore, rates of birth to un-wed mothers should still be an accurate indicator of the reproductive strategy of a population. Also, not all births to un-wed mothers are un-planned. As such, even planned pregnancies that lead to birth out of wedlock reveal a more r-selected population and should correlate strongly with low sex ratios.

Sex Ratios and Marriage Ratios      *Hypothesis Three: Since higher ratios of married to un-married people suggest a K-selected population, and higher sex ratios represent a population at the K end of the continuum, there should be a statistically significant ( $\alpha < .05$ ) positive relationship between marriage ratios and sex ratios. The result of this correlation reveals that the relationship between the variables Sex Ratios and Marriage Ratios is not statistically significant at the  $\alpha < .05$  level. The moderate positive relationship ( $r = .556$ ) suggests that there is general support*

for the theory of the r/K continuum; as numbers of men increase, dyadic power shifts to women, and the ratio of married to un-married people increases. Again, this lack of statistical significance ( $\alpha < .05$ ) could be due to the inclusion of only nine states, but it cannot be overstated that this lack of statistical significance fails to substantiate the presented hypothesis.

Sex Ratios and Violent Crime Rates      *Hypothesis Four: Since high violent crime rates are associated with an r-selected population, and low sex ratios represent a population at the r end of the continuum, there should be a statistically significant ( $\alpha < .05$ ) negative correlation between violent crime rates and sex ratios.* The coefficient produced by the statistical procedures shows general support for the hypothesis that sex ratios and violent crime rates have a negative relationship ( $r = -.420$ ). As lower numbers of males in a population (low sex ratios) will encourage a more r-selected reproductive strategy, and hence higher rates of violent crimes. This correlation, however, was not statistically significant at the  $\alpha < .05$  level, and therefore, the research hypothesis was not supported. As stated previously, the inclusion of only nine states is a possible explanation for a lack of significance in this correlation,

and therefore, any conjecture on this subject lacks substantiation.

Sex Ratios and Economic Status The result of Pearson's Correlation between the variables Sex Ratios and Socio-Economic Status yielded a coefficient signifying a strong positive relationship ( $r = .874$ ) significant at the  $\alpha < .01$  level. This means that the variables have a direct linear relationship; as sex ratios increase in a population (numbers of males increase) the socio-economic status of that population increases as well. This is not a surprising statistic considering the payment inequality between working men and working women. In 1994, women employed full time were making 71 percent of the wages men employed full time were making (Andersen, 1997). In addition, there are far more women who choose not to hold a paying job than men. According to the U.S. Census Bureau in 1990, 21.1 percent of men over the age of 16 were unemployed compared to 38.0 percent of women over the age of 16. It should not be surprising, therefore, that there exists such a strong positive correlation between sex ratios and socio-economic status.

Incidental Correlations Many of the relationships discovered in the Pearson's Correlation matrix appear somewhat counter-

intuitive and unexplainable, and others seem understandable to the point of being obvious. One correlation that seems to have very little explanation is that between the birth rate for 1991 and the violent crime rate ( $r = .703$ ;  $\alpha < .05$ ). The statistics indicate that there is a strong positive relationship between the variables; as the number of children born in 1991 increases, the violent crime rates increase as well. Perhaps this correlation is indirectly related to the sex ratios of a particular area, or perhaps there is another variable associated with this correlation. Regardless of the possibilities, the strong relationship between the variables is intriguing and a conceivable avenue for future research.

The strong positive correlation between violent crime rates and rates of birth to un-wed mothers for 1990 and 1991 appears to make more sense in light of current criminological theory ( $r = .841$ ;  $r = .833$ ;  $\alpha < .01$ ). It has been argued that the decline of family values and structure is responsible for much of the violent criminal activity that occurs in the United States (Siegel, 1995), and these statistics certainly seem to support this contention. However, it is possible that this relationship appears only as a consequence of the relationship between the primary Independent and Dependent variables. If violent crime rates and rates of birth to un-wed mothers are indicators of the social circumstances

surrounding either an r- or K-selected population, then it is likely that there will be a statistically significant relationship between the indicators themselves. It is possible, therefore, that this statistical correlation is merely showing support for the theory of the r/K continuum.

Another notable correlation within the variable matrix is that between violent crime rates and marriage ratios ( $r = -.902; \alpha < .01$ ). The strong negative relationship indicates that as the ratio of married to un-married people increases, violent crime rates decrease. Again, this relationship could be a product of the association of the primary Independent and Dependent variables in the study and, therefore, a reflection of the theory of r- and K-selection. It is also possible that this correlation has meaning more deeply rooted in the sociology of marriage. Perhaps marriage indicates an acceptance of general social norms, and thus, a greater conformity to the predominant behavior of a social group, namely law-abiding behavior. Marriage ratios could, in fact, be reliable indicators of violent criminal activity as a measure of general social conformity. Another possible explanation could center around individual maturity. Increased marriage may not cause a decrease in crime rates, but rather, marriage ratios may reflect a population with a higher mean age and, consequently, a higher maturity level.



Whether these explanations are plausible, remains debatable; however, this topic is certainly worthy of future research.

The final notable correlations are those between the variables Marriage Ratio and Rate of Birth to Un-Wed Mothers for 1990 and 1991 ( $r = -.941$ ;  $r = -.950$ ;  $\alpha < .01$ ). The strong negative relationship indicates that the ratios of married to un-married people have an inverse linear relationship with numbers of births to un-wed mothers; as one increases, the other decreases. This relationship should not be surprising because it is expected that marriage ratios in a population would have a direct bearing on the number of births out of wedlock. This was, however, a statistically significant correlation and worth mentioning in the study.

### Summary

In this chapter the research hypotheses were tested, and the statistical results were reported (See Table 2). In addition to the four hypotheses, other statistically significant correlations were discussed.

*Hypothesis One: Since high birth rates are more indicative of the r end of the continuum and low sex ratios represent an r-selected population, there should be a statistically significant ( $\alpha < .05$ ) negative correlation between birth rates and sex ratios. Pearson's Correlation*

yielded coefficients ( $r = .402$ ;  $r = .239$ ) that were not statistically significant at the  $\alpha < .05$  level. It was therefore necessary to reject the hypothesis that there is a statistically significant relationship between sex ratios and birth rates in 1990 and 1991 for the populations under study.

Table 2  
Summary of Findings

No.	HYPOTHESIS	r	$\alpha$	Outcome
1	Sex Ratio and Birth Rate 1990	.402	.28	Reject
1	Sex Ratio and Birth Rate 1991	.239	.54	Reject
2	Sex Ratio and Illegitimacy 1990	-.741	.02	Accept
2	Sex Ratio and Illegitimacy 1991	-.746	.02	Accept
3	Sex Ratio and Marriage Rate	.556	.12	Reject
4	Sex Ratio and Violent Crime Rate	-.420	.26	Reject

*Hypothesis Two: Since r-selected populations exhibit higher rates of birth to un-wed mothers, and low sex ratios represent an r-selected population, there should be a statistically significant ( $\alpha < .05$ ) negative correlation between rates of birth to un-wed mothers and sex ratios. The results of Pearson's Correlations provided coefficient values ( $r = -.741$ ;  $r = -.746$ ) reflecting statistically significant ( $\alpha < .05$ ) relationships between sex ratios and rates of birth to un-wed mothers. Therefore, the research hypothesis was*

confirmed that there is an inverse linear relationship between the variables; as ratios of men to women increase, the numbers of births out of wedlock decrease.

*Hypothesis Three: Since higher ratios of married to unmarried people suggest a K-selected population, and higher sex ratios represent a population at the K end of the continuum, there should be a statistically significant ( $\alpha < .05$ ) positive relationship between marriage ratios and sex ratios. The correlation between the variables did not produce a statistically significant ( $\alpha < .05$ ) coefficient ( $r = .556$ ), and therefore, the research hypothesis was not confirmed. There was not a significant linear relationship between sex ratios and marriage ratios for the populations under study.*

*Hypothesis Four: Since high violent crime rates are associated with an r-selected population, and low sex ratios represent a population at the r end of the continuum, there should be a statistically significant ( $\alpha < .05$ ) negative correlation between violent crime rates and sex ratios. The results of Pearson's Correlation did not demonstrate a statistically significant ( $\alpha < .05$ ) relationship between the variables ( $r = -.420$ ). The research hypothesis was not supported by the data. There is no statistically significant correlation between sex ratios and violent crime rates for the*

populations under study.

There were, however, other statistically significant relationships uncovered in the Pearson's Correlation matrix of which some were predictable and others without logical explanation. There was a very strong positive ( $r = .874$ ) statistically significant ( $\alpha < .01$ ) relationship between the variables Sex Ratios and Socio-Economic Status. There was a strong positive relationship ( $r = .703$ ) between violent crime rates and birth rates for 1990 ( $\alpha < .05$ ). In addition, a strong inverse correlation ( $r = -.902$ ) was demonstrated between the violent crime rates and marriage ratios ( $\alpha < .01$ ). Strong positive relationships between rates of birth to un-wed mothers for 1990 and 1991 and violent crime rates were illustrated by the correlation coefficients ( $r = .841$ ;  $r = .833$ ;  $\alpha < .01$ ). Finally, strong inverse relationships ( $r = -.941$ ;  $r = -.950$ ;  $\alpha < .01$ ) were found between the variables Marriage Ratios and Rates of Birth to Un-Wed Mothers for both 1990 and 1991.

The following chapter of this thesis will provide an overview of the entire project and provide insight into the relevance of this project in the field of criminology. The limitations of the research will be discussed, and directions for future research in this theoretical arena will be offered.

## CHAPTER V

### SUMMARY AND CONCLUSIONS

#### Summary

In the field of criminology, as in any other discipline, it is important to examine all possible theories for human behavior and more specifically, human deviance. If we aim to find the best or most viable explanation, it is necessary to set aside our political and/or personal biases in search of answers. It is through this process that solutions will be found and hopefully instituted. Today, many criminologists lean toward theoretical perspectives that integrate social interaction with individual behavior. They veer away from biological and/or evolutionary theories that include radical policy changes and/or scientific treatment programs. They plant their work in sociological theory and conventional treatment. In essence, they remain on "safer" ground, but the time has come to open our eyes and our minds to new theories and theories that were dismissed too soon because they were found to be controversial. We must embrace the work of all disciplines and examine whether this work complements or coincides with our own.

This research was based on the theory of the r/K continuum, an evolutionary/biological theory that centers around reproductive strategies between and within species. Near the r-end of the continuum, lie animals that allocate

most of their resources to reproducing as many offspring as possible, with as many mates as possible. (An example of an r-selected species might be salmon, laying thousands of eggs to be fertilized by as many males as possible.) Near the K-end of the spectrum, lie animals that allocate most of their resources to raising a few viable young to reproductive maturity. (An example of a K-selected species might be one of the higher primates, rearing a few young to full maturity with the help of a mate.) The behavioral differences associated with these strategies are related to the strategies themselves:

- r-selected animals will be more competitive, and therefore, more violent; they operate under a more self-centered approach, and have little regard for their own offspring once they are created. There is little "life-long mating" in the sense that a male and a female will not stay together after procreation.
- K-selected animals will take a more altruistic approach. A male and a female will often live and feed in pairs, spending much of their time providing for and raising their young. They will interact with the community, often relying on the help of those somewhat distantly related to them.

The difference between species is easy to see, but the difference between members of the same species is harder to

distinguish. Even harder to distinguish is this variation in the human species. An example would be the difference between males and females: males are more r-selected, and females are more K-selected. From a reproductive standpoint, males will be more successful in ensuring survival in the gene pool through reproduction with many different females. Since they cannot be sure (without DNA fingerprints) that they are truly the fathers of particular children, it would greatly increase their odds to mate with many women as much as possible. Females, however, cannot (usually) hold more than one child in their wombs, and it is also a large responsibility to raise even one child. Therefore, females would be better off finding a life-long mate to raise the few young they can possibly have in their period of fertility.

This research focused on the application of the theory of the r/K continuum to the human species, and more specifically, the seven hypotheses outlined by Ellis (1987; 1988; 1989a) and Walsh (1997) which are:

*Hypothesis One: Since r-selected strategies provoke greater violence and selfish motivation, and these traits are found more often in male members of an animal population than female members, violent criminality should be more prevalent in male humans than female humans;*

*Hypothesis Two: Since the groups that demonstrate r strategies of reproduction tend to produce offspring with certain physiological traits, violent criminal offenders should also exhibit high rates of twinning, low birth weights, and high rates of premature birthing;*

*Hypothesis Three: Since those individuals that lie closer to the r end of the continuum tend to have children earlier in life and in larger numbers, criminals and psychopaths should have many siblings and be born to younger parents;*

*Hypothesis Four: There should be a correlation between criminality in parents and the criminality in their children; the biological parents of criminals should have children who are also criminal;*

*Hypothesis Five: The racial and ethnic differences that exist in regard to the r/K continuum should be correlated with the associated behaviors of certain strategy selections; those exhibiting r-selected strategies should also demonstrate the highest rates of violence and criminal behavior;*



*Hypothesis Six: Since violent and criminal behavior is associated with a strategy closer to the r end of the spectrum, whichever social class (or stratum) exhibits the most r-selected traits should also demonstrate the highest degree of violent and criminal behavior; and*

*Hypothesis Seven: Since males tend to be more r-selected than females, populations with low sex ratios (more females than males) will have a greater propensity for an r strategy of reproduction and behavior than those populations with balanced or high sex ratios.*

The specific work in this research was related closely to Hypothesis Seven as a basis for the examination of other related variables. Previous research shows that sex ratios (ratios of males to females) in a population will often be a good indicator of where a species falls on the r/K continuum. This is based on the idea of Dyadic Power (Guttentag & Secord, 1983): whoever is in high demand (or in low numbers) will control the reproductive strategy. Therefore, if the ratio of men to women is significantly low (for whatever reason), the population will tend toward the r-end of the spectrum. Conversely, if the ratio of men to women is high, the population will tend toward the K-end of the spectrum. It was

the contention of this research that behavioral characteristics (birth rates, violent crime rates, marriage rates, and illegitimacy rates) depend directly on the ratio of males to females in the human population.

The methodology of this research included an examination of existing statistics published by the U.S. Census Bureau, the National Center for Health Statistics and the Federal Bureau of Investigation in order to find a correlation between environmental conditions and social behavior. Due to the exploratory nature of this study, it was necessary to establish a research design in which all data were consistent in year of publication and geography. For this reason, nine U.S. States were selected based on significantly high or low ratios of men to women between the ages of 15 and 49 (independent variable), and data regarding birth rates, rates of birth to un-wed mothers, marriages ratios, violent crime rates, and socio-economic status data (dependent variables) within those States were compiled from existing government data sources. It was expected that the data would provide support for the theory that human social and/or adaptive behavior is related to the ratio of men to women in society, and therefore, the r/K continuum. The testable hypotheses identified in this research are as follows:

Hypothesis One: Since high birth rates are more indicative of the r end of the continuum and low sex ratios represent an r-selected population, there should be a statistically significant ( $\alpha < .05$ ) negative correlation between birth rates and sex ratios;

Hypothesis Two: Since r-selected populations exhibit higher rates of birth to un-wed mothers, and low sex ratios represent an r-selected population, there should be a statistically significant ( $\alpha < .05$ ) negative correlation between rates of birth to un-wed mothers and sex ratios;

Hypothesis Three: Since higher ratios of married to un-married people suggest a K-selected population, and higher sex ratios represent a population at the K end of the continuum, there should be a statistically significant ( $\alpha < .05$ ) positive relationship between marriage ratios and sex ratio; and

Hypothesis Four: Since high violent crime rates are associated with an r-selected population, and low sex ratios represent a population at the r end of the

*continuum, there should be a statistically significant ( $\alpha < .05$ ) negative correlation between violent crime rates and sex ratios.*

After the data were collected, Pearson's Correlation coefficients were calculated for each of the testable hypotheses. Hypothesis One was not supported; no statistically significant relationship was found between sex ratios and birth rates in 1990 and 1991. Hypothesis Two was supported; a statistically significant inverse linear relationship was found between sex ratios and rates of birth to un-wed mothers for 1990 and 1991. Hypothesis Three was rejected; there is not a statistically significant relationship between sex ratios and marriage rates for the populations under study. Finally, Hypothesis Four was rejected; there was no significant correlation between sex ratios and violent crime rates.

There were other statistically significant relationships uncovered in the Pearson's Correlation matrix. There was a very strong positive relationship between the variables Sex Ratios and Socio-Economic Status. There was a strong positive relationship between violent crime rates and birth rates for 1990. In addition, a strong inverse correlation was demonstrated between the violent crime rates and marriage

ratios. Strong positive relationships between rates of birth to un-wed mothers for 1990 and 1991 and violent crime rates were found. Finally, strong inverse relationships were found between the variables Marriage Ratios and Rates of Birth to Un-Wed Mothers for both 1990 and 1991.

It is likely that the inclusion of only nine instead of all fifty states in the sample can account for the lack of statistical significance ( $\alpha < .05$ ) of the correlation coefficients which resulted in rejecting three of the four testable hypotheses. It is important to note that while the results of the study did not *statistically* support the theory behind the research, the general patterns appeared to agree with the trends predicted by the preliminary research.

### Discussion

The findings of this study show general support for the theoretical perspective. The trends appear to reflect the predictions of the testable hypotheses, but only one of these trends proved to be statistically significant. While there certainly appears to be some relationship between the Independent and Dependent variables in this study, it is impossible to state that those relationships truly exist with any degree of certainty without statistical significance.

The theory of the r/K continuum as it applies to

criminology incorporates many features of biology into a broader perspective through which proponents of this theory view human behavior. Because there are many facets of this theory, it is difficult to fully test its application to human social groups. The preliminary research appears to have a strong theoretical background, and this research shows tentative support for the theory of r- and K-selection.

#### Limitations of the Research

The major limitation of this study, aside from those presented by including only nine states in the sample, was a result of the unit of analysis chosen for this study. The intent of this research was to find a correlation between sex ratios and social behaviors (birth rates, rates of birth to un-wed mothers, marriage ratios and violent crime rates); but the biological and evolutionary bases for this relationship operate under certain assumptions, and these assumptions were not met by the sample group.

First, it must be assumed that the population under study is a relatively isolated population (*i.e.* very little immigration or emigration). Obviously, the principles of mate selection in a population limited in numbers of males or females is highly dependent on the inability to move to another nearby location in which there are higher numbers of

mates available. Therefore, in order to accurately measure the effects of skewed sex ratios, the study must be conducted on a population that has very little access to mates in close proximity.

The selection of U.S. states as the unit of analysis for this research was based on the availability of valid and reliable data pertaining to particular populations. As mentioned earlier, the data currently available regarding population dynamics and demographics came from many different sources. Unfortunately, a lack of consistency in data collection methods between these sources led to the selection of the unit of analysis constituting the "lowest common denominator" which turned out to be U.S. states.

States are not geographically isolated. There was no way to control or monitor the immigration and emigration patterns across state lines, and it was impossible to measure the temporary movement of individuals in and out of particular states in the U.S. This problem, of course, posed an enormous threat to the validity of this study, but due to the limitations of current data sources, it was necessary to accept the possible inaccuracies presented by this dilemma.

The second assumption of the theoretical perspective used in this study was that population demographics are relatively stable over a long period of time. Certainly, it would be extremely difficult to monitor the fluctuations of a

population over a long period of time, especially, a geographic area as large as a U.S. state. However, as stated in previous chapters, short-term as well as long-term adaptations occur in populations, and much of the research in this thesis was based on the presumption that some of the activity in a population at a given time is short-term adaptation. (This, of course, is true of a rapidly changing environment such as the modern United States.) In addition, the cross-sectional nature of this study eliminated much need for long-term tracking of population dynamics.

The final assumption of the theoretical perspective employed in this study is that population density is the same for all populations. It was mentioned in Chapter Two that the saturation level of the environment has a great deal of influence over the reproductive strategy selected by the population inhabiting it. It is obvious that the density of states differs greatly across the nation, and the density within states also has a great deal of variability. It would have improved the validity of this research to find some way of estimating population density other than taking an average density as reported by the U.S. Census Bureau (average density will not accurately depict the impact of population density on social behavior in an area as large as a state). Future researchers of this theory should examine and perhaps find a control mechanism for the effects of population density on



social behaviors.

#### Implications for Future Research

Due to the exploratory nature of this study, there are many avenues of possible future research in this area. Very few studies have explored the implications of biology and evolution in the field of criminology, and even newer is the application of the r/K continuum to human social behavior. The work with this theory is only just beginning. As such, there are unlimited means and methods of approaching this topic in future research, and it is only through subsequent research that the theory of r- and K-selection will enter the field of criminology as a viable explanation for human behavior.

As stated above, the limitations of this study were due in large part to the unit of analysis, U.S. states. The logical direction for future research in this theoretical realm, therefore, would be the selection of a more static unit of analysis. A case study of a smaller geographical area in relative isolation, or a comparative analysis of several isolated regions, would provide a more valid basis for this research. It would be possible then to monitor and/or control for immigration and emigration in the specified location, and it would also be feasible to examine the effects of population density on the sample. While the limited scope of case

studies often leads to a lack of reliability, it is necessary to establish the validity before determining the generalizeability of the theory.

The information in this research should serve as a stepping stone for future research involving the application of the r/K continuum to criminology. Not only should future research examine biological and evolutionary theory as it applies to criminology, but all theories presented to the scientific community should receive attention from every related field. It is anticipated that researchers will continue to expand the scope of their own work and examine the work of others in various fields of study in search of knowledge. Only through the integration of diverse theories and disciplines is it possible to fully understand the social and physical phenomena surrounding us.

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APPENDIX A

Summary of Results:  
Pearson's Correlation Matrix



Summary of Results:  
Pearson's Correlation Matrix

VARIABLES	SEX RATIO	VIOLENT CRIME RATE	MARRIAGE RATE	BIRTH RATE 1990	BIRTH RATE 1991	BIRTH TO UN-WED 1990	BIRTH TO UN-WED 1991	ECONOMIC STATUS
SEX RATIO	1.00	-.420	.556	.402	.239	-.741 *	-.746 *	.874 **
VIOLENT CRIME RATE	-.420	1.00	-.902 **	.571	.703 *	.841 **	.833 **	-.242
MARRIAGE RATE	.556	-.902 **	1.00	-.400	-.537	-.941 **	-.950 **	.234
BIRTH RATE 1990	.402	.571	-.400	1.00	.984 **	.247	.213	.511
BIRTH RATE 1991	.239	.703 *	-.537	.984 **	1.00	.406	.371	.369
BIRTH TO UN-WED 1990	-.741 *	.841 **	-.941 **	.247	.406	1.00	.992 **	-.484
BIRTH TO UN-WED 1991	-.746 *	.833 **	-.950 **	.213	.371	.992 **	1.00	-.486
ECONOMIC STATUS	.874 **	-.242	.234	.511	.369	-.484	-.486	1.00

\* Correlation is significant at the  $\alpha < .05$  level.

\*\* Correlation is significant at the  $\alpha < .01$  level.

APPENDIX B

Human Subjects Review Letter of Exemption



July 27, 1999

Dr. Tammy A. King, Assistant Professor  
Department of Criminal Justice  
✓ Courtney E. Ballard, Graduate Student  
Department of Criminal Justice  
UNIVERSITY

RE: HSRC Protocol #04-2000

Dear Dr. King and Ms. Ballard:

The Human Subjects Research Committee has reviewed your Protocol, "Sex Ratios and the r/K Continuum," (HSRC #04-2000), and determined that it is exempt from full committee review based on a DHHS Category 4 exemption.

Any changes in your research activity should be promptly reported to the Human Subjects Research Committee and may not be initiated without HSRC approval except where necessary to eliminate hazard to human subjects. Any unanticipated problems involving risks to subjects should also be promptly reported to the Human Subjects Research Committee.

Sincerely,

Eric Lewandowski  
Administrative Co-chair  
Human Subjects Research Committee

ECL/cc

c: File