



## Is the crime drop of the 1990s in Canada and the USA associated with a general decline in risky and health-related behavior? ☆

Sandeep Mishra\*, Martin Lalumière

Department of Psychology, University of Lethbridge, 4401 University Drive Lethbridge, Alberta, Canada T1K3M4

### ARTICLE INFO

#### Article history:

Available online 1 November 2008

#### Keywords:

Crime rates  
Risk taking  
Violence  
Substance use  
Accidents  
Mortality  
USA  
Canada

### ABSTRACT

Crime rates dropped unexpectedly and dramatically in the 1990s in Canada and the USA. The decline was not restricted to particular types of crime, the particular methodologies of crime reports, demographic characteristics, or geographical areas. Psychological studies of individuals have suggested a link between crime and different types of risky behavior (e.g., dangerous driving, unsafe sex, substance use). Based on this link, we examined whether national rates of various risky behaviors declined in the 1990s, and whether rates of crime and risky behavior covary over time. Several American and Canadian databases reporting annual or biennial data on risky behavior indicators were examined. Results indicate that most of the risky behavior indicators in the domains of violent behavior, accidents, sexual behavior, and school dropout declined in the 1990s. Furthermore, time series analyses suggest that rates of various risky behaviors tend to covary with homicide over long periods of time. An important exception to these results is substance use in various contexts. We discuss some theoretical implications of the results.

© 2008 Elsevier Ltd. All rights reserved.

In the 1990s, crime rates fell steeply in the United States (US) and Canada (Blumstein & Wallman, 2005; Zimring, 2006). Several tenable explanations for the decline have been proposed (for reviews, see Blumstein & Wallman, 2005; Finkelhor & Jones, 2005; Levitt, 2004; Zimring, 2006). Little attention has been paid, however, to other problem behaviors that are associated with crime at the individual level, such as risky behavior. Various risky

behaviors, such as unsafe sex, substance use, and interpersonal confrontation are common among criminal offenders, and tend to co-occur at the individual level (e.g., Caspi et al., 1997; Dryfoos, 1990). Furthermore, several theories specify a strong link between general risky behavior and crime (e.g., Daly & Wilson, 2001; Gottfredson & Hirschi, 1990; Jessor, 1991). In this paper, we examine various national databases to (1) determine whether, like crime, rates of various risky behaviors declined in the 1990s and (2) assess the association between various risky behaviors and crime at the national level.

### The crime drop

Homicide illustrates the steep decline in crime rates that occurred in the 1990s effectively, because homicide is less subject to report or recording biases compared to other crimes (Daly & Wilson, 1988; O'Brien, 2003). Although the US and Canada have different homicide rates, both countries experienced similar declines in homicide in the 1990s (43 and 33 percent respectively; Fig. 1). Other types of

☆ Thanks to Frances Aboud and three anonymous reviewers for their useful comments on the manuscript. The authors would also like to thank J. Michael Bailey, Grant Harris, Gail Hepburn, Danny Krupp, Christine Michell, Vernon Quinsey, Marnie Rice, Michael Seto, Kelly Suschinsky, Doug VanderLaan, John Vokey, and Robert Williams for comments and suggestions on the manuscript, Gail Hepburn for bringing workplace injury data to our attention, and Yvonne Kimpinski from Statistics Canada for help in data collection. A portion of this research was supported by a Masters Canada Graduate Scholarship awarded to SM, and a Standard Research Grant awarded to ML, both from the Social Sciences and Humanities Research Council of Canada.

\* Corresponding author. Tel.: +1 403 380 1877.

E-mail addresses: [sandeep.mishra@uleth.ca](mailto:sandeep.mishra@uleth.ca) (S. Mishra), [martin.lalumiere@uleth.ca](mailto:martin.lalumiere@uleth.ca) (M. Lalumière).

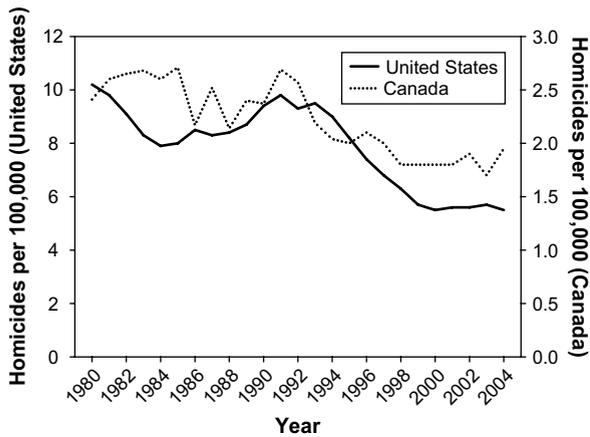


Fig. 1. Homicide rates for the United States and Canada. Source: FBI Uniform Crime Reports (US); Statistics Canada (Canada).

crime (e.g., assault, property, and sexual crimes) also declined significantly in the 1990s in both countries, suggesting that the drop in crime is a general phenomenon (Jones & Finkelhor, 2001; Lalumière, Harris, Quinsey, & Rice, 2005).

Data from government crime recording agencies and telephone surveys of victimization showed a drop in crime at the same time, suggesting again that the decline is a true phenomenon and not simply a reflection of changes in police reporting or less recording of crime in general. The FBI's Uniform Crime Reports (UCR), a database containing crimes reported by police, as well as the National Crime Victimization Survey (NCVS), an annual nationally representative telephone survey of 100,000 Americans, exhibit the same downward trend in crime rates. Data from Statistics Canada, obtained from police reports, show a similar drop (Ouimet, 2002, 2004).

The ubiquity of the crime drop is further demonstrated by its geographic and demographic generality. Although metropolitan areas in the US experienced the largest declines from 1990 to 2001 in homicide (45 percent), violent crime (37 percent), and property crime (32 percent), rural areas were also affected, with homicide, violent crime, and property crime dropping 35 percent, 3 percent, and 11 percent, respectively (Levitt, 2004). In Canada, similar 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 a decline in crime perpetration in the 1990s; data from the UCR indicate that arrest rates for total, violent, and property crimes dropped for all age groups from 1991 to 2001 (Bureau of Justice Statistics, 2004; Fox, 2005). Moreover, victimization rates for violent crimes show substantial declines for all age groups, ranging from 20 percent (age 65+) to 57 percent (age 20–24). Homicide-specific victimization and perpetration rates have also decreased for all age groups (Fox, 2005).

Numerous explanations have been advanced in an attempt to account for the crime drop, including an aging

population, increases in the number of police officers, a stronger economy, increased incarceration, and changes in abortion laws in the 1970s, among others (Blumstein & Wallman, 2005; Finkelhor & Jones, 2005; Levitt, 2004; Zimring, 2006). While each explanation can account for some portion of the decline in crime, many focus on US-specific phenomena, such as increased incarceration, and ignore the striking similarity between American and Canadian crime trends (Ouimet, 2002, 2004; Zimring, 2006). Many explanations also cannot address the drop in crime among all age groups. Finally, most explanations put forth to account for the drop in crime in the 1990s cannot explain the countervailing increases in crime during the 1970s and 1980s, thus casting doubt on the strength of these explanations in accounting for general variations in crime (Levitt, 2004).

### Crime and risky behavior

Although it is well established that crime declined in the 1990s, there has been little investigation of changes in other problem behaviors during that same time period, including risky behavior. In this paper, we define risky behavior as impulsive, reckless behavior that maximizes short-term gains (e.g., sexual gratification, emotional arousal, relief of negative feelings) with potential for immediate or future costs (e.g., car accident, unwanted pregnancy). This definition is an amalgam of overlapping conceptions of risky behavior (e.g., Daly & Wilson, 2001; Dryfoos, 1990; Gottfredson & Hirschi, 1990). Risky behavior typically includes promiscuous or unsafe sexual behavior, substance use, interpersonal aggression and violence, and other activities such as speeding while driving (Dryfoos, 1990).

Several theories suggest that non-criminal risky behavior and crime are linked. Daly and Wilson (2001) described crime as a form of risky behavior, and suggested that risky behavior, whether criminal or not, is the product of a "rational" decision-making process designed to solve adaptive problems that arise in certain situations or environments. Gottfredson and Hirschi (1990) suggested that low self-control combined with opportunity account for most criminal and non-criminal risky behaviors. Jessor's (1991) problem-behavior theory suggests that a balance of instigations (e.g., peer modeling) and controls (e.g., parental monitoring) determines the degree to which individuals engage in a "syndrome" of problem behaviors including substance use, delinquent behaviors, risky driving, and early sexual intercourse.

Considerable empirical evidence supports the link between general risk-taking and crime. Individuals who engage in criminal behaviors score higher than others on measures of poor self-control, impulsivity, and general thrill seeking. Several studies have also documented the co-occurrence of criminal and non-criminal risky behaviors within individuals (e.g., Caspi et al., 1997; Grasmick, Tittle, Bursik, & Arneklev, 1993; Jones & Quisenberry, 2004; Junger & Tremblay, 1999; Lalumière & Quinsey, 1996). These and other empirical studies support the notion of a general construct of deviance or problem behavior encompassing both criminal and risky behavior (e.g., Bartusch, Lynam,

Moffitt, & Silva, 1997; Donovan & Jessor, 1985; LeBlanc & Girard, 1997, Osgood, Johnston, O'Malley, & Bachman, 1988).

If criminal and risky behaviors are linked at the individual level, then national rates of non-criminal risky behaviors should follow the same temporal pattern as national rates of crimes, showing a drop in the 1990s. Furthermore, rates of non-criminal risky behaviors and crime should exhibit covariation, not only in the 1990s, but over longer periods of time. Some researchers have already noted declines in other problem behaviors in the 1990s, such as adolescent violence (Blumstein & Rosenfeld, 1999), teen births and teen suicide (Colen, Geronimus, & Phipps, 2006; Finkelhor & Jones, 2005), and children's behavioral problems in general (Achenbach, Dumenci, & Rescorla, 2003). In addition, fatal outcomes associated with risk-taking (homicide, suicide, motor vehicle accidents, and other fatal accidents) have been shown to covary over time at the national level (Holinger & Klemen, 1982).

We aimed to extend this previous research by investigating the temporal trends of a large set of diverse indicators or outcomes of risky behavior at the national level. The present study (1) examined whether rates of various risky behaviors (or outcomes of risky behaviors) declined with crime rates in the period from 1991 to 2001, and (2) examined the covariation between rates of crime and various indicators of risky behavior over long periods of time.

## Methods

### Data sources

All data were obtained from various agencies providing annual or biennial data at the national level. Crime data were obtained from the FBI Uniform Crime Reports (UCR). Several databases, including the Youth Risk Behavior Survey (YRBS) and data from the National Health Interview Survey (NHIS), reported weighted data accounting for non-response, the varying probabilities of selection, and clustered multi-stage sampling. Consequently, weighted data were used where possible. The sources cited provide more details about the methods used to adjust reported data (including standard errors for each year), as well as the reliability and validity of the measures (e.g., *Centers for Disease Control and Prevention, 2007a, 2007b, 2008; Statistics Canada, 2008*). All data were coded as rates (incidents per 100,000 of the relevant population) unless otherwise noted.

Risky behaviors were examined within the general population and among teenagers, a particularly risk-prone group, in the US and Canada. Risk indicators were classified into five broad categories, based on previous classifications of risky and problem behaviors (Dryfoos, 1990; Gottfredson & Hirschi, 1990; Jessor, 1991): violent behaviors, accidents and behaviors related to risk of accidents, sexual behavior, school dropout, and substance use. The sources of all indicators are provided below. YRBS indicators involve the reporting of the target behavior in the last 30 days unless otherwise indicated.

The category violent behaviors included the indicators, for teenagers, carried a weapon (YRBS), involved or injured in a physical fight (YRBS), attempted suicide (YRBS), and suicide (National Center for Health Statistics). Also included were population suicide rates (US: National Vital Statistics System; Canada: Statistics Canada).

Although accidents can be chance occurrences, risky behavior while driving or in the workplace can contribute to accidents; lack of caution, for example, is cited as a common cause of workplace accidents (Salminen, Saari, Saarela, & Rasanen, 1993). The category accidents and behaviors related to risk of accidents included number of car collision fatalities and injuries per 100,000 population in the US (National Vital Statistics System; NHTSA), number of car collision fatalities and injuries per 100,000 licensed drivers in Canada (Transport Canada), workplace injuries (number per 100 workers, US: Bureau of Labor Statistics, Canada: Association of Workers Compensation Boards of Canada), seatbelt use (YRBS), and bicycle helmet use (use in the last year; YRBS).

Some sexual activities may be seen as risky and the result of failures of inhibition. Riskier individuals would be less likely to use condoms and more likely to have sex with many partners; risky teenagers would also be more likely to engage in early intercourse and unprotected sex resulting in pregnancy (with two indicative outcomes, live birth or abortion). The category sexual behaviors included the percentage of high school students reporting ever having had intercourse (YRBS), having had sex before age 13 (YRBS), having had sex with four or more partners over a lifetime (YRBS), being presently sexually active (YRBS), condom and birth control use (in past 3 months; YRBS). Data for pregnancies, live births, and abortion for the general population and teenagers (rate per 1000 of relevant population) were obtained from the Guttmacher Institute (US), and Statistics Canada (Canada).

Rates of sexually transmitted diseases (STDs) in the general population are informative as an indirect assay of risky sexual behavior. Participating in unsafe sexual intercourse, either with multiple partners or without proper condom use increases the likelihood of contracting a disease (Holmes, Levine, & Weaver, 2004). The diagnostic rates of acquired immunodeficiency syndrome (AIDS) in the US, and the prevalence rates of syphilis, gonorrhea, and chlamydia in the general population were obtained from the Centers for Disease Control and Prevention in the US, and the Public Health Agency of Canada.

School dropout may be an indicator of risky behavior in that students who choose to dropout of school may tend to focus on the immediate rewards of non-school activities while ignoring the long-term consequences of missing school. School dropout may also result from risky or problem behaviors, including truancy, disruptiveness, or other behavior leading to expulsions. US rates of high school dropout were obtained from the National Center for Education Statistics (percentage of 16–24 year-olds not currently enrolled in school, and have not completed high school), and Canadian rates from Statistics Canada (percentage of 20–24 year-olds without a high school diploma and not enrolled in school).

The category substance use included teenagers having ever tried cigarettes, alcohol, marijuana, cocaine, and illegal steroids, in addition to the use of cigarettes, alcohol, marijuana, and cocaine in the last 30 days (YRBS). More specific statistics for teenage and young adult substance use were also obtained for smoking, drinking, marijuana, and illicit drug use (YRBS). These included regular smoking (20 of the last 30 days), and heavy smoking (smoked 10+ cigarettes in a single day in last 30 days). Teen alcohol indicators included reported drinking before age 13 and episodic heavy drinking (five or more drinks in a row in last 30 days). Teen marijuana indicators included reporting marijuana use before age 13. The Monitoring the Future study (MTF; Johnston, O'Malley, Bachman, & Schulenberg, 2007a, 2007b) was the source of statistics on teen and young adult use of marijuana and other illicit drugs in the past year. All indicators obtained from the MTF use the rate of reported use in the last year per 100,000 of the relevant population (teens, young adults).

General population cigarette smoking statistics from the US were obtained from the NHIS (Centers for Disease Control and Prevention, 2008). Canadian statistics for both teenage and adult smokers were obtained from the Canadian Tobacco Use Monitoring Survey. All indicators of cigarette smoking involved the percent of the relevant population reporting regular smoking. The category of substance use also includes events that involve substance use, including teens drinking and driving (YRBS), reporting riding with a drunk driver (YRBS), and using drugs or alcohol before sex (in past 3 months; YRBS). General population statistics for drinking and driving fatalities (US: National Highway and Traffic Safety Administration, NHTSA), and impaired driving charges (Canada: Transport Canada) were also obtained.

## Analysis

To show the magnitude of the drop in risky behavior in the 1990s, the percent difference in the prevalence of each risk indicator between 1991 and 2001 was calculated using the formula,  $[(\text{rate in 2001} - \text{rate in 1991}) / \text{rate in 1991}] \times 100$ . Covariation between risk indicators and crime was measured by correlating rates of risky behavior indicators with general population homicide rates (in the relevant country) over time. Using age-specific homicide rates in correlations (e.g., teen homicide rate correlated with teen suicide rate) produced similar results. Homicide was used as an index of crime because it is least subject to changes in definition over time, or reporting bias, and therefore serves as the most accurate indicator of crime levels over time (Daly & Wilson, 1988; O'Brien, 2003). The longest available time periods were used for the correlation analyses. Data were available since 1950 for some risk indicators, and covariation was measured from the earliest date to 2005 (the last year of available data for most indicators).

Time series analyses are susceptible to spurious results because the data for any given year are correlated with the values preceding and following it (autocorrelation), and variance within the time series is not standardized. Any interpretable time series analyses must therefore both

standardize variance and remove autocorrelation from each time series. Two time series analysis techniques were used to assess the degree of relationship between risk indicators and homicide over time: (1) partial correlations controlling for year, and (2) first-differenced cross-correlations. Both methods have been extensively used in criminological research (e.g., Britt, 1994; O'Brien, 1990, 1996; Wittebrood & Junger, 2002). A partial correlation quantifies the degree of association between two variables, while removing the effect of one or more third variables. Because year follows a linear trend over time, controlling for year consequently allows for the removal of linear trends from each time series. First-differenced cross-correlations remove the effect of autocorrelation by subtracting each data point from its predecessor (known as differencing). By differencing two time series and then cross-correlating them, it is possible to compare the two rates-of-change over time.<sup>1</sup> For both types of correlations, the logarithm of each data point was taken to standardize variance within the time series.

The two types of correlations between each risk indicator and homicide were calculated at lag 0 and the three lags before and after lag 0. Lags were calculated within three years of lag 0 because correlations at larger lags are prone to statistical noise and are less interpretable (Chatfield, 2004). A negative lag indicates that the first time series (homicide) lags behind the second (the risk indicator). For example, a -1 lag means that a peak in homicide rate or rate-of-change in 1991 was most highly associated with a peak in the risk indicator's rate or rate-of-change in 1992. Biennial time series were linearly interpolated to approximate missing values. Analyses were performed with SPSS 16.0.1.

## Results and discussion

Table 1 and Fig. 2 summarize the percent change in risky behavior from 1991 to 2001. Percent changes in crime over the same time period are provided as a basis for comparison. Table 1 also presents correlations between risk indicators and homicide for longer periods of time. The correlations are presented at lag 0, and the lag at which the maximum absolute magnitude of correlation occurs, within three years of lag 0. The number of data points (years) used in the analyses ranged from 13 to 56, and is provided in the last column.

The average partial and first-differenced correlations between risky behavior and homicide for each domain are shown in Fig. 3. The average correlation between other types of crime and homicide are provided as a basis for comparison.

The concordance between the correlation coefficients of both time series techniques used was large and significant ( $r = .821, p < .0001$ ), suggesting that the two methods have high convergent validity. This finding is particularly notable

<sup>1</sup> ARIMA modeling was also used to measure covariation between risk indicators and homicide. Results are not presented in this paper because of the method's shortcomings with shorter time series data sets, but we note that it provided very similar results (see Mishra, 2007).

**Table 1**

Summary of changes in risky behavior, 1991–2001, and covariation between risky behavior and homicide in the United States and Canada. The number of data points used for the correlational analyses is provided in the last column.

Indicator	% Change 1991–2001	Partial correlation		First-differenced cross-correlation		Data points
		Lag 0	Max (Lag)	Lag 0	Max (Lag)	
<b>Crime</b>						
Homicide	–43	–	–	–	–	–
Homicide (CA)	–33	–	–	–	–	–
Forcible rape	–25	.96***	.96*** (0)	.72*	.72* (0)	46
Sexual assault (CA)	–28	.09	.44* (+3)	.03	.24 (+1)	23
Property crime	–29	.96***	.96*** (0)	.67*	.67* (0)	46
Property crime (CA)	–35	.23	.33 (+3)	.07	.25 (–1)	29
<b>Violent behavior</b>						
Carried weapon (T)	–50	.72**	.94*** (–2)	.35	.51 (–3)	15
Involved in physical fight (T)	–23	.75**	.75** (0)	.39	.49 (+2)	15
Injured in physical fight (T)	–7	–.05	.48 (–2)	–.06	–.58 (+3)	15
Attempted suicide (T)	+21	.17	.26 (+2)	.22	.28 (–1)	15
Suicide (T)	–12	.76***	.79*** (–2)	.35	.44* (–1)	27
Suicide	–12	.67***	.79*** (+3)	–.09	.27* (–3)	56
Suicide (CA)	–11	.53***	.81*** (+3)	–.10	.24 (+2)	34
<b>Accidents</b>						
Car collision fatalities	–12	.62***	.81*** (–3)	.04	.31* (–2)	55
Car collision fatalities (CA)	–27	.36	.80*** (–2)	.28	.50* (–2)	20
Car collision injuries	–23	–.27	–.89*** (–2)	–.37	–.47 (–2)	17
Car collision injuries (CA)	–14	.13	.78*** (–2)	–.07	.53* (–2)	16
Speeding-related fatalities	–14	–.67***	–.81*** (+2)	–.27	–.46 (+2)	21
Workplace injuries	–32	.78***	.78*** (0)	.24	.59* (–1)	29
Workplace injuries (CA)	–27	.38*	.61** (–2)	.10	.24 (–2)	29
No seatbelt use (T)	–46	.32	.33 (+1)	.09	.29 (+1)	14
No bike helmet use (T)	–12	.84***	.84*** (0)	.44	.57* (+1)	15
<b>Sexual Behavior</b>						
Ever had sex (T)	–16	.51	.67** (+1)	.08	.49 (+1)	15
Had first sex before 13 (T)	–55	.16	.47 (–2)	–.10	–.43 (+3)	15
Sex with 4+ partners (T)	–24	.53	.71** (+1)	.17	.42 (+1)	15
Currently sexually active (T)	–12	.31	.57* (+1)	.03	.42 (+1)	15
No condom use (T)	–22	–.20	.76** (–3)	–.24	.28 (–3)	15
No birth control pill use (T)	+3	–.45	–.90*** (–3)	–.14	–.48 (–3)	15
Teen pregnancies (T)	–27	.83***	.83*** (0)	.54*	.54* (0)	31
Teen pregnancies (T) (CA)	–20	.51*	.51* (0)	.12	.23 (–1)	18
Live teen births (T)	–27	–.40**	–.58*** (–3)	.05	.13 (+1)	56
Live teen births (T) (CA)	–38	.27	–.35 (–3)	.10	.23 (–1)	30
Induced abortions	–19	.57***	.60*** (–1)	.39*	.47* (–1)	30
Induced abortions (CA)	+6	.10	–.40 (–3)	–.11	.35 (+1)	30
Teen induced abortions (T)	–44	.53**	.63*** (–3)	.27	.27 (0)	31
Teen induced abortions (T) (CA)	0	.10	.45* (+3)	–.14	.32 (+3)	30
AIDS	–43	.90***	.93*** (+1)	.60*	.65* (+1)	21
Syphilis	–78	.92***	.96*** (–1)	.66*	.70* (–1)	23
Syphilis (CA)	–31	.08	–.49* (+3)	.15	.31 (–1)	20
Gonorrhea	–48	–.33	–.92*** (+3)	.08	.43* (–3)	23
Gonorrhea (CA)	–51	–.09	–.50* (+3)	.24	–.33 (+3)	20
Chlamydia	+52	.17	.88*** (–3)	–.07	.51* (–3)	15
Chlamydia (CA)	–2	.60	.74*** (–3)	.17	.49 (+2)	12
<b>School dropout</b>						
School dropout (T)	–14	.03	.27 (+3)	–.04	.19 (–3)	34
School dropout (T) (CA)	–32	.43	.70* (–3)	.31	.31 (0)	14
<b>Substance use</b>						
Ever tried cigarettes (T)	–9	–.85***	–.92*** (–2)	–.70*	–.72* (–1)	15
Smoked in past 30 days (T)	+4	–.74***	–.80*** (–1)	–.44	–.44 (0)	15
Smoked >10 cigarettes/day (T)	–25	–.52	–.64* (+2)	–.37	–.59* (+3)	15
Ever tried alcohol (T)	–4	–.86***	–.86*** (0)	–.58*	–.58* (0)	15
Drank alcohol before 13 (T)	–12	–.81***	–.81*** (0)	–.48	–.48 (0)	15
Drank in past 30 days (T)	–8	–.77***	–.93*** (–1)	–.56*	–.72* (–1)	15
Episodic heavy drinking (T)	–5	–.78***	–.94*** (–2)	–.54*	–.66* (–1)	15
Ever tried marijuana (T)	+35	–.74**	–.97*** (–2)	–.56*	–.73* (–2)	15
Marijuana use before 13 (T)	+27	–.71**	–.82*** (+2)	–.41	–.54 (+1)	15
Marijuana use in past 30 days (T)	+38	–.64**	–.95*** (–2)	–.39	–.65* (–2)	15
Marijuana use in past year (T)	+35	–.65***	–.79*** (–2)	–.30	–.36 (–2)	31

(continued on next page)

Table 1 (continued)

Indicator	% Change 1991–2001	Partial correlation		First-differenced cross-correlation		Data points
		Lag 0	Max (Lag)	Lag 0	Max (Lag)	
		Marijuana use in past year (young adults)	–5	–.31	–.90*** (+3)	
Ever tried cocaine (T)	+37	–.92***	–.92*** (0)	–.70*	–.73* (–1)	15
Cocaine in past 30 days (T)	+60	–.77***	–.87*** (–1)	–.50	–.60* (–1)	15
Ever tried illegal steroids (T)	+46	–.24	.46 (–2)	–.17	–.52 (+3)	15
Illicit drug use in past year (T)	+33	–.65***	–.79*** (–2)	–.11	–.51* (–3)	31
Illicit drug use in past year (young adults)	–16	–.31	–.90*** (+3)	–.21	–.57* (+3)	20
Regular smoking (T)	+8	–.74**	–.80*** (–1)	–.44	–.44 (0)	15
Regular smoking (T) (CA)	–2	.22	–.53* (–3)	.05	.15 (+3)	18
Regular smokers age 18+	–11	–.33	–.79*** (–3)	–.26	–.32 (–3)	26
Regular smokers age 15+ (CA)	–30	–.74**	–.74** (0)	–.37	–.50 (+1)	13
Drinking & driving (T)	–15	–.71**	–.76** (–1)	–.38	–.45 (–1)	15
Drinking & driving fatalities	–35	–.60**	–.86*** (+3)	.07	–.52* (+3)	23
Impaired driving charges (CA)	–37	.31	.52* (–2)	.20	–.32 (+1)	24
Riding with drunk driver (T)	–23	–.23	–.69* (–3)	–.15	–.41 (–1)	15
Used substance before sex (T)	+19	–.67**	–.75** (–1)	–.35	–.48 (–1)	15

Notes: Data for teenagers are noted with (T). Canadian data are noted with (CA). Correlation significantly different from 0 at: \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .0001$ .

given that the two techniques use very different methods of de-trending time series to remove autocorrelation.

The results indicate that a majority (34 out of 39) of risk indicators in the categories of violence, accidents and behaviors related to accidents, sexual behaviors, and school dropout showed a decrease in the 1990s. An important exception to this pattern is substance use (only 15 out of 26 declined). The two time series analysis techniques revealed that many indicators of risky behavior covaried with homicide and homicide rates-of-change in both the US and Canada. The covariation between risky behavior and crime was not limited to the period from 1991 to 2001, but rather, was observed for time periods as long as 56 years.

### Changes in risky behavior

Six of seven indicators of violent risky behavior declined in the 1990s, with the sole exception being attempted suicide among teens in the US. This exception is puzzling, given that teen suicides decreased in the 1990s. There are many more suicide attempts than actual suicides, and it may be possible that fewer attempts over the 1990s resulted in mortality. The relationship between suicide (both for teenagers and the general population) and homicide over time provides further evidence for the relationship between crime and other behaviors associated with mortality documented by Holinger and Klemen (1982). The maximum partial correlations and first-differenced cross-correlations were all positive, with the exception of the rate-of-change of teens reporting being injured in a physical fight showing a negative association with the rate-of-change of homicide.

All nine indicators for accidents and behaviors related to risk of accidents declined in the 1990s. Most accident indicators positively covaried with homicide, with the exception of car collision injuries, and fatalities involving speeding in the US. Many accident-related indicators are indirect measures of risk-taking. Risky behavior likely partially contributes to car collision fatalities or injuries, but it is certainly not the only influence. Other factors have contributed to a reduction in car collision fatalities

and injuries, including mandatory seatbelt laws and widespread use of airbags, among others (Crandall, Olson, & Sklar, 2001). That collisions involving speeding—which perhaps reflect risky behavior more directly—show a negative association with homicide is puzzling given the general relationship between risky behavior and crime.

Seventeen of twenty-one indicators of risky sexual behavior decreased in the 1990s. Teen abortion in Canada showed no change. General population abortion rates (Canada), teens reporting no birth control pill use (US), and chlamydia (US) increased in the 1990s. Negative correlations with homicide were observed for teens reporting having had sex before age 13, no birth control pill use, live teen births, and some STDs. Increases in teens not using birth control pills may be due to several factors, including increased use of other contraceptives (e.g., condoms), or increased prevalence of abstinence programs. Although teen pregnancies were highly positively correlated with homicide in the US, teen births did not show the same positive relationship; getting pregnant may reflect impulsive, risky decision making more than carrying a child to term. For example, Geronimus (2004) has argued that in certain environments, teenage childbearing may be an adaptive decision, and not necessarily a risky, impulsive, or unwanted outcome. Increased abortion rates in Canada have been attributed to a 1988 Supreme Court ruling that allowed the opening of private clinics, making abortions more accessible (Henshaw, Singh, & Haas, 1999). Increases in chlamydia, and negative correlations between STDs and homicide are likely due to more prevalent and effective screening procedures for STDs in general, rather than actual increases in prevalence (Dicker, Mosure, Levine, Black, & Berman, 2000).

School dropout declined in the US and Canada in the 1990s, and positive correlations between school dropout and homicide were observed. Dropping out of school often indicates a focus on immediate, impulsive rewards of non-school activities, at the cost of potentially ignoring some long-term consequences (Eckstein & Wolpin, 1999). The decision to dropout of school is influenced by other factors

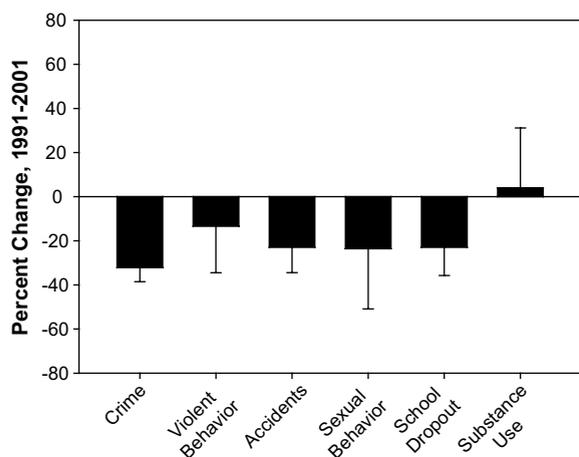


Fig. 2. Average percent decline of crime and risky behavior (M, SD).

as well, such as self-determination, motivation, social support, or school policy (Vallerand, Fortier, & Guay, 1997).

Fifteen of the twenty-six substance use indicators showed a drop in the 1990s. Most increases involved marijuana or other illegal drugs, not alcohol or tobacco. Several correlations between substance use and homicide show a negative relationship, as do most first-differenced correlations. Together, these results suggest that substance use appears to negatively covary with crime. These results are contrary to what would be expected from theories that link substance use and crime (e.g., self-control theory, Gottfredson & Hirschi, 1990; problem-behavior theory, Jessor, 1991).

Some increase in drug use in the 1990s may be due to a decreased perception of harmfulness, coupled with a widespread increase in societal acceptance (e.g., marijuana use among students and seniors; Bachman, Johnston, & O'Malley, 1998). The increase may also be in part due to a perception of drug use as "normal" among young people (Shiner & Newburn, 1997). The indicators of drug use

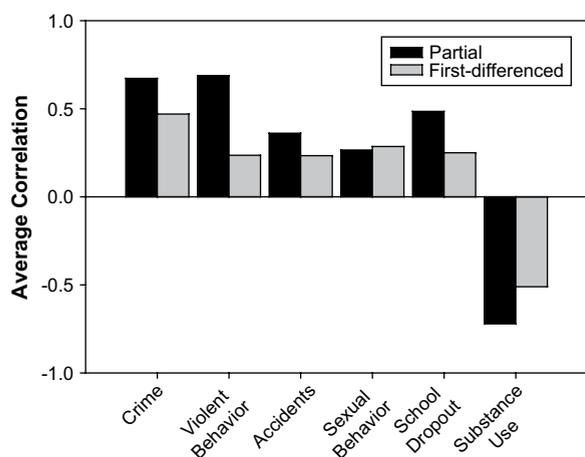


Fig. 3. Average correlation between indicators of crime, and risky behavior with homicide in five domains.

reported in this study primarily involve reporting any usage over the lifetime or the last year, not regular usage. Measures of more serious drug use, such as illicit drug addiction, may show a different pattern of results, because regular use of illicit substances is more closely associated with impulsivity (Kreek, Nielsen, Butelman, & LaForge, 2005). Nevertheless, because substance use is often illegal and can have negative long-term consequences, it is surprising that it does not follow the same temporal pattern as other risky behaviors. Substance use may not be related to the same individual or situational factors that facilitate other forms of risky behavior. Further research is required to better understand the relationship between drug use and other risky behavior at the aggregate level, particularly because drug use is highly associated with other risky behavior at the individual level (e.g., Osgood et al., 1988).

### Methodological limitations

Several methodological limitations in this study arise from incomplete or unavailable data. Numerous important indicators of youth behavior are only available since 1991. Longer time series would be useful in demonstrating more reliable trends; generally, shorter time series must be interpreted with caution. It is worth noting, however, that for most time series longer than 20 years, both types of correlations were positive and significant. Notable exceptions include substance use and STDs, the possible reasons for which were discussed earlier. Additional Canadian data would have been useful in providing further evidence for a more generalized decrease in North America.

Many first-differenced cross-correlations were not statistically significant. Longer time series would ameliorate this problem, as many correlations between risk indicators and homicide with 20 or more points were statistically significant. That most indicators were positively and highly correlated with homicide in two different ways, however, suggests that the relationship between risk indicators and crime is reliable. Excluding substance use, a clear exception to the general pattern of results, 87 percent of risk indicators dropped in the 1990s. A majority of maximum linear correlations (77 percent) and first-differenced correlations (85 percent) were positive. These results strongly suggest positive covariation between risky behavior (excluding substance use) and crime over time.

The pattern of mostly positive correlations was observed using national data, showing very general trends. These analyses, however, do not take into account potentially important state/provincial, municipal, or neighborhood influences. For example, we found that teenage live births were negatively correlated with homicide rates over time at the national level. At the neighborhood level, however, both homicide and birth rates have been shown to significantly covary with income inequality (Wilson & Daly, 1997). Examination of the relationship between risk-taking and crime at finer scales is important for future work.

Although every indicator we collected reflects impulsive risky behavior to some degree, not all are direct indicators of risk propensity. For example, riskier driving is likely to

lead to more car collision fatalities. There are, however, several independent influences on car collision fatalities, including emergency care and vehicle safety features, among others. Thus, while some of the variation in fatalities is likely due to risk-taking, it is not solely due to variation in risky behavior. Several other indicators, including accidents, STDs, and school dropout only partially reflect riskiness.

The indicators of risky behavior used in this study certainly do not encompass all behaviors that are considered impulsive. We could only include behaviors that have been measured on an annual or biennial basis. Based on anecdotal evidence, two forms of risky behavior seem to have increased in prevalence in the 1990s: extreme sports and gambling. We could not locate time series for these risky behaviors. Extreme sports (e.g., skydiving) seem to represent less impulsive forms of risk, because they require extensive preparation to participate, including planning ahead and engaging in lengthy training. These sports do, however, still have an elevated risk of harm relative to other sports.

Gambling expenditures have increased over the 1990s, but this increase is likely due to increased opportunity associated with the recent availability of internet gambling sites, increases in the number of casinos, and the introduction of readily available forms of gambling in the community (e.g., video lottery terminals in Canada; Cox, Yu, Afifi, & Ladouceur, 2005; Welte, Wieczorek, Barnes, Tidwell, & Hoffman, 2004). Furthermore, pathological gambling is more strongly associated with impulsivity than non-pathological gambling (Langewisch & Frisch, 1998), and the majority of gambling expenditures are likely not attributable to pathological gambling. Because of the link between crime and general risky behavior, we would expect that only impulsive forms of risky behavior (as defined in the introduction) would covary with crime over time, after accounting for changes in opportunities.

A decrease in general risky behavior may have led to a corresponding decrease in crime. For example, less frequent careless driving may lead to lower manslaughter rates, or a reduction in sexual activity may lead to fewer sexual crimes. Risky behaviors in several domains have decreased, however, many of which do not have direct or indirect criminal consequences (e.g., not using condoms, smoking). Further investigation into the criminal consequences of risky behavior would be informative.

Finally, it is important to emphasize that our results provide evidence for covariation between risky behaviors and crime at the national level, but do not identify the causes of this covariation. Further research is necessary to investigate the causal variables that influence changes in both risky and criminal behavior.

### Revisiting previous explanations of the crime drop

Our results cannot identify the causes of the crime drop. They do, however, inform hypotheses attempting to explain the decline in crime in the 1990s. Our results suggest that explanations for the crime drop should not focus on specific types of crime, or even crime specifically, but instead on general risky behavior. Explanations must also take into

account the widespread drop in crime and risky behavior for all age groups and geographic areas studied so far. Of the explanations already put forth to explain the crime drop, only some can account for a more general decrease in risky behavior.

Explanations involving changes in population demographics (e.g., aging population, legalization of abortion, increased prisoner incarceration) can account for changes in risky behavior. A reduction in the number of individuals who typically have a high propensity for risky behavior would result in lesser population rates of impulsive risky behavior. This reduction, however, would not explain the fact that all age groups exhibited a drop in crime and risky behavior in the 1990s. The reduction would also not explain the fact that Canada has not experienced the same increase in prisoner incarceration as the US (Zimring, 2006).

Other explanations, such as public policy shifts (e.g., increased police officers) or strong economic performance are not equally effective in explaining the decline in general risky behavior. It is unlikely that the number of police officers or the use of innovative policing strategies would have wide-ranging effects on risky behavior in disparate domains (i.e., sexual behavior or school dropout). An improved economy may affect risky behavior indirectly by fostering an optimistic sense of the future, thus reducing the appeal of risky behaviors that carry potentially heavy long-term costs. Evidence suggests, however, that most general indicators of economic performance are not strongly predictive of crime rates (Levitt, 2004, but see Wilson & Daly, 1997).

### What caused the crime (and risk) drop?

Many of the explanations for the crime drop have limited ability to explain the widespread drop in risky behavior and crime in the 1990s. Here we speculate on possible avenues for future research.

Daly and Wilson (2001) describe risky behavior and crime as analogous outcomes of steep future discounting, where the quality of one's future affects the utility of immediate risky behavior. Cues of limited local life expectancy or relative economic inequality may make risky behavior an attractive option to those who may benefit greatly, making risk-taking a 'rational' choice in some circumstances. For example, homicide rates increase with higher income inequality in Chicago neighborhoods (Wilson & Daly, 1997). The drop in crime may therefore be attributed to lesser discounting of the future or a more positive view of future prospects in the 1990s. An investigation into changes in the situational cues associated with future prospects over time may provide potential explanations for the crime and risk drop (see Mishra & Lalumière, 2008).

If crime and risky behavior are manifestations of the same underlying individual-level trait, the drop in criminal and risky behavior 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 and other deviant behavior is the result of low self-control and opportunity. Therefore, any fluctuations in criminal or deviant behavior over time, including the specific decrease

in the 1990s, must be due either to increased self-control in the general population, or a decrease in opportunity. What mechanisms may have facilitated an increase in self-control, or decrease in opportunities, however, remains an open question requiring study.

Our suggestions represent only some potential avenues for exploration of the reduction in crime and risky behavior. Any of a number of third variables may underlie the relationship between risk-taking and crime; changes in demographics, the economy, or education, for example, may affect the strength of the relationship between various types of risky behavior and crime over time. More research on the causal influences of both risky and criminal behavior is required.

A greater understanding of the relationship between crime and risky behavior, and the causes of the risk drop in the 1990s is needed. Further research could help design interventions or policies that lead to further reductions in risky behavior, therefore reducing negative health outcomes associated with risky and criminal behavior, including disease transmission, physical injury, and early mortality.

## References

- Achenbach, T. M., Dumenci, L., & Rescorla, L. A. (2003). Are American children's problems still getting worse? A 23-year comparison. *Journal of Abnormal Child Psychology*, 31, 1–11.
- Bachman, J. G., Johnston, L. D., & O'Malley, P. M. (1998). Explaining recent increases in students' marijuana use: impacts of perceived risk and disapproval, 1976 through 1996. *American Journal of Public Health*, 88, 887–892.
- Bartusch, D. R. J., Lynam, D. R., Moffitt, T., & Silva, P. A. (1997). Is age important? Testing a general versus developmental theory of antisocial behavior. *Criminology*, 35, 13–49.
- Blumstein, A., & Rosenfeld, R. (1999). Trends in rates of violence in the USA. *Studies on Crime and Crime Prevention*, 8, 139–167.
- Blumstein, A., & Wallman, J. (2005). *The crime drop in America*. New York: Cambridge University Press.
- Britt, C. L. (1994). Crime and unemployment among youths in the United States, 1958–1990: a time series analysis. *The American Journal of Economics and Sociology*, 53, 99–109.
- Bureau of Justice Statistics. (2004). Arrests by age group, number and rates for total offenses, violent offenses, and property offenses, 1970–2003. from Bureau of Justice Statistics Spreadsheets – Crime & Justice Electronic Data Abstracts. <http://www.ojp.usdoj.gov/bjs/dtdata.htm>. Accessed January 2007.
- Caspi, A., Begg, D., Dickson, N., Harrington, H., Langley, J., Moffitt, T. E., et al. (1997). Personality differences predict health-risk behaviors in young adulthood: evidence from a longitudinal study. *Journal of Personality and Social Psychology*, 73, 1052–1063.
- Centers for Disease Control and Prevention. (2007a). Youth risk behavior survey. <http://www.cdc.gov/yrbss>. Accessed January 2008.
- Centers for Disease Control and Prevention. (2007b). National vital statistics system. <http://www.cdc.gov/nchs/nvss.htm>. Accessed January 2008.
- Centers for Disease Control and Prevention. (2008). National health interview survey. <http://www.cdc.gov/nchs/nhis.htm>. Accessed January 2008.
- Chatfield, C. (2004). *The analysis of time series: An introduction*. Boca Raton, FL: Chapman & Hall/CRC.
- Colen, C. G., Geronimus, A. T., & Phipps, M. G. (2006). Getting a piece of the pie? The economic boom of the 1990s and declining teen birth rates in the United States. *Social Science & Medicine*, 63, 1531–1545.
- Cox, B. J., Yu, N., Afifi, T. O., & Ladouceur, R. (2005). A national survey of gambling problems in Canada. *Canadian Journal of Psychiatry*, 50, 213–217.
- Crandall, C. S., Olson, L. M., & Sklar, D. P. (2001). Mortality reduction with air bag and seat belt use in head-on passenger car collisions. *American Journal of Epidemiology*, 153, 219–224.
- Daly, M., & Wilson, M. (1988). *Homicide*. New York: Aldine de Gruyter.
- Daly, M., & Wilson, M. (2001). Risk taking, intrasexual competition, and homicide. *Nebraska Symposium on Motivation*, 47, 1–36.
- Dicker, L. W., Mosure, D. J., Levine, W. C., Black, C. M., & Berman, S. M. (2000). Impact of switching laboratory tests on reported trends in Chlamydia trachomatis infections. *American Journal of Epidemiology*, 151, 430–435.
- Donovan, J. E., & Jessor, R. (1985). Structure of problem behavior in adolescence and young adulthood. *Journal of Consulting and Clinical Psychology*, 53, 890–904.
- Dryfoos, J. G. (1990). *Adolescents at risk: Prevalence and prevention*. New York: Oxford University Press.
- Eckstein, Z., & Wolpin, K. I. (1999). Why youths dropout of high school: the impact of preferences, opportunities, and abilities. *Econometrica*, 67, 1295–1339.
- Finkelhor, D., & Jones, L. (2005). Why have child maltreatment and child victimization declined? *Journal of Social Issues*, 62, 683–714.
- Fox, J. A. (2005). Demographics and U.S. homicide. In Alfred Blumstein, & Joel Wallman (Eds.), *The crime drop in America*. New York: Cambridge University Press.
- Geronimus, A. T. (2004). Teenage childbearing as cultural prism. *British Medical Bulletin*, 69, 155–166.
- Gottfredson, M. R., & Hirschi, T. (1990). *A general theory of crime*. Stanford: Stanford University Press.
- Grasmick, H. J., Tittle, C. R., Bursik, R. J., Jr., & Arneklev, B. J. (1993). Testing the core empirical implications of Gottfredson and Hirschi's general theory of crime. *Journal of Research in Crime and Delinquency*, 30, 5–29.
- Henshaw, S. K., Singh, S., & Haas, T. (1999). Recent trends in abortion rates worldwide. *International Family Planning Perspectives*, 25, 44–48.
- Holinger, P. C., & Klemen, E. H. (1982). Violent deaths in the United States, 1900–1975: relationships between suicide, homicide, and accidental deaths. *Social Science & Medicine*, 16, 1929–1938.
- Holmes, K. K., Levine, R., & Weaver, R. (2004). Effectiveness of condoms in preventing sexually transmitted infection. *Bulletin of the World Health Organization*, 82, 454–461.
- Jessor, R. (1991). Risk behavior in adolescence: a psychosocial framework for understanding and action. *Journal of Adolescent Health*, 12, 597–605.
- Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Schulenberg, J. E. (2007a). *Secondary school students (NIH Publication No. 06-5883)*. In: *Monitoring the future national survey results on drug use, 1975–2005, Vol. 1*.
- Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Schulenberg, J. E. (2007b). *College students and adults ages 19–45 (NIH Publication No. 06-5883)*. In: *Monitoring the future national survey results on drug use, 1975–2005, Vol. 2*.
- Jones, L., & Finkelhor, D. (2001). The decline in sexual abuse cases. *Juvenile Justice Bulletin* 1–12, NCJ184741.
- Jones, S., & Quisenberry, N. (2004). The general theory of crime: how general is it? *Deviant Behavior*, 25, 401–426.
- Junger, M., & Tremblay, R. E. (1999). Self-control, accidents and crime. *Criminal Justice and Behavior*, 26, 485–501.
- Kreek, M. J., Nielsen, D. A., Butelman, E. R., & LaForge, K. S. (2005). Genetic influences on impulsivity, risk taking, stress responsivity and vulnerability to drug abuse and addiction. *Nature Neuroscience*, 8, 1450–1457.
- Lalumière, M. L., Harris, G. T., Quinsey, V. L., & Rice, M. E. (2005). *The causes of rape: Understanding individual differences in male propensity of sexual aggression*. Washington, DC: American Psychological Association.
- Lalumière, M. L., & Quinsey, V. L. (1996). Sexual deviance, antisociality, mating effort, and the use of sexually coercive behaviors. *Personality and Individual Differences*, 21, 33–48.
- Langevisch, M. W. J., & Frisch, G. R. (1998). Gambling behaviour and pathology in relation to impulsivity, sensation seeking, and risky behaviour in male college students. *Journal of Gambling Studies*, 14, 245–262.
- LeBlanc, M., & Girard, S. (1997). The generality of deviance: replication over two decades with a Canadian sample of adjudicated boys. *Canadian Journal of Criminology*, 39, 171–183.
- Levitt, S. D. (2004). Understanding why crime fell in the 1990s: four factors that explain the decline and six that do not. *Journal of Economic Perspectives*, 18, 163–190.
- Mishra, S. (2007). *Risk taking and the crime drop of the 1990s*. Unpublished masters thesis, Lethbridge, Alberta, Canada: University of Lethbridge.
- Mishra, S., & Lalumière, M. L. (2008). Risk taking, antisocial behavior, and life histories. In J. Duntley, & T. K. Shackelford (Eds.), *Evolutionary forensic psychology* (pp. 139–159). Oxford: Oxford University Press.
- O'Brien, R. M. (1990). Comparing detrended UCR and NCS crime rates over time: 1973–1986. *Journal of Criminal Justice*, 18, 229–238.
- O'Brien, R. M. (1996). Police productivity and crime rates: 1973–1992. *Criminology*, 34, 183–207.

- O'Brien, R. M. (2003). UCR violent crime rates, 1958–2000: recorded and offender-generated trends. *Social Science Research*, 32, 499–518.
- Osgood, D. W., Johnston, L. D., O'Malley, P. M., & Bachman, J. G. (1988). The generality of deviance in late adolescence and early adulthood. *American Sociological Review*, 53, 81–93.
- Ouimet, M. (2002). Explaining the American and Canadian crime "drop" in the 1990's. *Canadian Journal of Criminology*, 33, 33–50.
- Ouimet, M. (2004). Oh, Canada! La baisse de la criminalité au Canada et aux Etats-Unis entre 1991 et 2002. *Champ Pénal*, 1, 1–13.
- Salminen, S., Saari, J., Saarela, K. L., & Rasanen, T. (1993). Organizational factors influencing serious occupational accidents. *Scandinavian Journal of Work, Environment and Health*, 19, 352–357.
- Shiner, M., & Newburn, T. (1997). Definitely, maybe not? The normalisation of recreational drug use among young people. *Sociology*, 31, 511–529.
- Statistics Canada. (2008). <http://www.statcan.ca/>. Accessed January 2008.
- Vallerand, R. J., Fortier, M. S., & Guay, F. (1997). Self-determination and persistence in a real-life setting: toward a motivational model of high school dropout. *Journal of Personality and Social Psychology*, 72, 1161–1176.
- Welte, J. W., Wieczorek, W. F., Barnes, G. M., Tidwell, M., & Hoffman, J. H. (2004). The relationship of ecological and geographic factors to gambling behaviour and pathology. *Journal of Gambling Studies*, 20, 405–423.
- Wilson, M., & Daly, M. (1997). Life expectancy, economic inequality, homicide and reproductive timing in Chicago neighbourhoods. *British Medical Journal*, 314, 1271–1274.
- Wittebrood, K., & Junger, M. (2002). Trends in violent crime: a comparison between police statistics and victimization surveys. *Social Indicators Research*, 59, 153–173.
- Zimring, F. E. (2006). *The great American crime decline*. Oxford: Oxford University Press.