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Social-Information-Processing Patterns Mediate the Impact of Preventive Intervention on Adolescent Antisocial Behavior

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Abstract

In the study reported here, we tested the hypothesis that the Fast Track preventive intervention's positive impact on antisocial behavior in adolescence is mediated by its impact on social-cognitive processes during elementary school. Fast Track is the largest and longest federally funded preventive intervention trial for children showing aggressive behavior at an early age. Participants were 891 high-risk kindergarten children (69% male, 31% female; 49% ethnic minority, 51% ethnic majority) who were randomly assigned to an intervention or a control group by school cluster. Multiyear intervention addressed social-cognitive processes through social-skill training groups, parent groups, classroom curricula, peer coaching, and tutoring. Assigning children to the intervention decreased their mean antisocial-behavior score after Grade 9 by 0.16 standardized units ($p < .01$). Structural equation models indicated that 27% of the intervention's impact on antisocial behavior was mediated by its impact on three social-cognitive processes: reducing hostile-attribution biases, increasing competent response generation to social problems, and devaluing aggression. These findings support a model of antisocial behavioral development mediated by social-cognitive processes, and they guide prevention planners to focus on these processes.

Keywords

antisocial behavior; intervention; adolescent development; social cognition

Social-cognitive processes such as hostile-attribution biases and problem solving have been hypothesized to mediate children's development of antisocial behavior, and substantial empirical support for this hypothesis has come from prospective correlational studies (Dodge, Coie, & Lynam, 2006). These findings have compelled interventionists to improve young children's social-cognitive processes in order to indirectly prevent adolescent delinquent behavior (e.g., Raver et al., 2011). Although several interventions have yielded promising effects, surprisingly few empirical studies have tested the underlying premise of this hypothesis, namely, that positive intervention effects are mediated by children's social-

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Declaration of Conflicting Interests

K. L. Bierman, J. D. Coie, K. A. Dodge, M. T. Greenberg, J. E. Lochman, and R. J. McMahon are the developers of the Fast Track curriculum and have a publishing agreement with Oxford University Press. M. T. Greenberg is an author of the Promoting Alternate Thinking Strategies (PATHS) curriculum and has a royalty agreement with Channing-Bete, Inc. M. T. Greenberg is a principal in PATHS Training, LLC. R. J. McMahon is a coauthor of *Helping the Noncompliant Child* and has a royalty agreement with Guilford Publications, Inc.; he is also a member of the Treatments That Work Scientific Advisory Board with Oxford University Press.

cognitive processes. It is plausible that intervention effects are mediated through alternate mechanisms, such as placebo, academic gains, or environmental scaffolding of opportunity. In the current study, our goal was to test the hypothesis that the Fast Track intervention's positive effects on adolescent antisocial behavior are mediated by intervention effects on social-cognitive processes. Because a randomized controlled trial represents an experimental manipulation, this study also constitutes a methodologically rigorous test of the social-cognitive model of the development of antisocial behavior.

Social-Cognitive Mechanisms in Antisocial Behavior

Since Simon's (1967) information-processing model of problem solving, several loosely related theoretical traditions have hypothesized that noncognitive traits (Heckman, 2006), executive function of emotional regulation (Blair, 2002), social-emotional learning (Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011), agency skills (Larsen & Angus, 2011), social-information-processing patterns (Huesmann, 1988), and social competence (Dodge, Pettit, McClaskey, & Brown, 1986) are acquired through environmental experiences and mediate the impact of those experiences on later behavior, including aggression and antisocial-behavior problems.

As one example, a social-information-processing model (Crick & Dodge, 1994; Dodge et al., 1986; Huesmann, 1988) asserts that in response to socially challenging situations, individuals respond very rapidly with a sequence of mental operations that may lead to aggressive behavior. Individual differences in these operations are targets for intervention. The first step is to encode situational cues through attention and sensation. Competent responders accurately encode relevant cues about context and emotion, whereas aggressive individuals respond inaccurately and with hypervigilance to threat cues (Ribordy, Camras, Stefani, & Spaccarelli, 1988).

At the second step of interpreting encoded cues, competent responders accurately interpret other people's intentions, whereas aggressive individuals are biased toward hostile attributions (Dodge, 1980; Lochman, 1987). The third step is to adopt a goal for the situation. Competent responders balance goals, whereas aggressive individuals adopt retribution goals in response to provocations (Erdley & Asher, 1996). The fourth step is to generate possible behavioral responses to the cues. Competent responders generate competent solutions to interpersonal challenges, whereas aggressive responders access aggressive responses (Rabiner, Lenhart, & Lochman, 1990). At the fifth step of decision making, competent responders evaluate the likely positive and negative consequences of their potential responses, place value on those consequences, and select an optimal response to enact, whereas aggressive responders either fail to think about consequences (and instead respond impulsively) or evaluate the consequences of aggression as favorable by placing high value on short-term, selfish gains (Slaby & Guerra, 1988).

Prospective studies show that children develop stable patterns of processing social information at each of these steps, and these patterns predict growth in antisocial behavior across development, even when previous behavior is controlled (Dodge, Pettit, Bates, & Valente, 1995). Furthermore, processing patterns can be predicted from earlier life experiences, such as physical maltreatment (Pollak & Tolley-Schell, 2003) and peer social rejection (Dodge et al., 2003), and these processing patterns mediate the effect of those early experiences on later antisocial behavior (Dodge, Bates, & Pettit, 1990; Weiss, Dodge, Bates, & Pettit, 1992). This body of empirical findings supports the general hypothesis that social-information-processing patterns guide the development of antisocial-behavior problems, but the strength of the evidence has been limited by its correlational nature. Although attempts

have been made to account for confounding factors (Dodge et al., 1995), unmeasured third variables loom as alternate explanations.

Preventive Interventions in Antisocial Behavior

Numerous preventive interventions have been founded on the premises of the social-cognitive tradition; such interventions have been based on the assertion that training in social-cognitive processes can interrupt the adverse effect of early environmental experience and steer a child toward socially competent, nonaggressive behaviors. Guerra and Slaby (1990) taught decision-making skills to adolescent offenders. Hudley and Graham (1993) trained aggressive boys to make nonhostile attributions. Lochman and Wells (2004) taught coping skills to preadolescent aggressive boys. Jones, Brown, and Aber (2011) examined the results of a program focused on the use of the “4 Rs” (reading, writing, respect, and resolution) to promote social cognitive processes and reported its favorable impact on elementary school children’s teacher-rated aggressive behavior 2 years after intervention. Specifically, the intervention reduced hostile-attribution biases, decreased aggressive response strategies, and altered normative beliefs about aggression.

Durlak et al.’s (2011) meta-analysis of 213 prevention studies that aimed to enhance social-emotional learning yielded mean intervention effect sizes of .56 on these skills and .22 on conduct-problem behavior measured immediately after intervention. Six months later, the impact of intervention remained significant, although the effect sizes were reduced (.26 and . 14 for social-emotional learning and conduct problems, respectively). Wilson and Lipsey’s (2007) meta-analysis yielded a mean intervention effect size of .21 for school-based cognitive-behavioral programs on aggressive and disruptive behavior.

Analysis of mediation in intervention trials is less common. Cunha and Heckman (2010) found that what they termed “noncognitive traits” (but not academic skills) accounted for the Perry Preschool Project’s positive impact on adult outcomes. Raver et al. (2011) found that self-regulation skills mediated the impact of intervention on preschoolers’ kindergarten outcomes. Using the Fast Track intervention sample reported in the current study, the Conduct Problems Prevention Research Group (CPPRG, 2002b) focused on a cluster of five variables that had been targeted for intervention (parent discipline, parent behavior change, special-education placement, hostile-attribution bias, and competent response generation). The group found that the effect of intervention on these variables as measured in Grade 3 significantly mediated the effect of intervention on aggressive behavior as measured in Grade 4 and marginally mediated the effect of intervention on association with deviant peers as measured in Grade 4. When they analyzed just the two social-cognitive mediators, they found marginal evidence that hostile-attribution biases in Grade 3 mediated the impact of intervention on association with substance-using peers in Grade 4. These findings are consistent with social-cognitive models of development and prevention, but the evidence is incomplete. A study is needed that focuses on a more comprehensive array of social-cognitive variables with a longer-term antisocial-behavior outcome.

The Current Study

The Fast Track Program exposed high-risk kindergarten children to a multiyear intervention that addressed their social-cognitive processes through small group activities, classroom curricula, parent training, peer coaching, and tutoring. Intent-to-treat analyses of a randomized controlled trial yielded significant main effects of intervention on children’s aggressive behavior after Grade 1 (CPPRG, 1999), Grade 3 (CPPRG, 2002b), Grades 4 and 5 (CPPRG, 2004), and Grade 9 (CPPRG, 2007). Not all analyses yielded significant effects (e.g., no effects were found in Grades 7 and 8; CPPRG, 2010), and some analyses yielded significant effects only for the highest-risk subgroup (e.g., CPPRG, 2011).

Analyses of intervention's impact on social-cognitive processes yielded significant effects after Grade 1 on emotion recognition, competent response generation, and endorsement of retaliation (CPPRG, 1999); after Grade 3 on hostile-attribution biases ($p < .06$) and competent response generation ($p < .06$; CPPRG, 2002b); and after Grades 4 and 5 on a composite of hostile-attribution biases, retribution goals, response generation, and response evaluation (CPPRG, 2004). In the current study, we tested the hypothesis that intervention's impact on social-cognitive processes in Grades 1 through 5 would mediate intervention's impact on antisocial behavior after Grade 9.

Method

Participants

Kindergarten children from four geographic sites were screened as high-risk for adolescent antisocial behavior: The sites were Durham, North Carolina (90% ethnic minority, 10% ethnic majority; 80% qualified for reduced lunch price, an indicator of poverty); Nashville, Tennessee (54% ethnic minority, 46% ethnic majority; 78% qualified for reduced lunch price); Seattle, Washington (52% ethnic minority, 48% ethnic majority; 45% qualified for reduced lunch price); and rural central Pennsylvania (1% minority, 99% majority; 39% qualified for reduced lunch price). High-risk schools in each site (12 in Durham, 9 in Nashville, 16 in Seattle, and 18 in Pennsylvania) were selected based on crime and poverty statistics of the communities they served. In each site, schools were placed into one, two, or three paired sets matched for demographics (size, proportion of students who qualified for reduced lunch, and ethnic composition); within each pair, one set was randomly assigned to an intervention condition and the other set to a control condition.

A multiple-gating screening procedure (see Lochman & CPPRG, 1995, for details) that combined teacher and parent ratings of disruptive behavior was applied to all 9,594 kindergarteners across three cohorts (1991–1993) in these 55 schools. Children were selected based on a within-site standardized screen score by moving from the highest score downward until desired sample sizes were reached within sites, cohorts, and conditions. Ultimately, 891 children ($n = 445$ for the intervention condition and $n = 446$ for the control condition) participated. The mean externalizing-scale T score on the Kindergarten Teacher's Report Form of the Child Behavior Checklist (Achenbach, 1991) was 66.4 (national mean = 50, $SD = 10$).

The mean age of participants at the time of identification was 6.5 years ($SD = 0.48$) and at outcome was 15.8 years. The sample was 51% African American, 47% European American, and 2% other ethnicity, and consisted of 69% boys and 31% girls. Written consent from parents and oral assent from children were obtained. Parents were paid for completing interviews, and intervention-group parents were paid for group attendance. All procedures were approved by the institutional review boards of participating universities.

The Fast Track intervention

During the elementary school phase (Grades 1–5), intervention families were offered child social-cognitive skills training, academic tutoring, and parent training with home visiting. Parent and child group interventions were conducted during a 2-hr enrichment program that included social-cognitive skill-training friendship groups led by educational coordinators (Bierman, Greenberg, & CPPRG, 1996), parent-training groups led by family coordinators, and guided parent-child sharing time (McMahon, Slough, & CPPRG, 1996). Twenty-two weekly sessions were held during Grade 1, 14 biweekly sessions were held during Grade 2, and 9 monthly sessions were held each year during Grades 3 through 5. In addition, a universal curriculum to promote social-cognitive skills (the Fast Track adaptation of

Promoting Alternate Thinking Strategies, or PATHS, by Kusche & Greenberg, 1994) was provided to the classrooms in intervention schools across Grades 1 through 5. During Grades 6 through 9, adolescent developmental issues were addressed with group meetings for parents and children.

Intervention participation was defined as attendance at one or more group sessions—96% of parents and 98% of children participated during Grade 1. Of these families, 79% of parents and 90% of children attended at least 50% of all Grade 1 sessions (CPPRG, 2002a). Nonparticipation increased modestly across years, primarily because of residential moves. Intervention fidelity was ensured by manualization of all components, regular cross-site training and communication, weekly staff training, and ongoing clinical supervision. Outside interventions were neither encouraged nor discouraged and were assumed to occur at the same rate for participants in intervention and control groups.

Measures

Child social-cognitive processes—We measured five steps of children's social-cognitive processes in Grade 1 through Grade 5. Emotion-recognition skill (Step 1) was measured after Grade 1 using the Emotion Recognition Questionnaire (Ribordy et al., 1988). The child was asked to identify the emotion depicted in each of 16 vignettes (4 each for happiness, sadness, being worried, and anger). The coefficient alpha based on items used to create parcels for structural equation modeling was .60. Emotion-recognition skill was not measured in later years because of ceiling effects.

Hostile-attribution bias (Step 2) was measured after Grade 3 using the Home Interview With Child (HIC; CPPRG, 1991) measure, which described eight situations, and after Grades 4 and 5 using the What Do You Think (WYT; CPPRG, 1995) measure, which depicted six vignettes. Each latent construct captures the child's bias to attribute a peer provocateur's intentions to hostility when the offender ambiguously inflicts harm to the child (HIC: $\alpha = .68$; WYT: $\alpha = .61$). These measures were not included earlier in the study because of unreliability.

Retributional goal setting (Step 3) was measured using the WYT after Grades 4 and 5. This measure reflects the child's endorsement of retribution goals if confronted with an ambiguous provocation ($\alpha = .82$).

Response generation (Step 4) was measured after Grade 1 using the Social Problem Solving (SPS; CPPRG, 1991) measure, which described eight situations, and after Grades 4 and 5 using the WYT. The measures ask a child how he or she would solve a challenging peer group social initiation or provocation situation depicted in drawings. The SPS construct captures a child's tendency to generate socially competent responses ($\alpha = .73$). The WYT construct measures a child's tendency to generate aggressive responses ($\alpha = .69$).

Response evaluation (Step 5) was measured after Grades 4 and 5 using the WYT. Children were presented with several stories, and for each story, the child was presented with a hostile and a benign response and asked how effective and how acceptable each response would be. This construct measures the child's tendency to evaluate aggressive responses as effective and acceptable ($\alpha = .81$).

Adolescent antisocial behavior—Items from the Self-Reported Delinquency (SRD) instrument from the Denver Youth Survey (Elliott, Huizinga, & Ageton, 1985) measured antisocial behavior after Grade 9. This instrument documents, with high reliability and validity (Huizinga & Elliott, 1986), the number of times each of 25 acts, such as property damage, theft, assault, and substance use, was committed in the past year. Given the highly

skewed item distributions, items were truncated as no offense (scored 0), one offense (scored 1), and two or more offenses (scored 2). We rank-ordered the items by means and then averaged the item having the highest mean with the item having the lowest mean, the item having the second highest mean with the item having the second lowest mean, and so forth to create 13 new variables. We repeated the process until we created four subscales from the original 25 items (three subscales averaging across 6 items and one sub-scale averaging across 7 items), with subscales having similar means. The subscales were used to create a latent construct for adolescent antisocial behavior ($\alpha = .87$).

Results

Although the components of analyses are latent constructs derived from item clusters, Table 1 presents the instrument means, standard deviations, sample sizes, and interinstrument correlations for descriptive purposes. The analytic plan followed from four tests that are used in classic mediation testing.

Effect of intervention on adolescent antisocial behavior

Controlling for race, gender, cohort, site, and initial kindergarten risk score, we estimated the impact of random assignment to the intervention condition on the antisocial-behavior construct using a multigroup measurement-invariant structural equation model with standard errors clustered by kindergarten school to account for the initial randomization process. Full-information maximum-likelihood estimation accounted for missing data under the assumption that data were missing at random. The results are reported in Table 2, with fit indices rated as good following the procedures of Kline (2004). Each of the four parcels of items contributed significant variance to the antisocial-behavior construct. The mean antisocial-behavior-construct score for children assigned to the intervention group was −0.16 points lower than the mean among children assigned to the control condition ($p < .01$). Inspection of histograms of scores by groups indicated that the intervention group had a lower proportion of members with scores at the high end of the scale (item means > .3; .152 of the control group and .109 of the intervention group) and a higher proportion of members with scores at the low end of the scale (item means < .1; .614 of the control group and .686 of the intervention group). This finding is consistent with earlier reports based on a manifest scale (CPPRG, 2007).

Effect of intervention on social-cognitive processes

Latent constructs for each potential social-cognitive mediator were constructed based on the parcel method (Russell, Kahn, & Altmaier, 1998). First, factor loadings based on all items were rank-ordered, and items were divided into parcels such that the average loadings were equalized across groups. The sums across items in each parcel were then used as indicators for the latent construct. The benefits of this procedure are that it creates factor indicators that more closely follow a normal distribution, it increases model parsimony, and it enhances model fit by minimizing idiosyncrasies of items.

For each mediator, we estimated a multiple-group, measurement-invariant structural equation model (with groups indicated by intervention condition). The antisocial-behavior construct was estimated as a function of the child's initial risk score, gender, race, cohort, site, and the mediator. The mediator was simultaneously estimated as a function of the child's initial risk score, gender, race, cohort, and site. Standard errors were clustered by kindergarten school to account for the randomization process, and full-information maximum-likelihood estimation accounted for data missing at random. Table 3 summarizes the findings for the impact of random assignment to the intervention condition on each of the seven social-cognitive constructs.

Intervention had a significant impact on four of the seven constructs and a marginal impact on a fifth construct. Intervention was associated with higher emotion-recognition skills, lower hostile-attribution biases, more competent response generation, and response evaluation that devalued aggression.

Effect of social-cognitive processes on antisocial behavior

Table 4 shows the impact of each mediator on the antisocial-behavior construct. Five of the seven tests yielded significant coefficients, with antisocial behavior after Grade 9 being significantly predicted from hostile-attribution biases, retribution goals, competent and aggressive response generation, and aggressive response evaluation after Grades 1 through 5.

Mediation of the effect of intervention on antisocial behavior

We tested the indirect effect of intervention on antisocial behavior as mediated by each social-cognitive construct for each model. Bias-corrected confidence intervals were based on 10,000 samples, following Preacher and Kelley (2011). If the indirect effect was significant, we calculated the ratio of indirect to total effect to assess the effect size of the mediation.

As Table 5 shows, we found evidence of mediation of intervention's effect on antisocial behavior for three social-cognitive processes. First, intervention's impact on antisocial behavior in Grade 9 was significantly mediated by intervention's impact on hostile-attribution bias in Grades 4 and 5 ($p < .05$; standardized coefficient = −0.02, 95% bias-adjusted CI = [−0.07, −0.001]), and 13% of intervention's impact on antisocial behavior was mediated by improvement in attribution biases. Second, the impact of intervention on children's competent response generation measured after Grade 1 significantly mediated the intervention's impact on antisocial behavior ($p < .05$; coefficient = −0.02, 95% bias-adjusted CI = [−0.06, −0.003]), with 14% of intervention's impact on antisocial behavior mediated by improvements in response generation. Finally, the impact of intervention on aggressive response evaluation in Grades 4 and 5 marginally mediated the intervention's impact on antisocial behavior ($p < .10$; indirect effect = −0.02, with 90% bias-adjusted CI = [−0.04, −0.001]), with 9% of intervention's impact on antisocial behavior mediated by response evaluation.

Finally, to assess the joint effect across the three significant mediators, we estimated a single multiple-group, measurement-invariant structural equation model that included these three mediators, with the same analytic parameters as in previous models. The three mediators were allowed to covary. As Table 6 and Figure 1 show, the model had good fit. The indirect effect of intervention on antisocial behavior as mediated by social-cognitive processes was significant ($p < .05$), and 27% of intervention's impact on antisocial behavior after Grade 9 was mediated by the combined impact of intervention on hostile-attribution bias, competent response generation, and aggressive response evaluation.

Discussion

We found that the long-term positive impact of the Fast Track preventive intervention on reducing antisocial behavior in adolescence was partially accounted for by improvements in social-cognitive processes during elementary school, specifically, improving the benign attribution of peer provocations, increasing the generation of competent responses to social problems, and improving the evaluation of the outcomes of aggression as detrimental. These findings provide the most rigorous evidence to date testing the major theory of how adolescent problem behaviors develop across the life span, and they can guide future interventions.

Virtually all prior tests of a social-cognitive model of the development of adolescent antisocial behavior have been conducted in purely descriptive cross-sectional or prospective studies (Dodge et al., 2006). The current findings are based on an intervention experiment in which social-cognitive processes were altered through random assignment to intervention. When children improve these processes through intervention during elementary school, they decrease their antisocial behavior during adolescence. This finding is the strongest evidence ever reported that social-cognitive processes are a major psychological mechanism through which life experiences are stored and represented internally to guide later behavior. The study shows that the theories and methods of social-psychological experiments are relevant to the real-world behavior of aggressive children.

Which social-cognitive processes are crucial? The empirical findings support the roles of core processes of making benign (rather than hostile) attributions about other people's intentions, generating competent responses to social challenges, and evaluating the outcomes of aggressing ahead of time as unfavorable. These are by no means the only social-cognitive processes that might be important, but both theory and empirical findings support their central role.

Many programs to prevent antisocial behavior in children follow a logic model that focuses on proximal improvement in children's social competence, particular social-cognitive skills, as an indirect way to prevent distal problem-behavior outcomes. Although some programs have been at least somewhat successful in preventing adolescent antisocial behavior, it has not been clear how those programs achieved their outcomes, nor what the important proximal indicators are of successful programs. The findings of this study reveal that an important mechanism in intervention is the manner in which children process social information. To the extent that the Fast Track intervention succeeded in the proximal goal of improving these processes, long-term positive outcomes accrued. Perhaps more important than any specific intervention practices utilized in Fast Track is the mediating role of social-cognitive processes. Other intervention programs might take different (perhaps even better) approaches to intervening to improve these processes, but the current findings suggest that they will be successful in achieving long-term behavioral goals if they can improve social-cognitive processes in the short term.

Does a program improve outcomes by addressing multiple social-cognitive processes? Although descriptive studies have found that multiple processes improve model fit (e.g., Dodge et al., 1986; Dodge et al., 1995), the current findings are equivocal regarding the incremental roles of multiple processes. Although each of the three processes increased the proportion of variance accounted for in the long-term impact of intervention, the significance levels that tested unique increments did not meet standard criteria (ps = .17, 07, and .12, for hostile-attribution bias, competent response generation, and aggressive response evaluation, respectively).

How do we explain the nonsignificant social-cognitive findings in this report? Two social-cognitive processes (accurate encoding of cues and setting of retribution goals) were also hypothesized to be mediators, but the evidence did not support mediation. First, although intervention had a positive impact on children's accurate recognition of emotions after first grade, this process did not significantly predict antisocial behavior after ninth grade. It is plausible that this process is not crucial to antisocial development, or, alternately, that continued intervention and measurement is necessary in subsequent grades. Second, although setting of retribution goals predicted adolescent antisocial behavior (thus supporting this process in antisocial development), intervention did not have a significant impact on this process. It is plausible that a different intervention would have been more successful.

The current study had three limitations. First, although the evidence was based on experimental manipulation through intervention, the test of mediation nonetheless relied on correlations between social-cognitive processes in elementary school and antisocial behavior outcomes up to 8 years later. It is plausible that an unmeasured third variable would account for both intervention impacts. This variable might be yet another social-cognitive process or could be an entirely different mechanism (e.g., parenting; CPPRG, 2002b). Given the findings of Heckman (2006), it is doubtful that academic skills account for the findings because the Fast Track intervention did not have a sustained impact on a composite measure of academic outcomes in Grades 4 and 5 (derived from achievement test scores, grades, and grade retention; CPPRG, 2004), and so mediation by academic skills would not be plausible. The best way to test the possibility of third-variable causation will be through inclusion of more third variables in future models.

A second limitation is the possibility of diverse pathways for different subgroups. We did not have sufficient statistical power to test mediation separately for each of many subgroups, and although the findings held for the entire sample, they might not hold within each group. Finally, a limitation concerning the nonsignificant findings is that inadequate or poor timing of measurement might mask actual mediation effects.

In sum, this randomized controlled prevention trial provided evidence that social-cognitive processes mediate antisocial behavioral development, a finding that supports both prevention planning and developmental models.

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References

Achenbach, TM. Manual for Teacher's Report Form and 1991 Profile. Burlington: University of Vermont; 1991.

Bierman, KL.; Greenberg, MT. the Conduct Problems Prevention Research Group. Social skills training in the Fast Track Program. In: Peters, RD.; McMahon, RJ., editors. Preventing childhood disorders, substance use, and delinquency. Thousand Oaks, CA: Sage; 1996. p. 65-89.

Blair C. School readiness: Integrating cognition and emotion in a neurobiological conceptualization of child functioning at school entry. American Psychologist. 2002; 57:111–127. [PubMed: 11899554]

Conduct Problems Prevention Research Group. Home Interview With Child. 1991. Retrieved from http://www.fasttrackproject.org/techrept/h/hic/

Conduct Problems Prevention Research Group. What do you think. 1995. Retrieved from http://www.fasttrackproject.org/techrept/w/wyt/

Conduct Problems Prevention Research Group. Initial impact of the Fast Track prevention trial for conduct problems: I. The high-risk sample. Journal of Consulting and Clinical Psychology. 1999; 67:631–647. [PubMed: 10535230]

Conduct Problems Prevention Research Group. The implementation of the Fast Track program: An example of a large-scale prevention science efficacy trial. Journal of Abnormal Child Psychology. 2002a; 30:1–17. [PubMed: 11930968]

Conduct Problems Prevention Research Group. Using the Fast Track randomized prevention trial to test the early-starter model of the development of serious conduct problems. Development and Psychopathology. 2002b; 14:927–945.

Conduct Problems Prevention Research Group. The effects of the Fast Track program on serious problem outcomes at the end of elementary school. Journal of Clinical Child and Adolescent Psychology. 2004; 33:650–661. [PubMed: 15498733]

Conduct Problems Prevention Research Group. Fast Track randomized controlled trial to prevent externalizing psychiatric disorders: Findings from Grades 3 to 9. Journal of the American Academy of Child & Adolescent Psychiatry. 2007; 46:1250–1262. [PubMed: 17885566]

Conduct Problems Prevention Research Group. The difficulty of maintaining positive intervention effects: A look at disruptive behavior, deviant peer relations, and social skills during the middle school years. Journal of Early Adolescence. 2010; 30:593–624.

Conduct Problems Prevention Research Group. The effects of the Fast Track preventive intervention on the development of conduct disorder across childhood. Child Development. 2011; 82:331–345. [PubMed: 21291445]

Crick NR, Dodge KA. A review and reformulation of social information-processing mechanisms in children's social adjustment. Psychological Bulletin. 1994; 115:74–101.

Cunha F, Heckman JJ. Investing in our young people. National Bureau of Economic Research Working Paper Series. 2010 Jul.w16201 Retrieved from http://ssrn.com/abstract=1641577.

Dodge KA. Social cognition and children's aggressive behavior. Child Development. 1980; 51:162–170. [PubMed: 7363732]

Dodge KA, Bates JE, Pettit GS. Mechanisms in the cycle of violence. Science. 1990; 250:1678–1683. [PubMed: 2270481]

Dodge, KA.; Coie, JD.; Lynam, D. Aggression and antisocial behavior in youth. In: Damon, W.; Eisenberg, N., editors. Handbook of child psychology: Vol. 3. Social, emotional, and personality development. 6. New York, NY: Wiley; 2006. p. 719-788.

Dodge KA, Lansford JE, Burks VS, Bates JE, Pettit GS, Fontaine R, Price JM. Peer rejection and social information-processing factors in the development of aggressive behavior problems in children. Child Development. 2003; 74:374–393. [PubMed: 12705561]

Dodge KA, Pettit GS, Bates JE, Valente E. Social information-processing patterns partially mediate the effect of early physical abuse on later conduct problems. Journal of Abnormal Psychology. 1995; 104:632–643. [PubMed: 8530766]

Dodge KA, Pettit GS, McClaskey CL, Brown M. Social competence in children. Monographs of the Society for Research in Child Development. 1986; 51(2 Serial No 213)

Durlak JA, Weissberg RP, Dymnicki AP, Taylor RD, Schellinger KB. The impact of enhancing students' social and emotional learning: A meta-analysis of school-based universal interventions. Child Development. 2011; 82:405–432. [PubMed: 21291449]

Elliott, DS.; Huizinga, D.; Ageton, SS. Explaining delinquency and drug use. Beverly Hills, CA: Sage; 1985.

Erdley CA, Asher SR. Children's social goals and self-efficacy perceptions as influences on their responses to ambiguous provocation. Child Development. 1996; 67:1329–1344. [PubMed: 8890486]

Guerra NG, Slaby RG. Cognitive mediators of aggression in adolescent offenders: II. Intervention. Developmental Psychology. 1990; 26:269–277.

Heckman JJ. Skill formation and the economics of investing in disadvantaged children. Science. 2006; 312:1900–1902. [PubMed: 16809525]

Hudley C, Graham S. An attributional intervention to reduce peer-directed aggression among African American boys. Child Development. 1993; 64:124–138. [PubMed: 8436025]

Huesmann LR. An information-processing model for the development of aggression. Aggressive Behavior. 1988; 14:13–24.

Huizinga D, Elliott DS. Reassessing the reliability and validity of self-report delinquency measures. Journal of Quantitative Criminology. 1986; 2:293–327.

Jones SM, Brown JL, Aber JL. Two-year impacts of a universal school-based social-emotional and literacy intervention: An experiment in translational developmental research. Child Development. 2011; 82:533–554. [PubMed: 21410922]

Kline, RB. Beyond significance testing. Washington, DC: American Psychological Association; 2004.

Kusche, CA.; Greenberg, MT. The PATHS curriculum. Seattle, WA: Developmental Research and Programs; 1994.

Larsen RW, Angus RM. Adolescents' development of skills for agency in youth programs: Learning to think strategically. Child Development. 2011; 82:277–294. [PubMed: 21291442]

Lochman JE. Self- and peer perceptions and attributional biases of aggressive and nonaggressive boys in dyadic interactions. Journal of Consulting and Clinical Psychology. 1987; 55:404–410. [PubMed: 3597956]

Lochman JE. the Conduct Problems Prevention Research Group. Screening of child behavior problems for prevention programs at school entry. Journal of Consulting and Clinical Psychology. 1995; 63:549–559. [PubMed: 7673532]

Lochman JE, Wells KC. The coping power program for preadolescent boys and their parents: Outcome effects at the 1-year follow-up. Journal of Consulting and Clinical Psychology. 2004; 72:571–578. [PubMed: 15301641]

McMahon, RJ.; Slough, NM. the Conduct Problems Prevention Research Group. Family-based intervention in the Fast Track Program. In: Peters, RD.; McMahon, RJ., editors. Preventing childhood disorders, substance use, and delinquency. Thousand Oaks, CA: Sage; 1996. p. 90-110.

Pollak SD, Tolley-Schell SA. Selective attention to facial emotion in physically abused children. Journal of Abnormal Psychology. 2003; 112:323–338. [PubMed: 12943012]

Preacher KJ, Kelley K. Effect size measures for mediation models: Quantitative strategies for communicating indirect effects. Psychological Methods. 2011; 16:93–115. [PubMed: 21500915]

Rabiner DL, Lenhart L, Lochman JE. Automatic versus reflective social problem solving in relation to children's sociometric status. Developmental Psychology. 1990; 26:1010–1016.

Raver CC, Jones SM, Li-Grining C, Zhai F, Bub K, Pressler E. CSRP's impact on low-income preschoolers' preacademic skills: Self-regulation as a mediating mechanism. Child Development. 2011; 82:362–378. [PubMed: 21291447]

Ribordy SC, Camras LA, Stefani R, Spaccarelli S. Vignettes for emotion recognition research and affective therapy with children. Journal of Clinical Child Psychology. 1988; 17:322–325.

Russell DW, Kahn J, Spoth R, Altmaier EM. Analyzing data from experimental studies: Illustration of a latent variable structural equation modeling approach. Journal of Counseling Psychology. 1998; 45:18–29.

Simon HA. Motivational and emotional controls of cognition. Psychological Review. 1967; 74:29–39. [PubMed: 5341441]

Slaby RG, Guerra NG. Cognitive mediators of aggression in adolescent offenders: II. Assessment. Developmental Psychology. 1988; 24:580–588.

Weiss B, Dodge KA, Bates JE, Pettit GS. Some consequences of early harsh discipline: Child aggression and a maladaptive social information processing style. Child Development. 1992; 63:1321–1335. [PubMed: 1446555]

Wilson SJ, Lipsey MW. School-based interventions for aggressive and disruptive behavior: Update of a meta-analysis. American Journal of Preventive Medicine. 2007; 33(Suppl 2S):130–143.

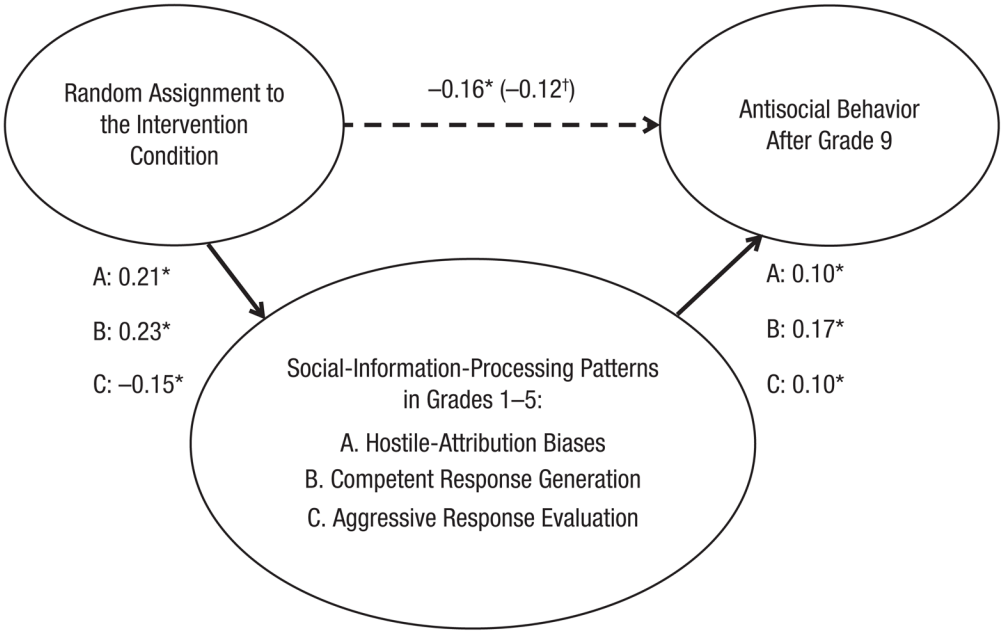

Fig. 1.

Structural equation model depicting the influence of random assignment to the intervention condition on antisocial behavior (assessed after children completed Grade 9), as mediated by three social-cognitive processes. The three mediators were allowed to covary. Asterisks indicate significant path coefficients (*$p < .05$; $^{\dagger}p < .10$). Along the upper path, the value outside parentheses is the coefficient for the effect of condition on antisocial behavior in the model without mediators, whereas the value inside parentheses is the coefficient for the effect of condition on antisocial behavior in the model with mediators.

Table 1

Descriptive Statistics and Bivariate Correlations Among Scales

	Intervention group			Control group			Bivariate correlations						
Measure	***n***	***M***	***SD***	***n***	***M***	***SD***	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1. ERQ	429	0.81	0.13	424	0.76	0.15	—						
2. HIC AB	404	0.61	0.24	385	0.65	0.26	.06	—					
3. WYT AB	412	3.16	0.77	402	3.26	0.76	.09**	.34**	—				
4. WYT GS	412	2.43	0.70	402	2.43	0.69	.18**	.11**	.37**	—			
5. SPS RG	428	0.71	0.17	425	0.67	0.18	−.07†	−.02	−.03	−.07*	—		
6. WYT RG	412	0.20	0.25	402	0.22	0.28	.14**	.19**	.40**	.60**	−.06†	—	
7. WYT RE	412	2.46	0.79	402	2.50	0.75	.15**	.16**	.31**	.63**	−.04	.55**	—
8. SRD antisocial behavior	347	0.09	0.17	334	0.11	0.19	.01	.06	.09**	.18**	−.07†	.14**	.15**

Note: Emotion-recognition skill was measured after Grade 1 using the Emotion Recognition Questionnaire (ERQ; Ribordy, Camras, Stefani, & Spaccarelli, 1988). Hostile-attribution bias (AB) was measured after Grade 3 using the Home Interview With Child (HIC; Conduct Problems Prevention Research Group, or CPPRG, 1991) measure and after Grades 4 and 5 using the What Do You Think (WYT; CPPRG, 1995) measure. Retributional goal setting (GS) was measured using the WYT measure after Grades 4 and 5. Response generation (RG) was measured after Grade 1 using the Social Problem Solving (SPS; CPPRG, 1991) measure and after Grades 4 and 5 using the WYT. Response evaluation (RE) was measured after Grades 4 and 5 using the WYT. Antisocial behavior was measured after Grade 9 using items from the Self-Reported Delinquency (SRD) instrument from the Denver Youth Survey (Elliott, Huizinga, & Ageton, 1985).

† $p < .10$.

* $p < .05$.

** $p < .01$.

Table 2

Effect of Random Assignment to the Intervention Condition on Antisocial Behavior After Grade 9

Modeling outcome	Estimate	*p*
Factor loadings for antisocial-behavior construct		
Parcel 1	1.14	.001
Parcel 2	0.89	.001
Parcel 3	0.97	.001
Parcel 4	0.90	.001
Estimates of effect on antisocial-behavior construct after Grade 9		
Durham (vs. Seattle)	−0.30	.01
Nashville (vs. Seattle)	−0.04	.73
Pennsylvania (vs. Seattle)	−0.21	.05
Cohort 1 (vs. Cohort 3)	−0.03	.73
Cohort 2 (vs. Cohort 3)	−0.04	.69
Male (vs. female)	0.35	.001
Black (vs. White)	0.21	.07
Initial risk score	−0.02	.62
Intervention	−0.16	.01

Note: The fit indices for the structural equation model are as follows: $\chi^2 = 93.46$, $p < .03$; root-mean-square error of approximation = .03; confirmatory fit index = .975.

Table 3

Results of the Structural Equation Model: Effect of Random Assignment to the Intervention Condition on Social-Cognitive Processes in Grades 1 Through 5

Process and measure	Standardized coefficient	*p*
Emotion-recognition skill		
ERQ: Grade 1	0.44	.001
Hostile-attribution bias		
HIC: Grade 3	−0.18	.04
WYT: Grades 4 and 5	−0.21	.05
Retributional goal setting		
WYT: Grades 4 and 5	−0.02	n.s.
Response generation		
SPS: Grade 1 (competent response generation)	0.23	.001
WYT: Grades 4 and 5 (aggressive response generation)	−0.10	n.s.
Response evaluation (endorse aggression)		
WYT: Grades 4 and 5	−0.15	.06

Note: Emotion-recognition skill was measured after Grade 1 using the Emotion Recognition Questionnaire (ERQ; Ribordy, Camras, Stefani, & Spaccarelli, 1988). Hostile-attribution bias was measured after Grade 3 using the Home Interview With Child (HIC; Conduct Problems Prevention Research Group, or CPPRG, 1991) measure and after Grades 4 and 5 using the What Do You Think (WYT; CPPRG, 1995) measure. Retributional goal setting was measured using the WYT measure after Grades 4 and 5. Response generation was measured after Grade 1 using the Social Problem Solving (SPS; CPPRG, 1991) measure and after Grades 4 and 5 using the WYT. Response evaluation was measured after Grades 4 and 5 using the WYT.

Table 4

Results of the Structural Equation Model: Effect of Social-Cognitive Processes in Grades 1 Through 5 on Antisocial Behavior After Grade 9

Process and measure	Standardized coefficient	*p*
Emotion-recognition skill		
ERQ: Grade 1	0.06	n.s.
Hostile-attribution bias		
HIC: Grade 3	0.03	n.s.
WYT: Grades 4 and 5	0.10	.02
Retributional goal setting		
WYT: Grades 4 and 5	0.14	.01
Response generation		
SPS: Grade 1 (competent response generation)	−0.10	.04
WYT: Grades 4 and 5 (aggressive response generation)	0.17	.01
Response evaluation		
WYT: Grades 4 and 5	0.10	.02

Note: Emotion-recognition skill was measured after Grade 1 using the Emotion Recognition Questionnaire (ERQ; Ribordy, Camras, Stefani, & Spaccarelli, 1988). Hostile-attribution bias was measured after Grade 3 using the Home Interview With Child (HIC; Conduct Problems Prevention Research Group, or CPPRG, 1991) measure and after Grades 4 and 5 using the What Do You Think (WYT; CPPRG, 1995) measure. Retributional goal setting was measured using the WYT measure after Grades 4 and 5. Response generation was measured after Grade 1 using the Social Problem Solving (SPS; CPPRG, 1991) measure and after Grades 4 and 5 using the WYT. Response evaluation was measured after Grades 4 and 5 using the WYT.

Table 5

Mediation Results: Tests of Single Mediators of the Effect of Intervention on Antisocial Behavior

	Indirect effect			
Process and measure	**Standardized coefficient**	***p***	**95% CI**	**90% CI**
Emotion-recognition skill				
ERQ: Grade 1 (χ^2 = 230.55; RMSEA = .029; CFI = .959)	0.03	n.s.	[0.017, 0.080]	[0.009, 0.070]
Hostile-attribution bias				
HIC: Grade 3 (χ^2 = 174.57; RMSEA = .025; CFI = .978)	−0.01	n.s.	[−0.032, 0.011]	[−0.027, 0.007]
WYT: Grades 4 and 5 (χ^2 = 163.11; RMSEA = .020; CFI = .983)	−0.02	.05	[−0.07, −0.001]	[−0.06, −0.003]
Retributional goal setting				
WYT: Grades 4 and 5 (χ^2 = 241.19; RMSEA = .032; CFI = .967)	0.00	n.s.	[−0.031, 0.023]	[−0.025, 0.018]
Response generation				
SPS: Grade 1 (χ^2 = 206.56; RMSEA = .033; CFI = .958)	−0.02	.05	[−0.06, −0.003]	[−0.06, −0.006]
WYT: Grades 4 and 5 (χ^2 = 174.79; RMSEA = .025; CFI = .976)	−0.02	n.s.	[−0.06, 0.009]	[−0.055, 0.004]
Response evaluation				
WYT: Grades 4 and 5 (χ^2 = 196.33; RMSEA = .032; CFI = .971)	−0.02	< .10	[−0.052, 0.000]	[−0.04, −0.001]

Note: Emotion-recognition skill was measured after Grade 1 using the Emotion Recognition Questionnaire (ERQ; Ribordy, Camras, Stefani, & Spaccarelli, 1988). Hostile-attribution bias was measured after Grade 3 using the Home Interview With Child (HIC; Conduct Problems Prevention Research Group, or CPPRG, 1991) measure and after Grades 4 and 5 using the What Do You Think (WYT; CPPRG, 1995) measure. Retributional goal setting was measured using the WYT measure after Grades 4 and 5. Response generation was measured after Grade 1 using the Social Problem Solving (SPS; CPPRG, 1991) measure and after Grades 4 and 5 using the WYT. Response evaluation was measured after Grades 4 and 5 using the WYT. CFI = confirmatory fit index; CI = confidence interval; RMSEA = root-mean-square error of approximation.

Table 6

Results of the Joint Mediation Model

Effect	Estimate	*p*	95% CI
Effect of intervention on hostile-attribution bias	−0.21	.05	—
Effect of intervention on competent response generation	0.23	.001	—
Effect of intervention on aggressive response evaluation	−0.15	.06	—
Unique effect of hostile-attribution bias on antisocial behavior	0.07	.17	—
Unique effect of response generation on antisocial behavior	−0.09	.07	—
Unique effect of response evaluation on antisocial behavior	0.07	.12	—
Direct effect of intervention on antisocial behavior, after mediators	−0.12	.08	—
Joint indirect effect	−0.05	.05	[−0.10, −0.01]
Ratio of indirect to total effect	0.27	.05	[0.05, 1.00]

Note: The structural-equation-model fit indices for the joint mediator model were as follows: χ^2 = 421.16; root-mean-square error of approximation = .026; confirmatory fit index = .969. CI = confidence interval.