LOW SELF-CONTROL, SOCIAL BONDS, AND CRIME: SOCIAL CAUSATION, SOCIAL SELECTION, OR BOTH?*

BRADLEY R. ENTNER WRIGHT
  University of Connecticut

AVSHALOM CASPI
TERRIE E. MOFFITT
  Institute of Psychiatry, University of London and University of Wisconsin–Madison

PHIL A. SILVA
  University of Otago Medical School, New Zealand

> This article examines the social-selection and social-causation processes that generate criminal behavior. We describe these processes with three theoretical models: a social-causation model that links crime to contemporaneous social relationships; a social-selection model that links crime to personal characteristics formed in childhood; and a mixed selection-causation model that links crime to social relationships and childhood characteristics. We tested these models with a longitudinal study in Dunedin, New Zealand, of individuals followed from birth through age 21. We analyzed measures of childhood and adolescent low self-control as well as adolescent and adult social bonds and criminal behavior. In support of social selection, we found that low self-control in childhood predicted disrupted social bonds and criminal offending later in life. In support of social causation, we found that social bonds and adolescent delinquency predicted later adult crime and, further, that the effect of self-control on crime was largely mediated by social bonds. In support of both selection and causation, we

found that the social-causation effects remained significant even when controlling for preexisting levels of self-control, but that their effects diminished. Taken together, these findings support theoretical models that incorporate social-selection and social-causation processes.

Criminological theories, especially those from the sociological perspective, have traditionally explained crime in terms of social causation—that social relationships promote or prevent criminal behavior. As supportive evidence they reference the frequently observed correlations of crime with school, work, family ties, peer delinquency, and prior delinquency. Recently, however, several prominent sociologists have incorporated childhood characteristics—such as low self-control and childhood antisocial behavior—into their theories of crime (Gottfredson and Hirschi, 1990; Sampson and Laub, 1990, 1993). This approach accepts the correlations between crime and social relationships, but explains them as being, at least in part, the outcome of social selection—that preexisting individual characteristics influence the development of social relationships and criminal behavior, and so the observed correlations between crime and social relationships may be spurious.

This article examines selection and causation issues in light of two questions: Do social relationships cause crime? Does prior delinquency cause later crime? Specifically, we test to what extent, if any, the correlations of crime with social bonds and of crime with prior delinquency attenuate when controlling for levels of childhood self-control. Social-causation models, in their pure form, predict no attenuation; social-selection models, in their pure form, predict complete attenuation; and mixed selection-causation models predict partial attenuation. We also test to what extent the effect of self-control on crime is mediated by social bonds. While previous studies have explored these issues, this article presents a direct and compelling test of these questions by (a) employing measures of self-control collected in childhood from multiple sources using multiple measurement instruments and (b) following individuals over time in order to measure social relationships and criminal participation in adulthood.

INTERPRETING THE CORRELATION BETWEEN SOCIAL BONDS AND CRIME

In this section we examine the causal linkage between social bonds and crime from the perspective of models of social causation, social selection, and mixed social selection/causation. We discuss the implications of these models, and we review previous empirical studies of them.

THEORETICAL MODELS

Do social relationships (or their absence) cause crime? This question is at the core of the sociological study of crime, and until recently, many criminologists assumed that social factors, and perhaps social factors alone, caused crime. In a sense, the relevant research issue has been how—not if—social causation occurred. Social control theory, perhaps the best known sociological theory of crime, assumes that individuals are inherently motivated to deviate, and they will do so unless they are restrained by strong bonds to society (Hirschi, 1969:10, 16). These social bonds tie individuals to the conventional beliefs, values, and activities of their parents, teachers, employers, and peers (Hirschi, 1969:16–26). Social learning theories also postulate social causation. Definitions favorable to crime are learned in small, intimate social groups, especially of delinquent peers (Sutherland, 1947). Likewise, criminal behavior can be learned by imitating criminals (Akers, 1985).

A more recent theory of crime, self-control theory, disavows social causation altogether in favor of social selection. It boldly claims that low self-control in childhood is "for all intents and purposes, *the* individual-level cause of crime" (italics in the original; Gottfredson and Hirschi: 1990:232). (For heuristic purposes we follow the lead of Gottfredson and Hirschi and refer to "high" and "low" self-control. In actual fact, they conceptualize and we test this concept as continuous, not dichotomous.) According to this theory, low self-control develops from inattentive and lax parental supervision, and it makes children unable to resist the momentary temptations of wrongdoing (Gottfredson and Hirschi, 1990:97). Low self-control is manifest by, among other things, impulsive behavior, lack of persistence in tasks, high levels of activity, physical responses to conflict, and risk taking (Gottfredson and Hirschi, 1990:89–94). It remains highly stable over the life course (Gottfredson and Hirschi, 1990:94).

After childhood, self-control expresses itself as delinquency and crime when individuals encounter opportunities for crime (Hirschi and Gottfredson, 1995:140, though self-control theory is noticeably vague about the nature and occurrence of such opportunities). Self-control does not predict absolute levels of crime, since, as per the age-crime curve, crime levels change with age. Self-control does predict, however, the relative rates of crime over the life course, assuming that the relative ordering of antisocial behavior within any cohort of people remains stable over time (Hirschi and Gottfredson, 1995). Self-control theory is thus a theory of social causation in childhood, but one of social selection thereafter (Sampson and Laub, 1995:147). Self-control determines not only criminal behavior but the development of social bonds as well. Individuals with low self-control

fit poorly into conventional society, and so they end up in weakened or broken social relationships (Gottfredson and Hirschi, 1990:157).

According to self-control theory, since criminal behavior and social bonds share their origins in childhood self-control, the correlation between them is causally spurious. After childhood ends, social relationships with peers, school, work, family, and marriage have no causal impact on criminal behavior. Gottfredson and Hirschi (1990) are clear on this controversial point: "Lack of perseverance in school, in a job, or in an interpersonal relationship is simply different manifestations of the personal factors assumed to cause crime in the first place. Taking up with delinquent peers is another example of an event *without causal significance*" (p. 251, italics added; see also pp. 154–168).

Several theories of crime incorporate processes of social selection and social causation. Notably, the theory of age-graded informal social control links childhood antisocial behavior to adult crime through two causal mechanisms (Sampson and Laub, 1990:609–612, 1993:123–138, 1995:145–148). First, in childhood individuals develop an underlying criminal propensity that expresses itself as antisocial behavior and carries on into adulthood as criminal behavior. Second, childhood antisocial behavior disrupts the formation of later social bonds (i.e., social selection). Nonetheless, these social bonds are not determined fully by childhood characteristics, and they have unique, causal effects on adult crime independent of individuals' preexisting characteristics (i.e., social causation). In other words, social bonds to school, work, and family in part reflect preexisting criminal propensity and in part cause crime.

Developmental theories of crime offer a similar mix of social selection and causation, albeit for separate groups of people (Moffitt, 1993; Moffitt et al., 1996; Patterson and Yoerger, 1993; Patterson et al., 1989). In Moffitt's theory, neuropsychological impairments in childhood can extend into adulthood and cause criminal behavior. These impairments can also ensnare individuals in delinquent friendships, broken family ties, failed schooling, and unemployment, and these social factors in turn cause crime. Individuals without impairments enter crime through a different pathway. They reach biological maturity—puberty—well before they reach social maturity—adult statuses such as a driver's license, the right to buy alcohol, and marriage. Caught in this maturity gap, they will observe that their delinquent peers have already acquired the "forbidden" resources and privileges that they desire, and so, by means of rationally motivated social mimicry, they turn to delinquency. Patterson's theory makes a similar case with "early starters," who exhibit childhood problem behaviors such as aggression and temper tantrums, and "later starters," who in adolescence experience decreased parental supervision and peer delinquency. Thus,

the theories of Sampson and Laub, Moffitt, and Patterson share a common emphasis on including social selection and social causation.

IMPLICATIONS AND PREVIOUS EVIDENCE

Wide-ranging implications arise from the possibility that selection processes alone generate the observed correlation between social bonds and criminal behavior. From a conceptual perspective, this spurious correlation undermines traditional sociological theories, and so if selection theories are to be accepted, causation theories are to be abandoned (Evans et al., 1997:479). Also, selection theories are highly parsimonious in that they explain crime with primarily one theoretical construct—low self-control or criminal propensity. In contrast, traditional social-causation theories reference multifaceted, multilevel social relationships, and social-selection/ causation theories incorporate both propensity and social relationships. Therefore, all else being equal, the parsimony of social-selection theories makes them the favored explanation of crime (Paternoster et al., 1997).

From a methodological perspective, if childhood characteristics determine crime and if these characteristics persist into adulthood (i.e., keep the same ranking relative to the self-control levels of other individuals), there is no need to assess them over time with longitudinal studies. "Identification of the causes of crime at one age may suffice to identify them at other ages as well—if so, cohort or longitudinal studies of crime are unnecessary" (Hirschi and Gottfredson, 1995:131). Further, if postchildhood social relationships have no causal effect on crime, they too need not be assessed at all. "Since such 'events' [such as school, work, interpersonal relationships, and delinquent peers] are predictable consequences of the causes of crime, there is little point in monitoring them" (Gottfredson and Hirschi, 1990:251). In the end, selection theories require only that researchers collect cross-sectional studies of enduring individual characteristics.

From a policy perspective, if the causes of crime are set in childhood and if they are immune to later social influence, social programs that attempt to rehabilitate criminal offenders are misguided and unworkable. "Clearly, the general thrust of the public policy implications of our theory is to counter the prevailing view that modifications of the criminal justice system hold promise for major reductions in criminal activities" (Gottfredson and Hirschi, 1990:255). Also, "[self-control] accounts for the failure of efforts to treat delinquents or to deter them by the threat of punishment" (Hirschi and Gottfredson, 1995:140). Consequently, public policy should attempt not to rehabilitate current offenders, but only to prevent future offenders by cultivating self-control in childhood, a developmental period when psychological characteristics are assumed to be still malleable.

Numerous studies have tested models of social selection versus social causation, and their findings give mixed evidence in support of both causation and selection processes. An exhaustive review is beyond the scope of this article, but here we reference some recently published examples. As evidence of social causation, Horney et al. (1995) analyzed a group of recently interned convicts. They controlled for preexisting heterogeneity in criminal tendencies by examining within-person variation in social ties and crime. Prior to the convicts' arrest, short-term changes in school attendance and spousal residence predicted less criminal offending. Further evidence of social causation was provided by Paternoster and Brame (1997), who analyzed 11- and 12-year-olds in the National Youth Survey. They controlled for unobserved heterogeneity with random-effects models. Even so, peer delinquency predicted more frequent criminal offenses. As evidence of social selection, Evans et al. (1997) analyzed a cross-sectional sample of adults. They controlled for self-reported self-control and analogous behaviors, such as drunk driving, drug use, and physical accidents. Only a few social bonds significantly predicted criminal behavior, and their effects diminished when controlling for self-control and analogous behaviors. As evidence of both selection and causation, Sampson and Laub (1990, 1993) analyzed the Gluecks' longitudinal study of delinquent boys, from correctional schools, and nondelinquent boys, from public schools, aged 10 to 17. They controlled for heterogeneity in criminal propensity with the original sampling procedure plus measures of adolescent antisocial behavior. The delinquent study members encountered more problems in their education, employment, and personal relationships (i.e., social selection). Nonetheless, the quality of social bonds in adulthood significantly predicted criminal behavior net of adolescent delinquent and antisocial behavior (i.e., social causation). This prior evidence—in support of both social selection and causation—suggests that the assumptions underlying a pure social-selection model or a pure social-causation model might be overly strong, and that while useful as sensitizing principles, these pure models do not seem to be supported as comprehensive theories of crime.

INTERPRETING THE CORRELATION BETWEEN PRIOR DELINQUENCY AND CRIME

We now turn to the correlation between prior delinquency and later criminal behavior. Again we examine this linkage from the perspective of social-causation, social-selection, and social-selection/causation models, discussing their implications and reviewing previous empirical tests of them.

THEORETICAL MODELS

Does previous delinquency cause later crime? Various social-causation theories answer yes (Nagin and Paternoster, 1991:166). For example, prior criminal involvement might weaken conventional social bonds, thereby damaging those relationships that once helped deter criminal behavior (Agnew, 1985; Hirschi, 1969). Likewise, criminal acts, and the formal sanctions that they might solicit, can give individuals greater exposure to and affinity for other law violators. Through these processes of reinforcement and modeling, criminal acts can thus increase criminal participation (Akers, 1985; Sutherland, 1947).

In contrast, self-control theory casts the correlation between delinquency and crime over time as spurious. Criminal behavior at any age is determined by childhood self-control, which is stable by adolescence, and therefore delinquent or criminal acts at one time have no causal bearing on those acts at another time (Sampson and Laub, 1995:147).

The theory of age-graded informal social control explains criminal stability as resulting from both social selection and social causation (Sampson and Laub, 1995:147–148). As social selection, differences in criminal propensity span from childhood into adulthood (Caspi et al., 1996a). As social causation, delinquent behavior at one time can jeopardize social relationships, such as at work and in marriage. These, in turn, diminish individuals' life chances, which leads to criminal behavior. Moffitt's (1993; Moffitt et al., 1996) theory posits a similar, life-course persistent trajectory in which delinquent behavior produces later criminal behavior via processes of contemporary continuity (i.e., enduring neuropsychological impairments) and also via processes of cumulative continuity (i.e., social bonds are disrupted in the course of growing from child to adult).

IMPLICATIONS AND PREVIOUS EVIDENCE

As with the social bond-crime correlation, the possibility of spurious correlation between repeated measures of criminal behavior over time has wide-ranging implications. Conceptually, social-selection models are again the more parsimonious for the same reason—they explain criminal stability with one theoretical construct. Methodologically, selection models again question the need for longitudinal studies. If prior criminal behavior does not affect later criminal behavior, why record both? For policy, selection models discount the existence of secondary deviance (Becker, 1963), and so, if they are correct, policymakers need not worry about social sanctions having latent negative effects.

Various studies have tested for individuals' underlying heterogeneity in criminal tendencies, and here we reference several recently published examples. Each of these studies used statistical methods, such as random-

effect models, to model heterogeneity, but nonetheless, they found contrary results. As evidence of social causation, Nagin and Paternoster (1991) analyzed a longitudinal study of high school sophomores. They modeled unobserved propensity for crime with self-reported measures of theft, and they found that previous offending had a positive causal effect on later offending. Paternoster and Brame (1997) modeled criminal propensity with measures of general delinquent activity, and they too found previous delinquency to have a causal effect. As evidence of social selection, Nagin and Farrington (1992) analyzed a longitudinal study of 8-year-old working-class boys. They modeled unobserved criminal propensity with measures of criminal convictions between ages 10 and 31. They found that the positive association between earlier and later criminal behavior was "largely attributable to stable, unmeasured individual differences" (p. 235). As evidence of both social causation and social selection, Paternoster et al. (1997) studied releasees from youth training schools, and they found evidence of both change and continuity in criminal offending and that the change could not be attributed solely to processes of self-selection. The prior evidence on this issue supports both social-selection and social-causation processes, implying again that pure selection or causal models may not be workable as comprehensive theories.

A TEST OF SOCIAL SELECTION AND SOCIAL CAUSATION

Missing from previous studies is perhaps a more direct test of social-selection versus social-causation models. This test would observe *in childhood* those personal characteristics, such as low self-control, thought by selection theories to spawn later criminal behavior. It would then observe *in adolescence or adulthood* those social bonds and delinquent behaviors thought by causation theories to bring about crime. It would then test how much, if at all, childhood characteristics diminish the associations between social bonds and crime and between early delinquency and later crime. For such a study, social-causation theories predict no attenuation; social-selection theories predict complete attenuation; and social-selection/causation theories predict partial attenuation.

The need for this more direct test has been recognized by proponents of both selection and causation theories. Gottfredson and Hirschi (1990) wrote that it is difficult to assess "criminal tendencies independent of opportunity to commit criminal acts." One solution, they proposed, is that "tendencies may be assessed *before* crime is possible; that is, the measure of criminality, i.e., propensity, is constructed from information available in

the preadolescent years" (p. 220, italics in the original). Laub and Sampson (1993) added that self-control theory's spuriousness hypothesis is "rarely examined directly" (p. 305).

This article offers such a direct test. We analyze data from a longitudinal study of a birth cohort that was followed from birth through age 21. The study contains childhood and adolescent measures of self-control as well as adolescent and young adult measures of social bonds and criminal offending. These data allow for a direct test of social-selection and social-causation theories of crime, which we conducted by examining the following questions:

- How much, if at all, do the correlations between social bonds and crime attenuate when controlling for self-control?
- How much, if at all, does the correlation between delinquency and later crime attenuate when controlling for self-control?
- How much, if at all, is the effect of self-control on crime mediated through social bonds?

THE DUNEDIN STUDY

The data analyzed in this article come from the Dunedin Multidisciplinary Health and Development Study (Silva and Stanton, 1996). The members of this study are children born from April 1972 through March 1973 in Dunedin, New Zealand, a city of approximately 120,000 people. A total of 1,037 study members (91% of the eligible births) participated in the first follow-up assessment at age 3. These study members formed the base sample for a longitudinal study that has since been followed up, with high levels of participation, at ages 5 (N = 991), 7 (N = 954), 9 (N = 955), 11 (N = 925), 13 (N = 850), 15 (N = 976), 18 (N = 1,008), and 21 (N = 992).

At each assessment, the study members were given a diverse battery of psychological, medical, and sociological tests. Study members are brought into the research unit within 60 days of their birthday for a full day of data collection. They are given, in private, standardized modules regarding various research topics, which are administered by trained examiners. In addition to the self-reported data, data were collected about the study members from parents, teachers, informants, and trained observers.

Various cross-national comparisons have established the generalizability of findings from the Dunedin study to other industrialized countries, especially in the area of crime (Moffitt et al., 1995). The rates of crime victimization in New Zealand match closely those found in surveys of other countries (van Dijk and Mayhew, 1992). The rates of criminal offending in New Zealand are comparable to those in other industrialized countries, such as the United States, Canada, Australia, and the Netherlands

(Junger-Tas et al., 1994; van Dijk and Mayhew, 1992). Our own replication studies suggest that the predictors of problem behavior are the same between the Dunedin study and a similar longitudinal sample of black and white youth collected in Pittsburgh (Moffitt et al., 1995).

The Dunedin study has collected multiple measures from multiple sources about study members' levels of self-control, social bonds, and criminal behavior. We describe these variables in Appendix 1, presenting each variable's content, the age at which it was collected, from whom it was collected, univariate statistical descriptions, and citations of previous published studies that have used the measurement instrument and provide information about its reliability and validity.

SELF-CONTROL MEASURES

The self-control variables measured in childhood include Lack of Control-Irritability-Distractibility, Impulsivity I, Impulsivity II, Lack of Persistence, Inattention I, Hyperactivity I, Hyperactivity II, Hyperactivity III, and Antisocial Behavior. These nine variables comprise over 150 separate test items in the Dunedin study. These items were collected from eight sources—study members, parents, two trained observers, and four teachers—at five ages—ages 3, 5, 7, 9, and 11.

The self-control variables measured in adolescence include Impulsivity III, Impulsivity IV, Hyperactivity IV, Inattention II, Inattention III, Physical Response to Conflict, and Risk Taking. These seven variables comprise over 50 separate test items from three sources—study members, parents, and informants—at two ages—ages 15 and 18.

The measurement of self-control has been a contentious issue in previous studies (e.g., Hirschi and Gottfredson, 1993; Longshore et al., 1998; Piquero and Rosay, 1998), so we now discuss at length the self-control measures collected in the Dunedin study.

To begin with, it should be recognized that self-control itself is not difficult to measure, but rather, it simply has not been measured often in the data sets most often used by criminologists. This is because the conceptual importance of childhood characteristics for theories of crime is just now being widely accepted. In contrast, developmental psychologists have long studied and measured childhood antisocial behavior and low self-control, but they have rarely collected data on later criminal activity and social ties. In this context, the Dunedin study offers a unique opportunity, for it has involved a multidisciplinary team of psychologists, criminologists, and sociologists who have included age-appropriate measures of self-control, crime, and social ties in a longitudinal study spanning from childhood to young adulthood.

It is significant that the Dunedin study measured self-control during

childhood, for self-control theory claims that self-control is best measured in childhood. This is because external opportunities in adolescence can alter expressions of later low self-control; therefore, self-control is most clearly assessed before there exists an abundance of opportunities for criminal behavior (i.e., in childhood). Additionally, when studies concurrently measure self-control, delinquency, and social bonds, as is the case with cross-sectional studies, temporal ordering is lost and the resulting findings are causally ambiguous and difficult to interpret. Any empirical relationship observed between self-control and delinquency or social bonds is open to interpretations of reciprocal or reverse causation (Evans et al., 1997:493).

The self-control measures in the Dunedin study fit squarely within Gottfredson and Hirschi's specification of self-control. They include measures of impulsivity, a lack of persistence, high activity levels, risk taking, and responding to conflict physically. One measure, Antisocial Behavior, in particular fits Hirschi and Gottfredson's (1993) prescription for measuring self-control in childhood: "The question becomes, can independent indicators of self-control be identified? With respect to crime, we have proposed such items as whining, pushing, and shoving (as a child)" (p. 53). Polakowski (1994) adds empirical evidence here, finding that self-control "is significantly comprised by early behavioral indicators of aggression and fighting" (p. 41). Almost these exact behaviors are measured in the Rutter Hyperactivity and Antisocial Behavior scales, which as described in Appendix 1, measure fussiness, fighting, and bullying. They were collected in the Dunedin study at ages 5, 7, 9, and 11, from both parents and teachers.

The measures of self-control are highly intercorrelated, both within and across developmental periods. The intercorrelations between the 16 self-control variables are presented in Appendix 2, and to summarize, of the 120 correlations presented, all but 6 are statistically significant. This intercorrelation is specified in self-control theory, which holds that the traits that compose self-control "come together in the same person, and . . . tend to persist through life" (Gottfredson and Hirschi, 1990:91). The reliability of the 9 childhood self-control measures is alpha = .86, and the reliability of the 7 adolescent measures is alpha = .64. These compare favorably with those found in other studies. For example, the self-control measures used by Evans et al. (1997) had a reliability of .61.

In addition to their conceptually relevant content, the self-control measures in the Dunedin study come from multiple sources, including the study members themselves, parents, other family members, friends, teachers, and trained observers. To convey the importance of having data from multiple sources, we must consider several possible types of self-control measures. Two distinctions are most relevant here. Data can be self-

reported (i.e., by the study member) or reported by others (i.e., about the study member by other people). Data can also directly measure the psychological characteristics of self-control (e.g., impulsiveness, risk taking, lack of persistence) or can infer self-control by measuring its noncriminal manifestations—what Gottfredson and Hirschi term "analogous behaviors" (e.g., accidents, drinking, smoking).

These two distinctions identify four possible types of measures: self-reported self-control, self-reported analogous behavior, other-reported self-control, and other-reported analogous behavior. Self-reported measures are alleged to be less valid for individuals with low self-control (Gottfredson and Hirschi, 1993:48). Measures of analogous behavior have been criticized as potentially tautological—using manifestations of low self-control to predict manifestations of low self-control (Akers, 1991:204). To the extent that these criticisms hold true, the worst measures of self-control would be self-reported analogous behaviors, such as individuals' reporting whether they smoke or drink. These commonly used measures risk invalidity and tautology. Conversely, the best measures would be other-reported, direct measures of self-control: for example, a teacher or parent assessing a child's impulsivity or lack of persistence. Because such measures are reported by others, they do not suffer from low self-control reporting bias, and because they measure self-control directly, their use to predict delinquency avoids potential tautology. This is not to imply that only other-reported, direct measures of self-control are of use to researchers—in fact, this article uses self-reported direct measures (in childhood and adolescence) and other-reported analogous behavior measures (antisocial behavior in childhood)—but rather, other-reported, direct measures should be used whenever possible, and the findings produced by them should be deemed most trustworthy.

Finally, one additional feature of the Dunedin study enhances its value for measuring and testing self-control—its low rates of attrition. Hirschi and Gottfredson (1993) claim that high attrition rates in longitudinal studies can bias analyses of self-control. They write that there is a "general unwillingness or inability of those low on self-control to participate in surveys (see Hirschi, 1969), thereby restricting the range of both independent and dependent variables, [and] all correlations may be seriously attenuated" (p. 48). This problem is minimized in the Dunedin study due to the low attrition rates (3%–4%) between the initial and final interviews.

SOCIAL BOND MEASURES

The social bonds variables were measured in adolescence and young adulthood, and we focus on four types of bonds: with delinquent peers, school, job, and marriage and family. We chose these four social bonds because self-control theory clearly and unequivocally states that any

observed correlation between them and delinquency is causally spurious and will disappear once levels of prior self-control are taken into account (Gottfredson and Hirschi, 1990:154–168). Therefore, the relationship between these social bonds and crime, net of self-control, provides "a crucial test of [self-control] theory vis-à-vis the standard theories of positive criminology" (Gottfredson and Hirschi, 1990:167). Measures of these bonds include Friends Are Delinquent, Companion For Delinquency, Friends Are Good Citizens, Educational Aspirations, Months Education, Educational Achievement, Did Not Like-Left School, Months Unemployment, Months Full-Time Employment, Occupational Aspirations, Job Desirability, Living with Parents, Involvement with Parents, Intimacy with Parents, Intimacy with Partner, and Companionship with Partner. These 16 variables comprise 46 self-reported interview items collected at ages 18 and 21.

DELINQUENCY AND CRIME MEASURES

A fourth, and last, category of variables are measures of delinquency and crime. These include Delinquency at Age 15 and Crime at Age 21. Both of these measures are self-reported variety scores that record how many types of illegal acts each study member committed at least once in the previous year. They are scored from 0 to 29 and 0 to 48 illegal acts, respectively. Variety scores such as these are endorsed by proponents of self-control theory. "Indeed, it appears that the best available operational measure of the propensity to offend is a count of the number of distinct problem behaviors engaged in by a youth (that is, a variety scale)" (Hirschi and Gottfredson, 1995:134). Variety scales do not, however, incorporate the frequency of committed criminal acts, a difficult concept to operationalize since its meaning varies by the severity of the act (e.g., 10 drunken drivings versus 10 homicides). (The distribution of the age-21 crime measure was skewed somewhat to the right. To test the robustness of our ordinary least squares analyses, we reran our analyses using a transformed measure of age-21 crime, obtained by taking its natural logarithm, and the pattern of findings did not change.)

In addition to the substantive variables described above, we also used measures of gender and social class as control variables. Gender is a dummy variable coded 1 = male. It correlated with age-21 crime at $r = .32$, which was statistically significant. The social-class measure averages the socioeconomic status of study members' families across the first 15 years of the study (Wright et al., 1999). It correlated with age-21 crime at $r = -.02$, which was not statistically significant.

By and large there were not many missing data in these measures, with one main exception. The Diagnostic Interview Schedule for Children (DISC), collected at age 11, had about 20% missing cases. This was not a

great concern because each of the DISC measures was replicated at other ages with variables containing fewer missing data. For any variable that had missing data, in the regression equations, we created a dummy variable indicating which cases were missing. We then recoded the substantive variable to its mean and included both it and the missing dummy variable in the regression equation (Little and Rubin, 1987).

RESULTS

In this section, we present four sets of analyses that test the social-selection and the social-causation processes of crime.

SOCIAL-SELECTION PROCESSES

Our first set of analyses examined if low self-control correlated with later criminal behavior and disrupted social bonds, as per the social-selection model, and it did. Table 1 presents the correlations between self-control and criminal behavior. All 16 of the childhood and adolescent self-control variables, with two exceptions, significantly correlated ($p \leq .05$) with delinquency at age 15 and crime at age 21. The significant correlations ranged from $r = .06$ to $r = .46$. To summarize these correlations, we created two summary scales that comprised the self-control variables. One scale averaged the standardized scores of the nine childhood self-control variables. The other averaged the seven adolescent self-control variables. The two summary scales both significantly correlated with the measures of criminal behavior. Childhood self-control correlated at $r = .23$ with age-15 delinquency and $r = .21$ with age-21 crime, and adolescent self-control correlated at $r = .41$ with delinquency and $r = .45$ with crime. We note that the correlation between adolescent self-control and crime ($r = .45$) slightly exceeded that found between delinquency and crime ($r = .42$).

The correlations reported in Table 1 compare favorably in size to those found in previous studies that have related self-control to various forms of deviance. Such correlations include $r = .36$ and $r = .40$ (Gibbs and Giever, 1995:251), $r = .32$ and $r = .34$ (Piquero and Tibbetts, 1996:496), $r = .15$ to .30 (Wood et al., 1993:119), $\beta = .32$ (Burton et al., 1994:228), $\beta = .30$ (Evans et al., 1997:489), and $\beta = .18$ (Arneklev et al., 1993:234). Importantly, these previous correlations were produced in cross-sectional studies, and yet they did not exceed those found in the Dunedin study across a span of several years ($r = .41$ and .45), and in fact, some were even less than found here across a decade ($r = .23$ and .21). These correlations in Table 1 give additional confidence in our measures of self-control, for a measure of self-control can be "validated by its ability to predict subsequent behavior" (Gottfredson and Hirschi, 1990:220).

Table 1. Correlations Between Self-Control and Delinquency and Crime

	Delinquency At Age 15	Crime at Age 21
Self-Control in Childhood (Ages 3–11)		
Lack of Control, Irritability, and Distractibility (Observer Report, Ages 3, 5)	.04	.06*
Impulsivity I (Parental and Teacher Report, Ages 9, 11)	.18*	.19*
Impulsivity II (Self-Report, Age 11)	.17*	.15*
Lack of Persistence (Parental and Teacher Report, Ages 9, 11)	.16*	.15*
Inattention I (Self-Report, Age 11)	.16*	.12*
Hyperactivity I (Parental and Teacher Report, Ages 5, 7, 9, 11)	.17*	.15*
Hyperactivity II (Parental and Teacher Report, Ages 9, 11)	.14*	.14*
Hyperactivity III (Self-Report, Age 11)	.14*	.15*
Antisocial Behavior (Parental and Teacher Report, Ages 5, 7, 9, 11)	.22*	.17*
Childhood Self-Control Scale (Summation of Above Variables)	.23*	.21*
Self-Control in Adolescence (Ages 15–18)		
Impulsivity III (Self-Report, Age 18)	.24*	.31*
Impulsivity IV (Informant Report, Age 18)	.17*	.23*
Hyperactivity IV (Self-Report, Age 15)	.46*	.25*
Inattention II (Parent, Age 15)	.23*	.18*
Inattention III (Informant, Age 18)	.03	.11*
Physical Response to Conflict (Self-Report, Age 18)	.30*	.36*
Taste for Risk (Self-Report, Age 18)	.15*	.29*
Adolescent Self-Control Scale (Summation of Above Variables)	.41*	.45*

NOTES: N = 748 to 956. Cells present simple correlation coefficients. Data from the Dunedin (New Zealand) Multidisciplinary Health and Development Study.
  * $p < .05$ (two-tailed tests).

Table 2. Correlations Between Self-Control and Social Bonds

	Childhood Self-Control Scale	Adolescent Self-Control Scale
Peer Group		
Friends Are Delinquent	.07*	.33*
(Self-Report, Ages 18, 21)		
Companion for Delinquency	.04	.25*
(Self-Report, Age 21)		
Friends Are Good Citizens	−.27*	−.38*
(Self-Report, Ages 18, 21)		
School		
Educational Aspirations	−.23*	−.18*
(Self-Report, Ages 15, 18)		
Months Education	−.34*	−.29*
(Self-Report, Age 21)		
Educational Achievement	−.39*	−.30*
(Self-Report, Ages 18, 21)		
Did Not Like, Left School	.09*	.17*
(Self-Report, Age 18)		
Job		
Months Unemployment	.29*	.21*
(Self-Report, Age 21)		
Months Full-Time Employment	−.04	−.04
(Self-Report, Age 21)		
Occupational Aspirations	−.27*	−.25*
(Self-Report, Ages 18, 21)		
Job Desirability	−.06	−.11*
(Self-Report, Age 21)		
Family		
Living with Parents	−.12*	−.25*
(Self-Report, Age 21)		
Involvement with Parents	−.11*	−.25*
(Self-Report, Age 18)		
Intimacy with Parents	−.08*	−.19*
(Self-Report, Age 18)		
Partner		
Intimacy with Partner	−.12*	−.17*
(Self-Report, Age 21)		
Companionship with Partner	−.14*	−.14*
(Self-Report, Age 21)		

NOTES: N = 773–778 for partner variables, N = 920–1,012 for remaining variables. Cells present simple correlation coefficients. Data from the Dunedin (New Zealand) Multidisciplinary Health and Development Study.

 * p < .05 (two-tailed tests).

Table 2 presents the correlations between self-control and social bonds. The two self-control summary scales significantly correlated with nearly every measure of social bonds. Study members with low self-control had more delinquent peers, diminished bonds to school, lesser work achievements, and weakened family and partner ties. The significant correlations between self-control and social bonds ranged from $r = .07$ to $r = .39$, magnitudes consistent with those found in previous studies (Evans et al., 1997:490; Sampson and Laub, 1990:615). Taken together, the correlations presented in Tables 1 and 2 are evidence of social-selection processes in the generation of criminal behavior, for low self-control prospectively predicts disrupted social bonds and criminal behavior. Whether these selection effects are strong enough to preempt social causation is the critical question, and we take it up in the following analyses.

SOCIAL-CAUSATION PROCESSES

Our next set of analyses examined if social bonds correlated with criminal behavior, as per the social-causation model, and we found that they did. The first column in Table 3 presents the correlations between social bonds and delinquency. To facilitate the remaining analyses, we present these correlations as standardized regression coefficients estimated by regressing crime at age 21 on each social bond measure separately plus gender and social class (for a total of 16 regression equations). As shown in column one, the social bond variables correlated with crime at levels ranging from $\beta = .129$ (with educational aspirations) to $\beta = .479$ (companion for delinquency), and all were statistically significant.

The statistical significance of these correlations is important for the purposes of this study. Both selection and causation models assume that social bonds correlate with crime; they simply differ in their causal interpretation of these correlations. These countering interpretations can be distinguished empirically only if social bonds and crime are first correlated. Put differently, a spurious correlation must first be a correlation. A lack of initial correlation between social bonds and crime would argue equally strongly against both models. We make this point because it identifies a problem found in previous research. Evans et al. (1997) adopted a similar analytic strategy to the one we use in this article. They started with 13 social bond measures, but only 3 of them were significantly associated with crime *before* they controlled for self-control (Table 3, p. 492). Thus, it is not clear how well the data used by Evans et al. (1997) could distinguish selection versus causation models.

SOCIAL CAUSATION NET OF SOCIAL SELECTION

Our third set of analyses tested the strength of the social-causation

effects when we controlled for social selection. We did this with three tests. In the first test we examined how much, if at all, the correlations between social bonds and adult crime attenuated when we controlled for levels of childhood self-control. This is the appropriate test of pure selection theories, which predict complete attenuation from childhood. We present the relevant findings in the second and third columns of Table 3. Column two reports the standardized regression coefficients obtained when we regressed crime at age 21 on each social bond variable separately, controlling for gender and social class, as we did in column one, plus all nine childhood self-control variables (from Lack of Control to Antisocial Behavior). Column three calculates how much the effect of each social bond on crime attenuated with the addition of the childhood self-control variables. To illustrate, the full effect of Educational Aspirations on crime, controlling for gender and social class, was $\beta = -.129$ (column one). Its partial effect, controlling for gender, social class, and the nine childhood self-control variables, was $\beta = -.117$ (column two). Controlling for the childhood self-control variables therefore attenuated the effect of Educational Aspirations by 9% (1 - (-.117 / -.129)) (column three). Across the 16 social bond variables in Table 3, we observed attenuation from -1% (an actual increase in coefficient size) up to 13%. The median attenuation level was 5.5%. In addition, the effect of each social bond variable on crime was still statistically significant even when we controlled for childhood self-control. (In analyses not shown, we reestimated the equations in Table 3 twice. Once we used the self-control summary scales instead of the separate variables. A second time we used weighted factors created from the separate self-control variables. Both reanalyses produced findings similar to those in Table 3, though with slightly less overall attenuation; hence our choice to present the equations controlling for the self-control variables separately. We report only partial regression coefficients in Tables 3 and 4 for parsimony of presentation. Full specifications of the models are available from the authors.)

While our first test took selection models, like self-control theory, at their word and examined the effect of only childhood self-control, our second test relaxed this childhood restriction. It examined how much, if at all, the correlations between social bonds and adult crime attenuated when we controlled for measures of childhood and adolescent self-control. We did this because it seems sensible to us that self-control, like most any other individual psychological characteristic, evolves over the life course. To be clear, this is still a selection model, but it is no longer self-control theory, per se, but rather a modification of it that allows for dynamic, rather than static, self-control after childhood.

Table 3. Regression of Crime at Age 21 on Social Bonds and Prior Delinquency, With and Without Controls for Self-Control

Independent Variables = Social Bonds and Delinquency	Dependent Variable = Crime at Age 21				
	(1) Full Regression Coefficient, Not Controlling for Self-Control	(2) Partial Regression Coefficient, Controlling for Childhood Self-Control	(3) Amount of Attenuation Introduced by Childhood Self-Control	(4) Partial Regression Coefficient, Controlling for Childhood and Adolescent Self-Control	(5) Amount of Attenuation Introduced by Childhood and Adolescent Self-Control
Delinquent Peer Group					
Friends Are Delinquent (Self-Report, Ages 18, 21)	.464 (16.6)*	.470 (16.8)*	–1%	.387 (13.4)*	17%
Companion for Delinquency (Self-Report, Age 21)	.479 (17.7)*	.481 (17.9)*	0%	.413 (15.6)*	14%
Friends Are Good Citizens (Self-Report, Ages 18, 21)	–.432 (–15.2)*	–.424 (–14.5)	2%	–.338 (–11.3)*	22%
School					
Educational Aspirations (Self-Report, Age 18)	–.129 (–4.08)*	–.117 (–3.66)*	9%	–.084 (–2.78)*	35%
Months Education (Self-Report, Age 21)	–.236 (–7.19)*	–.232 (–6.79)*	2%	–.147 (–4.29)*	38%
Educational Achievement (Self-Report, Ages 18, 21)	–.208 (–6.31)*	–.199 (–5.67)*	4%	–.126 (–3.64)*	39%
Did Not Like, Left School (Self-Report, Age 18)	.177 (5.84)*	.169 (5.55)*	5%	.100 (3.41)*	44%
Job					
Months Unemployment (Self-Report, Age 21)	.175 (5.66)*	.155 (4.78)*	11%	.109 (3.60)*	38%
Months Full-Time Employment (Self-Report, Age 21)	–.129 (–4.21)*	–.115 (–3.73)*	11%	–.099 (–3.45)*	23%
Occupational Aspirations (Self-Report, Ages 18, 21)	–.193 (–6.16)*	–.187 (–5.85)*	3%	–.135 (–4.46)*	30%
Job Desirability (Self-Report, Age 21)	–.156 (–5.15)*	–.147 (–4.86)*	6%	–.114 (–4.06)*	27%

Table 3. (continued)

Independent Variables = Social Bonds and Delinquency	(1) Full Regression Coefficient, Not Controlling for Self-Control	Dependent Variable = Crime at Age 21			
		(2) Partial Regression Coefficient, Controlling for Childhood Self-Control	(3) Amount of Attenuation Introduced by Childhood Self-Control	(4) Partial Regression Coefficient, Controlling for Childhood and Adolescent Self-Control	(5) Amount of Attenuation Introduced by Childhood and Adolescent Self-Control
Family					
Living with Parents (Self-Report, Age 21)	-.320 (-11.0)*	-.312 (-10.6)*	2%	-.227 (-7.79)*	29%
Involvement with Parents (Self-Report, Age 18)	-.149 (-4.91)*	-.138 (-4.52)*	7%	-.055 (-1.87)*	63%
Intimacy with Parents (Self-Report, Age 18)	-.153 (-5.02)*	-.140 (-4.60)*	8%	-.073 (-2.52)*	52%
Partner					
Intimacy with Partner (Self-Report, Age 21)	-.220 (-6.69)*	-.201 (-6.08)*	9%	-.157 (-5.07)*	29%
Companionship with Partner (Self-Report, Age 21)	-.129 (-3.86)*	-.112 (-3.33)*	13%	-.081 (-2.60)*	37%
Delinquency					
Delinquency (Self-Report, Age 15)	.388 (13.7)*	.375 (12.9)*	3%	.285 (8.90)*	27%

NOTES: $N = 776$ for partner variables. $N = 956$ for remaining variables. Cells present standardized OLS regression coefficients with t-values in parentheses. Data from the Dunedin (New Zealand) Multidisciplinary Health and Development Study. All equations control for gender and social class. Dummy variables used in equations to control for missing cases.

* $p < .05$ (two-tailed tests).

We present the findings of our second test in the fourth and fifth columns of Table 3. Column four reports the standardized regression coefficient obtained when regressing crime on each social bond, controlling for gender and social class, as we did in column one; the nine childhood self-control variables, as we did in column two; plus the seven adolescent self-control variables (from Impulsivity III to Taste for Risk.) Column five calculates how much the effect of each social bond attenuated from column one to column four. To illustrate, the partial effect of Educational Aspirations on crime, controlling for gender, social class, childhood self-control, and adolescent self-control was $\beta = -.084$, a 35% attenuation from its original, full zero-order value of $\beta = -.129$. The attenuation introduced when controlling for the adolescent self-control variables ranged from 14% to 63%, with a median of 25%. Despite this moderate-to-strong attenuation, the effect of each social bond variable, with one exception, remained statistically significant. This is evidence of both robust social-selection processes and robust social-causation processes.

Our third and final test of the net effect of social causation examined how much, if at all, the correlation of adolescent delinquency and adult crime attenuated when we controlled for levels of self-control. We present this test in the last row of Table 3. This row presents the standardized regression coefficients obtained by regressing crime on delinquency, net of gender and social class (column 1), net of gender, social class, and childhood self-control (column 2), and net of gender, social class, and childhood and adolescent self-control (column 4). We found that Delinquency at Age 15 predicted Crime at Age 21, controlling for gender and social class, at $\beta = .388$. When we controlled for childhood self-control, this dropped to $\beta = .375$, a mere 3% attenuation. When we controlled for adolescent self-control, it dropped further to $\beta = .285$, a 27% attenuation. Delinquency remained a statistically significant predictor of crime, even when controlling for childhood and adolescent self-control.

In analyses not presented, we replicated the analyses in Table 3 using a measure of official crime—the number of times that study members were convicted of a crime through age 21 (logged)—as the dependent variable, and we found similar levels of attenuation. While several of the social bond variables did not significantly correlate with study members' number of criminal convictions ("intimacy with parents" through "companionship with partner"), of those that did, the median amount of attenuation introduced by the childhood low self-control measures was 8%, and the amount of attenuation introduced by adding the adolescent self-control measures was 24%. The effect of delinquency at age 15 on convictions at age 21 attenuated 6% and 15%, respectively, when controlling for childhood and adolescent self-control.

SOCIAL MEDIATION

Our final set of analyses tested processes of social mediation. We did this by examining how much the correlations between self-control and adult crime were mediated by social bonds. We regressed crime at age 21 on low self-control in childhood (net of gender and social class) three times, once controlling for only gender and social class, once controlling for social bonds as well, and once controlling for delinquency also. We then repeated these three regression equations using low self-control in adolescence, instead of childhood. We present our findings in Table 4, with the childhood low self-control regressions on top, and the adolescent ones on the bottom. Each cell in this table reports standardized regression coefficients, t values, unstandardized coefficients, and unstandardized standard errors.

Our analyses found substantial mediation. The standardized effect of low self-control in childhood on adult crime (net of gender and social class) was $\beta = .135$. This attenuated to .052 when we controlled for the social bond variables. As such, the effect of low self-control on crime was mostly (62%) mediated by selection into social bonds. It further attenuated to .034 when controlling for delinquency as well (75% mediation). Likewise, the effect of adolescent self-control on crime attenuated from .390 to .176 to .147 when controlling for social bonds and then delinquency (55% and 62% mediation, respectively). Replications of these analyses with official data—number of criminal convictions (logged)—produced similar findings for childhood self-control but even more mediation for adolescent self-control. When predicting number of convictions, childhood self-control attenuated from $\beta = .177$ to $\beta = .065$ to $\beta = .047$ when we controlled for social bonds and then delinquency. Adolescent self-control, however, attenuated almost completely from $\beta = .244$ to $\beta = .072$ to $\beta = .029$, which suggests that social bonds and delinquency play a substantial role in mediating the effects of concurrent self-control on official crime.

We further examined the mediation of low self-control in childhood on crime via social bonds in Figure 1. This path diagram regresses crime on the endogenous measures of conventional social bonds (a global average of education, work, family ties, and partnership variables), peer delinquency, adolescent self-control, and delinquency plus the exogenous measure of childhood self-control (and gender and social class as control variables). As shown in this figure, low self-control in childhood significantly predicted social bonds, adolescent self-control, and delinquency, and each of these, in turn, significantly predicts crime at age 21. When we compared the relative magnitudes of the indirect effects, we found that the strongest causal pathways were through adolescent low self-control (.431 * .157 = .068) and delinquent peers (.102 * .440 = .045). Other significant

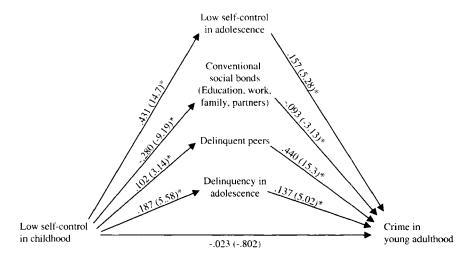Table 4. Regression of Crime at Age 21 on Self-Control, With and Without Controls for Social Bonds and Delinquency

| | Dependent Variable = Crime at Age 21 | | |
Independent Variable	(1) Full Regression Coefficent	(2) Partial Regression Coefficient, Controlling for Social Bonds	(3) Partial Regression Coefficient, Controlling for Social Bonds and Delinquency
Low Self-Control in Childhood	.135 (4.18)*	.052 (1.90)	.034 (1.28)
	.642 (.154)	.244 (.129)	.163 (.128)
R^2	.122	.453	.472
Low Self-Control in Adolescence	.390 (13.3)*	.176 (6.38)*	.147 (5.28)*
	1.80 (.135)	.812 (.127)	.680 (.129)
R^2	.248	.474	.486

NOTES: $N = 956$. Cells present standardized coefficients and t values (in top row) and unstandardized coefficients and standard errors (in bottom row). All equations control for gender and social class. Data from the Dunedin (New Zealand) Multidisciplinary Health and Development Study. Dummy variables used to control for missing cases.
*$p < .05$ (two-tailed tests).

indirect effects, of lesser magnitude, were through conventional social
bonds (−.280 * −.093 = .026) and through delinquency (.187 * .137 = .026).
The direct effect of childhood low self-control on crime in Figure 1 was
statistically insignificant.

Figure 1   Mediated Effects of Low Self-Control on Criminal Behavior

NOTES: Numbers report standardized regression coefficients with *t* values in paren-
theses. All equations control for gender and social class.

* $p < .05$ (two-tailed tests).

DISCUSSION

In this study we examined the social-selection and social-causation
processes that produce criminal behavior. We tested how much, if at all,
the correlations between social bonds and crime and between delinquency
and crime attenuated when we controlled for study members' levels of
self-control. We consistently found partial attenuation. The attenuation
was weakest when we controlled only for childhood self-control, averaging
less than 10%. It strengthened considerably when we relaxed temporal
ordering and controlled for adolescent self-control, averaging about 30%.
Even when controlling for childhood and adolescent self-control, however,
the social bond and delinquency measures remained statistically significant
predictors of adult criminal behavior. We also tested how much, if at all,
the effect of self-control on crime was mediated by social bonds, and we
found high levels of mediation, ranging from about two-thirds to three-
quarters.

This pattern of findings gives evidence for the coexistence of both social-selection and social-causation processes in generating criminal behavior (e.g., Evans et al., 1997). Moreover, theories that emphasize solely selection or causation processes, while parsimonious, appear to be excessively oversimplified. That is, self-control had direct (in the case of adolescent self-control) and indirect effects on crime, and social bonds had net direct effects on crime. This being the case, we believe that a promising avenue for criminological theories continues to be bringing these two processes together (e.g., Elliott and Menard, 1996; Piquero and Tibbetts, 1996; Thornberry, 1996).

Given that selection and causation processes appear to operate across the life course—or at least during the first several decades of life—it may be more productive to cease pitting selection and causation theories against each other and move to a different set of questions aimed simultaneously at the macro- and proximal-levels of analysis. On the one hand, it is important to situate social selection and social causation in larger macro structures and to inquire about how social institutions may shape or constrain these processes over space and time. For example, how might the causal linkages between social bonds and crime change from one historical period to another? How does location in social structure shape persons and the social bonds that they form? On the other hand, it is important to identify the proximal mechanisms through which social-selection effects and social-causation effects operate. For example, in terms of social-selection effects, it may be profitable to integrate decision-making theory with self-control theory in an effort to understand how individual differences in self-control affect the "choice" to engage in criminal behavior, a topic for which research has been under way (e.g., Nagin and Paternoster, 1993; Piquero and Tibbetts, 1996). Similarly, in terms of social-causation effects, it may be important to test the social-psychological mechanisms through which educational achievements reduce criminal behavior. Do these effects come about through the influence of newly acquired credentials on expanding life opportunities, or are they the result of upward social comparisons that may motivate youths to engage in normative behaviors? Attention to these linking mechanisms is critical for advancing theory in the study of crime.

Another issue deserving attention is the conceptualization and specification of criminal propensity. Perhaps the most important contribution of Gottfredson and Hirschi's theory is their advocacy of low self-control. They have developed a broad concept with explicit linkages to deviant behavior and have forced criminological theory to address the complexities that it implies. Unfortunately, however, they have insufficiently supported their ideas with empirical data, leaving it difficult to assess fully the relative value of self-control as capturing criminal (and broader deviant)

propensity. Would other conceptualizations of criminal propensity offer more explanatory and predictive power? Which measurement instruments best measure self-control or other conceptualizations? These questions point to necessary research in the development of selection-causation models of crime.

The coexistence of selection and causation processes found in this article has various implications for research methodology and public policy. Given apparently robust social-causation processes, it may be premature to abandon longitudinal studies of crime, for cross-sectional studies cannot adequately capture the breadth and changing nature of relationships between people and their environment over time. If for no other reason, advocates of social-selection models need longitudinal studies to test their thesis that longitudinal studies are not needed (i.e., to demonstrate predominant selection effects).

For policy purposes, our findings support the value of social interventions in childhood and adolescence: childhood interventions because characteristics have already begun to form in the early years that can ultimately lead to criminal behavior, adolescent interventions because social relationships at this age appear still to influence criminal behavior above and beyond individuals' preexisting characteristics.

We conclude with a comment about the future of the selection-causation issue in the criminological literature. Should some researchers continue to advocate either a pure social-selection or social-causation model, we believe that the burden is now on them to present data in accord with their argumentation. Compelling data would measure self-control (or any other criminal propensity) in childhood, for postchildhood measures have different, more ambiguous meanings. These data would measure social bonds and crime in adolescence or adulthood. They would then find initial, robust correlations between social bonds and crime that diminish almost completely when controlling for preexisting personal characteristics (or not diminish at all in the case of causation theories). Absent such data, it is becoming increasingly difficult to accept either pure social-selection or social-causation theories as comprehensive explanations of crime, and instead the direction of criminological theories should be toward continuing to develop theories that integrate these two processes throughout the life course.

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Bradley R. Entner Wright is Assistant Professor in the Department of Sociology at the University of Connecticut. His work focuses on the social psychology of deviance.

Avshalom Caspi is Professor in the Department of Psychology at the University of Wisconsin and in the Social, Genetic, and Developmental Psychiatry Research Centre, Institute of Psychiatry, University of London. His work focuses on personality development and psychopathology across the life course.

Terrie E. Moffitt is Professor in the Department of Psychology at the University of Wisconsin and in the Social, Genetic, and Developmental Psychiatry Research Centre, Institute of Psychiatry, University of London. She is also Associate Director of the Dunedin Multidisciplinary Health and Development Research Unit at the University of Otago Medical School, Dunedin, New Zealand. Her work focuses on the developmental origins of antisocial behavior and on theoretical explanations of antisocial behavior across the life course.

Phil A. Silva is Director of the Dunedin Multidisciplinary Health and Development Research Unit at the University of Otago Medical School, Dunedin, New Zealand.

Appendix 1. Description of Variables

Variable	Age(s) Collected	Source(s)	Number of Items	X	S.D.	Range	Instrument, Description, Citation(s)
Childhood Self-Control							
Lack of Control, Irritability & Distractibility	3, 5	Observer	10	1.2	1.7	0–9	Dunedin Behavioral Ratings. Emotionally labile, extremely overactive, impulsive, undercontrolled, rough, withdraws from difficult tasks, requires constant attention, brief attention to tasks, lacks persistence in reaching goals, resists directions, lacks confidence in tasks (Caspi et al., 1995).
Impulsivity I	9, 11	Parent, Teacher	16	.40	.31	0–2	Diagnostic and Statistical Manual, Version III (DSM-III). Acts before thinking, shifts excessively between activities, needs lots of supervision, has difficulty awaiting turn (McGee et al., 1992).
Impulsivity II	11	Self-Report	8	1.5	2.2	0–16	Diagnostic Interview Schedule for Children(DISC)-Child Version (Anderson et al., 1987; Costello et al., 1982).
Lack of Persistence	9, 11	Parent, Teacher	24	.42	.35	0–1.9	DSM-III. Fails to finish tasks, difficulty sticking to activity, easily distracted, difficulty concentrating (McGee et al., 1992).
Inattention I	11	Self-Report	7	1.5	2.1	0–14	DISC-Child Version (Anderson et al., 1987; Costello et al., 1982).
Hyperactivity I	5, 7, 9, 11	Parent, Teacher	25	1.2	1.0	0–5.2	Rutter Behavior Scale. Runs and jumps about, squirmy, fussy, cannot settle, has short attention span (McGee et al., 1985; Moffitt, 1990; Rutter et al., 1970).
Hyperactivity II	9, 11	Parent, Teacher	8	.29	.34	0–2	DSM-III. Runs and climbs about excessively, difficulty sitting still, "on the go" as if "driven by a motor" (McGee et al., 1992).
Hyperactivity III	11	Self-Report	8	2.0	2.8	0–16	DISC-Child Version. (Anderson et al., 1987; Costello et al., 1982).

Variable	Age(s) Collected	Source(s)	Number of Items	X	S.D.	Range	Instrument, Description, Citation(s)
Antisocial Behavior	5, 7, 9, 11	Parent, Teacher	61	1.5	1.2	0–7.6	Rutter Behavior Scale. "Flies off handle," destroys belongings, fights, disobedient, tells lies, bullies other children, steals things (McGee et al., 1985; Moffitt et al., 1996; Rutter et al., 1970).
(Reliability of above Variables = .86)							
Adolescent Self-Control							
Impulsivity III	18	Self-Report	20	56	23	0–100	Multidimensional Personality Questionnaire. Not planful, reflective, careful, rational (Caspi et al., 1994; Tellegen and Waller, in press).
Impulsivity IV	18	Informant	1	.55	.65	0–2	Dunedin Multidisciplinary Child Development Study Survey Instrument. Impulsive, rushes into things without thinking what might happen (Wright et al., 1999).
Hyperactivity IV	15	Self-Report	15	7.2	4.8	1–30	DISC. Restless, unable to sit still, hyperactive, always on the go (Costello et al., 1982; McGee et al., 1990; Miech et al., 1997).
Inattention II	15	Parent	14	4.5	4.8	0–27	Peterson and Quay Behavior Problem Checklist. Short attention span, does not finish things, lacks perseverance, easily diverted from task at hand (Bartusch et al., 1997; Quay and Peterson, 1987).
Inattention III	18	Informant	1	.44	.62	0–2	Dunedin Multidisciplinary Child Development Study Questionnaire. Problems in keeping mind on work and other important things, problems with concentration.
Physical Response to Conflict	18	Self-Report	3	.35	.33	0–1	Multidimensional Personality Questionnaire. Responds to conflict physically, ready to fight when taken advantage of, ready to hit someone when angry, does not "turn the other cheek" when treated badly (Caspi et al., 1994; Tellegen and Waller, in press).

Variable	Age(s) Collected	Source(s)	Number of Items	X	S.D.	Range	Instrument, Description, Citation(s)
Risk Taking	18	Self-Report	22	62	21	0–100	Multidimensional Personality Questionnaire. Prefers exciting and dangerous activities (Caspi et al., 1994; Tellegen and Waller, in press).
(Reliability of above Variables = .64)							
Social Bonds							
Friends Are Delinquent	18, 21	Self-Report	2	2.3	.94	1–5	Dunedin Multidisciplinary Child Development Study Questionnaire. Portion of friends who do things that are against the law.
Companion for Delinquency	21	Self-Report	1	.33	.47	0–1	Dunedin Multidisciplinary Child Development Study Questionnaire. Have someone with whom to get in trouble or to break the law.
Friends Are Good Citizens	18, 21	Self-Report	2	3.9	.83	1–5	Dunedin Multidisciplinary Child Development Study Questionnaire. Portion of friends thought of as good citizens.
Educational Aspirations	15, 18	Self-Report	2	4.5	1.7	0–7	Dunedin Multidisciplinary Child Development Study Questionnaire. Plans for education, from one year of secondary school to university attendance.
Months Education	21	Self-Report	1	33	17	1–64	Life-History Calendar. Months spent in full-time education between ages 15 and 21 (Caspi et al., 1996b).
Educational Achievement	18, 21	Self-Report	3	4.2	2.0	0–7	Dunedin Multidisciplinary Child Development Study Questionnaire. Level of education achieved, from one year of secondary school to university attendance (Miech et al., 1997).
Did Not Like, Left School	18	Self-Report	1	.10	.30	0–1	Dunedin Multidisciplinary Child Development Study Questionnaire. Left school because did not like it.
Months Unemployment	21	Self-Report	1	5.8	10	0–67	Life-History Calendar. Months of unemployment between ages 15 and 21 (Caspi et al., 1996b, 1998).
Months Full-Time Employment	21	Self-Report	1	.51	.34	0–1	Life-History Calendar. Months of full-time employment of the months not in school between ages 15 and 21 (Caspi et al., 1996b).

Variable	Age(s) Collected	Source(s)	Number of Items	X	S.D.	Range	Instrument, Description, Citation(s)
Occupational Aspirations	18, 21	Self-Report	2	3.9	1.3	1–6	Elley and Irving Occupational Status Scale. Vocational aspirations for age 25 coded into levels of occupational aspirations (Elley and Irving, 1976).
Job Desirability	21	Self-Report	12	0	1	–3.3–4.5	Index of job desirability. Job quality of current/ most recent job (Jencks et al., 1988).
Living with Parents	21	Self-Report	1	53	19	0–83	Life-History Calendar. Number of months lived with parents between ages 15 and 21 (Caspi et al., 1996b).
Involvement with Parents	18	Self-Report	1	3.8	1.0	1–5	Dunedin Multidisciplinary Child Development Study Questionnaire. Involved with and attached to parents (Nada Raja et al., 1992).
Intimacy with Parents	18	Self-Report	1	.55	.50	0–1	Dunedin Multidisciplinary Child Development Study Questionnaire. Can talk to parents about a problem or when feeling upset (Nada Raja et al., 1992).
Intimacy with Partner	21	Self-Report	19	30	5.9	4–38	Dunedin Multidisciplinary Child Development Study Questionnaire. Cohesive and intimate romantic current/recent partnership (Newman et al., 1997).
Companionship with Partner	21	Self-Report	6	8.9	1.9	2–12	Dunedin Multidisciplinary Child Development Study Questionnaire. Spend time together, do things together share interests and hobbies together (Newman et al., 1997).
Delinquency and Crime							
Delinquency-Age 15	15	Self-Report	29	2.2	3.5	0–28	Self-reported delinquency structured interview. Variety scale of delinquent acts such as vandalism, theft, drug use, truancy, and assault (Elliott and Huizinga, 1989; Moffitt, 1989; Moffitt et al., 1994).
Crime-Age 21	21	Self-Report	51	4.7	4.4	0–29	Self-reported crime structured interview. Variety scale of criminal acts such as vandalism, theft, drug use, assault, rape, arson, and fraud (Elliott and Huizinga, 1989; Moffitt, 1989; Moffitt et al., 1994).

NOTE: Data from the Dunedin (New Zealand) Multidisciplinary Health and Development Study.

Appendix 2. Intercorrelations of the Self-Control Variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) Lack of Control	1.00															
(2) Impulsivity I	.39*	1.00														
(3) Impulsivity II	.13*	.29*	1.00													
(4) Lack of Persistence	.36*	.83*	.29*	1.00												
(5) Inattention I	.19*	.38*	.62*	.41*	1.00											
(6) Hyperactivity I	.42*	.76*	.29*	.73*	.35*	1.00										
(7) Hyperactivity II	.28*	.66*	.19*	.57*	.26*	.72*	1.00									
(8) Hyperactivity III	.13*	.25*	.50*	.26*	.46*	.29*	.29*	1.00								
(9) Antisocial Behavior	.30*	.70*	.29*	.61*	.33*	.69*	.52*	.22*	1.00							
(10) Impulsivity III	.02	.19*	.14*	.17*	.10*	.13*	.10*	.13*	.13*	1.00						
(11) Impulsivity IV	.10*	.26*	.02	.23*	.08*	.21*	.17*	.12*	.23*	.19*	1.00					
(12) Hyperactivity IV	.09*	.27*	.26*	.26*	.26*	.24*	.18*	.26*	.22*	.29*	.20*	1.00				
(13) Inattention II	.26*	.54*	.15*	.59*	.25*	.49*	.39*	.22*	.41*	.17*	.31*	.29*	1.00			
(14) Inattention III	.16*	.24*	.07	.26*	.09*	.20*	.15*	.12*	.15*	.19*	.36*	.16*	.30*	1.00		
(15) Physical Response	.04	.17*	.14*	.16*	.13*	.17*	.15*	.14*	.18*	.24*	.20*	.20*	.16*	.08*	1.00	
(16) Risk Taking	-.01	.12*	.08*	.11*	.04	.08*	.07*	.09*	.11*	.30*	.14*	.09*	.10*	.12*	.21*	1.00

NOTES: Cells present simple correlations. Data from the Dunedin (New Zealand) Multidisciplinary Health and Development Study.
* $p < .05$ (two-tailed tests).