



Report prepared for Brå by Alex R. Piquero, Wesley G. Jennings  
and David P. Farrington

# Effectiveness of Programs Designed to Improve Self-Control

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brottsförebyggande rådet

Swedish National Council for Crime Prevention



# Effectiveness of Programs Designed to Improve Self-Control

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## **Brå – a centre of knowledge on crime and measures to combat crime**

The Swedish National Council for Crime Prevention (Brottsförebyggande rådet – Brå) works to reduce crime and improve levels of safety in society by producing data and disseminating knowledge on crime and crime prevention work and the justice system's responses to crime.

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# Foreword

Much attention has been paid in both criminology and psychology to the importance of self-control in regulating individual's antisocial, delinquent or criminal behaviour. Many programs have also been introduced to improve self-control. But how well do they work? What does the research tell us?

There are never sufficient resources to conduct rigorous scientific evaluations of all the crime prevention measures employed in an individual country like Sweden. For this reason, the Swedish National Council for Crime Prevention (Brå) has commissioned distinguished researchers to carry out an international review of the research published in this field.

This report presents a systematic review, including statistical meta-analysis, of the effects of programmes on self-control itself and on delinquent and criminal behaviour, which has been conducted by Professor Alex R. Piquero of the University of Maryland College Park (United States), Assistant Professor Wesley G. Jennings of the University of Louisville (United States) and Professor David P. Farrington of Cambridge University (United Kingdom).

The study follows a rigorous method for the conduct of a systematic review. The analysis combines the results from a number of evaluations that are considered to satisfy a list of empirical criteria for measuring effects as reliably as possible. The meta-analysis then uses the results from these previous evaluations to calculate and produce overviews of the effects that the programmes to improve self-control do and do not produce. Thus the objective is to systematically evaluate the results from a number of studies in order to produce a more reliable picture of the opportunities and limitations associated with programmes in relation to crime prevention efforts.

The systematic review, and the statistical meta-analysis, in this case builds upon a large number of high quality evaluations. Even though important questions remain unanswered, the study provides an accessible and far-reaching overview of programmes to improve self-control and their effects.

Stockholm, September 2009

*Jan Andersson*  
Director-General

# Abstract

Gottfredson and Hirschi's general theory of crime has generated significant controversy and research, such that there now exists a large knowledge base regarding the importance of self-control in regulating antisocial behavior over the life course. Reviews of this literature indicate that self-control is an important correlate of antisocial activity. There has been some research examining programmatic efforts designed to examine the extent to which self-control is malleable, but little empirical research on this issue has been carried out within criminology, largely because the theorists have not paid much attention to policy proscriptions. This study evaluates the extant research on the effectiveness of programs designed to improve self-control up to age 10 among children and adolescents, and assesses the effects of these programs on self-control and delinquency/crime. Meta-analytic results indicate that: (1) self-control programs improve a child/adolescent's self-control; (2) these interventions also reduce delinquency; and (3) the positive effects generally hold across a number of different moderator variables and groupings as well as by outcome source (parent-, teacher-, direct observer-, self-, and clinical report). Theoretical and policy implications are also discussed.

**Key words:** self-control, prevention, intervention, general theory, malleability



# INTRODUCTION

It can be stated with certainty that Gottfredson and Hirschi's general theory of crime stands as one of criminology's most important theories. Developed largely in response to parental socialization efforts involving child monitoring, recognition of child deviant behavior, and punishment of such deviant behavior, the theorists isolate the individual characteristic of self-control as the key correlate of antisocial, delinquent, and criminal behavior. According to Gottfredson and Hirschi, self-control is comprised of six inter-related characteristics including: (1) impulsivity and inability to delay gratification, (2) lack of persistence, tenacity, or diligence, (3) partaking in novelty or risk-seeking activities, (4) little value of intellectual ability, (5) self-centeredness, and (6) volatile temper. These characteristics are believed to come together for individuals with low self-control.

Since its inception, the theory has generated a significant amount of theoretical criticism, commentary, especially with respect to its key independent variable of self-control (Grasmick et al., 1993; Piquero et al., 2000; Tittle et al., 2004; Goode, 2008), and summary statements about the empirical knowledge base identify self-control as an important, but not sole correlate of varied antisocial activity (Pratt & Cullen, 2000). At the same time, much less attention has been paid to the malleability of self-control.

There is significant variation in how scholars interpret Gottfredson and Hirschi's stance on whether self-control is absolutely or relatively stable once established by late childhood/early adolescence. Some criminologists have interpreted Gottfredson and Hirschi to mean that self-control is resistant to any change, once established. Our reading, which we believe is consistent with Gottfredson and Hirschi, is such that self-control appears malleable during the first 10/12 years of life, but after this point, while self-control tends to improve with age as socialization continues to occur, it is largely unresponsive to any external intervention effort. Thus, although absolute levels of self-control may change within persons (increasing rather than decreasing), relative rankings between persons will remain constant over the life course. As they (1990, pp.107-108) note: "Combining little or no movement from high self-control to low self-control with the fact that socialization continues to occur throughout life produces the conclusion that the proportion of the population in the potential offender pool should tend to decline as cohorts age...Even the most active offenders burn out with time...Put another way, the low self-control group continues over time to exhibit low self-control. Its size, however, declines." Elsewhere (1990, p. 177), they point out that "...individual differences in self-control are established early in life (before differences in criminal behavior, however the state defines it, are possible) and are reasonably stable thereafter."

The existing research on the stability of self-control tends to suggest that it is not absolutely stable within persons (once established by ages 10/12) and that it tends to change (increase) with age (Arneklev et al., 1998; Turner & Piquero, 2002; Winfree et al., 2006; Hay & Forrest, 2006; Mitchell & MacKenzie, 2006), but remains relatively impervious to alterations by the criminal justice system after adolescence and in adulthood (Mitchell & MacKenzie, 2006). Although these findings are consistent with the general theory of crime, interpreting and integrating these findings within the context of the theory has not come easy because Gottfredson and Hirschi have not devoted much attention to policy issues. This has been an unfortunate consequence because discussions of theory and policy must be closely intertwined as good theory should lead to good policy and good policy is guided by sound theory. Of course, this is not to suggest that the theorists have not devoted any attention to policy.

In their strongest policy statement, Hirschi and Gottfredson (2001, p. 93) downplay any potential effectiveness of the criminal justice system: "Self-control theory leads to the conclusion that the formal criminal justice system can play only a minor role in the prevention and control of crime. Because potential offenders do not consider the long-term consequences of their acts, modification of these consequences will have little effect on their behavior. Because criminal acts are so quickly and easily accomplished, they are only rarely directly observed by agents of the criminal justice system. As a result, even large increases in the number of such agents would have minimal effect on the rates of most crimes". Instead, the theorists are quick to point out the things that do not work and instead point to the few things they think will be effective, mainly to the socializing agents that are responsible for child-rearing.

More specifically, they (Hirschi & Gottfredson, 1995; Hirschi & Gottfredson, 2001, pp. 93-94) advance the following eight recommendations for crime control policy:

1. Do not attempt to control crime by incapacitating adults; this is so because by the time offenders are identified and incarcerated in adulthood, they have already finished the brunt of their criminal activity;
2. Do not attempt to control crime by rehabilitating adults; this is so because the age effect makes treatment unnecessary and no treatment program has been shown to be effective;
3. Do not attempt to control crime by altering the penalties available to the criminal justice system; this is so because legal penalties do not have the desired effect because offenders do not consider them. Increasing the certainty and severity will have a highly limited effect on the decisions of offenders;

4. Restrict unsupervised activities of teenagers; by limiting teens' access to guns, cars, and alcohol, opportunities become restricted;
5. Limit proactive policing including sweeps, stings, intensive arrest programs, and aggressive drug policies;
6. Question the characterization of crime offered by agents of the criminal justice system and repeated by the media; this is so because evidence suggests that offenders are not dedicated, professional;
7. Support programs designed to provide early education and effective child care; this is so because prevention/intervention in the early years are the most important. Programs that target dysfunctional families and seek to remedy lack of supervision have shown promise; and
8. Support policies that promote and facilitate two-parent families and that increase the number of caregivers relative to the number of children; this is so because large and single-parent families are handicapped with respect to monitoring and discipline (the key elements in producing adequate socialization and strong self-control). Programs to prevent teen pregnancies should be given high priority.

One of these policy proscriptions in particular (#7) points to the possibility that efforts aimed at children and young adolescents may improve self-control and also have the added benefit of preventing delinquency/crime. In fact, there exists a fairly large stock of programmatic efforts aimed at improving self-control among children (up through age 10), but this line of research has not been integrated into the discussion of Gottfredson and Hirschi's theory, either by criminologists or the theorists themselves. Currently, there is no summary statement, similar to Pratt and Cullen's (2000) statement regarding the effect of self-control on antisocial activity, about the extent to which these programs are effective. Such a 'taking-stock' summary seems critical at this stage of the theory's life-course.

## The Current Study

There has been much attention paid in both criminology and psychology with respect to the importance of self-control in regulating antisocial, delinquent, and criminal behavior over the life course. Given the importance of self-control, there have also been several programmatic efforts designed to improve self-control among children and adolescents. In an effort to build the knowledge base in this area, this study asks two critical questions: (1) What is the effectiveness of programs designed to improve self-control up to age 10 among children and adolescents? and (2) What are the effects of these programs on self-control and delinquency/crime? Examining both self-control and delinquency outcomes would provide a comprehensive review that identifies a large number of studies and will likely evince a sound-

er conclusion and inform policy prescription for the general theory of crime. This meta-analysis, then, focuses on two inter-related outcomes: (1) What are the effects of self-control improvement programs up to age 10 for improving self-control among children/adolescents (self-control as the dependent variable)?; and (2) What are the effects of self-control improvement programs on delinquency outcomes (delinquency as the dependent variable).

# METHODS

## Criteria for Inclusion and Exclusion of Studies in the Review

Studies that investigated the effects of self-control improvement programs on child behavior problems such as conduct problems, anti-social behavior and delinquency were included. Following the more general systematic reviews (e.g., Campbell Collaboration), studies were only included if they had a randomized controlled trial design with post-test measures of self-control and/or child behavior problems for the experimental and control participants. The preliminary eligibility criteria are as follows: 1. Types of Studies: The study must have used a randomized controlled experimental design; 2. Types of Participants: The review was primarily focused on children ages 10 and under or the mean age of the sample was no greater age 10 at the start of the intervention. Studies with mentally and/or physically handicapped subjects were not included; 3. Type of Intervention: Studies were eligible for this review when self-control improvement was a major component of the intervention; 4. Types of Outcomes: The study must have included at least one child-based outcome measure of self-control and/or at least one child-based behavioral outcome measure of general behavior problems including antisocial behavior and delinquency; 5. Sufficient Data: The study had to provide adequate post-test data for calculating an effect size if one was not provided (i.e., means and standard deviations, *t*-tests, *F*-tests, *p*-values, etc.); 6. There is no restriction to time frame; 7. There are no geographic restrictions; 8. Both published and unpublished reports were considered; 9. Qualitative studies were not included; and 10. Studies needed to be published in English.

## Search Strategy for Identification of Relevant Studies

Several strategies were used to perform an exhaustive search for literature fitting the eligibility criteria: (1) A keyword<sup>1</sup> search was con-

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<sup>1</sup> "Self-control" or "self control;" or "impulsivity" and "childhood" or "preschool" or "school" and/or "delinquency" or "conduct disorder" or "antisocial behavior" or "aggression" or "physical aggression" or "behavior problems".

ducted across a number of online abstract databases<sup>2</sup>; (2) The reference lists of previous reviews of early childhood prevention/intervention programs in general and self-control improvement programs specifically were consulted (Aos et al., 2004, 2006; Karoly et al., 1998; Greenwood et al., 2006; Suhodolsky et al., 2004; Farrington & Welsh, 2007); (3) Hand searches were carried out on leading journals in the field<sup>3</sup>; (4) The publications of research and professional agencies were searched<sup>4</sup>; and (5) Recognized scholars (experts) in various disciplines who were knowledgeable in the specific area of self-control improvement programs were contacted.

Several strategies were used to obtain full-text versions of the studies found through the searches of the various abstract databases. First, we attempted to obtain full-text versions from the electronic journals available through several university library systems. When electronic versions were not available, we used print versions of journals available at the library. If the journals were not available at the university libraries, we used the Interlibrary Loan System (ILL) to try to obtain the printed version from the libraries of other institutions. In the case where these methods failed, we then made attempts to contact the author(s) of the article and/or the agency that funded the research to try to obtain a copy of the full-text version of the study.

## Details of Study Coding Categories

All eligible studies were coded on a variety of criteria such as reference information (title, authors, publication year, etc.); nature of description of selection of sample, outcomes, etc.; nature and description of control group; unit of analysis; sample size; a description of the self-control improvement intervention; reports of statistical significance (if any); and effect sizes (if any). One investigator independently coded each eligible study, and consulted with co-authors regarding the final coding decisions. Further, we attempted to assess the quality of the studies in terms of research design, sample bias, and attrition bias.

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<sup>2</sup> Criminal Justice Abstracts, National Criminal Justice Reference Services (NCJRS) Abstracts, Sociological Abstracts, Dissertation Abstracts, Government Publications Office, Monthly Catalog (GPO Monthly), PsychINFO, C2 SPECTR (The Campbell Collaboration Social, Psychological, Educational and Criminological Trials Register), Australian Criminology Database (CINCH), MEDLINE, Future of Children (publications), and Helping America's Youth.

<sup>3</sup> Criminology, Criminology and Public Policy, Justice Quarterly, Journal of Research in Crime and Delinquency, Journal of Criminal Justice, Police Quarterly, Policing, Police Practice and Research, British Journal of Criminology, Journal of Quantitative Criminology, Crime and Delinquency, Journal of Criminal Law and Criminology, Policing and Society, as well as psychology/psychiatry journals including among others, Child Development.

<sup>4</sup> Vera Institute of Justice, Rand Corporation, Australian Institute of Criminology, Cochrane Library, American Psychiatric Association, OJJDP (Office of Juvenile Justice & Delinquency Prevention), NICE (National Institute for Health and Clinical Excellence, United Kingdom), and Swedish National Council for Crime Prevention.

## Criteria for Determination of Independent Findings

It is the case that most outcome studies rely on multiple measures, but there is disagreement as to how this issue should be handled with some researchers opting to use only one outcome source over another for reasons such as teacher ratings are likely to be less biased than parent reports and systematic “unbiased” observer ratings may be more accurate than teacher ratings (Farrington & Welsh, 2003). Other meta-analyses have averaged the effect sizes (ESs) across outcome measures and outcome sources when generating an individual effect size for each study (McCart et al., 2006). Still, others have noted that this method may lead to the loss of important information and create some difficulty when interpreting the overall effect (Casey & Berman, 1985).

In light of the apparent controversy over which method is more appropriate, we adopted a method of compromise, and report a series of effect sizes by outcome measure (e.g., self-control and delinquency) and outcome source (e.g., parent report, teacher report, direct observation, self-report, and/or clinical report). Further, if a study included more than one treatment condition, then only the treatment condition that used a self-control improvement program was used to generate the relevant ESs. In addition, in the case where multiple control groups exist, then only the outcomes for the no-treatment control group (or wait-list control group) were used to calculate the ES. Similarly, when multiple treatment groups existed where each treated group received a self-control improvement program, then only one ES was calculated for the study by averaging the mean and standard deviation across the treatment groups and then comparing this one pooled mean and standard deviation to that of the control group in order to generate the ES for the study. As one more method for ensuring the statistical independence of findings, we calculated only one single ES for one particular sample in the event that multiple studies reported findings from the same sample of treated youth.

## Analytic Procedures

We rely on Cohen’s (1988)  $d$  for determining the effect sizes for this meta-analysis. The main source of information for calculating Cohen’s  $d$  was the standardized mean difference, but in situations where means and standard deviations were not provided  $t$ -values,  $f$ -values,  $p$ -values, partial  $r$  etc. was used to calculate the effect sizes (see Lipsey & Wilson 2001 for the relevant formulas). Hedges and Olkin (1985) recommend calculating an unbiased ES that accounts for the discrepancy between the sample ES and the population ES. These authors also suggest that an ES of a small sample study does not have as much “impact” on the overall ES as does an ES calculated from a large sample study. As such, they recommend using inverse variance weights when performing a meta-analysis. Therefore, we used the Hedges and

Olkin adjustment and inverse variance weights when determining the ESs in the analysis.

All of the meta-analysis results were estimated using Lipsey and Wilson's SPSS macros relying on a random effects model using inverse variance weight methods. It is also our general assumption that the individual ESs were not likely to be homogeneous so we estimated a series of moderator analyses using Lipsey and Wilson's SPSS analog to the ANOVA macro. Some of the relevant variables that are included in the moderator analyses include publication year, country of publication, small/large samples, published/not published, treatment type, treatment modality (group/individual), treatment duration, and treatment setting. The last stage of the analysis presents the results from a weighted least squares regression model (estimated with inverse variance weights and random effects) where the variables mentioned above are included as predictors of the ES. Publication bias is also evaluated using traditional methods including a comparison of the mean effect size for published/unpublished studies and an investigation of publication bias with a funnel plot and associated test statistics (e.g., Kendall's test and Egger's test) estimated with the 'metafunnel' macro available in Stata.



# RESULTS

## Literature search

As discussed above we used several mechanisms when attempting to locate studies that may be relevant for inclusion. Following an initial identification of over 5,000 hits, we sorted through the titles and abstracts and removed any that were inconsistent with the inclusion criteria. This process reduced the number of potentially relevant studies to 247 studies. These 247 studies were then electronically downloaded, copied from the library, or requested via Interlibrary Loan (ILL). Upon receiving the documents, each study was thoroughly reviewed and final coding decisions were made as to whether the study conformed to each of the inclusion criteria. For the most part, studies were excluded because of the lack random assignment, targeting mostly older adolescents, focused on mentally and/or physically handicapped children, or did not contain any relevant self-control and/or behavioral outcome measures/data. Thus, the final coding decisions left 34 studies (see Table 1) that met each inclusion criteria as outlined previously and were used in the analysis that follows. These 34 studies generated 43 self-control ESs and 28 delinquency ESs.

## Characteristics of Studies Included in Meta-Analysis

Table 2 presents a series of descriptive statistics characterizing the 34 included studies. Nearly two-thirds of the studies were from published data (61.8%) and the overwhelming majority were performed in the United States (91.2%). Most studies drew their samples from high-risk/low income populations (64.7%) and most were based on mostly male (55.9%) and white (67.6%) samples. Less than twenty percent reported attrition problems as measured by losing at least 15% of their original sample for a variety of reasons such as moving, unable to locate, etc. Overall, a substantial majority were group-based interventions (67.6%) and were operated in a school setting (79.4%). While most could be broadly characterized as social skills development programs (32.4%), a considerable number of the interventions focused on cognitive coping strategies (26.5%), video tape training/role playing (20.6%), immediate/delayed rewards clinical interventions (11.8%), and relaxation training (8.8%).

The studies spanned over four decades with the earliest study published in 1975 and the most recent published in 2008 ( $M=1989.65$ ;  $SD=10.37$ ). While there were some studies with relatively small samples as well as those with considerably large samples, on average the studies included approximately 129 children/adolescents ( $SD=165.57$ ). On average, the children/adolescents were 6.23 years of age at the time of the intervention ( $SD=2.03$ ) with a range of 3 to 10 years old.

Table 1. Meta Analysis Studies (n=34).

<b>Author, Publication Date</b>	<b>Location</b>	<b>Year of Intervention</b>	<b>Sample Size</b>	<b>Targeted Age</b>
Arnold and Forehand (1978)	US	N/R	N=32	4-5 years old
Atwood et al. (1978)	New Mexico	N/R	N=80	4th – 5th grade
Augimeri et al. (2007)	Toronto, Ontario, Canada	1985-1988	N=32	Mean Age 9 years old
*Avila (1985)	Gainesville, Florida	N/R	N=57	5th grade
*Baggerly (1999)	US	N/R	N=30	Kindergarten
Barkley et al. (2000)	Worcester, Massachusetts	1991-1996	N=119	Mean age 5 years old
Bierman et al. (2008)	Pennsylvania	N/R	N=356	4 years old
*Bosse (1985)	US	N/R	N=103	5-6 years old
*Cambron (1981)	Louisville, Kentucky	N/R	N=30	7-9 years old
CPPRG (1999a,b)	North Carolina, Tennessee, Washington, and Pennsylvania	N/R	N=891	1st graders
Denkowski and Denkowski (1984)	US	N/R	N=45	3rd – 5th grade
*Drucker (1982)	New York	N/R	N=120	1st – 3rd grade
*Herman (1981)	Detroit, Michigan	N/R	N=130	4-6 years old
*Hoover (1985)	Southwest US	N/R	N=70	Mean age 8 years old
Jackson and Calhoun (1982)	US	N/R	N=40	5-6 years old
*Jones (2003)	Eugene, Oregon	N/R	N=59	2-4 years old
Lakes and Hoyt (2004)	Mid-western US	2000-2001	N=207	5th grade
Larkin and Thyer (1999)	Gainesville, Georgia	N/R	N=52	Pre-K – 3rd grade
Lynch et al. (2004)	Lansing, Michigan	1996-1997	N=399	4-5 years old
McConaughy et al. (1999)	US	N/R	N=82	Kindergarten
Mischel and Baker (1975)	US	N/R	N=60	Mean age 4.5 years old
Mischel and Patterson (1976)	US	N/R	N=70	Mean age 4.5 years old
*Pedro-Carroll (1983)	New York	1982	N=75	3rd – 6th grade
*Porter (1982)	US	N/R	N=34	1st – 2nd grade
Reid and Borkowski (1987)	Indiana	N/R	N=77	2nd – 4th grade
Riggs et al. (2006)	Seattle, Washington	N/R	N=329	Mean age 8 years old

Author, Publication Date	Location	Year of Intervention	Sample Size	Targeted Age
*Rineer (1987)	Southwestern US	1986-1987	N=42	Kindergarten
Saltz et al. (1977)	Detroit, Michigan	1972-1975	N=146	3-5 years old
Sandy and Boardman (2000)	New York City, New York	1997-1999	N=404	2-6 years old
Toner et al. (1978)	Madison, Wisconsin	N/R	N=90	Preschool – 3rd grade
Tremblay et al. (1991)	Montreal, Quebec, Canada	1985-1987	N=249	7 years old
Trostle (1988)	Pennsylvania	N/R	N=48	3-6 years old
*Tsamas (1991)	US	1989	N=61	Preschool
Zakay et al. (1984)	Tel-Aviv, Israel	N/R	N=74	Mean age 10 years old

Note. Asterisk (\*) indicates unpublished data. N/R=Not reported.

Overall, nearly every study included a measure of self-control<sup>5</sup> and data relevant for calculating a standardized mean effect size (94.1%), and more than half of the studies provided data for generating a standardized mean effect size for a delinquency-related outcome.<sup>6</sup> And although both self-control and delinquency outcomes were assessed, a number of different outcome sources were included overall such as parent-, teacher-, direct observer-, self-, and clinical reports.

## Types of Interventions

Considering the variability of the self-control improvement interventions, it is important to discuss some examples of the broad categories of intervention type. The most recognizable of the social skills development programs are studies of the Conduct Problems Prevention Research Group (CPPRGa, 1999) and Tremblay et al.'s (1991) Montreal Youth Study. The social skills development intervention in the CPPRG study is called Fast Track and uses a “unified model of prevention” where a number of integrated intervention programs are applied such

<sup>5</sup> Some examples of measures used to assess self-control included: Kansas Reflectivity-Impulsivity Scale for Preschoolers (KRISP: Wright, 1971), Kendall and Wilcox Self-Control Rating Scale (SCRS: Kendall & Wilcox, 1979), Social Skills Rating System (self-control sub-scale) (Gresham & Elliot, 1990), and Burks' Behavior Rating Scale (impulsivity sub-scale) (Burks, 1996).

<sup>6</sup> Some examples of measures used to assess delinquency included: Child Behavior Checklist (externalizing problems, e.g. aggression or delinquency sub-scales) (CBCL: Achenbach, 1986, Achenbach & Edelbrock, 1983, 1986), Eyberg Child Behavior Inventory (ECBI: Eyberg & Robinson, 1983; Funderburg & Eyberg, 1989), and Social Behavior Questionnaire (fights subscale) (SBQ: Tremblay et al., 1991).

Table 2. Descriptive Statistics -- Included Studies (N=34).

<b>Variables</b>	<b>n</b>	<b>M</b>	<b>SD</b>	<b>Min</b>	<b>Max</b>
Published					
Yes (=1)	21	61.8%	--	--	--
No (=0)	13	38.2%	--	--	--
USA study					
Yes (=1)	31	91.2%	--	--	--
No (=0)	3	8.8%	--	--	--
Population Type					
High-Risk/Low Income (=1)	22	64.7%	--	--	--
Universal (=0)	12	35.3%	--	--	--
Gender Composition (mostly male)					
Yes (=1)	19	55.9%	--	--	--
No (=0)	15	44.1%	--	--	--
Race Composition (mostly white)					
Yes (=1)	23	67.6%	--	--	--
No (=0)	11	32.4%	--	--	--
Attrition Problems					
Yes (=1)	5	14.7%	--	--	--
No (=0)	29	85.3%	--	--	--
Treatment Setting					
Group (=1)	23	67.6%	--	--	--
Individual (=0)	11	32.4%	--	--	--
Treatment Modality					
School (=1)	27	79.4%	--	--	--
Clinic (=0)	7	20.6%	--	--	--
Type of Intervention					
Social Skills Development	11	32.4%	--	--	--
Cognitive Coping Strategies	9	26.5%	--	--	--
Video Tape Training/Role	7	20.6%	--	--	--
Playing	4	11.8%	--	--	--
Immediate/Delayed Rewards	3	8.8%	--	--	--
Relaxation Training					
Publication Year	34	1989.65	10.37	1975	2008
Sample Size	34	128.62	165.57	30	891
Age at Intervention	34	6.23	2.03	3	10
Duration of Intervention (weeks)	34	7.09	5.43	0	13
Parent Report (Yes=1)	9	26.5%	--	--	--
Teacher Report (Yes=1)	22	64.7%	--	--	--
Direct Observer Report (Yes=1)	8	23.5%	--	--	--
Self-Report (Yes=1)	6	17.6%	--	--	--
Clinical Report (Yes=1)	14	41.2%	--	--	--
Self-Control Outcome (Yes=1)	32	94.1%	--	--	--
Delinquency Outcome (Yes=1)	19	55.9%	--	--	--

as: curriculum, parent groups, child social skills training groups, parent-child sharing time, home visiting, child peer pairing, and academic tutoring. The program involves lessons addressing four domains of skills: (1) skills for emotional understanding and communication; (2) friendship skills; (3) self-control skills; and (4) social problem solving skills (CPPRGa, 1999, p. 635). Comparatively, Tremblay et al.'s intervention also involved multiple program components, but one of these core competencies involved social skills training and was administered within small groups of prosocial peers. Another key component of Tremblay et al.'s intervention was self-control improvement sessions developed around themes such as "look and listen," "following rules," "what to do when I am angry," "what to do when they do not want to play with me," and "how to react to teasing" (p. 154).

Jackson and Calhoun's (1982) study was classified as a cognitive coping strategies intervention, which involved "cognitive self-instructional training where children are taught to covertly emit verbalizations that will cue or guide their non-verbal behavior" (Jackson & Calhoun, 1982, p. 7). Similarly, Reid and Borkowski's (1987) versions of cognitive coping strategies focuses on using psychoeducational tasks where an instructor verbalizes correct self-control statements such as "find out what I am supposed to do," "consider all answers," "stop and think," "mark my answer," and "check my answer" while performing various tasks, and then has the child repeat these steps and verbalize these statements while performing similar tasks.

Toner et al. (1978) is an example of a study classified as a video tape training/role playing intervention. Here, the children are sat in front of a television and told by the instructor: "Here is my television. The boy you will see on TV has been told not to touch the toys that are in front of him. Watch closely" (p. 285). During the course of watching the video, the boy in the video would either do things appropriately or be resistant to commands at times. At each response time (whether appropriate or resistant), the subject was asked whether the boy's response in the video was correct. If the subject replied with an affirmative response, then the video continued. Following the video tape training, the subject was also left alone for a period of time and their behavior and self-control was observed. Baggerly (1999) is another example of a video tape training/role playing intervention where didactic lectures, experiential activities (e.g., role playing), and viewing videos of child-centered play sessions were used with the intention of improving the children/adolescents' self-control. The children /adolescents in this particular study received the training for 35 minutes twice a week for five weeks and then once a week for the remaining five weeks.

The immediate/delayed rewards clinical interventions can best be characterized by Mischel and Baker (1975). This type of intervention took place in an experimental room where the room was divided by a

wooden barrier where there were battery operated toys and interesting games on one side of the barrier and a table and chair along with a desk bell on the other side of the barrier. The experimenter showed the child how to use the desk bell and informed them that once they left the room, the child could ring the bell and the experimenter would return. Upon returning (after the child rang the bell) the experimenter would reward the child and play a “game” with them. After a series of further instructions, the experimenter would then continue this interaction and assess the child’s ability to “transform the reward objects that face him during the delay period in ways that either permit or prevent effective delay of gratification” (p. 259).

The final classification of the intervention type in the included studies was relaxation training interventions. Lakes and Hoyt’s (2004) study was the most identifiable of this intervention type and involved periods of meditation where the children/adolescents were instructed to clear their minds of thoughts and worries while performing deep breathing techniques. Following this exercise, the subjects were then instructed to ask him/herself three questions intended to promote self-monitoring: 1) Where am I?; 2) What am I doing?; and 3) What should I be doing? After answering these questions the subjects were told to correct their thoughts and behavior if they were not consistent with the expectations of the particular situation. Ultimately, the instructors encouraged these exercises while emphasizing that the subject (not anyone else) is responsible for regulating their own behavior (p. 289).

## Quality Assessment

It is important to note several methods for assessing the “quality” of the included studies. One of the most agreed upon determinants of study quality is the study’s research design. Because all of the included studies were based on a randomized controlled experiment to evaluate the effectiveness of self-control improvement interventions, it is reasonable to assume that these studies are of high quality. Yet, it was rare for any of the studies to provide any detail on whether the randomization process was compromised or if attrition had any differential effects for the experimental/control groups. Thus, it is possible that some group imbalances might have arisen by chance. Further, most of the studies did not provide any information on whether the experimental/control groups were treated similarly throughout the course of the intervention by those who administered the intervention. Therefore, while we are confident that most studies were of sufficient quality because they used a research design involving random assignment, we still included a measure of whether there was substantial attrition reported in a particular study as a control measure (e.g., potential moderator) in the analysis that follows.

## Calculating Standardized Mean Difference Effect Sizes (ESs)

Self-control and delinquency ESs were computed by calculating Cohen's *d* from the available information, i.e., predominantly means and standard deviations. Although, Cohen's *d* is the most common effect size statistic, consideration should be given to sample size differences across studies (Hedges & Olkin, 1985; Lipsey & Wilson, 2001). Per Hedges and Olkin, the individual ESs were adjusted according to their samples size to correct for this bias. Tables 3 and 4 display the results of the individual unbiased ESs and corresponding confidence intervals calculated for each study based on the self-control and delinquency outcomes by outcome source (parent-, teacher-, direct observer-, self-, clinical report), respectively.<sup>7</sup>

As seen in Table 3, the majority of the ESs were positive suggesting that self-control improvement programs have beneficial results insofar as improving a child/adolescent's self-control at post-test assessment. Further, a number of the ESs across outcome source were significant (as indicated by the confidence interval for the ES not including zero) providing evidence that the positive effects appear real, particularly for the clinical self-control ESs. Turning toward the effect of self-control improvement programs on delinquency (Table 4), the majority of the individual mean ES are again positive suggesting that interventions such as these not only promote self-control improvement but also reduce delinquency at post-test assessment.<sup>8</sup> Forest plots displaying the mean ESs by outcome type (regardless of outcome source) are provided in Figures 1 and 2 in order to show how the total ESs for self-control and delinquency are distributed.<sup>9</sup>

Hedges and Olkin (1985) suggest using the inverse variance weight to weight each individual ES by the sample size of the treated and control groups when calculating an overall standardized mean difference effect size in order to give more weight to the ESs generated from larger samples. Thus, after applying the inverse variance weight to the individual ESs by outcome type and outcome source, the mean ESs from a series of random effects models (using Lipsey and Wilson's 2001

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<sup>7</sup> There were no post-test data based on clinical reports to calculate an individual study ES for delinquency.

<sup>8</sup> Since the confidence intervals for several ES's contain zero, care should guide interpreting these results.

<sup>9</sup> Forest plots were also estimated for each outcome type by outcome source separately. Due to page space requirements, these results are not displayed, but are available upon request.

Table 3. Self-Control Effect Sizes.

Study	Parent Report ES (LCI,UCI)	Teacher Report ES (LCI,UCI)	Direct Observer Report ES (LCI,UCI)	Self-Report ES (LCI,UCI)	Clinical Report ES (LCI,UCI)
Arnold & Forehand (1978)					0.63 (-0.10, 1.36)
Atwood et al. (1978)					1.02 (0.35, 1.69)*
Augimeri et al. (2007)					
Avila (1985)		0.59 (0.02, 1.16)*			
Baggerly (1999)					
Barkley et al. (2000)		0.02 (-0.33, 0.37)			
Bierman et al. (2008)	0.09 (-0.13, 0.31)	0.24 (0.02, 0.46)*	0.19 (0.04, 0.48)*	0.35 (0.13, 0.57)*	
Bosse (1985)					0.27 (-0.14, 0.68)
Cambron (1981)			0.54 (-0.24, 1.32)		
CPPRG (1999a)	-0.04 (-0.16, -0.05)*	-0.09 (-0.21, 0.03)			
Denkowski & Denkowski (1984)				0.35 (-0.28, 0.98)	
Drucker (1982)					0.10 (-0.23, 0.43)
Herman (1981)		0.35 (-0.06, 0.76)			0.68 (0.27, 1.09)
Hoover (1985)		0.48 (0.01, 0.95)*			0.28 (0.04, 0.52)*
Jackson & Calhoun (1982)					0.76 (-0.06, 1.58)
Jones (2003)	0.15 (-0.11, 0.41)		0.05 (-0.21, 0.31)		
Lakes & Hoyt (2004)		0.20 (-0.07, 0.47)	0.42 (0.15, 0.69)*		
Larkin & Thyer (1999)				1.33 (0.74, 1.89)*	
Lynch et al. (2004)		0.71 (0.51, 0.91)*			
McConaughy et al. (1999)	0.47 (0.02, 0.92)*	0.22 (-0.21, 0.65)	0.15 (-0.28, 0.58)		
Mischel & Baker (1975)					0.71 (0.12, 1.30)*
Mischel & Patterson (1976)					1.00 (0.20, 1.80)*
Pedro-Carroll (1983)		0.68 (0.21, 1.15)*			
Porter (1982)				5.10 (4.20, 6.00)*	2.86 (2.04, 3.68)*
Reid & Borkowski (1987)		0.21 (-0.34, 0.76)			0.00 (-0.53, 0.53)
Riggs et al. (2006)					0.32 (0.08, 0.56)*
Rineer (1987)		1.44 (0.79, 2.09)			
Saltz et al. (1977)					0.75 (0.38, 1.12)*
Sandy & Boardman (2000)	1.72 (1.39, 2.05)*	-0.23 (-0.56, 0.10)			
Toner et al. (1978)					0.58 (0.13, 1.03)*
Tremblay et al. (1991)	-0.51 (-0.73, -0.03)				
Trostle (1988)		0.03 (-0.54, 0.60)			
Tsamas (1991)		-0.32 (-0.87, 0.23)			
Zakay et al. (1984)				0.56 (0.05, 1.07)*	

Note. Asterisk (\*) indicates that effect size is significant. ES=effect size; LCI=Lower 95% confidence interval; UCI=Upper 95% confidence interval.



Table 4. Delinquency Effect Sizes.

Study	Parent Report ES (LCI,UCI)	Teacher Report ES (LCI,UCI)	Direct Observer Report ES (LCI,UCI)	Self-Report ES (LCI,UCI)
Arnold & Forehand (1978)				
Atwood et al. (1978)				
Augimeri et al. (2007)	1.14 (0.38, 1.90)*			
Avila (1985)				
Baggerly (1999)	-0.58 (-1.31 0.15)	-0.50 (-0.24, 1.24)		
Barkley et al. (2000)	-0.06 (-0.29, 0.41)	0.00 (-0.35, 0.35)	0.25 (-0.10, 0.60)	
Bierman et al. (2008)	0.13 (-0.09, 0.35)	0.28 (0.06, 0.50)*	0.19 (-0.03, 0.41)	0.21 (-0.01, 0.43)
Bosse (1985)				
Cambron (1981)		0.13 (-0.63, 0.89)		
CPPRG (1999a)	0.01 (-0.11, 0.13)	0.00 (-0.12, 0.12)	-0.08 (-0.20, 0.04)	
Denkowski & Denkowski (1984)		0.57 (-0.08, 1.22)		
Drucker (1982)				
Herman (1981)				
Hoover (1985)				
Jackson & Calhoun (1982)				
Jones (2003)	0.35 (-0.61, -0.09)*		-0.07 (-0.33, 0.19)	
Lakes & Hoyt (2004)		0.23 (-0.04, 0.50)		
Larkin & Thyer (1999)		2.39 (1.76, 3.02)*	3.19 (2.54, 3.84)*	
Lynch et al. (2004)		0.53 (0.33, 0.73)*		
McConaughy et al. (1999)	0.40 (-0.05, 0.85)	0.26 (-0.19, 0.71)	0.27 (-0.18, 0.72)	
Mischel & Baker (1975)				
Mischel & Patterson (1976)				
Pedro-Carroll (1983)		0.99 (0.52, 1.46)*		
Porter (1982)		1.94 (1.16, 2.72)*		
Reid & Borkowski (1987)		0.26 (-0.29, 0.81)		
Riggs et al. (2006)		0.37 (0.13, 0.61)*		
Rineer (1987)				
Saltz et al. (1977)				
Sandy & Boardman (2000)	0.83 (0.42, 1.24)*	0.63 (0.28, 0.98)*		
Toner et al. (1978)				
Tremblay et al. (1991)	-0.51 (-0.86, -0.16)*			0.21 (-0.12, 0.54)
Trostle (1988)				
Tsamas (1991)	0.06 (-0.47, 0.59)			
Zakay et al. (1984)				

Note. Asterisk (\*) indicates that effect size is significant. ES=effect size; LCI=Lower 95% confidence interval; UCI=Upper 95% confidence interval.

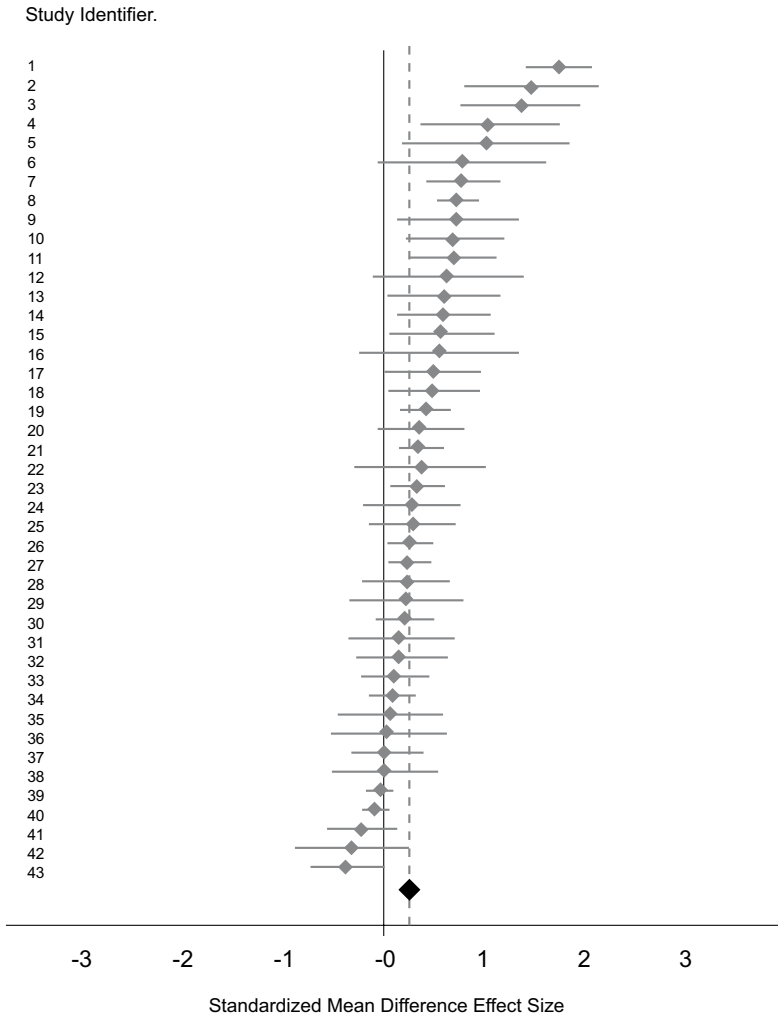


Figure 1. Forest Plot of the Distribution of Total Number of Self-Control Effect Sizes.

SPSS macros) are presented in Table 5.<sup>10</sup> Importantly, with the exception of the self-control ES based on parent reports ( $p = .20$ ) all of the ESs are positive and significant, and ranged from having a small effect (0.28) to having a rather substantial moderate effect (0.61), suggesting that self-control improvement programs are by and large successful at improving self-control regardless of the post-test assessment source. Comparatively,

<sup>10</sup> It was necessary to remove two extreme outliers before calculating the mean ESs in order to eliminate the potential for over-inflating the mean ES. For this reason, Larkin and Thyer (1999) and Porter's (1982) individual study ESs were not used in any of the analysis presented herein.

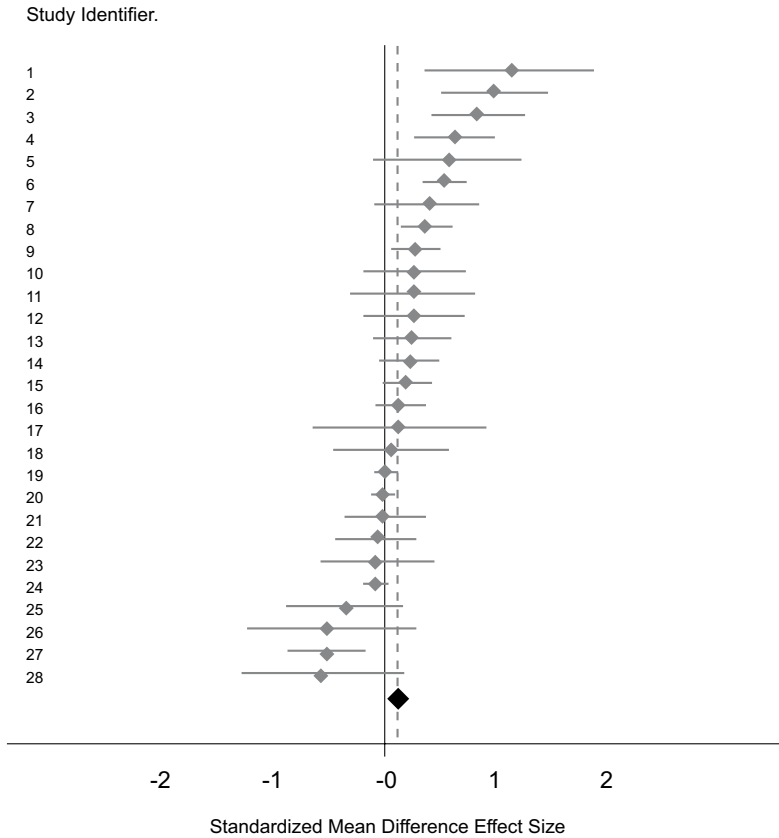


Figure 2. Forest Plot of the Distribution of Total Number of Delinquency Effect Sizes.

the results are not as robust for the delinquency ESs.<sup>11</sup> Nevertheless, all of the ESs are positive and the teacher reports results suggest that self-control improvement programs have a significant, small-to-moderate effect on improving self-control at post-test assessment.

## Homogeneity Tests

It is safe to assume that the individual study ESs are unlikely to be homogenous, i.e., all of the individual study ESs do not come from the same population. Thus, it is necessary to estimate the  $Q$  statistic as a method for examining whether this homogeneity assumption was vio-

<sup>11</sup> There were only two delinquency ESs available for the self-report outcome source, and considering that the ES was the same across these two studies no further analysis was conducted with the self-report delinquency ESs.

Table 5. Mean Effect Sizes by Outcome Type and Outcome Source.

Outcome Sources	n	Mean ES	Lower 95% CI	Upper 95% CI	z-test	Significance	Q-statistic	Significance
Self-Control								
Parent Report	6	0.33	-0.18	0.84	1.27	p=.20	105.05	p<.001***
Teacher Report	15	0.28	0.07	0.48	2.67	p<.01**	79.90	p<.001***
Direct Observer Report	5	0.29	0.14	0.43	3.79	p<.001***	2.58	p=0.63
Self-Report	4	0.61	0.20	1.02	2.90	p<.05*	9.67	p=0.02*
Clinical Report	13	0.47	0.31	0.64	5.63	p<.001***	19.37	p=0.08+
Delinquency								
Parent Report	9	0.09	-0.17	0.34	0.67	p=.50	40.14	p<.001***
Teacher Report	14	0.30	0.13	0.46	3.51	p<.001***	45.66	p<.001***
Direct Observer Report	5	0.09	-0.09	0.26	0.96	p=.34	7.84	p=0.09+

Note. PR=parent report; TR=teacher report; DOB=direct observer report; SR=self-report; CLIN=clinical report. CI=confidence interval. \*p<.05 \*\*p<.01 \*\*\*p<.001.

lated.<sup>12</sup> The results (Table 5) suggest that all of the mean ESs by outcome type and outcome source (with the exception of the self-control direct observer report ES) were in fact heterogeneous; therefore, we explored potential moderating variables that may help explain some of the heterogeneity in the ESs.

## Moderator Analyses

We selected a number of potential moderators based on previous meta-analyses and also chose several other factors that may be particularly relevant including: whether the study was published (yes/no) or performed (yes/no) in the United States, targeted a high-risk/low income population (yes/no), the gender (mostly male: yes/no) and race composition (mostly white: yes/no), whether there were any noted attrition problems (yes/no), the treatment modality (group: yes/no) and setting (school: yes/no), and the type of intervention (social skills development, cognitive coping strategies, video tape training/role playing, immediate/delayed rewards clinical intervention, or relaxation training). We included four continuous measures as moderators: the year of publication, the total sample size, age at the start of the intervention, and the duration of the intervention (in weeks).<sup>13</sup> For all categorical variables, moderator analyses were conducted using Lipsey and Wilson's (2001) SPSS macros for the analog to the ANOVA (with random effects), whereas the moderator analyses for the continuous variables were

<sup>12</sup> The Q statistic is distributed as a chi-square with k-1 degrees of freedom where k is the number of effect sizes (Hedges & Olkin, 1985).

<sup>13</sup> Due to the skew in the duration of the intervention (some studies were longer than a year), this variable was recoded as 0 if the intervention lasted less than one week, 1 if it lasted one week, 2 if it lasted two weeks, through 12 if it lasted twelve weeks. Interventions greater than twelve weeks were coded as 13.

investigated by analyzing the correlations (calculated by taking the square root of  $R^2$ ) between the moderators and the ESs.

The results of the analog to the ANOVA analyses (with random effects) investigating possible moderators of the self-control ESs are presented in Table 6 while the results for possible moderators of the delinquency ESs are displayed in Table 7.<sup>14</sup> Virtually all of the self-control ESs for all of the categorical moderator variable groupings were significant and appeared to be consistent, for the most part, by outcome source (parent-, teacher-, direct observer-, self-, and clinical report) (Table 6).

Overall, the overwhelming majority of the ESs were positive suggesting that regardless of how the ES was contrasted the effect of self-control improvement programs seem to benefit the children/adolescents insofar as improving their self-control by post-test assessment. Some examples of the significant categorical moderators included: gender composition, where females evinced higher self-control gains ( $Q_{\text{between}} = 3.25$ ;  $df = 1$ ;  $p = .07$ ;  $\tau^2 = 0.27$ ,  $se = 0.17$ ), race composition ( $Q_{\text{between}} = 2.14$ ;  $df = 1$ ;  $p = .07$  (one-tailed);  $\tau^2 = 0.30$ ,  $se = 0.19$ ), and attrition problems ( $Q_{\text{between}} = 3.25$ ;  $df = 1$ ;  $p = .07$ ;  $\tau^2 = 0.27$ ,  $se = 0.17$ ) for the self-control parent report ES and published versus not published ( $Q_{\text{between}} = 3.46$ ;  $df = 1$ ;  $p = .06$ ;  $\tau^2 = 0.08$ ,  $se = 0.04$ ) for the self-control teacher report ES.

Turning toward the analog to the ANOVA (with random effects) results for the possible categorical moderators of the delinquency ESs, it appears that most ESs are positive and significant suggesting that self-control improvement programs can also benefit children/adolescents in terms of reducing their delinquency by post-test assessment. An example of the significant categorical moderators for the delinquency ES included: gender composition ( $Q_{\text{between}} = 25.43$ ;  $df = 1$ ;  $p < .001$ ;  $\tau^2 = 0.01$ ,  $se = 0.01$ ) for the delinquency teacher report ES.

Following these categorical moderator estimations, correlations were computed for the possible continuous moderator variables of the ESs. The results for the self-control ESs and the delinquency ESs by outcome source are presented in Tables 8 and 9, respectively. For the most part, the correlations for year of publication and the self-control ESs were negative indicating that older studies had larger ESs, although only one of the correlations was significant (self-control clinical report ES =  $-0.47$ ,  $p < .05$ ). The majority of the correlations between total sample size and the self-control ESs (Table 8) were negative as

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<sup>14</sup> Some of the potential categorical moderators could not be examined using analog to the ANOVA tests since there was either no variation (e.g., all of the studies that had parent reports that contributed to the mean ES targeted high-risk/low income populations) or only one study was different from the rest (e.g., five of the six studies that had parent reports that contributed to the mean ES were published and only one study was from unpublished data). When this second situation was encountered, the ESs were still estimated for the different groupings in order to determine if either/both of the two ESs were significant.

Table 6. Self-Control Weighted Effect Sizes, Confidence Intervals, z-tests and Q statistics of Moderators (with Random Effects).

Variables	n	ES	z-test	Q-statistic
Published (Yes / No)				
PR	5 / 1 <sup>a</sup>	0.37 / 0.15	1.23 / 0.21	--
TR	9 / 6	0.16 / 0.51	1.44 / 3.27*	6.21 / 9.66+
DOB	3 / 2	0.30 / 0.20	3.70*** / 0.90	1.33 / 1.05
SR	3 / 1	0.38 / 1.33	3.92*** / 4.43***	--
CLIN	9 / 4	0.55 / 0.32	5.68*** / 2.56*	8.81 / 3.10
USA study (Yes / No)				
PR	5 / 1	0.47 / -0.38	1.77+ / -0.64	--
TR	15 / 0	0.28	2.67**	--
DOB	5 / 0	0.29	3.79***	--
SR	3 / 1	0.61 / 0.56	2.93** / 1.49	--
CLIN	13 / 0	0.47	5.63***	--
Population Type (High-Risk, Low Income / Universal)				
PR	6 / 0	0.33	1.27	--
TR	10 / 5	0.26 / 0.30	2.27* / 1.68+	7.49 / 8.97+
DOB	4 / 1	0.23 / 0.42	2.57* / 3.00**	--
SR	3 / 1	0.61 / 0.56	2.92** / 1.49	--
CLIN	7 / 6	0.54 / 0.42	4.20*** / 4.43***	6.87 / 6.76
Gender Composition (mostly male) (Yes / No)				
PR	4 / 2	0.04 / 0.88	0.14 / 2.33*	1.23 / 4.64*
TR	8 / 7	0.33 / 0.22	2.40* / 1.55	8.97 / 6.91
DOB	3 / 2	0.17 / 0.32	1.12 / 3.71***	1.08 / 0.81
SR	3 / 1	0.74 / 0.35	4.43*** / 3.18**	--
CLIN	5 / 8	0.44 / 0.49	3.23** / 4.76***	3.47 / 9.06
Race Composition (mostly white) (Yes / No)				
PR	4 / 2	0.08 / 0.81	0.80 / 0.05*	1.05 / 4.75*
TR	8 / 7	0.40 / 0.13	3.10* / 0.96	8.33 / 7.22
DOB	5 / 0	0.29	3.79***	--
SR	3 / 1	0.61 / 0.21	2.93** / 1.49	--
CLIN	8 / 5	0.47 / 0.47	4.79*** / 3.28**	8.41 / 4.49
Attrition Problems (Yes / No)				
PR	2 / 4	0.88 / 0.04	2.33* / 0.14	4.64* / 1.23
TR	4 / 11	0.14 / 0.33	0.76 / 2.92**	1.59 / 14.80
DOB	1 / 4	0.26 / 0.31	2.36* / 2.98**	--
SR	3 / 1	0.35 / 0.74	3.18** / 4.43***	--
CLIN	3 / 10	0.55 / 0.43	3.77*** / 4.98***	4.49+ / 9.88
Treatment Modality (Group / Individual)				
PR	6 / 0	0.33	1.27	--
TR	12 / 3	0.26 / 0.35	2.41* / 1.55	16.37 / 0.22
DOB	4 / 1	0.28 / 0.54	3.60*** / 1.35	--
SR	3 / 1	0.65 / 0.35	3.27** / 0.84	--
CLIN	4 / 9	0.45 / 0.48	3.54*** / 4.61***	2.52 / 10.36

Variables	n	ES	z-test	Q-statistic
Treatment Setting (School / Clinic)	5 / 1	0.37 / 0.15	1.23 / 0.22	--
PR	14 / 1	0.26 / 0.48	2.63** / 1.23	--
TR	4 / 1	0.31 / 0.05	3.90*** / 0.19	--
DOB	3 / 1	0.65 / 0.35	3.27** / 0.84	--
SR	10 / 3	0.45 / 0.57	5.12*** / 2.90**	10.67 / 2.15
CLIN				
Type of Intervention				
Social Skills Development				
PR	6	0.33	1.27	--
TR	7	0.00	-0.08	--
DOB	3	0.21	2.33*	--
SR	1	0.35	3.18**	--
CLIN	1	0.32	2.67**	--
Cognitive Coping Strategies				
PR	0	--	--	--
TR	4	0.68	6.74***	--
DOB	0	--	--	--
SR	2	0.89	4.53***	--
CLIN	5	0.22	1.94*	--
Video Tape Training/Role Playing				
PR	0	--	--	--
TR	3	0.52	3.54***	--
DOB	1	0.54	1.35	--
SR	0	--	--	--
CLIN	3	0.70	4.97***	--
Immediate/Delayed Rewards				
PR	0	--	--	--
TR	0	--	--	--
DOB	0	--	--	--
SR	4	0.60	4.96***	--
CLIN				
Relaxation Training				
PR	0	--	--	--
TR	1	0.20	1.25	--
DOB	1	0.42	3.00**	--
SR	1	0.35	1.09	--
CLIN	0	--	--	--

<sup>a</sup>. This column presents the number of studies that provide ESs by outcome source and by moderator grouping. For instance, 5 studies that provided self-control ESs based on parent reports were published, whereas 1 study that provided self-control ESs based on parent reports were not published. \*p<.10 \*\*p<.05 \*\*\*p<.01 \*\*\*\*p<.001.

Table 7. Delinquency Weighted Effect Sizes, Confidence Intervals, z-tests and Q statistics of Moderators (with Random Effects).

Variables	n	ES	z-test	Q-statistic
Published (Yes / No)				
PR	7 / 2 <sup>a</sup>	0.20 / -0.45	1.32 / -1.33	9.55 / 0.11
TR	10 / 4	0.30 / 0.29	3.53*** / 1.56	6.28 / 8.83*
DOB	4 / 1	0.09 / -0.07	1.06 / -0.25	--
USA study (Yes / No)				
PR	7 / 2	0.08 / 0.14	0.47 / 0.38	5.13 / 4.94*
TR	14 / 0	0.30	3.51***	--
DOB	5 / 0	0.09	0.96	--
Population Type (High-Risk, Low Income / Universal)				
PR	9 / 0	0.09	0.67	--
TR	11 / 3	0.31 / 0.25	3.50*** / 1.65+	14.45 / 0.57
DOB	5 / 0	0.09	0.96	--
Gender Composition (mostly male) (Yes / No)				
PR	7 / 2	-0.03 / 0.44	-0.20 / 1.63+	9.39 / 1.66
TR	7 / 7	0.03 / 0.41	0.59 / 7.90***	6.62 / 13.61*
DOB	4 / 1	-0.03 / 0.19	-0.45 / 1.72+	--
Race Composition (mostly white) (Yes / No)				
PR	7 / 2	-0.01 / 0.37	-0.04 / 1.28	8.51 / 1.98
TR	9 / 5	0.29 / 0.30	2.93** / 2.52**	10.21 / 4.91
DOB	4 / 1	0.19 / -0.08	2.27** / -1.26	--
Attrition Problems (Yes / No)				
PR	2 / 7	0.44 / -0.03	1.63+ / -0.20	1.66 / 9.39
TR	4 / 11	0.14 / 0.33	0.76 / 2.92**	1.59 / 14.80
DOB	1 / 4	0.19 / -0.03	1.72+ / -0.46	--
Treatment Modality (Group / Individual)				
PR	9 / 0	0.09	0.67	--
TR	11 / 3	0.29 / 0.33	3.58*** / 1.47	14.50 / 0.63
DOB	5 / 0	0.09	0.96	--
Treatment Setting (School / Clinic)				
PR	7 / 2	0.05 / 0.29	0.29 / 0.76	6.08 / 3.83*
TR	13 / 1	0.28 / 0.57	3.69*** / 1.47	--
DOB	4 / 1	0.09 / -0.07	1.06 / -0.24	--



Variables	n	ES	z-test	Q-statistic
Type of Intervention				
Social Skills Development				
PR	8	0.15	0.95	--
TR	7	0.22	2.63**	6.31
DOB	5	0.09	0.96	--
Cognitive Coping Strategies				
PR	0	--	--	--
TR	2	0.46	2.83**	0.52
DOB	0	--	--	--
Video Tape Training/Role Playing				
PR	1	-0.58	-1.08	--
TR	3	0.41	1.99*	9.37**
DOB	0	--	--	--
Immediate/Delayed Rewards				
PR	0	--	--	--
TR	0	--	--	--
DOB	0	--	--	--
Relaxation Training				
PR	0	--	--	--
TR	2	0.32	1.71+	0.64
DOB	0	--	--	--

<sup>a</sup> This column presents the number of studies that provide ESs by outcome source and by moderator grouping. For instance, 7 studies that provided delinquency ESs based on parent reports were published, whereas 2 studies that provided delinquency ESs based on parent reports were not published. + $p < .10$  \* $p < .05$  \*\* $p < .01$  \*\*\* $p < .001$ .

well, suggesting that smaller studies had larger ESs, yet only one of the correlations was significant (self-control self-report ES= -0.63,  $p < .05$ ). Three of the five correlations between age at the time of the intervention and self-control effect size were significant, two indicating that studies with older children/adolescents had larger ESs (self-control teacher report= 0.36,  $p < .10$ ; self-control direct observer report= 0.85,  $p < .01$ ) and one correlation suggesting that studies with younger children/adolescents had larger ESs (self-control clinical report= -0.36,  $p < .10$ ). Only two of the correlations between the duration of the intervention and self-control ES were significant: shorter interventions had larger ESs (self-control teacher report= -0.57,  $p < .01$ ) and longer interventions had larger ESs (self-control self-report= 0.78,  $p < .01$ ).

Comparatively, two of the three correlations between year of publication and the delinquency ESs (Table 9) were positive and significant, indicating that more recent studies had larger ESs (delinquency parent report= 0.46,  $p < .05$ ; delinquency direct observer report= 0.64,  $p < .05$ ). All of the correlations between total sample size and the delinquency ESs were negative (e.g., smaller studies had larger ESs), although only one of these correlations was significant (delinquency direct observer report= -0.88,  $p < .01$ ). Only one of the correlations was significant between age at the time of intervention and the delinquency ESs (delinquency teacher report= 0.37,  $p < .10$ ) and the duration of the intervention and the delinquency ESs (delinquency direct observer re-

Table 8. Moderator Correlations with Self-Control Effect Sizes.

<b>Variables</b>	<b>n</b>	<b>Correlation (sq rt. of R<sup>2</sup>)</b>
Publication Year		
PR	6	0.20
TR	15	-0.29
DOB	5	-0.24
SR	4	-0.01
CLIN	13	-0.47*
Total Sample Size		
PR	6	-0.19
TR	15	-0.27
DOB	5	0.10
SR	4	-0.63*
CLIN	13	-0.29
Age at Intervention		
PR	6	-0.31
TR	15	0.36+
DOB	5	0.85**
SR	4	0.32
CLIN	13	-0.36+
Duration of Intervention		
PR	6	0.12
TR	15	-0.57**
DOB	5	-0.10
SR	4	0.78**
CLIN	13	-0.26

Note. \*p<.10 \*p<.05 \*\*p<.01 \*\*\*p<.001

Table 9. Moderator Correlations with Delinquency Effect Sizes.

<b>Variables</b>	<b>n</b>	<b>Correlation (sq rt. of R<sup>2</sup>)</b>
Publication Year		
PR	9	0.46*
TR	14	-0.20
DOB	5	0.64*
Total Sample Size		
PR	9	-0.02
TR	14	-0.26
DOB	5	-0.88**
Age at Intervention		
PR	9	0.32
TR	14	0.37+
DOB	5	-0.14
Duration of Intervention		
PR	9	0.16
TR	14	-0.26
DOB	5	-0.72**

Note. \*p<.10 \*p<.05 \*\*p<.01 \*\*\*p<.001

port= -0.72,  $p < .01$ ), suggesting that studies with older children/adolescents and those that were shorter in time span had larger ESs than those with younger children/adolescents and operated over a longer period of time.

## Meta-Analysis Weighted Least Squares Regressions

The moderator analyses pointed toward some significant moderators of the ESs for self-control and delinquency by outcome source. It remains important to examine the nature of the moderators within a multivariate context to determine whether any of the moderators could be considered significant predictors of the variation in the ESs across the studies net of the effect of the other possible moderators. To examine this, a series of meta-analysis weighted least squares regression models (with random effects estimated using the maximum likelihood function available in Lipsey and Wilson's 2001 SPSS macro) were estimated by outcome type and outcome source. Based on sample size constraints and with attention to key moderators described above, each of the regressions was estimated with the same demographic moderators of gender and race composition, as well as age at the time of the intervention. Any additional potentially significant predictors were introduced in a stepwise fashion. The final models presented in Tables 10 (predicting self-control ESs) and 11 (predicting delinquency ESs) only display the results of the moderators that were significant for predicting the variation in the individual study ESs.

The regression results predicting the self-control ESs (Table 10) identified several key predictors across the various outcome sources such as: gender, where females evinced higher self-control ( $b = -0.77$ ,  $se = 0.15$ ,  $p < .001$ ) and race ( $b = -0.51$ ,  $se = 0.12$ ,  $p < .001$ ) composition for parent report self-control ES; race composition ( $b = 0.40$ ,  $se = 0.10$ ,  $p < .001$ ), treatment modality ( $b = 0.22$ ,  $se = 0.17$ ,  $p < .10$ ), and interventions that utilized cognitive coping strategies ( $b = 0.83$ ,  $se = 0.12$ ,  $p < .001$ ) for teacher report self-control ES; age at intervention ( $b = 0.06$ ,  $se = 0.04$ ,  $p < .10$ ) for direct observer report self-control ES and for self-report self-control ES ( $b = 0.09$ ,  $se = 0.06$ ,  $p < .001$ ); and published/not published ( $b = 0.18$ ,  $se = 0.14$ ,  $p < .10$ ), gender ( $b = -0.33$ ,  $se = 0.22$ ,  $p < .05$ ) and race ( $b = -0.25$ ,  $se = 0.21$ ,  $p < .10$ ) composition, interventions that utilized video tape training/role playing ( $b = 0.64$ ,  $se = 0.25$ ,  $p < .001$ ), and age at the time of intervention ( $b = -0.06$ ,  $se = 0.04$ ,  $p < .05$ ) for clinical report self-control ES.

For the most part, the same significant predictors of the delinquency ESs (Table 11) were similar to those that were significant for predicting self-control ESs. Significant predictors included: gender ( $b = -0.38$ ,  $se = 0.28$ ,  $p < .10$ ) and race ( $b = -0.39$ ,  $se = 0.22$ ,  $p < .05$ ) composition, year of publication ( $b = 0.04$ ,  $se = 0.02$ ,  $p < .05$ ), and age at the

Table 10. Self-Control Meta-Analysis Weighted Least Squares Regressions (with Random Effects).

Variables	b	se	Beta
Published (Yes / No) CLIN	0.18+	0.14	0.32
Gender Composition (mostly male) (Yes / No)	-0.77***	0.15	-0.70
PR	0.03	0.10	0.04
TR	-0.11	0.18	-0.40
DOB	Dropped for collinearity	--	--
SR	-0.33*	0.22	-0.57
CLIN			
Race Composition (mostly white) (Yes / No)	-0.51***	0.12	-0.49
PR	0.40***	0.10	0.56
TR	All mostly white	--	--
DOB	0.38	0.41	0.44
SR	-0.25+	0.21	-0.42
CLIN			
Treatment Modality (Group / Individual)	0.22+	0.17	0.17
TR			
Type of Intervention Cognitive Coping Strategies			
TR	0.83***	0.12	0.97
Video Tape Training/Role Playing			
CLIN	0.64***	0.25	0.93
Age at Intervention			
PR	-0.10	0.11	-0.12
TR	0.03	0.03	0.13
DOB	0.06+	0.04	0.79
SR	0.09*	0.06	0.77
CLIN	-0.06+	0.04	-0.33

Note. \* $p < .10$  \*\* $p < .05$  \*\*\* $p < .01$  \*\*\*\* $p < .001$  (one-tailed tests).

time of the intervention ( $b = 0.20$ ,  $se = 0.09$ ,  $p < .01$ ) for parent report delinquency ES; gender composition ( $b = -0.34$ ,  $se = 0.10$ ,  $p < .001$ ), interventions that used cognitive coping strategies ( $b = 0.19$ ,  $se = 0.13$ ,  $p < .10$ ), and age at the time of the intervention ( $b = 0.05$ ,  $se = 0.03$ ,  $p < .05$ ) for teacher report delinquency ES; and gender composition ( $b = -0.24$ ,  $se = 0.17$ ,  $p < .10$ ) for direct observer report delinquency ES.

## Publication Bias Analysis

While disagreement exists as to whether meta-analyses should include unpublished studies (Dush et al., 1989; Eppley et al., 1989; McLeod & Weisz, 2004), we opted to err on the side of inclusion. This permitted the inclusion of 13 additional studies, all dissertations that were from unpublished data. Although we have already presented comparisons between the self-control and delinquency ESs by outcome

Table 11. Delinquency Meta-Analysis Weighted Least Squares Regressions (with Random Effects).

Variables	b	se	Beta
Gender Composition (mostly male) (Yes / No)	-0.38+	0.28	-0.38
PR	-0.34***	0.10	-0.66
TR	-0.24+	0.17	-0.68
DOB			
Race Composition (mostly white) (Yes / No)	-0.39*	0.22	-0.40
PR	-0.05	0.11	-0.10
TR	Dropped for collinearity	--	--
DOB			
Type of Intervention Cognitive Coping Strategies			
TR	0.19+	0.13	0.27
Publication Year			
PR	0.04*	0.02	0.43
TR			
DOB			
Age at Intervention			
PR	0.20**	0.09	0.53
TR	0.05*	0.03	0.30
DOB	0.02	0.13	0.09

Note. \*p<.10 \*p<.05 \*\*p<.01 \*\*\*p<.001 (one-tailed tests).

source for published/not published studies in the analog to the ANOVA tests previously (when possible), we still explored the potential for publication bias.

There are a number of methods that may be used to assess publication bias both statistically and visually, and we opted to estimate the possible presence of publication bias through the use of a funnel plot (which is available as a macro in Stata 10.0—“metafunnel”) and calculating relevant test statistics (e.g., Kendall’s and Egger’s tests, which can be estimated using the “metabias” macro in Stata 10.0) (Borenstein, 2005; Sterne & Harbord, 2004).

The results of the funnel plots by outcome type (regardless of outcome source) are displayed in Figures 3 and 4, respectively. According to the funnel plots estimated by outcome type (where the larger studies are plotted at the top and the smaller studies are plotted at the bottom) and the relevant Kendall and Egger’s tests, there is some indication of significant publication bias for the self-control ESs (Kendall’s test:  $z = 1.96$ ,  $p = 0.05$ ; Egger’s test:  $3.27$ ,  $p < .01$ ), but not for the delinquency ESs.<sup>15</sup>

<sup>15</sup> Funnel plots were also estimated for each outcome type by outcome source separately. Due to page space requirements, these results are not displayed, but are available upon request.

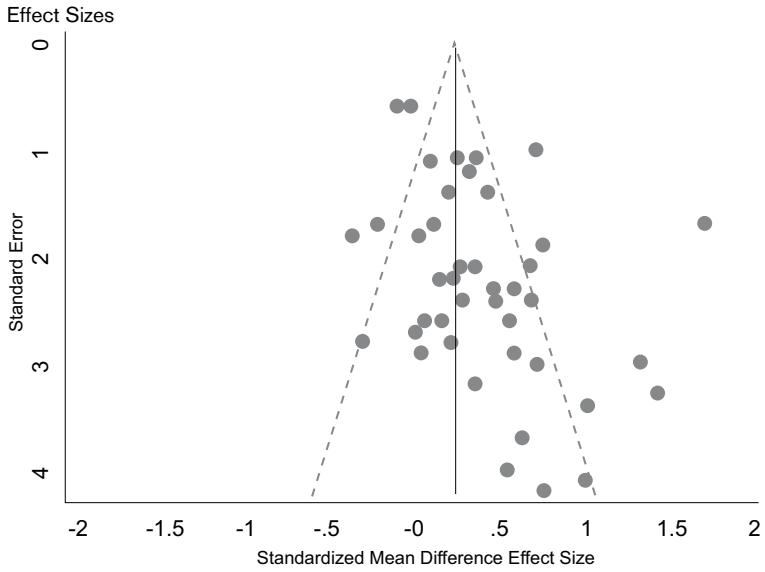


Figure 3. Funnel Plot Examining Publication Bias in Total Number of Self-Control.

Note. Kendall's test: ( $z = 1.96, p = 0.05^*$ ). Egger's test: ( $t = 3.27, p < 0.01^{**}$ ).

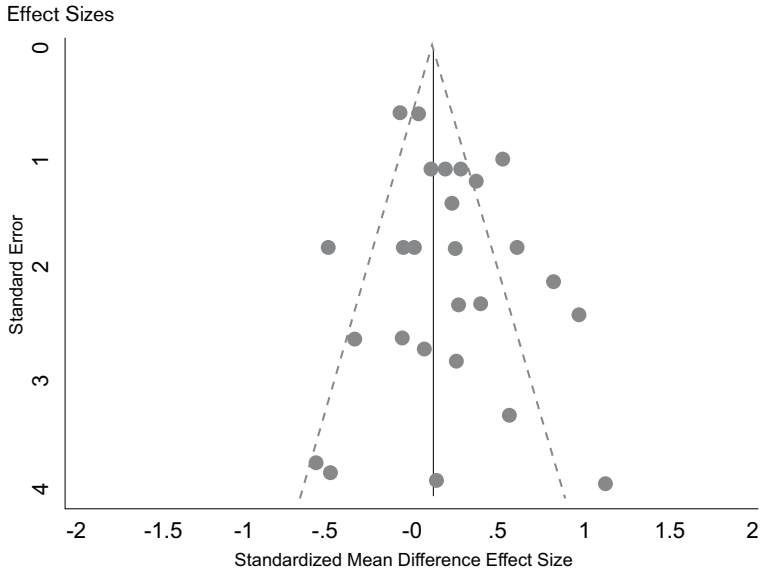


Figure 4. Funnel Plot Examining Publication Bias in Total Number of Delinquency.

Note. Kendall's test: ( $z = -0.22, p = 0.83$ ). Egger's test: ( $t = 1.64, p = 0.11$ ).

# DISCUSSION

Gottfredson and Hirschi's general theory of crime has been the subject of intense theoretical and empirical attention aimed at assessing the critical hypothesis linking self-control to antisocial activity. At the same time, comparable attention has not been paid to assessing policy recommendations emanating from the theory, namely whether self-control is malleable, and if it is, what programmatic efforts support modification. To provide some evidence on this issue, we performed a meta-analysis of programmatic interventions aimed at improving self-control, an effort which would bear directly on a key policy prescription for Gottfredson and Hirschi's general theory. Specifically, this study focused on two inter-related outcomes: (1) What are the effects of self-control improvement programs up to age 10 for improving self-control among children/adolescents (self-control as the dependent variable)?; and (2) What are the effects of self-control improvement programs on delinquency outcomes (delinquency as the dependent variable)?

After identifying 34 studies that met a series of highly stringent inclusion criteria, the analyses indicated that: (1) self-control improvement programs improve a child/adolescent's self-control; (2) these interventions also reduce delinquency; and (3) the positive effects generally hold across a number of different moderator variables and groupings as well as by outcome source (parent-, teacher-, direct observer-, self-, and clinical report). Unpacking these findings yields the overall conclusion that self-control is malleable, that self-control can be improved, and that reductions in delinquency follow from this self-control improvement.

Before we address the larger policy issue and cast it in the current criminal justice context, we acknowledge several limitations. First, we only examined outcomes during a certain period of the life course (before age 10/12); therefore, it would be worthwhile to examine if the effectiveness of self-control improvement programs persists over time, particularly into late adolescence and early adulthood. Second, we did not assess how these efforts may/may not improve outcomes in other life-course domains (e.g., improve academic performance). To the extent that the general theory is indeed general, it stands to reason that the interventions reviewed in this study may likely affect outcomes in other life-course domains. Third, examining the effectiveness of these efforts across other moderating influences not examined here are worth consideration, especially neighborhood context. Research has shown that childrearing practices and socialization influences are affected by neighborhood context and this should receive further consideration (Leventhal & Brooks-Gunn, 2000; Pratt et al., 2004; Wikstrom & Sampson, 2003). Finally, although the focus of the current study was on effectiveness of self-control improvement

programs for improving self-control and reducing delinquency, future studies should make efforts to measure the relative costs and benefits of interventions such as these across a variety of life course domains.

Aside from Gottfredson and Hirschi's policy strategy of making criminal events less attractive to potential offenders by making them more difficult to successfully commit crime by increasing the certainty of detection, the theorists have also identified an important policy proscription that emanates from the general theory of crime, one that has import for the larger policy discussion. Our effort shows that interventions aimed at improving socialization and child-rearing practices (which produce more self-control) in the first decade of life offers benefits for the improvement of self-control as well as the reduction of delinquency/crime. It appears that investment in these sorts of efforts—in lieu of the more cost-prohibitive incarceration policies of the recent past—should be an important part of the policy response, especially because self-control is malleable and responsive to external sources of socialization.

In this regard, researchers know a bit more about the characteristics that programs should not adopt more so than about the characteristics that make them particularly successful. In particular, programs that are based on specific training efforts, that are focused and of short-duration are successful ingredients for improving self-control and, in turn, reducing delinquency. Such efforts should serve as successful exemplars that warrant replication and extension allthewhile recognizing that scaling these programs up may not be as effective as keeping them narrow and targeted.



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