

RISK TAKING AND THE CRIME DROP OF THE 1990s

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ABSTRACT

Risk Taking and the Crime Drop of the 1990s

Crime rates dropped unexpectedly and dramatically in the 1990s. Chapter One describes this drop, and evaluates previous explanations for the decline. A theoretical and empirical link between crime and risk taking at the individual level is discussed, as is the methodology of a study to test whether such a link is observed at the aggregate level. Chapter Two describes the results of the study investigating the relationship of crime and risk taking at the aggregate level. Results indicate, for most measures, that a decline in non-criminal risky activities occurred in the 1990s, paralleling the decline in crime, and various cross-correlational analyses suggest rates of criminal and non-criminal risky activities tend to co-vary over time. Chapter Three describes a theoretical framework based on life history theory that can help to explain the causes of the crime and risk taking drop in the 1990s, and suggests future avenues of research.

ACKNOWLEDGEMENTS

I have a confession: This thesis has a few mistakes in it. Every time the term “I” is used, I really mean “we.” Research is not an endeavor that one can undertake alone (after all, there is no “I” in research), and it is absolutely necessary to thank all of those people who helped me get to where I am today.

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CHAPTER ONE

The Crime Drop

ABSTRACT

Crime rates dropped unexpectedly and dramatically in the 1990s. The decline was not restricted to particular types of crimes, methodology of crime reports, demographic characteristics, or geographical areas. Many hypotheses on the causes of the crime drop have been proposed, but none appear fully satisfactory. Empirical studies and theories of crime have suggested a link between crime and risk taking. Based on this link, rates of various risky behaviours should show the same decline as crime in the 1990s, and rates of crime and risky behaviour should covary over time. Various American and Canadian databases reporting annual or biennial data on risky behaviours were examined. Various methods for cross-correlational analyses are described, including first differencing and ARIMA modeling, as methods to investigate the degree of covariation between crime and risk taking.

The Crime Drop

In the early 1990s, rates of criminal behaviours unexpectedly began to fall sharply in both the United States and Canada, commanding much popular and academic attention (e.g., Blumstein & Wallman, 2005). Homicide rates illustrate this decline effectively, because homicide rates are the least subject to reporting or recording biases (O'Brien, 2003). Although the United States and Canada have different homicide rates, both countries experienced a similar decline in homicide rates in the early 1990s, as shown in Figure 1.1. Figures 1.2 and 1.3 demonstrate a decrease for property and sexual crimes in the United States and Canada over the same time period, demonstrating that the decline is a very general phenomenon.

Data from governmental crime recording agencies and telephone surveys of victimization show a drop in crime at about the same time, suggesting the observed drop is not due to biased police reporting, or less recording of crime in general. The Federal Bureau of Investigation's (FBI) Uniform Crime Reports (UCR), a database containing crimes reported by police, as well as the National Crime Victimization Survey (NCVS), a nationally representative telephone survey of 100,000 Americans, demonstrate the same downtrend in the rate of crime. In the period from 1991 to 2001, the UCR shows drops ranging from 24 to 46 percent for all categories of crime. Reported criminal victimizations dropped even more significantly, with the NCVS showing a decrease in victimization rates ranging from 45 to 58 percent for all categories of crime (Levitt, 2004). Official data from Statistics Canada, obtained from police reports, demonstrate a similar drop (Ouimet, 2002, 2004).

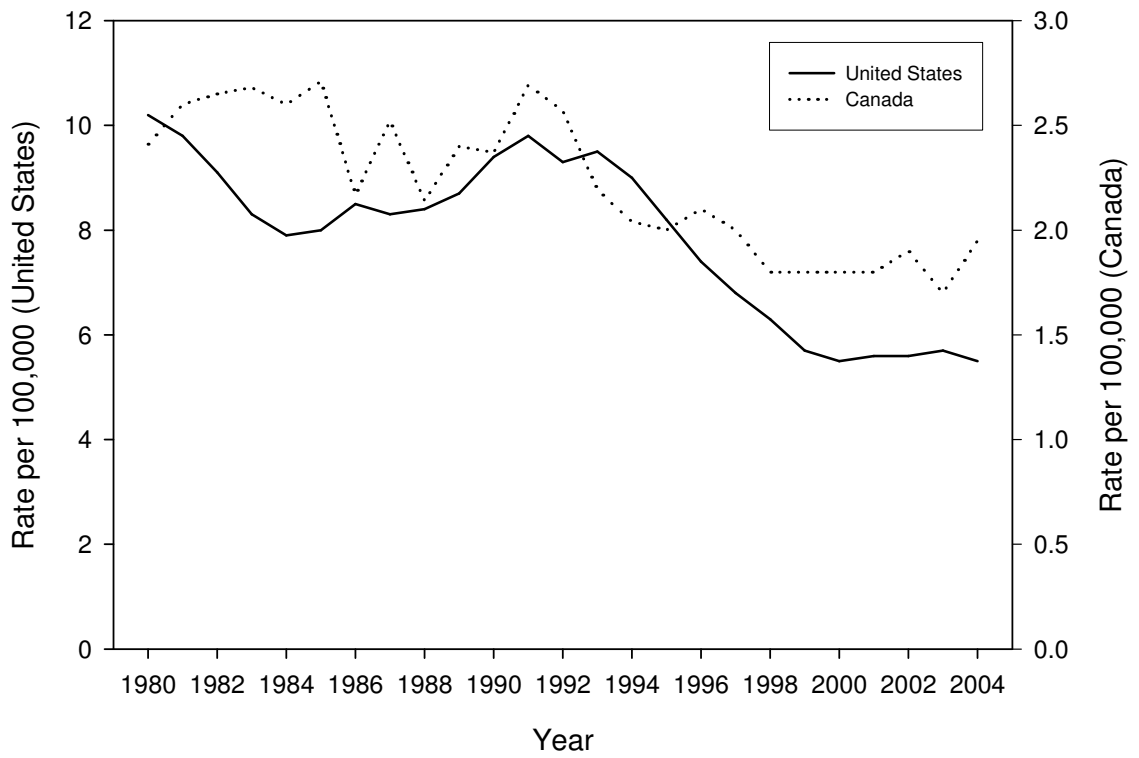


Figure 1.1 Homicide rates for the United States and Canada. Source: FBI Uniform Crime Reports (United States); Statistics Canada (Canada).

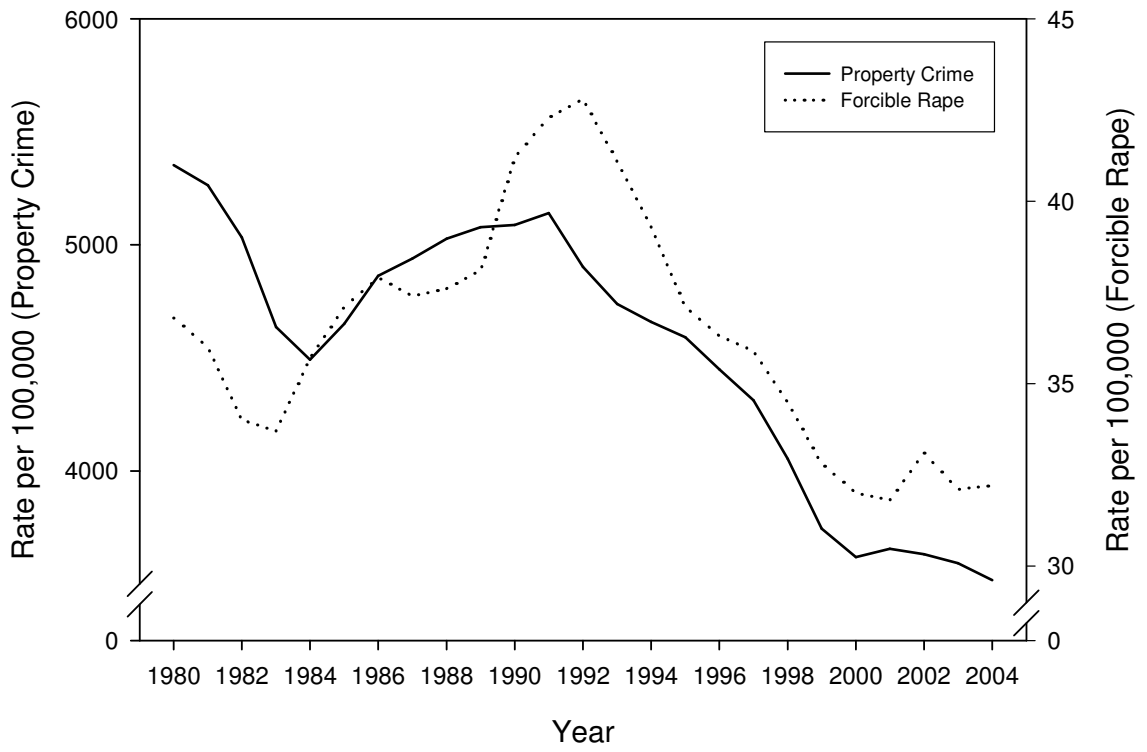


Figure 1.2 Property crime and forcible rape rates in the United States. Source: FBI Uniform Crime Reports.

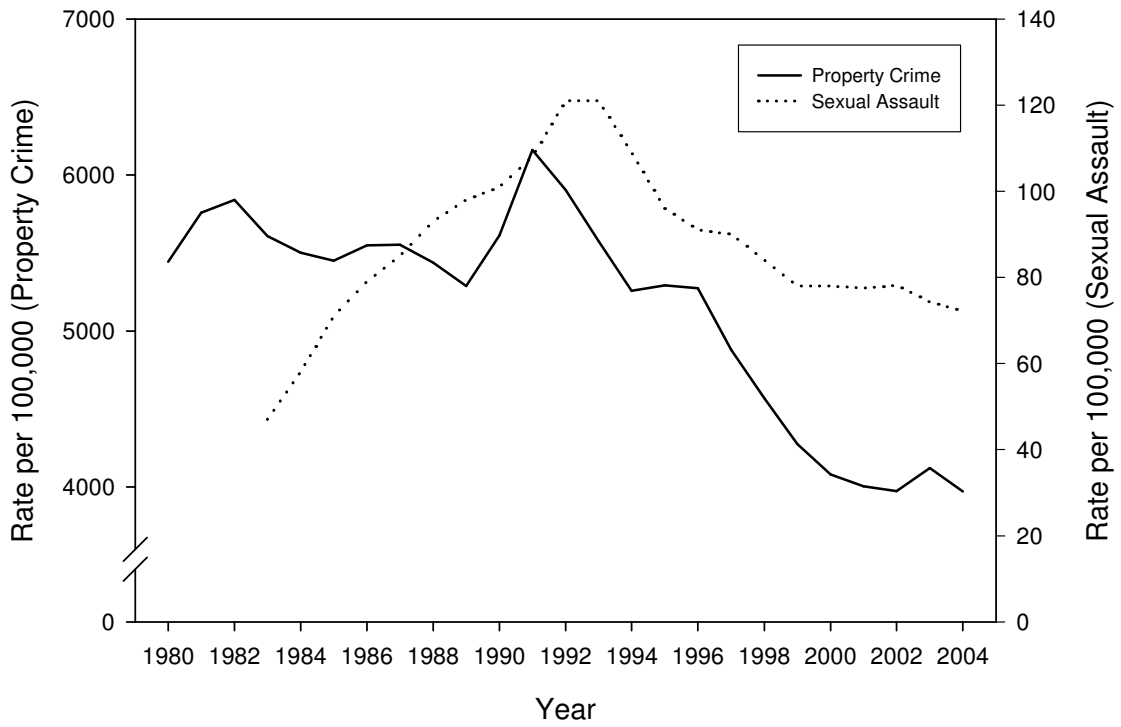


Figure 1.3 Property crime and sexual assault rates in Canada. Source: Statistics Canada.

The ubiquity of the crime drop is further demonstrated by its geographic and demographic generality. Although metropolitan areas in the United States experienced the largest declines from 1991 to 2001 in homicide (45 percent), violent crime (37 percent), and property crime (32 percent), rural areas were similarly affected, with homicide, violent crime, and property crime dropping 35 percent, 3 percent, and 11 percent, respectively (Levitt, 2004). In Canada, similar widespread trends can be observed in the sparsely populated Atlantic Provinces where homicide has decreased by 58 percent, as well as in heavily populated Ontario where homicide has decreased by 46 percent (Ouimet, 2002, 2004). Different age groups have also shown some degree of decline in crime; data from the UCR reveal arrest rates for total crime, violent crime, and property crime have dropped for all age groups from 1991 to 2003 (see Table 1.1). Furthermore, victimization rates for violent crime show a similar decrease for every age group: The smallest decrease observed was 20 percent (for those age 65 and older), and the largest decrease observed was 57 percent (for those age 20 to 24). Fox (2005) convincingly showed that homicide victimization and perpetration rates have decreased for all age groups.

Explaining the Crime Drop

Since the crime drop phenomenon has come to the forefront of criminologists' attention, various explanations have been developed and tested (e.g., Blumstein & Wallman, 2005; Levitt, 2004). These explanations can be grouped into three general categories: (1) demographic effects resulting from an aging population and increased access to abortion, (2) public policy shifts, such as an increase in police officers, innovative policing strategies, and increased prisoner incarceration, and (3)

Table 1.1. Percentage change in arrest rates for different age groups, United States, 1991-2001. Source: FBI Uniform Crime Reports.

Age Group	Type of Crime		
	<i>All</i>	<i>Violent</i>	<i>Property</i>
14 and under	-16.7	-18.9	-45.9
15-17	-15.1	-39.2	-39.4
18-20	-6.8	-26.2	-26.6
21-24	-11.8	-20.9	-33.6
25 and over	-16.5	-18.1	-36.0

socioeconomic factors such as a strong economy and a decrease in the illegal drug trade. Although each may explain part of the observed variance in crime rates, no explanation appears to be completely satisfactory in explaining the widespread and robust drop in crime.

Demographic shifts toward an older population and a lower number of at-risk individuals due to the legalization of abortion in the early 1970s have been implicated in diminishing crime rates (Donahue & Levitt, 2001; Fox, 2005). Although these demographic explanations certainly account for some of the drop in crime, there are some problems to consider. For instance, criminal offending and victimization have decreased for all age groups, pointing to a non-demographically linked factor.

Regarding abortion specifically, Donahue and Levitt (2001) suggested that the greater availability of abortion following its legalization in the United States in 1973 influenced crime rates, through the unintentional abortion of children at risk for criminal behaviour twenty years later. Abortion was legalized in Alaska, California, Hawaii, New York, and Washington (D.C.) at least two years before the 1973 national legalization. Thus, it would be expected that crime rates would diminish earlier in these states than in the rest of the country, as demonstrated by Donahue and Levitt. Joyce (2004a) performed more comprehensive analyses of the homicide and arrest rates among teenagers and young adults born before and after 1970, in the five states that legalized abortion early. Comparing these crime rates to other cohorts unexposed to legalized abortion suggest that Donahue and Levitt's conclusions were premature, as all cohorts experienced the crime drop at precisely the same time. Further compelling counter-evidence is provided by Joyce (2004b), looking at the effect of abortion on crime based on race. The effect of the availability of abortion on crime rates should be disproportionately larger in blacks than

in whites, because the fecundity reduction in black populations was much larger than in whites (Joyce, 2004b). Crime rates decreased similarly for both blacks and whites in the 1990s, casting further doubt on the abortion hypothesis as a sufficient explanation for the drop in crime.

Public policy shifts, such as increased prisoner incarceration (Spelman, 2005), the hiring of more police officers (Eck & Maguire, 2005), and the use of innovative crime-fighting strategies (Levitt, 2004), have gathered much attention as explanations for decreasing crime rates. The increase in prisoner populations and in the number of police officers on the streets has been occurring over the last 20 years in the United States, and so cannot reasonably explain the entire magnitude of the sudden drop in crime specifically in the 1990s. In addition, Canada has seen neither increased incarceration nor the hiring of more police officers, yet crime has dropped significantly and at the same time as in the United States. In the period from 1991 to 1999, the incarceration rate and police officers per capita in the United States increased by 42 and 11 percent respectively, whereas in Canada it decreased by 3 and 11 percent (Ouimet, 2002). Some American cities, such as Dallas, experienced a significant drop in crime (down 60 percent from 1991 to 2001) even with a decrease in number of police officers per capita (Levitt, 2004). Finally, because the crime drop was such a widespread phenomenon in the United States, innovative policing strategies cannot possibly explain the decrease, because not all cities adopted such measures (Eck & Maguire, 2005; Levitt, 2004).

Socioeconomic variables have also been implicated in the drop in crime, with researchers specifically pointing to a stronger economy and the receding crack cocaine epidemic. A stronger economy and greater labor opportunity (including higher youth wages) is hypothesized to deter property crime by making it less appealing. Although this

hypothesis has been supported (e.g., Gould, Weinberg, & Mustard, 2002), the effect is small, amounting to a one percent decrease in crime rate with every one percent decrease in the unemployment rate (Levitt, 2004).

The crack cocaine trade was widely thought to be spawning an epidemic in the mid-1980s, when it became immensely popular due to its low cost and extreme intoxicating effects (Blumstein & Rosenfeld, 1998; Levitt, 2004). As a result, violence arose between rival gangs competing for territorial space to sell the drug. Although the ebbing of the crack cocaine trade may account for some of the decrease in crime, it is important to note Canada did not have as pronounced a crack cocaine problem as the United States did, but still experienced the robust drop in crime. In addition, many suburban and rural areas of the United States never experienced a crack cocaine problem, yet demonstrated a significant drop in crime.

Each of the demographic, public policy, and socioeconomic factors outlined above very likely had some influence on crime rates, some more so than others (Finkelhor & Jones, 2005, have reviewed and evaluated other explanations for the crime drop). They do not, however, provide satisfactory explanations for the significant and widespread drop in crime in the 1990s. Many of the explanations put forth lose some of their appeal once Canadian data are considered. Specifically, explanations of the drop in crime resulting in part from increased number of police officers per capita, innovative policing strategies, or prisoner incarceration rates are severely weakened once Canadian crime rates are considered; Canada experienced the same pronounced drop in crime in the early 1990s, without experiencing the aforementioned factors. Finally, as shown by Levitt (2004), all explanations put forth to explain the drop in crime in the early 1990s, including greater access to abortion in the early 1970s, do a poor job of explaining the

countervailing increases in crime during the 1970s and 1980s, casting doubt on the strength of these explanations in accounting for general variations in crime rates.

The limitations of criminological explanations may be due to the fact that they focus on too narrow a target of explanation. Many explanations involve U.S.-specific phenomena, such as increased incarceration, and ignore the parallel between Canadian and American crime data (Ouimet, 2002). Other explanations focus on factors only applicable to specific crimes (e.g., changes in access to firearms, advances in emergency medicine leading to fewer homicides), ignoring the fact that the decline is quite general across all types of crime. Perhaps what requires explanation is something even more general than a widespread drop in criminal behaviour.

Crime and Risk Taking

Risk taking generally refers to impulsive, reckless behaviour that maximizes short-term gains (e.g., sexual gratification, emotional arousal) with potential for immediate or future losses. Many theories on the causes of crime suggest a correlation between crime and non-criminal risk taking. Depending on the theory, crime may be a form of risk taking, crime and risk taking may be different manifestations of the same trait (e.g., impulsive tendencies), or both crime and risk taking may be affected by the same developmental or situational factors. Although the nature of the association between crime and risky behaviour varies in these theories, they all provide an underlying explanation for both criminal and non-criminal risk taking (e.g., Daly & Wilson, 2001; Gottfredson and Hirschi, 1990; Jessor, 1991; Osgood, Johnston, O'Malley, & Bachman, 1988). In this section, three theories are described suggesting an association between criminal and general risk behaviour.

Daly and Wilson (2001) describe crime as a form of risk taking, and suggest that risk taking behaviour in general represents a “rational” attempt to solve problems in adverse situations or environments. In most situations, engaging in criminal or risky behaviour has costs that significantly exceed potential benefits. Both criminal and non-criminal risk taking, however, may represent adaptive behaviours that maximize benefits relative to costs in situations of social competition and competitive disadvantage. In situations of intense competition, Wilson and Daly (1985) proposed that some individuals (particularly young males) develop a “taste for risk” to better compete for reputations, status, resources, and mates—tokens of reproductive success in the human ancestral environment. This taste for risk varies with competitive success and future prospects. They suggested that homicides, for example, are most often unfortunate consequences of interpersonal conflicts over these tokens. They have accumulated much evidence linking indicators of intensity of competition to crime rates and also timing of reproduction (Daly & Wilson, 2001; Wilson & Daly, 1997).

The utility of criminal and risk taking behaviour is further increased in situations of competitive disadvantage. Although adolescence and young adulthood is a time when most individuals engage in some degree of risky or criminal behaviour due to competition, there are some for whom escalating risky or criminal behaviour is a “rational” option. If one is able to compete legitimately for resources, status, or mates, it is not “rational” to engage in costly criminal or risky behaviour. If one is at competitive disadvantage and cannot compete legitimately, however, it is more “rational” to accept more potential costs given that such individuals have much to gain and often little to lose from escalating risky behaviour. Thus, what started out as a mere “taste for risk” for some results in more serious criminal engagement for those at competitive disadvantage.

Other theories of crime suggest that an underlying trait influences the expression of both criminal and risk taking behaviour. Gottfredson and Hirschi's (1990) self-control theory suggests that crime and risky behaviour are consequences of a tendency to focus on temptations of the moment and ignore long-term consequences. According to Gottfredson and Hirschi, low self-control varies across individuals, and refers to a tendency toward impulsive behaviours that maximize short-term gains. Individuals with low self-control avoid deferring gratification, are impulsive, insensitive to the needs of others, short-sighted, and tolerant of risk, leading to participation in criminal and non-criminal risky behaviours. In support of this notion, many studies have reported significant correlations between individual degree of self-control, criminal activities, and non-criminal risky activities (e.g., reckless driving, drug use, sexual promiscuity; Jones & Quisenberry, 2004; Junger & Tremblay, 1999). In addition, it is well known that individuals who engage in criminal or antisocial behaviours score higher than others on measures of poor self-control, impulsivity, and general thrill seeking (e.g., Grasmick, Tittle, Bursik Jr., & Arneklev, 1993; Lalumière & Quinsey, 1996; White et al., 1994).

Developmental and situational factors that give rise to both risky and criminal behaviour have been identified, suggesting that risk and crime are intimately linked. Jessor's (1991) problem-behaviour theory suggests that risk factors and protective factors modulate the degree to which individuals engage in a "syndrome" of problem behaviours including substance use, delinquent behaviours, risky driving, and early sexual intercourse, as well as criminal behaviour. Risk factors represent instigations to involvement in problem behaviour, and protective factors represent controls against participation in such behaviours (Jessor, 1991). Risk factors such as poor parental controls or deviant peer group facilitate engagement in problem behaviours. Protective

factors such as participation in conventional activities and high self-esteem serve to act as controls against participation in problem behaviours. The notion of risk and protective factors and their influence on both risk taking and criminal behaviour has been supported empirically in a number of studies (e.g., Jessor, 1991).

Crime and risk taking may represent analogous, rational behavioural options in the context of intense social competition and competitive disadvantage. Both crime and risk taking may also be the product of an underlying trait, such as low self-control, or the product of developmental influences such as risk and protective factors. Regardless, all of these theories suggest that crime and various forms of non-criminal risky behaviour are related and covary at the individual level.

If criminal and risk taking behaviours are tightly linked, as suggested by various theoretical formulations and empirical data at the individual level, then rates of non-criminal risk taking behaviours should follow the same temporal pattern as rates of crimes, showing a drop in the early 1990s and covarying over time. In the following study, changes in indicators of risky behaviours that have been tracked for large samples or whole populations over many years are examined to address this question.

Method

This section describes the behavioural indicators of risk used, the sources of the archival data, and the analytical procedures utilized to analyze the data.

Archival data were obtained from surveys of risk taking behaviours (or outcomes of risk taking behaviours) conducted annually or biennially, or from comprehensive databases providing annual data. Risk taking behaviours were examined for the general population and for teenagers, a particularly risk-prone group, in the United States and Canada. When possible, risk taking was examined for a time period that saw an increase

(1980s), a decrease (1990s), and a period of stability (2000s) in crime rates, as well as longer time series that extend prior to 1980. Available risk behaviours were classified into five broad categories: violent behaviours, substance use, accidents and behaviours related to risk of accidents, sexual behaviour, and school dropout.¹

The category *violent behaviours* includes carrying a weapon, getting involved or injured in a physical fight, and suicide, behaviours generally considered impulsive or reckless (Hirschi & Gottfredson, 2000). Data on the proportion of high school students carrying a weapon and getting involved or injured in a physical fight were collected from the Youth Risk Behaviour Surveillance System (YRBSS), a representative survey of high-school students conducted every two years since 1991 in the United States. In the most recent survey (2005), 13,917 students from 44 different states were surveyed. U.S. suicide rates were collected from the National Vital Statistics System, and Canadian suicide rates were obtained from Statistics Canada.

The category *substance use* includes having tried alcohol, cigarettes, marijuana, and regular smoking, as well as use of illicit drugs, in both high school and young adult populations. Several studies have demonstrated that a general risk taking disposition is associated with alcohol use (e.g., Cherpitel, 1999), cigarette use (e.g., Mitchell, 1999), as well as other drug use (e.g., Zuckerman & Kuhlman, 2000).

Statistics from the United States on the percentage of high school students who tried smoking, alcohol, or marijuana, as well as the percentage of high school students who are regular smokers, were obtained from the YRBSS. High school illicit drug use statistics were also obtained from the Monitoring the Future survey (Johnston, O'Malley,

¹ Some of the risk indicators refer to behaviour that could lead to an arrest (e.g., getting involved in a physical fight, illegal substance use), but most do not.

Bachman, & Schulenberg, 2006a). Young adult drug use statistics (for individuals aged 19 to 28) were obtained from the Monitoring the Future survey (Johnston, O'Malley, Bachman, & Schulenberg, 2006b). General population smoking statistics from the U.S. were obtained from the National Health Interview Survey, conducted by the National Center for Health Statistics. Canadian statistics for both teenage and adult smokers were obtained from the Canadian Tobacco Use Monitoring Survey, conducted by Health Canada.

The variable category *accidents and behaviours related to risk of accidents* includes car collision fatalities and injuries, car collisions involving speeding, drinking and driving behaviours and fatalities, workplace injuries, and seatbelt and bicycle helmet use. Although accidents can be fortuitous, risk taking while driving or in the workplace may lead to an accident. For example, lack of caution is often mentioned as a cause of workplace accidents (Salminen, Saari, Saarela, & Rasanen, 1993). Fatal motor vehicle collision statistics in the United States were obtained from the National Vital Statistics System and the Insurance Institute for Highway Safety, and Canadian statistics were obtained from Transport Canada. Statistics regarding drinking and driving behaviour, as defined by those drivers with blood alcohol content over the legal limit of 0.08 percent, were obtained from the Insurance Institute for Highway Safety in the United States, and the Traffic Injury Research Foundation of Canada. Drinking and driving trends in high school students were obtained from the YRBSS. Workplace injury data were obtained from the United States Bureau of Labor Statistics and the Association of Workers Compensation Boards of Canada. Seatbelt and bicycle helmet use statistics were obtained from the YRBSS.

The category *sexual behaviours* includes the variables, for teenagers, ever having had intercourse, having had sex with four or more partners, use of alcohol before sex, condom use, pregnancies, live births and, for the general population, sexually transmitted diseases. Some sexual activities are generally seen as risky and the result of failures of inhibition. Individuals who are more risk accepting would be less likely to use condoms and more likely to have sex with many partners; risk accepting teenagers would also be more likely to engage in unprotected sex resulting in pregnancy (Hirschi & Gottfredson, 2000; Santelli, Lindberg, Finer, & Singh, 2007). The rates of sexually transmitted diseases in the general population are informative with regard to the relative frequency of risky sexual behaviours, because those participating in unsafe sexual intercourse, either with multiple partners or without proper condom use, are more likely to contract such diseases (e.g., Holmes, Levine, & Weaver, 2004). Sexual behaviour data on teenagers were obtained from the YRBSS survey of high school students. Teenage pregnancy and live births data were obtained from the Guttmacher Institute in the United States and Statistics Canada. Finally, data regarding the prevalence of sexually transmitted disease for syphilis, gonorrhea, and chlamydia were obtained from the Centers for Disease Control and Prevention in the United States, and the Public Health Agency of Canada.

Finally, *school dropout* may reflect the expression of risk-accepting tendencies in that students who choose to drop out of school may tend to focus on the immediate and impulsive rewards of non-school activities while ignoring the long-term consequences of missing school. The rates of high school dropout were obtained from the National Center for Education Statistics in the United States and Statistics Canada. American dropout rates are defined as the percentage of 16 to 24 year olds who are not currently enrolled in school, and have not completed a high school program. Canadian dropout rates are

defined as the percentage of 20 to 24 year olds without a high school diploma and not currently enrolled in school.

Analytical Procedures

The percentage difference in the prevalence of each risk behaviour was calculated between 1991 and 2001 to show the magnitude of the drop in risk taking indicators in the 1990s. Representative risk behaviours from each domain are presented graphically to show temporal trends.

Cross-correlation analyses were used to compare time series of different indicators of risk taking in various domains with homicide rates. Homicide rates were used as an index of crime because they are least subject to changes in definition over time, or reporting bias, and serve as an accurate indicator of crime levels over time (O'Brien, 2003). A brief overview of the basic methodology of the time series analyses are presented here (for a thorough treatment, see Chatfield, 2004, and McCleary & Hay, 1980).

Cross-correlations between homicide and risk indicators were examined for two time periods: (1) 1980 to 2005, and (2) 1950 to 2005. The period from 1980 to 2005 was chosen to reflect the time during which crime rates increased (the 1980s), decreased (the 1990s), and stabilized (the 2000s). Cross-correlation analyses were also conducted for longer time series, some beginning as far back as 1950, in an attempt to thoroughly examine the long-term relationship between risk taking indicators and crime.

Cross-correlations are presented between various risk indicators and homicide in three ways, for both time periods. First, non-differenced, log transformed cross-correlations are presented to illustrate the size and directional relationship between risk indicators and homicide. Second, cross-correlations with first differencing were used to

illustrate the relationship between the *rate of change* of various risk indicators and homicide over time. Finally, cross-correlations with ARIMA modeling were used to describe the relationship between longer time series.

Two time series can be compared with a cross-correlation function (CCF), whereby the strength of the relationship between two series is calculated at different lags. Cross-correlation of time series requires a number of assumptions. Specifically, any time series to be cross-correlated must not exhibit autocorrelation or systematic changes in mean or variance over time, where autocorrelation refers to the degree to which a value at some point in time in a series can be predicted from another value at some other time.

Although it is useful to directly cross-correlate time series to obtain an idea of the relationship between them, the presence of autocorrelation in either of two series being compared can introduce spurious correlation, making a CCF difficult to clearly interpret (Cardinal, Daw, Robbins, & Everitt, 2002). Transformations of autocorrelated time series are thus required in order to allow for accurate interpretation. Differencing is a method of pre-processing a time series by seeking to remove linear trends in data and remove autocorrelation by subtracting each data point in a series from its predecessor. By differencing two time series and then cross-correlating them, it is possible to compare the two rates of change over time. The logarithm of each data point is also taken in order to control for fluctuations in the variance of a series over time (McCleary & Hay, 1980).²

Box-Jenkins, or autoregressive integrated moving average (ARIMA) modeling techniques, represent a more sophisticated method of transforming and de-trending non-stationary time series (Chatfield, 2004; McCleary & Hay, 1980). This technique aims to

² An alternate, less complex method can also be used to compare time series: A partial correlation between two time series, with year partialled out to remove the effect of time from both series.

construct a mathematical model effectively describing the autocorrelation within a time series, then to remove the model's predictions from the original data, thereby removing the autocorrelation from the time series (Cardinal et al., 2002).

The notation $ARIMA(p,d,q)$ represents a mathematical model of the time series, describing three parameters: autoregressive (p), differencing (d), and moving average (q). The autoregressive parameter describes the degree to which a time-lagged value of the time series can be used as a predictor of itself, the differencing parameter specifies the number of differencing passes required, where a time-lagged version of the series is subtracted from itself before being used as a predictor, and the moving average parameter describes changes in mean over the time series. In order to identify the three parameters required to build an ARIMA model most likely to best fit the data, autocorrelation and partial autocorrelation function plots (ACF, PACF) are used, as described by McCleary and Hay (1980), with the goal of minimizing the number of terms included in the model for simplicity.

For each time series analyzed using ARIMA procedures in this study, the ACF and PACF were plotted in order to determine the specific values of the autoregressive (p) and moving-average (q) terms (McCleary & Hay, 1980). First differencing (i.e., $d = 1$) was used for all time series, as all time series in this study followed linear trends, and were significantly autocorrelated. Natural logarithms were taken of all data points in order to obtain a constant variance across time series as well (Chatfield, 2004; McCleary & Hay, 1980). Following the identification of the ARIMA parameters, a good fit to the time series data was verified by looking at the ACF plots of the residuals. If the residuals of the model exhibited no autocorrelation and constant variance over time, the goals of transforming and de-trending the time series data were achieved. The residuals of the

transformed data series were then used for cross-correlation. Each time series was modeled independently, ensuring a proper fit for each series.

Only time series with at least 20 or more data points were subject to ARIMA modeling. Multiple time series in different risk domains (suicide, motor vehicle collision deaths, and live teen births) contained 50 or more data points, so the cross-correlations between these time series and homicide rates can be considered statistically reliable. Of note, many time series consisted of data collected every other year (e.g., the YRBSS). Because the time series methods utilized require annual data to allow for differencing, biennial time series were linearly interpolated to approximate missing values (Land, Lamb, & Mustillo, 2001).

CHAPTER TWO

Did Risk Taking Drop With Crime in the Early 1990s?

ABSTRACT

Various American and Canadian databases reporting annual or biennial data on risky behaviours were examined, and several cross-correlations between risk taking rates and homicide rates were calculated, including first-differenced cross-correlations and ARIMA residual correlations. Results suggest, for most measures, that a decline in non-criminal risky activities occurred in the 1990s, and various cross-correlational analyses suggest rates of criminal and non-criminal risky activities tend to covary over time. An important exception to this pattern is substance use in various contexts. The implications of the results on understanding the causes of the crime drop in the 1990s are discussed.

Overview

In the first part of this section, the results for the five categories of risk taking indicators are discussed, and show the magnitude of the change in risk indicators over the period spanning 1991 to 2001. In addition, the timing of the decline is discussed for each indicator where possible. Table 2.1 summarizes these results. In the table, YRBSS refers to data from U.S. high school students in grades 9 to 12. Conclusions that cannot be made based on limited time frames of data are left unmarked. Percentage decreases from 1991 to 2001 were calculated using the formula, *rate in 2001 minus rate in 1991, divided by rate in 1991*. For comparison, rates of change for different crimes are presented as well. The figures present data from 1980 to 2005, when possible.

In the second part of this section, cross-correlations were examined between all risk indicators and homicide rates in the United States and Canada respectively, for the period 1980 to 2005 (Tables 2.2 and 2.3), and for longer time periods when possible (Tables 2.4 and 2.5). For each table, the number of data points (years) used in all analyses is provided, as well as the log-transformed cross-correlation, first differenced cross-correlations (with log-transformation), and ARIMA cross-correlations between each risk indicator and U.S. or Canadian homicide rates at lag 0, and at the lag at which the maximum correlation occurs, within 5 years of lag 0. A positive lag indicates that the first time series (homicide) lags the second (risk indicators). For example, a “+1” lag means that a peak in homicide in 2000 was most highly associated with a peak in the risk indicator in 2001. Conversely, a “-1” lag means that a peak in homicide in 2000 was most highly associated with a peak in the risk indicator in 1999.

Table 2.1 Summary of trends in risk taking, United States (U.S.) and Canada (CAN), 1991-2001.

Indicator	% Change 1991-2001*	Decline starts or becomes steeper in early 1990s?
<i>Crime</i>		
Homicide (U.S.)	-43	Yes
Homicide (CAN)	-33	Yes
Forcible rape (U.S.)	-25	Yes
Sexual assault (CAN)	-28	Yes
Property crime (U.S.)	-29	Yes
Property crime (CAN)	-35	Yes
<i>Violence</i>		
Carried a weapon (YRBSS)	-37	-
Involved in physical fight (YRBSS)	-23	-
Injured in physical fight (YRBSS)	-7	-
Suicide (U.S.)	-12	No
Suicide (CAN)	-11	No
<i>Substance Use</i>		
Tried alcohol (YRBSS)	-4	-
Tried cigarettes (YRBSS)	-9	-
Tried marijuana (YRBSS)	+35	-
Used illicit drugs (not including marijuana) in last year, high school (U.S.)	+33	-
Used marijuana in the last year, high school (U.S.)	+55	-
Used illicit drugs (not including marijuana) in last year, young adult (U.S.)	-16	No
Used marijuana in the last year, young adult (U.S.)	-5	No
Regular smokers, high school (U.S.)	+9	-
Regular smokers, high school (CAN)	-2	-
Regular smokers, 18+ (U.S.)	-11	No
Regular smokers, 15+ (CAN)	-30	-
<i>Accidents</i>		
Car collision fatalities (U.S.)	-12	No
Car collision fatalities (CAN)	-27	No
Car collision injuries (U.S.)	-23	Yes
Car collision injuries (CAN)	-14	-
Collisions involving speeding	-9	No
Drinking and driving fatalities (U.S.)	-20	Yes

Drinking and driving fatalities (CAN)	-20	Yes
Drinking and driving (YRBSS)	-15	-
Riding with a drunk driver (YRBSS)	-23	-
Workplace injuries (U.S.)	-32	Yes
Workplace injuries (CAN)	-27	Yes
No seatbelt use (YRBSS)	-46	-
No bicycle helmet use (YRBSS)	-12	-
<i>Sexual Behaviour</i>		
Had sex (YRBSS)	-16	-
Sex with 4+ partners (YRBSS)	-24	-
Used alcohol/drugs before sex (YRBSS)	+19	-
Been/gotten someone pregnant (YRBSS)	-21	-
No condom use (YRBSS)	-22	-
Teenage pregnancies (U.S.)	-27	Yes
Teenage pregnancies (CAN)	-20	Yes
Live teenage births (U.S.)	-27	Yes
Live teenage births (CAN)	-38	Yes
Syphilis (U.S.)	-78	Yes
Syphilis (CAN)	-31	Yes
Gonorrhea (U.S.)	-48	Yes
Gonorrhea (CAN)	-51	No
Chlamydia (U.S.)	+52	-
Chlamydia (CAN)	-2	-
<i>School Dropout</i>		
High school dropout rate (U.S.)	-14	No
High school dropout rate (CAN)	-32	-

*If 2001 data was not available, the last reported year of data was used.

Violent Behaviour

The rates of all five indicators of violent behaviour declined in the 1990s, from 7 to 37 percent. The timing of the decrease can only be evaluated for suicide data, and seems to have occurred in the late 1980s for the U.S. and Canada—the Canadian data are harder to interpret due to high variability from year to year. Suicide rates in the United States and Canada, from 1980 to 2003, are shown in Figure 2.1.

Substance Use

Seven of the eleven indicators showed a decline in the 1990s. Figure 2.2 shows the prevalence of regular smokers in the general population in the United States (1983-2004) and Canada (1981-1988, 1991-2002), and the prevalence of regular smokers in high school, age 15 to 19, in the U.S. (1991-2005) and Canada (1991-2003). Both the Canadian and American data suggest the prevalence of regular smokers in the general population has been declining since the late 1980s, although the Canadian data show a second steep drop in the mid-1990s. Although the teenage smoking data show a small decline in Canada (two percent), and an increase in the United States (eight percent) from the period from 1991 to 2001, there was a clear decline in teenage smoking in the U.S. since the mid-1990s (24 percent decline from 1995 to 2001), and in the late 1990s in Canada. Declines were also observed for illicit drug use, including marijuana use in young adults aged 19 to 28. Illicit drug use in general, as well as marijuana use more specifically among teenagers, increased substantially in the 1990s.

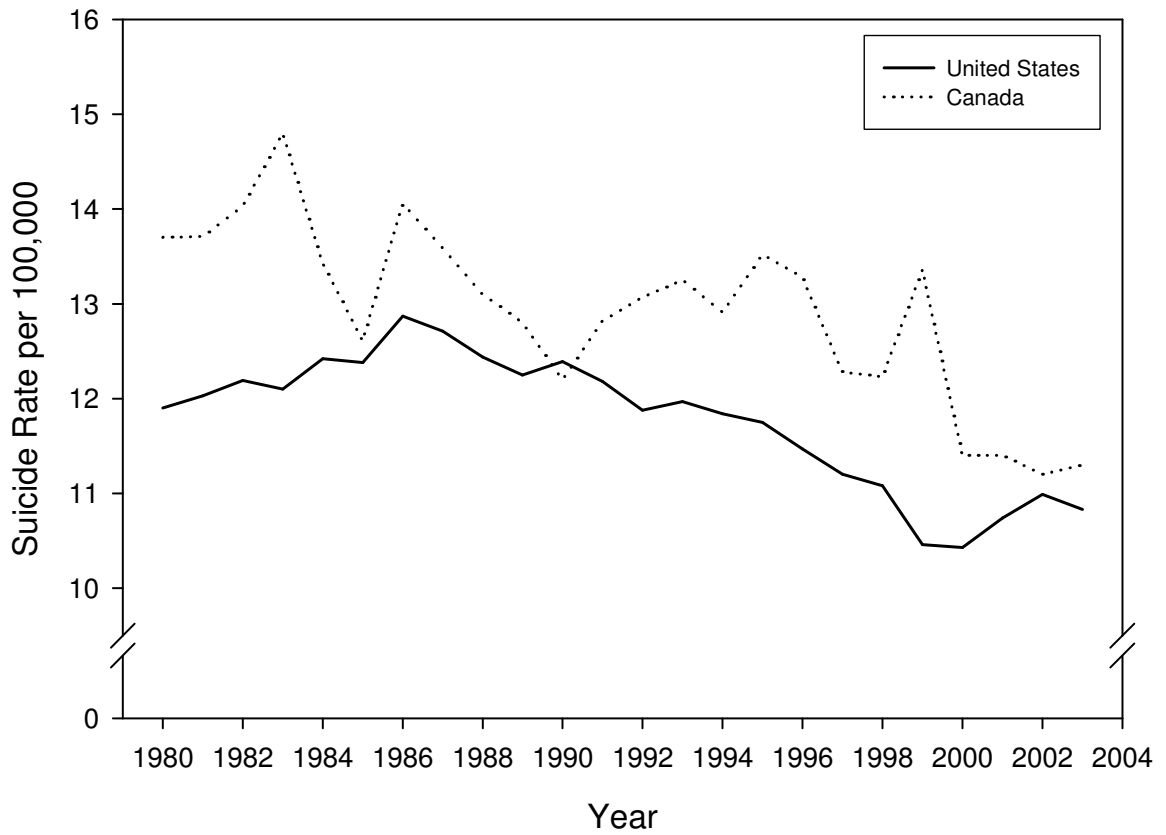


Figure 2.1 Suicide rates in the United States and Canada. Source: National Center for Injury Prevention and Control (United States); Statistics Canada (Canada).

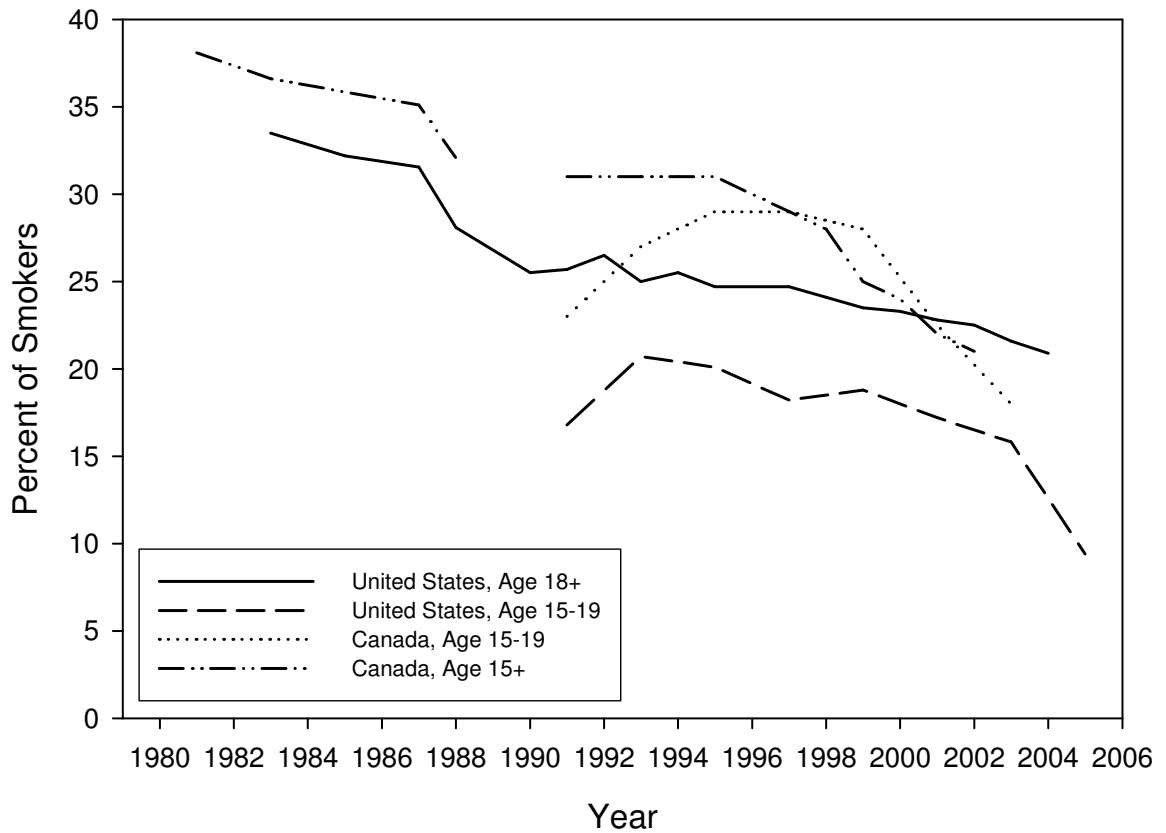


Figure 2.2 Prevalence of regular smokers in the general population and in high school, age 15-19, in the United States and Canada. Source: National Health Interview Survey, Youth Risk Behaviour Surveillance System (United States); Canadian Tobacco Use Monitoring Survey (Canada).

Accidents

All 13 accident indicators showed a decline in the 1990s, from 9 to 46 percent. For some indicators the decline started in the early 1990s, as illustrated in Figure 2.3 for workplace injury rates. Car injury rates in the United States began to decline after 1989, collisions involving speeding after 1986, and the other indicators showed an earlier decline. In both the U.S. and Canada, all drinking and driving fatality rates declined during the 1980s, with steeper declines in the 1990s. The timing of high school students' drinking and driving behaviour cannot be determined. The number of students reporting no bicycle helmet or seatbelt use also declined during the 1990s, but timing cannot be determined.

Sexual Behaviour

Of the 15 indicators of risky behaviour, 13 showed a decline in the 1990s. Among teenagers in particular, the decline was observed for the percentage reporting having had sexual intercourse (1991-2005), having had sexual intercourse with four or more partners (1991-2005), consuming alcohol or drugs before participating sexual intercourse (1991-2005), and having been or gotten someone pregnant (1991-2003). All but one teenage indicator (use of alcohol or drugs before sex) showed a decline since the early 1990s.

Figure 2.4 shows teenage pregnancy rates in the United States (1980-2000) and Canada (1983-2000), as well as teenage live birth rates in the U.S. (1980-2004) and Canada (1980-2003). All four indicators show a decline in the early 1990s, approximately occurring in 1991, with the exception of teen pregnancy rates in Canada, which started declining in 1994.

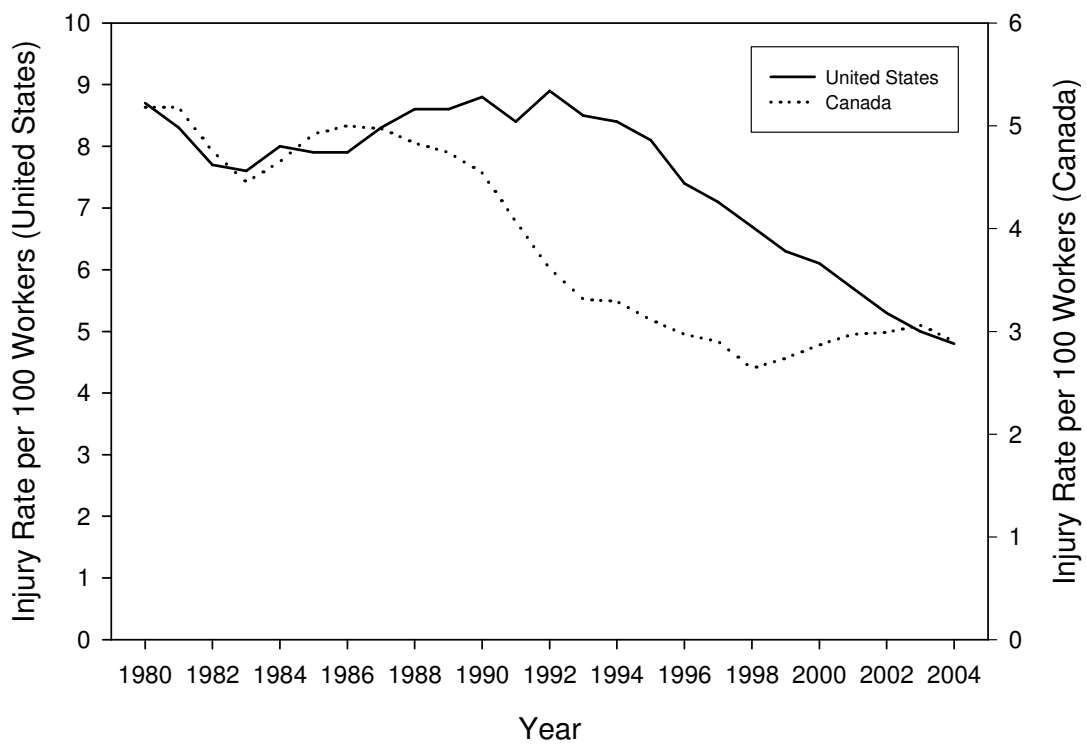


Figure 2.3 Workplace injury rate per 100 workers in the United States and Canada.

Source: Bureau of Labor Statistics (United States); Association of Worker's Compensation Boards of Canada (Canada).

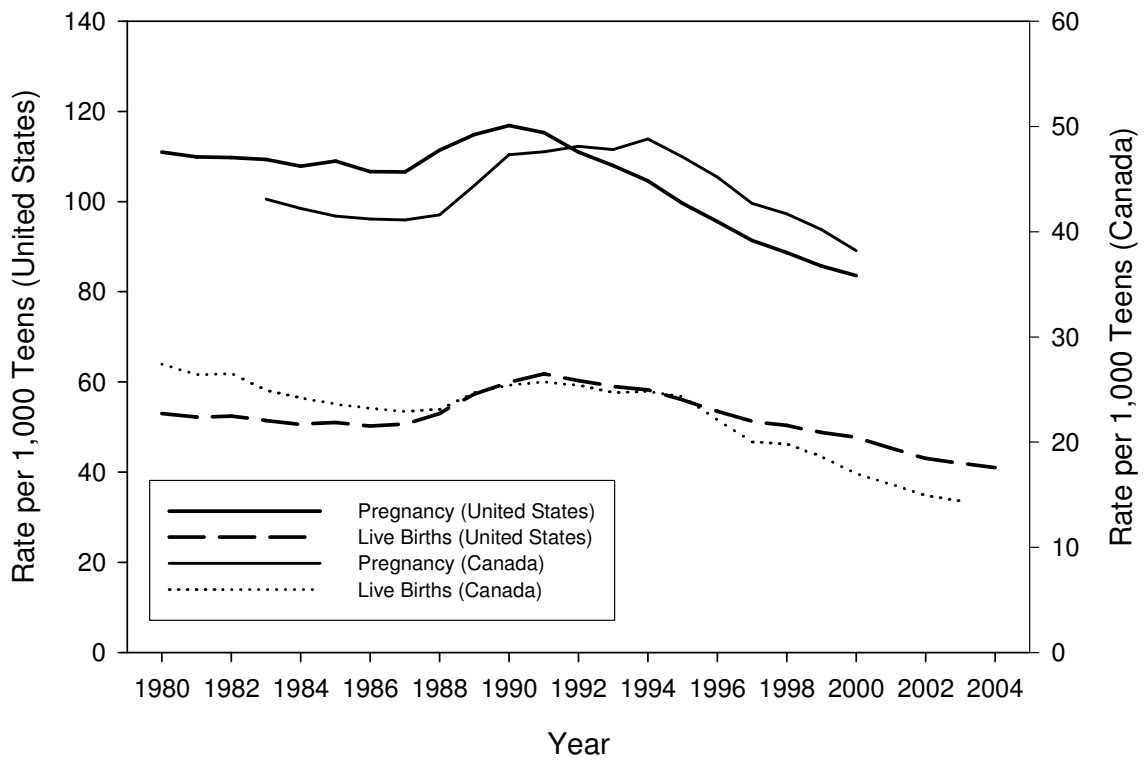


Figure 2.4 Teen pregnancy rate and live birth rate per 1,000 teenagers, age 15 to 19, in the United States and Canada. Source: Guttmacher Institute, National Centers for Disease Control and Prevention (United States); Statistics Canada (Canada).

The rates of the sexually transmitted diseases chlamydia, gonorrhea, and syphilis generally decreased in the 1990s, with some exceptions. Chlamydia rates increased in the U.S., and declined marginally in Canada, although exhibiting an increase in the latter half of the 1990s in Canada. Rates of gonorrhea and syphilis were already declining in the 1980s, but also show steeper declines in the early 1990s.

School Dropout

High school dropout rates for the United States and Canada are shown in Figure 2.5. Only the American data extend back long enough to estimate the timing of the decline, and the data suggest the decline began prior to the early 1990s.

Summary of Trends

Forty of the 46 indicators of risky behaviour (excluding crime data) exhibited a decline over the course of the 1990s. The only six exceptions involve substance use, use of alcohol or drugs before sex, and rates of chlamydia in the US. Of the indicators that show a decline in the 1990s, fifty percent exhibit declines that either began or became steeper in the early 1990s. Most other indicators showed an earlier onset of decline.

Covariation between Crime and Risk Rates

Log transformed cross-correlations, first differenced log-transformed cross-correlations, and ARIMA modeled cross-correlations between risk indicators and homicide in the United States are shown Tables 2.2 and 2.4. Table 2.2 shows cross-correlations from 1980 to 2005, and Table 2.4 shows cross-correlations for longer time series extending for 25 years or more. Cross-correlations between homicide rates and two other crimes, sexual and property crimes, are also provided to provide a basis for

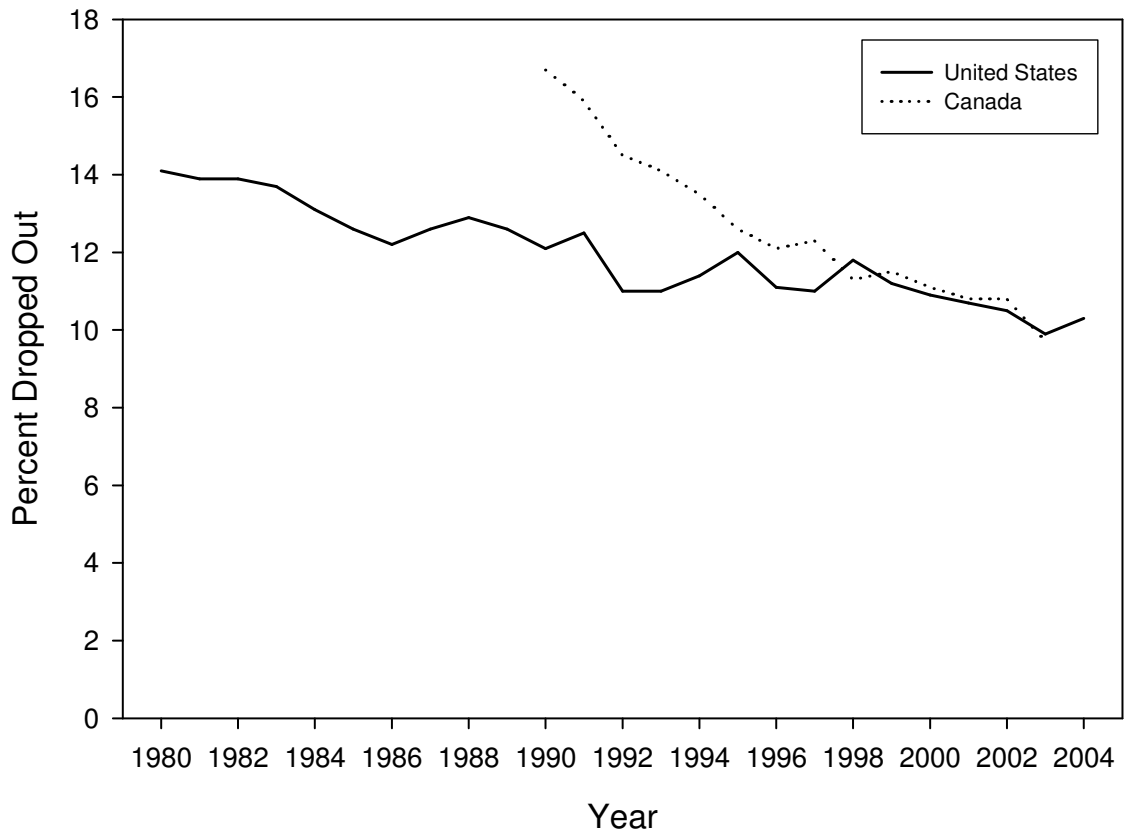


Figure 2.5 High school dropout rates, in the United States and Canada. Source: National Center for Education Statistics (United States); Statistics Canada (Canada).

comparison. Tables 2.3 and 2.5 show the corresponding cross-correlations between homicide rates and risk indicators in Canada. The vast majority of non-differenced cross-correlations were large, positive, and significant in both the United States and Canada. Most of the largest cross-correlations occurred at a time lag of zero, and where this does not occur, the largest correlations generally occurred within a three-year lag.³

First differenced cross-correlations (rates of change) were of smaller magnitude overall, but many were positive and significant. The rate of change of many substance use indicators did not covary in the expected direction with the rate of change in homicide in both the U.S. and Canada, and instead showed negative correlations. Interestingly, risk indicators from other domains, such as accidents and sexual behaviours, also showed negative correlations when substances were involved: Drinking and driving fatalities (U.S. and Canada), drinking and driving among teenagers, and the use of alcohol or drugs before sex among teenagers were all negatively correlated with homicide rates. The relationship between homicide in the United States and school dropout also exhibited a negative relationship, but only for the period from 1980 to 2005; when longer time series were used, this negative relationship did not hold (see Table 2.4).

ARIMA modeling, where applicable, also show the same general pattern of covariation between homicide and most risk indicators. ARIMA analyses for indicators with 20 or more points from the period of 1980 to 2005 revealed that regular smokers and school dropout rates were negatively correlated with American homicide rates. When ARIMA analyses were conducted on longer time series, where it is more reliable (greater than 25 data points), only two indicators were observed to negatively correlate with

³ The alternate use of a partial correlation between homicide and risk indicators, with time partialled out, provides similar results for all cross-correlations.

Table 2.2 The relationship between homicide and risk indicators in the United States, 1980-2005.

Indicators	Data Points	Log Transformed		First Differenced		ARIMA	
		Cross-Correlation		Cross-Correlation		Cross-Correlation	
		Lag 0	Maximum (Lag)	Lag 0	Maximum (Lag)	Lag 0	Maximum (Lag)
<i>Crime</i>							
Forcible rape	25	.809*	.809* (0)	.609*	.703* (-1)	.314	.554* (-1)
Property crime	25	.972*	.972* (0)	.758*	.758* (0)	.702*	.702* (0)
<i>Violent Behaviour</i>							
Carried a weapon (YRBSS)	14	.975*	.975* (0)	.602*	.602* (0)		
Involved in fight (YRBSS)	14	.985*	.985* (0)	.414	.757* (+1)		
Injured in fight (YRBSS)	14	.689*	.689* (0)	.069	.316 (-2)		
Suicide	25	.834*	.834* (0)	.445*	.445* (0)	.451*	.451* (0)
<i>Substance Use</i>							
Tried alcohol (YRBSS)	14	.686*	.686* (0)	-.645*	-.645* (0)		
Tried cigarettes (YRBSS)	14	.623*	.713* (+2)	-.676*	-.697* (-1)		
Tried marijuana (YRBSS)	14	-.713*	-.770* (-1)	-.539	-.713* (-1)		
Regular smokers, 18+	25	.698*	.698* (0)	-.327	.347* (+3)	-.393	-.393 (0)
Illicit drugs in past year (no marijuana), high school	31	-.396	-.454 (+1)	-.300	-.534* (-2)	-.157	-.437* (-2)
Marijuana in past year, high school	31	-.673*	-.712* (-1)	-.342	-.632* (-2)	.201	.410 (+4)
Illicit drugs in past year (no marijuana), college, adults	20	.577*	.883* (-4)	-.196	-.648* (+5)	-.394	-.441 (+3)
Marijuana in past year (college, adults)	20	.359	.865* (-4)	-.336	-.597* (+3)	-.223	-.399 (-2)
Regular smokers, high school	14	.268	.667* (+3)	-.479	-.479 (0)		
<i>Accidents</i>							
Car collision fatalities	25	.706*	.706* (0)	.149	-.265 (+3)	.367	.367 (0)
Car collision injuries	19	.736*	.804* (-2)	-.020	.444* (-1)		
Collisions involving speeding	19	.552*	.721* (-3)	.103	.431 (-5)		
Drinking & driving fatalities	23	.703*	.714* (-3)	.206	-.428 (+3)	.285	-.338 (+3)
Drinking & driving (YRBSS)	14	.775*	.775* (0)	-.258	-.358 (-1)		
Riding with drunk driver (YRBSS)	14	.856*	.856* (0)	-.148	.457 (+2)		
Workplace injuries	25	.925*	.925* (0)	.253	.559* (-1)	.102	.619* (-1)
No seatbelt use	14	.870*	.870* (0)	.086	.294 (+1)		
No bike helmet use	14	.986*	.986* (0)	.517	.625* (+1)		
<i>Sexual Behaviours</i>							
Had sex (YRBSS)	14	.934*	.934* (0)	.040	.517* (+1)		
Sex with 4+ partners (YRBSS)	14	.952*	.952* (0)	.124	.440 (+1)		
Used alcohol/drugs before sex (YRBSS)	14	-.862*	-.862* (0)	-.239	-.388 (-1)		
Been/gotten someone pregnant (YRBSS)	13	.612*	.688* (+2)	-.162	.365 (+5)		
No condom use (YRBSS)	14	.890*	.890* (0)	-.389	.446 (-3)		
Teen pregnancies	22	.920*	.920* (0)	.593*	.702* (-1)	.511*	.511* (0)
Teen births	25	.828*	.828* (0)	.529*	.529* (0)	.416*	.416* (0)
Syphilis	22	.970*	.970* (0)	.656*	.699* (-1)	-.009	.564* (-3)
Chlamydia	14	-.913*	-.913* (0)	-.061	.553 (-4)		
Gonorrhea	22	.680*	.791* (-3)	.043	.510* (-4)	.278	-.468 (+2)
<i>School Dropout</i>							
School dropout	25	.708*	.708* (0)	-.049	-.381 (-1)	-.104	-.416 (-1)

* Correlation significantly different from 0 at $p < .05$.

Table 2.3 The relationship between homicide and risk indicators in Canada, 1980-2005.

Indicators	Data Points	Log Transformed Cross-Correlation		First Differenced Cross-Correlation		ARIMA Cross-Correlation	
		Lag 0	Maximum (Lag)	Lag 0	Maximum (Lag)	Lag 0	Maximum (Lag)
<i>Crime</i>							
Sexual assault	22	-.023	.375 (+3)	.035	.256 (+1)	.499*	.499* (0)
Property crime	25	.855*	.855* (0)	.312	.312 (0)	-.113	.501* (-1)
<i>Violent Behaviour</i>							
Suicide	25	.636*	.649 (+2)*	-.172	.196 (-1)	-.171	-.240* (-2)
<i>Substance Use</i>							
Regular smokers, Age 15-19	13	.864*	.864* (0)	.050	.152 (+3)		
Regular smokers	18	.153	.603 (+3)	-.322	-.501 (+1)		
<i>Accidents</i>							
Motor vehicle collision deaths	20	.821*	.821* (0)	-.267	.467* (-3)	-.333	.547* (-3)
Motor vehicle collision injury	16	.589*	.589* (0)	-.397	.675* (+4)		
Drinking & driving fatalities	16	.857*	.857* (0)	.217	-.447 (+3)		
Workplace injuries	25	.868*	.870* (-1)	.118	.173 (-1)	-.161	.217 (+4)
<i>Sexual Behaviour</i>							
Teenage pregnancies	18	.287	.287 (0)	.119	.234 (-1)		
Live teenage births	25	.810*	.810* (0)	.100	.225 (-1)	-.109	.236 (-1)
Syphilis	20	.628*	.672* (-1)	.153	.314 (-1)	.101	.397 (-1)
Chlamydia	12	.247	.396 (-3)	.168	.490 (+2)		
Gonorrhea	20	.768*	.768* (0)	.239	.239 (0)	.314	.520* (+2)
<i>School Dropout</i>							
School dropout	14	.913*	.913* (0)	.305	.305 (0)		

* Correlation significantly different from 0 at $p < .05$.

Table 2.4 The relationship between homicide and risk indicators in the United States over longer time series of 25 or more years.

Indicators	Data Points	Log Transformed Cross-Correlation		First Differenced Cross-Correlation		ARIMA Cross-Correlation	
		Lag 0	Maximum (Lag)	Lag 0	Maximum (Lag)	Lag 0	Maximum (Lag)
<i>Crime</i>							
Forcible rape	45	.668*	.668* (0)	.732*	.732* (0)	.459*	.459* (0)
Property crime	45	.851*	.851* (0)	.674*	.674* (0)	.587*	.587* (0)
<i>Violent Behaviour</i>							
Suicide	54	.588*	.662* (+2)	-.080	.283* (-3)	-.133 *	.330* (-3)
<i>Substance Use</i>							
Regular smokers, all ages	25	.334	.369 (-5)	-.286	.304 (+3)	-.393*	-.393* (0)
Illicit drugs in past year (no marijuana), high school	31	-.415	-.468 (+1)	-.436	-.584* (-1)	-.013	-.384 (-3)
Marijuana in past year, high school	31	-.691*	-.722* (-1)	-.448	-.718* (-2)	.068	.331 (+4)
<i>Accidents</i>							
Car collision fatalities	55	-.037*	-.479* (+5)	.037	.310* (-2)	.108	.284* (-1)
Workplace injuries	29	.919*	.919* (0)	.243	.585* (-1)	.205	.603* (-1)
<i>Sexual Behaviours</i>							
Teen pregnancies	29	.763*	.763* (0)	.648*	.648* (0)	.556	.556* (0)
Teen births	55	-.636*	-.697* (+5)	.051	.134 (+1)	-.165	.191 (+1)
<i>School Dropout</i>							
School dropout	33	.745*	.745* (0)	-.009	.211 (-3)	-.016	.282 (+5)

* Correlation significantly different from 0 at $p < .05$.

Table 2.5 The relationship between homicide and risk indicators in Canada over longer time series of 25 or more years.

Indicators	Data Points	Log Transformed Cross-Correlation		First Differenced Cross-Correlation		ARIMA Cross-Correlation	
		Lag 0	Maximum (Lag)	Lag 0	Maximum (Lag)	Lag 0	Maximum (Lag)
<i>Crime</i>							
Property crime	29	.633*	.702* (+1)	.100	.277 (-1)	-.127	.468* (-1)
<i>Violent Behaviour</i>							
Suicide	34	.512*	.654* (+2)	-.098	.237 (+1)	-.100	.229 (+2)
<i>Accidents</i>							
Workplace injuries	29	.867*	.867* (0)	.113	.230 (-2)	-.183	.243 (+4)
<i>Sexual Behaviour</i>							
Live teenage births	30	.863*	.863* (0)	.100	.225 (-1)	.021	.181 (-1)

* Correlation significantly different from 0 at $p < .05$.

homicide: The prevalence of regular smokers in the United States. It is important to interpret the cross-correlations from ARIMA models with caution, particularly for shorter time series. At least 50 points are generally recommended for a reliable ARIMA cross-correlation estimate, particularly given that such analyses are sensitive to minor fluctuations in short time series, and may lead to misleading estimates (McCleary & Hay, 1980).

Discussion

Several theories suggest that crime and risk taking behaviour are linked. The crime drop phenomenon of the 1990s provided a unique opportunity to investigate whether the reduction in crime was also related to a general reduction in risk taking behaviour. Based on the theoretical links suggested between crime and risk taking, as well as previous findings specifically linking crime and risky behaviour at the individual level, it was predicted that available indicators of risk taking would show a decrease in the 1990s, and rates of criminal and risky behaviour would vary over time in a parallel manner.

Results indicate that a majority (40 out of 46) of indicators of risk taking in the categories of violent behaviours, substance use, accidents and behaviours related to accidents, sexual behaviours, and school dropout have decreased in the 1990s. Many of these indicators showed a decrease either beginning or becoming steeper in the early 1990s; other declines were a continuation of an earlier decline beginning in the 1980s. Many risk indicators (with the important exception of behaviours involving substances) exhibited positive and significant correlations with homicide rates in the period of rising and falling crime rates, 1980 to 2005, as well as in longer time series extending before 1980, in both the United States and Canada. When the magnitude of the cross-

correlations between homicide and risk indicators are compared to the magnitudes of the cross-correlations between homicide and other types of crimes, it seems that most risk indicators covary with homicide over time to roughly the same degree as other crimes do in both the U.S. and Canada, especially when allowing for time lags.

In the following, changes in risk indicators in the 1990s are discussed for all five categories of risky behaviour. Some strengths and limitations of the study are then pointed out, and a discussion of the implications of the results for explanations of the crime in the 1990s offers a conclusion.

Violent Behaviour

The rates of all five indicators of violent risk taking behaviour declined in the 1990s. The timing of the drops for suicide in the United States and Canada appear to have occurred in the late 1980s, indicating that the decline observed in the 1990s may be part of a longer downtrend. Cross-correlation analyses suggest that changes in these indicators paralleled homicide rates in the period from 1980 to 2005. When longer time series are considered, it is clearer that suicide rates covary with rates of homicide in both the United States and Canada, as has been previously reported (e.g., Holinger & Klemen, 1982).

Although the crime drop in the 1990s is observed for all age groups, it is worth noting that the crime rate began dropping earlier for older individuals (Fox, 2005). For example, the homicide rate declined sharply for teenagers and young adults in the early 1990s, whereas the decline was observed earlier in those aged 25 and older. Suicide rates plotted by age were examined (data not shown) and it was observed that teenagers and young adults (age 14 to 24) showed a drop in the early to mid-1990s, whereas older adults (age 25 and older) showed a drop at the end of the 1980s. There might be, therefore, a closer parallel between crime and suicide (and perhaps other risk indicators)

when data are examined as a function of age. Young people, who are typically more impulsive and present-oriented compared to older adults, may be more “resistant” to the factors that decrease risk taking propensity.

Substance Use

Seven of the eleven substance use indicators showed a drop in the 1990s, with the exception of high school students reporting illicit drug or marijuana use in the past year, and high school students reporting regular smoking. Timing can be evaluated for illicit drug and marijuana use in high school students, as well as regular smokers in the United States. The data suggest that illicit drug and marijuana use has been declining since the early 1980s among high school students, with a relatively sharp increase observed in the early 1990s. Since the mid-1990s, however, a decline has been observed for marijuana use, and stabilization has been observed for illicit drug use among high school students.

Data on the prevalence of regular smokers in the United States suggest that the drop observed in the 1990s is a continuation of one that started much earlier. In addition, cross-correlation analyses suggest substance use in general does not parallel homicide rates from 1980 to 2005, or in longer time series. Other indicators involving substance use, such as drinking and driving, and the use of drugs or alcohol before sex in teenagers, also do not show a close relationship with crime rates, contrary to what would be expected from theories of crime that link substance use and crime (e.g., problem-behaviour theory, self-control theory).

It may be possible that some drug use increase may be due to a decreased perception of risk or harmfulness, coupled with a widespread increase in societal acceptance. Such an argument has been put forth regarding increased marijuana use in students and seniors (Bachman, Johnston, & O’Malley, 1998). Nevertheless, because

substance use is often illegal (e.g., marijuana use; under-age drinking) and can have negative long-term consequences, it is surprising that it does not follow the same temporal pattern as other risky behaviours, and indicates that substance use may not respond to the same traits or situational factors that may facilitate other forms of risk taking.

Accidents

All 13 indicators for accidents and behaviours related to risk of accidents showed a decrease in the 1990s. Some indicators, such as workplace injuries, produced curves strikingly similar to crime rate curves. Others, such as car collision injuries and fatalities, showed a decline beginning in the 1980s. Cross-correlation analyses reveal that almost all indicators of accidents covary positively with homicide rates in the U.S. and Canada, with the exception of car collision fatalities (U.S.), drinking and driving fatalities (U.S. and Canada), and reported drinking and driving among teenagers (YRBSS). It is interesting to note, again, that two of those three indicators involve substance use. When car collision fatalities are examined over a longer time span (55 years), they are significantly correlated with homicide rates, suggesting that the limited time span of 1980 to 2005 does not necessarily describe the temporal relationship between car collision fatalities and crime rates effectively.

While car collision fatalities and homicide seem to covary, and perhaps have common determinants, it is important to note that other factors unrelated to homicide have certainly led to a reduction in car collision fatalities and injuries. The introduction of mandatory seatbelt laws and the widespread use of airbags have contributed to a reduction in car collision fatalities (e.g., Crandall, Olson, & Sklar, 2001), but accidents involving speeding, which perhaps reflect risk taking more directly, also show a decline

in the 1990s. Regardless, the cross-correlation analyses suggest that almost all indicators of accidents and homicide rates share common determinants.

Sexual Behaviour

Most indicators of sexual risk taking have also shown a decrease in the 1990s, with thirteen of fifteen indicators decreasing from 1991 to 2001. Looking at risky behaviour among teenagers first, all indicators—with the exception of substance use before sex—have shown a decrease, with declines often beginning in the mid-1990s. Cross-correlation analyses also support a similar pattern of results, with all indicators positively covarying with homicide over time, except for substance use before sex.

Sexually transmitted diseases in the general population have decreased in both the United States and Canada, with the exception of only chlamydia in the United States. Since 2001, many sexually transmitted diseases have increased in prevalence. The recent increase in some sexually transmitted diseases in the United States and Canada is probably explained by a recent improvement in screening procedures (Cates Jr., 1999). Cross-correlation analyses show that most sexually transmitted diseases also covary with homicide, similarly to teenage sexual behaviour, providing more support for covariation between crime and sexual risk taking.

School Dropout

The dropout rate for high school students in both the United States and Canada has steadily decreased since the early 1990s, although the drop in the United States started much earlier. For the period of 1980 to 2005, cross-correlation analyses reveal that school dropout rates are negatively correlated with homicide in the United States and positively in Canada. When longer time series are examined, however, a positive

relationship is observed for school dropout for both countries. The longer time series cross-correlation is likely more reliable.

The decision to drop out of school is likely due to multiple factors, such as self-determination, persistence, motivation, or school policy (e.g., Vallerand, Fortier, & Guay, 1997). Dropping out of school represents a focus on immediate, impulsive rewards of non-school activities, at the cost of ignoring the long-term consequences of a limited education, and empirical research suggests that such is the case (Eckstein & Wolpin, 1999). It is particularly interesting to note that even given the multiple influences on school dropout, there is a positive cross-correlation between high school dropout and homicide rates in both the United States and Canada. This observation is consistent with the notion that common traits or situational factors underlie behaviours as seemingly disparate as school dropout and homicide.

Methodological Strengths and Limitations

The diverse nature of the data collected provides strong evidence for a widespread decrease in risk taking behaviour paralleling crime rates, with the important exception of behaviours involving substances. In addition, three different cross-correlation analysis techniques exhibit high concordant validity in revealing that many indicators of risky behaviour, save for those in the domain of substance use, are positively correlated with homicide rates in both the United States and Canada.

There also exist obvious methodological limitations in this study, arising from incomplete or unavailable data. Many important indicators of youth behaviour are only available since 1991, making it difficult to support claims that adolescent risky behaviours began decreasing at the same time as crime in the early 1990s, when in fact the data may be reflecting downtrends beginning in the 1980s or even earlier. In addition,

Canadian data for youth risk behaviours would have been useful in claiming a more generalized decrease in North America. The fact that U.S. youth risk indicators generally covary with homicide rates over the limited period of available data, however, suggests a link between crime and risky behaviour among youth more generally.

Many cross-correlations, although in the expected direction, were not statistically significant. Longer time series would ameliorate this problem, because many indicators with 20 or more points that are correlated with homicides are correlated significantly. The fact that many indicators are positively and fairly highly correlated with homicide, however, suggests that the relationship between risk indicators and crime is reliable.

Some forms of risky behaviours, sometimes referred to as extreme sports, seem to have become more prevalent rather than less. Unfortunately, time series could not be located for these activities. These extreme sports (e.g., rock climbing, parachute jumping) seem to represent less impulsive forms of risk taking, because they require training and preparation. To participate in such activities, one must plan ahead, engage in lengthy training, and generally exercise some degree of caution. The indicators of risk taking located for this study involve little training and preparation, if any at all. Because of the link between impulsivity and crime, it would be expected that only impulsive forms of risk taking (as defined in the introduction) would covary over time with crime.

Gambling represents another popular form of risk taking that may not accurately represent impulsive decision-making. Studies suggest significant differences between non-pathological and pathological gambling, with only the latter associated with increased impulsivity (e.g., Langewisch & Frisch, 1998). Although measures associated with gambling, such as gambling expenditures per capita, have exhibited increases since the early 1990s, these expenditures reflect all gambling-related spending, not only

pathological gambling. Thus, increases in aggregate expenditures may be due to increased patronage at casinos, increased accessibility of gambling venues, or more frequent non-pathological gambling (e.g., Welte, Wieczorek, Barnes, Tidwell, & Hoffman, 2004). In addition, aggregate measures of gambling-related expenditures do not necessarily accurately reflect individual-level behaviour, even when standardized per capita.

Typical surveys of teenagers and health-related databases rarely include information on healthy, non-risky behaviours. It is thus possible that not just risk taking has dropped in the 1990s; people may simply be less active (i.e., staying home to watch television or use the Internet). Interestingly, the YRBSS provides data on physical exercise, and shows that the percentage of students who exercised in the last week increased by nine percent from 1991 to 2001. Furthermore, the percentage of students attending physical education class one or more days during an average school week increased by 14 percent. The increase in physical activity suggests teenagers are not simply less active, but rather are allocating time to less risky (and more prosocial) activities.

Cross-Validation of the Relationship between Risk and Crime

Risk taking and crime are clearly related at the individual level, as predicted by numerous theories (e.g., Wilson & Daly, 1985; Gottfredson & Hirschi, 1990; Jessor, 1991), and such theorizing is supported by substantial empirical evidence (e.g., Grasmick et al., 1993; Lalumière & Quinsey, 1996; White et al., 1994). Results from this study suggest that crime and risky behaviours are also related at the aggregate level, because both behaviours exhibit reliable covariation over both short and long time frames. It is possible, however, that the relationship between crime and risk taking be positive over

time periods of 20 or more years, but may not exhibit similar covariation year to year, or within shorter time periods. Alternative statistical methods are necessary in future studies to further elucidate the relationship of non-criminal risk taking and crime rates at the aggregate level, and to provide cross-validation of the findings in the present study.

If crime and risk are closely related, crime and risk taking rates should demonstrate a consistent and similar relationship in short time frames. If a principal components analysis was conducted on a number of social variables in individual years, including crime, risk taking, and other variables that measure behaviour at the aggregate level, one should expect a factor to emerge that encompasses both crime and risk taking, if both are highly related behaviours. Of particular importance would be the inclusion of forms of risk taking that require planning and forethought, such as participation in extreme sports such as skydiving. One should not expect that extreme sports risk behaviours, or non-pathological forms of gambling behaviours should load with crime or other forms of risk, given that extreme sports and some gambling behaviours do not necessarily reflect impulsive or necessarily reckless behaviour that is solely focused on short-term gains.

Alternatively, crime and risk taking may load on different but correlated factors. In this case, crime and risk taking may not represent manifestations of similar underlying traits or mechanisms, but rather, behaviours that correlate and may share similar causes. Further evidence would be provided by conducting a multiple regression of social variables and crime. If crime and risk are strongly related, indicators of risky behaviour should be strong predictors of crime rates for different time periods. Although the results in the present study suggest that crime and risk are related and covary over time at the

aggregate level, further cross-validation would illuminate the way that crime and risk are linked.

Revisiting Previous Explanations of the Crime Drop

The results of this study suggest that explanations for the crime drop should not focus on individual types of crimes, or even crime specifically, but instead on risk taking in general. Here, well-known theories of the crime drop are re-visited in light of the findings.

The demographic effects of an aging population and the legalization of abortion in the 1970s can be expected to have an effect on rates of risky behaviour. A reduction in the number of at-risk individuals (the young, and those with poor prospects) in the general population would result in lesser impulsive risk taking in general. In addition, fewer individuals in a given age-class may lead to reduced competition and thus to lesser risk taking within that class, as suggested by Daly and Wilson (1985). A reduction of the number of at-risk individuals would not explain, however, the observed tendency for all age groups to show a crime or risk drop. For example, the number of workplace injury claims has decreased from 1990 to 2001 among individuals over 50 years old by about as much as it has for younger individuals (Breslin, Smith, Koehoorn, & Lee, 2006).

Public policy shifts are not completely satisfactory in explaining the general drop in risk taking. It is hard to imagine that the number of police officers or the use of innovative policing strategies would have wide-ranging effects on risk taking in different domains (i.e., sexual behaviour or school dropout rates). Increased prisoner incarceration could have an effect on rates of risk taking, by removing the opportunities of at-risk individuals. As noted before, however, Canada has not experienced an increase in the number of incarcerated individuals.

A strong economy should presumably deter property crime by reducing its appeal. The results suggest a more generalized phenomenon, however, one involving a reduction in the expression of all forms of risk taking and criminality, not simply property crime. An improved economy may affect risk taking indirectly by fostering an optimistic sense of the future, and thus reducing the appeal of risk taking behaviours that carry potentially heavy long-term costs. Finally, the crack cocaine epidemic constitutes an isolated problem in the eighties only affecting certain large urban centers in the United States, with little influence in Canada, and no observed influence in rural areas. A reduction in the general use of disinhibitory drugs would potentially affect risk taking in general, but such reduction has not been observed.

What Caused the Crime (and Risk) Drop?

Many of the previously suggested explanations for the crime drop are limited in their ability to explain the widespread drop in risk taking and crime in the 1990s. Here, avenues for future research into the generalized drop in crime and risk taking are suggested, from theories of crime that specifically link crime and risk propensity.

Wilson and Daly (1985) proposed that crime may simply be a form of risk taking behaviour, and both arise in particular situational contexts (e.g., interpersonal conflict). Daly and Wilson (2001) suggested that risky behaviour and crime are outcomes of steep future discounting, whereby the quality of one's future affects the utility of risk. Cues of low local life expectancy or socioeconomic inequality may facilitate engaging in risk taking, particularly if some individuals could improve their situations by engaging in such behaviour, making risk taking and crime a "rational" choice in certain circumstances. Based on this theoretical framework, the drop in crime in the 1990s may be attributed to lesser discounting of the future and more positive perceptions of

competitive abilities. An investigation into changes in the situational cues associated with future prospects and competitive abilities over time may provide clues to the causes of the crime and risk drop. A recent innovative analysis by Fabio et al. (2006) suggested that variability in rates of violence over time are due to situational or social factors (i.e., period effects), rather than stable differences between individuals (i.e., cohort effects).

If crime and risk taking are manifestations of the same underlying trait, the drop in criminal and risk taking behaviour may be due to diminished expression or lower prevalence of the trait in question. Gottfredson and Hirschi's (1990) self-control theory proposes that crime is the result of low self-control and opportunity. Although they acknowledged that other factors, such as age and specific motivations, can also account for crime, they proposed that variation in self-control and opportunity will account for most of the variation in criminal activities. Therefore, according to self-control theory, any fluctuations in criminal or risky behaviour rates over time, including the specific decrease in the early 1990s, must be due either to increased self-control in the general population, or a decrease in opportunity.

Jessor's (1991) problem-behaviour theory describes a "syndrome" of problem behaviour including substance use, delinquent behaviours, risky driving, and early sexual intercourse. These and other problem behaviours are the result of the combination of protective (e.g., parental monitoring) and risk factors (e.g., deviant peer group). Jessor's theory suggests that the decline in crime and risk in the early 1990s may be due to changes in the prevalence of risk factors and protective factors.

Conclusion

There is some evidence to suggest that the crime drop phenomenon is not restricted to just the United States and Canada, but reflects a generalized trend across

most Western countries. In Germany, the total criminal offence rate dropped eight percent between 1993 and 1999, and the total number of crimes recorded by the British Crime Survey dropped by 16 percent between 1993 and 1999 (Ouimet, 2002).

Understanding the ubiquitous nature of the crime drop in not just the United States and Canada, but across the industrialized world, would be worth pursuing. It is, after all, good news that the rates of many harmful risky behaviours have decreased; a better understanding of the causes of the decrease could help design interventions or policies to maintain or accelerate the decrease. Although existing theories of crime suggest some hypotheses for the causes of the crime and risk drop, a consideration of life history theory and risky behaviour as an evolved, “rational” response to environmental conditions may provide a more comprehensive framework to better understand fluctuations in risky behaviour.

CHAPTER THREE

Life History Theory and the Causes of the Crime Drop

ABSTRACT

Risk taking is traditionally described as reckless, impulsive, or dangerous behaviour with little utility. A consideration of risk taking and risk-acceptance as an evolutionarily adaptive response to environmental cues is illuminating, particularly in the context of life history theory. Life history theory seeks to understand the adaptive allocation of energetic resources to important biological functions, such as reproduction, growth, and survival, and is conceptualized as tradeoffs between traits that constrain each other, based on the limitations imposed by finite energetic resources. The utility of risk taking behaviour varies based on environmental and situational conditions that change the relative attractiveness of risky strategies, and the relative importance of current versus future circumstances. Life history tradeoffs may be relevant to understanding the causes of the crime and risk drop of the 1990s. Indicators of a shift from short-term to long-term life history strategies, and cues that facilitate such a shift are discussed in the context of the drop in crime and risk.

A Brief Introduction to Life History Theory

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

A key concept in life history analysis is the idea of tradeoffs: Organisms must allocate a finite amount of effort or energy to endeavors that constrain each other, such as number of offspring and size of offspring (Stearns, 1992). Natural selection favours a pattern of allocation that optimizes fitness in a particular environment; that is, the strategy of effort or energy allocation that maximizes fitness is “optimal” given the characteristics of a particular environment (Kaplan & Gangestad, 2005). There are a number of tradeoffs that have been well documented in animals, for example, current and future reproduction, mating and parenting effort, and growth and reproduction. These tradeoffs are relevant in the evolution of a diversity of life history strategies in various species, as well as variations in life history within a single species. These important tradeoffs will be discussed in the context of risky behaviour, particularly in how each tradeoff affects potentially adaptive risk acceptance in different environmental and situational contexts.

Survival, the Present, and the Future

Organisms have limited effort and energetic resources to allocate to different essential life-sustaining activities, and this limitation forces tradeoffs such as that

between current reproduction and future reproduction. Current reproduction incurs costs such as compromised immune function, reduced chance of survival, and lowered expected future reproduction. Delaying current reproduction incurs opportunity costs of not reproducing at all (Kaplan & Gangestad, 2005). Organisms “decide” on a schedule of reproduction based on optimality of allocation of resources in a particular environment. If mortality due to extrinsic factors (e.g., predation, accidents) increases, it makes little sense for an organism to delay reproduction given the potentially severe opportunity costs of not reproducing at all in a dangerous environment. Consequently, effort and energy in this particular environment should be allocated toward earlier reproduction, minimizing the chances of death without reproducing. This tradeoff has direct consequences for aging; short-term allocations of effort and energy may accelerate senescence.

The time horizon of an organism, determined from environmental cues to mortality rates and life expectancy, has a powerful influence on life history. Under the eye of selection, organisms able to most accurately assess their time horizons based on internal and external mortality cues and most able to exhibit the appropriate behavioural response (for example, reproducing early if mortality is high) would obtain higher fitness and pass this ability to future generations. In the context of decision making, a limited time horizon leads organisms to value immediate, small short-term rewards more highly than larger distal future rewards, a pattern known as future discounting. Discounting of the future may appear on the surface to be a risky strategy, but choosing such a strategy in face of particular environmental conditions may be the best decision, reproductively speaking. For example, Harvey and Zammuto (1985) showed that the age of first reproduction in females is related to life expectancy at birth, both within and among various species of wild mammals.

Humans appear to exhibit similar sensitivity to time horizons by discounting the future if time horizons appear to be short, or if the projected quality of one's future is low. The decision to engage in risky behaviour may be contingent on an actor's assessment of his own need and how the available behavioural options might meet that need. For example, individuals experiencing economic inferiority, short life expectancy, low resource holding potential, or low social status, may rightly perceive that their average outcome (e.g., a minimum wage job) will be poor (Wilson & Daly, 1997). Such people often appear to engage in behaviours reflective of future discounting, such as competitive risk taking or interpersonal violence, perhaps because their perceived need for social, reproductive, or financial advancement exceeds the mean advancement resulting from lower risk (future-oriented) behaviours.

Engaging in discounting behaviours may lead to immediate gains in reputation, reproductive opportunities, or material resources. Potentially costly risky or criminal behaviour becomes an appealing option, because the benefits may far outweigh the costs for an individual with poor future prospects and a shortened time horizon. A decision to engage in risk taking in some conditions may suggest that there has been selection pressure for the higher valuation of short-term, risky options if such behaviours resulted in positive fitness consequences under these conditions.

Under this perspective, age-specific risk rates reflect different valuations in short versus long-term rewards. The valuation of safety and survival changes relative to life stages, particularly in comparison with potential immediate rewards such as mating access (Daly & Wilson, 2001; Hill & Chow, 2002). Young males aged 18 to 24 are particularly likely to engage in risk-accepting behaviour, as competition for status, mates, and resources in that period of time reaches its peak (Wilson & Daly, 1985). This period

of time allows for the potential of high risks and high gains, as the costs of not obtaining resources and a mate are significant in a fitness sense, and risk taking may be necessary in order to obtain favorable outcomes (Hill & Chow, 2002).

Of course, there are situations in which the future is less discounted, and behaviour is focused on maximizing long-term outcomes. Other stages of life history have been associated with decreases in risky behaviour, such as having moved up the status ladder, possession of a high quality long-term mate, and parental investment in children (Hill & Chow, 2002). For individuals who have already obtained a mate through competition, and are the progenitors of offspring, effort and energy may shift from that of competition and mating effort to that of parental effort, facilitating a decrease in risky behaviour in the process.

A number of studies have investigated the role of time horizon perception and future prospects on discounting the future and outcomes involving risk. Wilson and Daly (1997) compared Chicago neighborhoods' homicide rates, local life expectancy, economic inequality, and women's reproductive timing. Interpersonal conflict can be thought of as an outcome of steep future discounting and a risk-accepting response to the stresses of social competition (Wilson & Daly, 1997). In addition, many homicides occur as a direct result of male-male competition over status, or over mates (e.g., Wilson & Daly, 1985). Therefore, in a situation of limited life expectancy, it is likely that males would escalate competition that sometimes ends in homicide, and indeed, Wilson and Daly found that homicide rates increased as local life expectancy decreased, even after removing the effects of homicide on life expectancy.

A shift toward immediate reproduction trading off with later reproduction should be observed in situations of short time horizons, given that the likelihood of successfully

reproducing in the future is diminished in such a situation. Wilson and Daly (1997) found support for this hypothesis, demonstrating that birth rates were highest in neighborhoods with lowest life expectancy, and disproportionately higher in younger mothers. Thus, cues of competitive disadvantage and social disparity appear to influence the relative value of current and future reproduction, and current and future prospects, resulting in potential discounting of the future.

Unpredictability of environments also plays an important role in the modulation of risk taking behaviour. Risk acceptance may constitute a more effective strategy when future prospects are unknown. If an individual was to utilize a 'safe', risk-averse strategy in the face of uncertainty, they may not survive to reproduce again if conditions become particularly bad. A risky strategy, although paradoxical, may be a safer strategy in the long-term in the face of unpredictability. Following from this prediction, Hill, Ross, and Low (1997) found that reported risk taking behaviour was higher in college students that exhibited higher future unpredictability beliefs and shorter lifespan estimates. Further research demonstrated that early cues of unpredictability, such as parental divorce or family unreliability, are associated with a risk-accepting life history strategy (Ross & Hill, 2002). It is also possible that divorced or unreliable parents genetically passed on traits that predispose their offspring toward risky behaviour, and previous research has shown that there is some genetic transmission of risk-accepting tendencies from parents to offspring (e.g., Cadoret, Yates, Troughton, Woodworth, & Stewart, 1995). Behaviour genetics research also suggests, however, that the importance of the environment in motivating behaviour cannot be discounted.

In sum, similar tradeoffs are seen in humans that are seen in other animals, wherein short time horizons and unpredictable environments may lead to a greater

valuation of immediate rewards and discounting of the future, as evidenced by greater risky and criminal behaviour in individuals with more negative future prospects.

Mating and Parenting Effort

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

The sex difference in minimal parental investment creates a situation in which the sex that exhibits greater minimal parental investment, usually female, becomes a valuable resource which members of the opposite-sex, usually males, compete for (Trivers, 1972). Because a pregnant female is essentially removed from a pool of potential mates, an effective (or operational) sex ratio imbalance facilitates the evolution of intense male-male competition for the limited number of available females. That certain males can monopolize the available pool of females more than others increases male variance in reproductive success, fuelling competition further (Bateman, 1948).

Over evolutionary time, there may have been stronger selection pressure on men to seek and be open to sexual opportunities, given that an increase in sexual partners likely increased the reproductive success of men more than women over time. A tendency for men to invest more energy in mating effort than women has been well established (reviewed in Gaulin & McBurney, 2001; see also Schmitt, 2005). Although men are

generally more likely than women to invest in mating relative to parental effort, there is substantial variation within the sexes. Some men may be completely monogamous and invest copious amounts of time and energy into their offspring; others may attempt to have as many sexual encounters as possible, never investing in offspring. Similar, but perhaps smaller, variation in allocation of energy to mating and parental effort is seen in women. In both men and women, a tendency toward early reproduction and high mating effort is generally associated with greater risk taking behaviour (reviewed in Lalumière, Harris, Quinsey, & Rice, 2005).

Early reproduction and high mating effort are associated with risk taking and delinquent behaviours. In both sexes, risk taking is highly associated with being or getting someone pregnant in adolescence (Bingham & Crockett, 1996; Jessor, Costa, Jessor & Donovan, 1983). Teenaged fathers, for example, are much more likely to have committed serious crimes (Stouthamer-Loeber & Wei, 1998), and to have encountered risk factors associated with risk-accepting behaviour, such as low socioeconomic status or parental antisociality, among others (Fagot, Pears, Capaldi, Cosby, Leve, 1998). Early pregnancy in females has also been associated with risky behaviour, with childhood aggression predicting early motherhood (Serbin et al., 1998). Other studies have investigated mating effort more generally in relationship to risky conduct. Lalumière and Quinsey (1996) found that variables that measured antisocial tendencies were also related to mating effort and to a history of multiple uncommitted sexual relationships. Risky, antisocial males are also more likely to utilize sexual coercion, aggression, or deception in the pursuit of mating opportunities.

Why are risky individuals more likely to engage in potentially costly mating behaviours, exhibiting high mating effort and low parental effort? Adolescents exhibit a

marked peak in risky behaviour, including increased sexual behaviour, immediately after puberty, with a systematic decline occurring sometime thereafter. This peak during adolescence may be due to escalated intra-sex competition for mates (Campbell, 1995; Daly & Wilson, 1988; Wilson & Daly, 1985). Because of the sex differences in minimal parental investment outlined earlier, there is greater variability in male than in female reproductive success, and there are great fitness benefits bestowed upon males that succeed, and great costs for males that do not.

It should be mentioned that behaviours that are considered risky may reflect hard to fake displays of prowess or social status, such as willingness to fight, fearlessness, or independence, and so adolescent risky behaviour may serve as an “honest signal” of good genes or health, or of other desirable qualities to females (Lalumière & Quinsey, 2000; Zahavi & Zahavi, 1997). This notion is supported by the fact that gang leaders and dominant males seem to enjoy increased access to sexual partners, and by the fact that young males are more likely to engage in risky behaviour when in the presence of peers (Daly & Wilson, 2001).

Desistance from criminal and risky behaviour for most individuals occurs after adolescence, likely as a function of a shift in allocation of energy from mating to parenting effort. Marriage, stable work, and aging are all reliable correlates of desistance from risky and criminal behaviour. A shift from mating to parenting effort (or vice versa) should be observed when the cost-benefit ratio favors one type of effort over the other. Investing in a committed relationship with a high quality mate, for example, may offer greater fitness benefits in the long-term. The costs of attempting to gain multiple mating opportunities—such as time and effort allocated to courting, risks associated with sexual aggression, or retaliatory violence from partner’s relatives—may exceed the benefits of

investing in a long-term relationship with a single partner, and allocating effort and energy to children borne of that partnership.

A proximal explanation for risky behaviour involves testosterone, a hormone that some studies have associated with increased risky behaviour (e.g., Alluja & Torrubia, 2004). Testosterone is found at much higher levels in men than women, an observation consistent with the fact that men are much more likely to engage in risky behaviour than women. The marked spike in testosterone levels in males at puberty coincides with a significant increase in risky behaviour, suggesting that testosterone may play a role in modulating such conduct (Ellis & Coontz, 1990).

Interestingly, some factors associated with desistance from risky behaviour are also associated with a decrease in testosterone levels. For example, Burnham and colleagues (2003) found that men in committed, long-term relationships exhibit lower testosterone levels. The same effect was found in men in a longitudinal study, but it was also found that both men and women with lower stable circulating levels of testosterone were more likely to currently be involved in a relationship (van Anders & Watson, 2006). In addition, higher stable testosterone levels have been associated with multiple partnering (van Anders, Hamilton, and Watson, 2007). Expectant fathers also have lower testosterone levels, presumably facilitating a shift toward parenting effort, and away from mating effort (Berg & Wynne-Edwards, 2001). Together, these findings implicate testosterone as a possible proximal influence for risky behaviour, although these studies are all correlational, not experimental. It may indeed be the case that situational factors, such as being in a long-term relationship or impending fatherhood, may decrease testosterone levels in turn decreasing risk taking. Individual differences, however, may

also play an important role, in that stable levels of circulating testosterone may influence whether an individual ends up in a stable relationship or not.

To summarize, mating effort and parenting effort tradeoff against each other, based on relative costs and benefits. Younger and unmated individuals engaged in intense competition have more to gain and less to lose from engaging in risky behaviour. With age, greater social status, a long-term relationship, and children, however, the relative valuation of benefits and costs stemming from risky behaviour changes significantly, and a shift from mating to parenting effort is observed.

Growth, Reproduction, and Competitive Disadvantage

Embodied capital refers to intrinsic attributes, such as health or attractiveness, that allow for successful competition for resources, mates, and status (Lalumière et al., 2005). Individuals with low embodied capital may experience consistent competitive disadvantage, such that a conditional strategy of persistent risky behaviour, although costly, may represent their best chance for obtaining at least some resources, status, or mates. Individuals with low embodied capital would likely project their future prospects to be poor, and would perceive their average outcome to be poor as well, thus affecting the cost-benefit ratio of risky behaviour.

Competitive disadvantage has been empirically shown to influence rates of risky and criminal behaviour. Wilson and Daly (1997) demonstrated that Chicago neighborhoods with higher local income disparity also experienced higher homicide rates. If one is able to compete legitimately for resources, status, or mates, it is not beneficial to engage in costly risky or criminal behaviour. Individuals who are at a competitive disadvantage relative to others, however, have much to gain and often little to lose from discounting the future and engaging in risky conduct. The constraints of low

embodied capital shift the cost-benefit ratio of risky behaviours, making them a more beneficial option throughout the lifetime.

Cues of unpredictable or adverse future environments can influence growth trajectories and the adoption of life-course persistent risky behaviour, and such behaviour may represent a manifestation of a life history tradeoff between investment in long-term growth and earlier reproduction. Infants exhibit a predictable growth trajectory when they experience typical prenatal conditions. Low birth weight caused by poor maternal nutrition (Godfrey, Robinson, Barker, Osmond, & Cox, 1996), however, can often lead to rapid compensatory growth during the early years of a child's life, in addition to health problems later in life (Gluckman & Hanson, 2004; Lummaa, 2003).

The experience of poor maternal nutrition in utero may serve as a cue to the developing fetus that conditions experienced during development (in this case, limited resource availability), are likely to continue after birth and in the future. Thus, compensatory growth and accelerated development in the early part of a child's life may occur as a pre-emptive adapted response that is likely to confer benefits in a future environment, extrapolated and predicted based on environmental conditions during early development. Gluckman and Hanson (2004) describe such phenotypic responses to potential future environmental conditions as *predictive adaptive responses*, in which an organism adaptively modifies its physiology in anticipation of future environmental conditions.

Individuals that exhibit compensatory growth may reproduce earlier in life, but their lack of investment in long-term growth results in a much higher senescence rate in later life. Such a mechanism may represent an attempt to mature and reproduce earlier than other potential competitors in a cohort, albeit at the cost of not being able to

reproduce for very long. Empirical evidence supports an early reproduction/long-term growth life history tradeoff, in that individuals experiencing early compensatory growth senesce faster, and suffer negative reproductive consequences later in life (Lummaa, 2003; Phillips et al., 2001; Eriksson et al., 2001).

The development of persistent risky behaviour may be related to such tradeoffs between growth (or investment in embodied capital more generally) and reproduction. A number of social or psychological environmental variables have been implicated in the development of life-course persistent offending: Parental abuse, poor nutrition (in utero or during childhood), neurodevelopmental perturbations, and general developmental instability (Harris, Rice, & Lalumière, 2001; Lalumière, Harris, & Rice, 2001).

Neurodevelopmental perturbations and poor nutrition may serve as cues of developmental disadvantage to a mother and her fetus, and thus facilitate the development of risk-accepting strategies. Early parental abuse and subsequent development of persistent risky behaviour may also reflect the same mechanism, in that parental abuse may suggest (analogous to poor nutrition) low embodied capital and thus a difficult future.

During World War II, food supplies were limited by the German army in some parts of the Netherlands, leading to severe food shortages. Males whose mothers experienced low resource availability were not only of low birth weight, and experienced lower reproductive success over their lifetime (Lumey & Stein, 1997), but also exhibited much higher frequencies of risky behaviour compared to males whose mothers who did not experience low resource availability (Neugebauer, Hoek, & Susser, 1999). Thus, persistent risky behaviour may develop as a conditional life history strategy based on environmental cues predictive of negative future prospects and competitive disadvantage.

The lack of desistence of risk-accepting behaviour in life-course persistent offenders can be explained by low embodied capital and other consequences of compensatory growth in response to early predictive environmental cues. In both cases, an individual has little prospect of improving competitive standing relative to others in the population, and experiences little ability to legitimately acquire a stable job, a long-term relationship partner, or good social standing, all factors that have been shown to be associated with the desistence of risk-accepting behaviour in adolescent-limited delinquents.

In sum, an investment in long-term growth and later reproduction is contrasted with an investment in short-term growth, and the forfeiture of future reproduction, with the former favored in situations where future prospects are positive, and the latter favored when there are cues of relative disadvantage and negative future prospects.

Applying Life History to Understanding the Causes of the Crime Drop

As explained in Chapter One, in the early 1990s, rates for all types of crimes fell sharply in both Canada and the United States (Blumstein & Wallman, 2005; Lalumière et al., 2005; Levitt, 2004). The decline in crime occurred at almost the same time in Canada as in the United States, with homicide, for example, falling 37 percent in Canada, and 42 percent in the United States between 1991 and 2003 (Levitt, 2004). A number of explanations have been put forth to explain the crime drop, including an aging population, increases in the number of police officers, a stronger economy, and changes in abortion laws in the 1970s (Levitt, 2004). While each explanation can account for a small portion of the decline in crime, none appear to explain a significant amount of the variation in criminal behaviour. In addition, many explanations involve U.S.-specific phenomena, such as increased incarceration, and ignore the parallelism between the

Canadian and American crime data (Ouimet, 2002). It is quite possible that criminological hypotheses of the decline in crime may be focusing on a too narrow target of explanation.

The study presented in Chapters One and Two suggests that explanations of the crime drop neglect to consider the broader category of behaviour that most crimes belong to, specifically, risk taking behaviour. Archival data from the United States and Canada show that since the early 1990s, risky behaviours in the domains of violence, some types of drug use, accidents, and sexual behaviour have dropped significantly, and in a manner that closely parallels the drop in crime. These results confirm an intimate link between crime and risky behaviour in general, and suggest that what requires explanation is not simply the drop in crime, but a more general drop in risk taking.

What facilitated a decrease in criminal and risky behaviour in general in the 1990s? It is suggested that risky behaviours are a part of a life history strategy oriented toward short-term gains, one in which the future is either short or unfavorable. The life history framework presented in this chapter is applied to suggest potential causes of the crime and risk drop, in the hope that these suggestions may represent fruitful avenues of research. Indicators of a possible shift from a focus on short-term gains (future discounting) to a focus on long-term gains (future acceptance) in the early 1990s are discussed, and environmental cues that may have influenced such a shift are suggested.

Future discounting is often a response to cues of a limited time horizon and unfavorable future prospects. In such a situation, risky behaviours become more highly valued in that the benefits outweigh any potential (often delayed) costs. In the early 1990s, a significant drop in risky behaviour was observed for the entire population of the United States and Canada, suggesting that time horizons were perceived to be longer, and

future prospects were more positive. Therefore, one would hypothesize to find *indicators* of investment in long-term, future outcomes, instead of short-term outcomes, and an increase in behaviours suggestive of an optimistic view of the future. In addition, if risky behaviour is affected by time horizons and the quality of one's future, then environmental *cues* predictive or indicative of a benevolent future should be observed to precede or accompany the drop in risky behaviour in the 1990s.

Preliminary data provide some support for the notion that a shift toward positive future orientation was observed over the course of the 1990s. For example, according to the Youth Risk Behaviour Surveillance Survey, teenagers have lived healthier lives by exercising more, and eating more fruits and vegetables since the early 1990s. Doctor's visits for tests diagnostic of long-term chronic diseases such as cancer and diabetes have also increased during that time span, suggesting that people are investing time in physical maintenance. Despite greater testing, several types of cancer have declined during the same time period (Wingo et al., 2003). Depression rates, ostensibly reflective of pessimism about future prospects, decreased over 25 percent in Canada since the early 1990s (Patten, 2002). It is important to interpret such data with caution, given that many phenomena could be explained by other factors, such as decreased depression rates observed due to increased antidepressant prescriptions. Together, however, these indicators suggest that as of the early 1990s, people may have exhibited a greater interest in long-term, future oriented behaviours rather than behaviours reflective of short-term, immediate rewards. Collection of other measures of future orientation would provide further tests of a shift from short-term to long-term oriented behaviours since the early 1990s.

Reproductive and parenting behaviours have also changed since the early 1990s. Investment in high mating effort and attempts at immediate reproduction are associated with a shorter time horizon and more negative future prospects, whereas greater investment in parenting and one's offspring suggests a longer-term and more future oriented perspective. Therefore, it should be expected that indicators of parenting effort should have increased, and indicators of high mating effort (or outcomes of mating effort) should have decreased since the early 1990s. Since that time, a shift towards greater parenting effort seems to have occurred; mothers have delayed reproduction, with decreases in birth rates observed for all ages, except for those aged 30 to 44, for whom reproductive future is short (U.S. National Center for Health Statistics, NCHS). There are significantly fewer teenage pregnancies (down more than 20% in both the United States and Canada since 1991), in addition to fewer live births among teenagers (NCHS).

It would also be expected that parents allocate more resources to fewer offspring. Even divorce rates have decreased since the early 1990s, suggesting that people may be investing more in long-term relationships (NCHS). Collection of more data relevant to reproductive outcomes and investment in children will provide further tests as to whether there has been a shift toward long-term strategies involving investing in children, as opposed to more short-term, mating effort oriented strategies since the early 1990s.

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

data has been collected at the state level to investigate the relationship of reproductive outcomes and obesity rates since the 1990s. These data suggest that there is indeed an inverse relationship between indicators of immediate reproduction, such as teenage pregnancy, and long-term investment in growth, such as body mass index.⁴ Certainly, such results must be interpreted with caution at present and further data must be collected, but preliminary results suggest that a tradeoff between immediate reproduction and long-term growth may have occurred in concert with the drop in risky behaviour in the 1990s.

A generalized shift from short-term to long-term oriented life history strategies may have occurred in the early 1990s, and some evidence provides preliminary support for this hypothesis. People appear to be focusing more on the future and long-term favorable outcomes, rather than maximizing short-term outcomes. Greater investment in parenting effort (reflecting quality of offspring) as opposed to mating effort (reflecting quantity of offspring) has also been observed. Finally, an investment in long-term maintenance and growth has been observed instead of investment in short-term reproduction. The question still remains, however: What caused this shift from short-term to long-term strategies? Given that time horizons and future prospects are hypothesized to have a strong influence in whether individuals engage in short-term or long-term behaviours, it is likely that cues suggestive of a quality future and long time horizons are responsible for a consequent life history shift.

Several environmental and situational variables that may be associated with increases in risky behaviour and short-term life history strategies have been suggested in

⁴ It is not suggested that obesity is adaptive. Investment in growth and long-term health means saving calories rather than spending them, and in today's easy access to caloric-rich food this process leads to obesity.

this chapter, including perceived length of time horizons, projected quality of future prospects, unpredictability of environments, quality of early environment, intensity of competition, and competitive disadvantage. Changes in each of these environmental and situational variables may have preceded or accompanied the drop in risky behaviour in the early 1990s, and would represent important avenues of investigation.

Life expectancy has been increasing for some time in North America. People probably perceive the length of their time horizon in more ecologically relevant ways than simply looking at a calculated national average life expectancies, and so cues such as the presence of older relatives (parents, grandparents), as well as the presence of older individuals within smaller local populations (e.g., neighborhoods within a city) would be indicative of a lengthier expected future. In communities in which there are many sources of extrinsic mortality, such as homicide or accidents, risky behaviours are more often observed (Wilson & Daly, 1997). The recent increase in body mass index may itself provide a cue to the health of others, generating positive estimates of one's future health. A reduction in extrinsic sources of mortality and improvements in health may also manifest in a perception of lesser unpredictability of the future, a factor associated with risk-accepting behaviour. Thus, it is possible that, at the community level, sources of extrinsic mortality have decreased, and cues to future health have increased, leading to more future-oriented and less risky behaviour.

Other cues relevant to time horizons and future prospects may include decreases in perceived inequality, leading to less interpersonal competition and less potential for individuals to suffer competitive disadvantage. If inequality and competition is low in a current social environment and it is reasonable to predict that such conditions will continue into the future, people will engage in less risky behaviour. Although inequality

between the richest and the poorest has been increasing at the national level since the early 1990s, it may be possible that communities at a lower level, such as neighborhoods, may have experienced a more egalitarian distribution of wealth, leading to less inequality and less risk-acceptance as a response to competition. Comparison of different communities since the early 1990s would shed light on what time horizon-relevant cues may influence life history strategies.

Although increases in body mass index may represent an indicator suggesting a shift toward investment in long-term growth, it may also represent a cue in itself, indicative of better future prospects. In an ancestral environment, if most individuals of a local population were well-fed and healthy, one could likely extrapolate that current and future prospects are likely good, particularly in terms of resource availability. Thus, in a modern environment where obesity is extremely prevalent, an evolved tendency to perceive the future as more positive as a consequence of the somatic qualities of other members of the population could “trick” people into thinking the future is positive. Of course, the causes of the increase in obesity prevalence may not be related to life history at all. The increased accessibility of readily available and inexpensive foods that are high in fats and sugars likely play an important role in the increased prevalence of obesity observed today, and so any investigation into obesity as an indicator of a shift in life history strategy, or as a cue of better future prospects, must be conducted with caution.

Time series analyses, such as those presented in Chapter Two, would shed some light on the causes of the crime drop, as covariation in the rates of the various cues and indicators of time horizons and future prospects with rates of crime and risk taking would suggest an underlying relationship. In addition, methods discussed earlier such as principal components analysis and multiple regressions would provide more evidence of

any link between cues and indicators and risk and crime rates. Indicators such as high prevalence of older individuals in the community, or local life expectancy, for example, should show significant ability to predict crime and risk taking rates.

Further compelling evidence for the ability of cues of future prospects to affect risky behaviour in general could be obtained in laboratory experiments. If, upon presentation of relevant cues of future prospects, individuals in laboratory experiments exhibited a shift toward or away from risk-accepting behaviour, one could claim with some confidence that extrinsic cues of future prospects have an important effect on risk taking propensity. For example, the presentation of compelling cues of either competitive advantage or disadvantage relative to others may affect risk taking in laboratory tasks. The manipulation of physiological states relevant to well-being and resource availability could also be manipulated. For example, do hungry individuals take more risks, based on their immediate inability to obtain important resources?

Life history theory provides a useful framework for understanding the causes of the crime and risk taking drop in the 1990s. Based on this framework, reduced risk taking and criminal behaviour are likely indicators of a shift from short-term to long-term life history strategies. Investigating other indicators of a shift in life history strategy, and cues that facilitated such shifts by utilizing both archival data and laboratory experiments will likely present further insights as to what caused the drop in crime and risk in the 1990s.

Crime and other risk taking behaviours have important ramifications for societal well-being, as well as economic and social importance. Better understanding the psychological and motivational processes that underlie fluctuations in risk taking and criminal behaviour has enormous implications for guiding public policy and facilitating the greater well-being of people everywhere.

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