

Mediators of Effects of a Selective Family-Focused Violence Prevention

Approach for Middle School Students

The Multisite Violence Prevention Project

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**Abstract**

This study examined how parenting and family characteristics targeted in a selective prevention program mediated effects on key youth proximal outcomes related to violence perpetration. The selective intervention was evaluated within the context of a multi-site trial involving random assignment of 37 schools to four conditions: A universal intervention composed of a student social-cognitive curriculum and teacher training, a selective family-focused intervention with a subset of high-risk students, a condition combining these two interventions, and a no-intervention control condition. Two cohorts of sixth-grade students (total  $N = 1062$ ) exhibiting high levels of aggression and social influence are the sample for this study. Analyses of pre-post change compared to controls using intent-to-treat analyses found no significant effects. However, estimates incorporating participation of those assigned to the intervention and predicted participation among those not assigned revealed significant positive effects on student aggression, use of aggressive strategies for conflict management, and parental estimation of student's valuing of achievement. Findings also indicated intervention effects on two targeted family processes: Discipline practices and family cohesion. Mediation analyses found evidence that change in these processes mediated effects on some outcomes, notably aggressive behavior, and valuing of school achievement. Results support the notion that changing parenting practices and the quality of family relationships can prevent the escalation in aggression and maintain positive school engagement for high-risk youth.

Key Words: Violence prevention, middle school, family intervention.

## Mediators of Proximal Effects of a Selective Family-Focused Violence Prevention

### Approach for Middle School Students

With the growing roster of beneficial prevention efforts for major public and behavioral health problems, there is increasing interest in extending our understanding beyond the basic information that interventions affect their intended outcomes (Farrington & Welsh, 2007). In particular, it is important to determine whether intervention effects can be attributed to changes in the risk and protective factors they target (i.e., the action theory; Chen, 1990) and in accordance with the underlying theoretical formulation of preventive impact (i.e., the conceptual theory; Chen, 1990; Flay et al., 2005; Guerra, Williams, Tolan, & Modecki, 2008). Such tests not only elaborate understanding about the meaning of intervention effects (or lack thereof) but also can provide a needed test of key contentions about developmental psychopathology and ecological contributors to risk (Chen, 1990; Tolan, Szapocznik, & Sambrano, 2007).

Analyses of mediated relations permit testing both the action theory and the conceptual theory of a preventive intervention (MacKinnon, 2008, p. 39). Labeling the intervention-to-mediator effect  $a$ , the mediator-to-outcome relation  $b$ , the intervention-to-outcome effect  $c$ , and representing the mediated effect by  $ab$  (the indirect effect of the intervention on the outcome via the mediator) and  $c'$  (the intervention-to-outcome relation with the mediator in the model), three results other than full mediation are possible. First, an intervention may have effects on outcomes or functional markers but this may not be due to the factors theorized to explain the difference ( $c$  is significant but  $ab$ ,  $b$  and possibly  $a$  are not, representing failure of action theory; MacKinnon, Taborga, & Morgan-Lopez, 2002). Second, an intervention may have effects on intended intervention targets but the theoretical relation is mis-specified such that there is no impact on the outcome even with effects on mediators ( $a$  is significant, but  $c$  and possibly  $b$  are not, representing a failure of conceptual theory; Flay, et al., 2005; MacKinnon,

Lockwood, Hoffman, West, & Sheets, 2002; MacKinnon et al., 2002). Third, both  $a$  and  $b$  may be significant but  $ab$  is not. A Monte Carlo study of detection of mediation found that the joint significance of  $a$  and  $b$  demonstrated both the highest statistical power to detect mediation and adequate protection from Type I error, compared to other approaches to assessing mediation (MacKinnon, Lockwood, et al., 2002).

Tests of mediation also should be constructed in a manner consistent with the theorized timing of mediated effects. Interventions aim at changing the relations among variables, thus, it is likely that a mediated intervention effect will only be visible at a time when the intervention has created its intended disequilibrium in the relations among variables (cf., MacKinnon, 2008, p. 196). In the case of the current study, change in parental effective discipline practices coupled with increasing family cohesion should precede change in youth behavior with only a brief interval of time in between, making it desirable to assess the effects of change in the mediator and change in the outcome in the intervention posttest assessment.

Thus, from both theoretical and methodological viewpoints, testing the mediation of proximal effects on outcomes thought to mark propensity for later outcomes (e.g., aggression or cognitions supporting aggression at post-test as markers for increased violence throughout adolescence) is an important aspect of testing the value of a prevention effort and for testing underlying theories guiding the interventions (Tolan & Gorman-Smith, 2002). Such tests can help (a) advance the evaluation of how preventive interventions work, (b) improve the validity of developmental psychopathology theories, and (c) enhance risk and protective factor formulations used to guide these efforts.

In recent years there has been a growing emphasis on the value of family-focused interventions to prevent violence for youth at high risk for violence (Metropolitan Area Child Study Research Group, 2002). Family-focused trials have suggested that efficacy is due to impact on parenting practices and

family relationships (Lochman & Wells, 2002; Patterson, DeGarmo, & Forgatch, 2004). However, tests of mediation of family intervention effects on outcomes related to aggression have returned mixed results. In analyses of the *Familias Unidas* program, Pantin and colleagues (2009) found results that suggested partial mediation of intervention effects on substance use, but no intervention effect or mediation on externalizing behaviors. However, other studies have found mediation of family intervention effects on aggression by mother-child relationship quality (Zhou, Sandler, Millsap, Wolchik, & Dawson-McClure, 2008), effective discipline practices (Bernat, August, Hektner, & Bloomquist, 2007), and a composite of harsh, responsive, and stimulating parenting (Brotman, O'Neal, Huang, Gouley, Rosenfelt, & Shrout, 2009).

### **Parenting and Family Processes Believed to Mediate Prevention Effects**

These studies of mediated intervention effects and others have identified patterns of potential mediators (Kaminski, Valle, Filene, & Boyle, 2008). Prominent among these are parenting practices that include use of consistent and contingent reward and correction, coupled with adequate monitoring of child activities and companions (Dishion & McMahon, 1998; Kaminski et al., 2008). Other studies have suggested that increasing parental involvement in schooling can have beneficial effects, particularly for high-risk youth (Tolan, Gorman-Smith, & Henry, 2004). Developmental risk studies have found that adolescent delinquency and violence tend to occur in families with low family organization, poor problem-solving abilities, and low cohesion that taxes family connections in times of stress (Sheidow, Henggeler, & Schoenwald, 2003; Tolan, 2002; Henry, Tolan, & Gorman-Smith, 2001).

The present report focuses on mediation of the proximal (immediate) effects of the GREAT Schools and Families selective intervention (Smith et al., 2004) on outcomes such as aggression and achievement motivation, through intervention-related changes in parenting practices and family relationship characteristics. Aggression and associated cognitions, along with school achievement, are proximal markers of risk for continued or increased violence as youth progress through adolescence

(USDHHS, 2001). Also, because victimization and perpetration risk are closely linked, particularly for high-risk youth, we tested for effects on victimization as well (Mercer, McMillen, & DeRosier, 2009).

Consistent with other studies of mediation in family intervention effects (Pantin et al., 2009; Brotman et al., 2009) and with systems theories (e.g., Bronfenbrenner, 1979; Minuchin, 1974), we expected that family intervention would impact multiple, interacting, family relationships and parenting practices variables, and that these in turn would be associated with broad, positive change in youth aggressive behavior, strategies for solving problems, and commitment to school. Our more specific expectations regarding mediated relations are illustrated in Figure 1. They may be described as follows. Regarding the relation between the initial variable and the mediator (*a*), through teaching and modeling, intervention sessions were designed to promote increased use of effective discipline practices and to lessen avoidance of discipline. Other intervention sessions encouraged increased parental involvement in the child's education, partly through teaching strategies to improve parent relationships with school personnel. Intervention activities had the theme of increasing general parental involvement with the child and monitoring of the child's activities. Sessions also stressed consistency of family rules and clarity of family organization. It was also believed that participation in the family intervention would improve the quality of family relationships, seen in evidence of greater family cohesion. The expected relations between mediating variables and outcome variables (*b*) derive from developmental risk studies (e.g., Tolan, Gorman-Smith, and Henry, 2003) that have linked parenting and family characteristics to academic and social behavior. Based on these studies, we expected that higher levels of parent involvement and more effective discipline practices would be associated with lower aggression and related variables (e.g., less endorsement of aggressive problem-solving strategies). Improved family relationships, coupled with more effective discipline and greater parental involvement were seen as likely to produce stronger evidence of youth commitment to school and to prevent decay in such commitment in adolescence (Tolan, Gorman-Smith, & Henry, 2004). We timed the intervention to

occur during a period when such commitment normally declines, and we organized the intervention to encourage parental involvement in school and other parenting and family characteristics thought to deter loss of engagement. Because of the importance of these intervening processes, we also tested hypotheses about mediation of change in school engagement of youth by targeted parenting and family processes. By promoting these protective processes, we hoped to reduce risk in those at elevated risk.

A developmental-ecological perspective suggests that intervention would modify typical developmental change and engagement in key tasks during this age period (Tolan, et al., 2007). As has been found consistently in other developmental studies, tracking our non-intervention control group has shown that for the general population there is precipitous and consistent deterioration in achievement, behavior, and important relationships with parents and teachers during middle school years (Multisite Violence Prevention Project [MVPP], 2009, 2010). Another prominent feature of the middle school years is the increasing importance of peers and their influences on youth behavior (Dodge, Lansford, & Dishion, 2006). For example, although peer acceptance and influence are relatively strongly and negatively related to aggression among children in the elementary grades, during middle school that relation diminishes and can even reverse (Miller-Johnson, Costanzo, Coie, Rose, Browne, & Johnson, 2003). Such an increase in the acceptability and influence of aggressive youth occurs at a time when peer influence on behavior becomes the most important factor in explaining aggression (Hawkins et al., 1992). This led us to consider high-risk youth as important targets for selective interventions not only because of their own aggressive tendencies but also because they may have substantial influence on others (Farrell & Camou, 2006).

In the present study we selected youth who were not only rated as elevated in aggression but also rated as having high levels of social influence. By selecting youth on these two characteristics, we believed that the intervention might change aggression in the general student population by reducing aggression in the most aggressive students and through the social influence of these aggressive youth on

others. Indeed, results from a randomly-selected sample of the full student bodies of participating schools found that the selective intervention was associated with positive effects on school levels of aggression (MVPP, 2009). Our finding that intervening with youth who have high levels of aggression and high social influence can have an ecological effect on overall levels of aggression in schools raises a number of questions. One of these questions, and the subject of this paper, concerns the extent to which the selective intervention changed its theoretical family-based mediators, and whether change in these mediators was associated with short-term change in key student outcomes that might have, over the course of middle school, produced the overall preventive effects.

### **The Present Study**

This study assesses the immediate (post-test) effects of the selective intervention of the Multisite Violence Prevention Project (MVPP, 2004). For these analyses we compared students in conditions that were assigned to receive the selective intervention (e.g., selective only and combined selective plus universal) with students in the no-intervention control and universal only condition. This report extends previous reports of effects on growth in the school-wide random sample (MVPP, 2009) and in the targeted sample that represent the population of aggressive and influential students that received the selective intervention (MVPP, 2011). The latter study found significant intervention effects in analyses weighted by intervention dosage for intervention effects that were theoretically consistent but marginal or non-significant in intent-to-treat analyses. These papers raise the question of how such intervention effects were mediated, leading to the present paper's focus on immediate post-intervention effects for the high-risk (targeted) sample. Specifically, in this study we analyzed short-term program effects on the eight outcomes included in MVPP (2011): Child aggression, victimization, use of aggressive strategies, use of prosocial strategies, aggressive cognitions, and achievement motivation. We also tested the direct effects of the intervention on parenting and family relationship characteristics, and examined if those effects mediated the outcome effects. All interventions were implemented over the school year,

with two successive cohorts of sixth graders beginning in 2001. Data for this report came from teacher ratings of individual students and student and parent reports and ratings that were collected during the fall (pretest) and spring (post-test) of the sixth-grade school year.

## **Method**

### **Settings and Participants**

Participants were two successive cohorts of high-risk (targeted) students and their families, selected from among sixth graders in 37 schools from four communities: Chicago, Illinois; Durham, North Carolina; Northeastern Georgia; and Richmond, Virginia. All participating schools included a high percentage of students from low-income families based on eligibility for the federal free or reduced lunch program (i.e., 42% to 96% across sites). Participating middle schools in Durham and Richmond included nearly all middle schools serving those urban public school systems. Middle schools in Georgia were those serving the six school districts in the Northeastern part of the state. Chicago schools served grades K-8 but all other schools were grade 6-8 middle schools. Additional details regarding school recruitment and community characteristics are reported in Henry, Farrell, and MVPP (2004).

The sample analyzed in this study consisted of 1062 male and female students, with their families, across the four experimental conditions. Eighty-six percent (86%) of those recruited consented to participate in the study, and 98% of those assessed at Wave 1 also were assessed at Wave 2. Of those, 1062 had sufficient data for inclusion in these analyses.

Over two-thirds of the students in the final sample (69%) were male; 70% reported their ethnic identification as Black or African-American, 15% as non-Hispanic White, and 15% as Latino/Hispanic ethnicity. Nearly two-thirds (61%) reported the presence of an adult male in the home. More detailed description of the demographic composition of the targeted sample can be found in another report (MVPP, 2010).

**Selection of targeted sample.** Two core sixth-grade teachers from each school identified students whose behavior was in the top 25% of aggression based on the following behaviors: 1) gets into physical fights, 2) intimidates others, 3) gets angry easily, and 4) encourages others to fight. They were then asked to rate each identified student on their level of social influence using four items (on a 1-5 scale): 1) *other students listen to him/her about how to behave and what is good, important, or cool*, 2) *he or she sets the trends among the students*, 3) *he or she seems to be respected by other students*, and 4) *other students try to be like and imitate him/her*. Those students with an average rating across teachers above 3.5 were selected. This cut score was set after inspection of distributions with an intention to select the 30-40% among the aggressive students rated most socially influential. Validity testing showed a strong correlation ( $r = .7$ ) between peer ratings of social influence and the results of this procedure (Henry, Miller-Johnson, Simon, Schoeny, & MVPP, 2006). This process identified up to 25 students to recruit at each school, with the specific number depending on grade size and our requirement to include at least 5% of the grade. Teachers were not informed that the identification was related to intervention eligibility.

### **Description of the Selective Intervention<sup>1</sup>**

The GREAT Families Program was a 15-week intervention conducted in groups of 4 to 8 high-risk students and their parent(s) or guardian(s) (see Smith, et al., 2004 for details). Multiple family groups were used to deliver the program efficiently and to encourage the development of social support among participants, normalize developmental and ecological challenges, and reinforce skill attainment and use (Quinn, 2004; Tolan, Gorman-Smith, & Henry, 2004). Each meeting started with sharing a meal provided by the project, followed by reviewing the prior week's homework assignment and a guided discussion of the topic scheduled for that week, with each one related to a core program area. Role-play, behavioral practice, and homework assignments were used to promote skill attainment and to

help with connecting within-session work to actual parenting and family challenges during the time between sessions.

All intervention providers had prior experience in family intervention. Most had a master's degree in psychology, social work, public health, or a related field, and had worked with high-risk populations similar to those in the program. Interventionists received approximately 20 hours of training in the theory, content, and delivery of the program and had ongoing weekly supervision with the trainer at their site. Weekly conference calls were used to maintain consistency and fidelity across sites. Training also addressed cultural issues for working with low income, minority families. Although efforts were made to match families and facilitators by race or ethnic background, this was not always possible. Site supervisors observed each interventionist during at least two sessions per cohort and interventionists and family members provided reports on completion of key activities to ensure fidelity.

Child-care for younger siblings and transportation were provided as needed. Families received increasing amounts for attendance over the course of the intervention (\$10 to \$25 per session). Interventionists kept in contact with families who missed sessions, and offered makeup sessions.

**Participation in the study and in the selective intervention.** Of those contacted for possible participation in the study, 74% consented to participate. Of those families contacted for participation in the selective intervention, 45% of the eligible families attended at least one session, and 37% attended eight or more sessions across the two cohorts. African-American families attended fewer sessions (8.7) than either White (9.9) or Hispanic (10.6) families,  $F(2, 2101)=17.02, p < .01$ . The participation rates in this study are comparable to that attained in other similar family-focused prevention trials (e.g., Spoth, Clair, Greenberg, Redmond, & Shin, 2007).

### **Consent and Assessment Procedures**

All study procedures were approved by the institutional review boards at the four participating universities and CDC. Consent and assent letters were sent home with students. At three sites where it

was permitted, students received a \$5 gift card for returning the forms, whether or not they agreed to participate. Telephone follow-ups and home visits for consent were used to increase participation rates.

Teacher ratings of individual students in each cohort were collected during the fall (pretest) and spring (post-test) of the sixth grade year. Pretest and post-test parent interviews and student surveys were conducted by project staff who had received extensive training in the interview procedures. The parent interview was available in Spanish and English and took approximately 40 minutes to complete. At three sites, students received a \$5 gift card for participating in the assessment. Schools in the fourth site did not permit students to be compensated for participation.

### **Measures**

We assessed parenting and family characteristics targeted in the selective intervention and proximal child functioning outcomes including behavior (i.e., aggression and victimization), social-cognitive characteristics related to aggression that were expected to change in response to changes in parenting and family relationships (i.e., use of aggressive strategies, use of prosocial strategies), and the student's value for achievement in school, that also was expected to change in response to changes in parenting. Below we report Cronbach's *alpha* coefficients from Cohort 1 pretest data. Tests by language of administration found that *alphas* were within .05 across English and Spanish administrations unless otherwise noted in the descriptions that follow.

**Aggression perpetration.** We created a composite aggression score from three sources. Students completed the aggression scale of the Problem Behavior Frequency Scale (PBFS; Farrell, Kung, White, & Valois, 2000). Students indicated the frequency of seven aggressive behaviors using a 6-point scale ( $\alpha = .92$ ). Parents and teachers completed the Aggression Subscale of the Behavioral Assessment System for Children (BASC; Reynolds & Kamphaus, 1992; parent  $\alpha = .85$ ; teacher  $\alpha = .95$ ).

**Victimization.** *Student-Reported Overt Victimization* (6 items;  $\alpha = .93$ ) and *Relational Victimization* (6 items;  $\alpha = .85$ ) scores from the PBFS were combined to represent overall victimization

( $r = .71$  between the two).

**Social-Cognitive Processes.** *Use of aggressive strategies* was assessed with four vignettes of potential conflict situations from the *Goals and Strategies Measure* (Chung & Asher, 1996). Scores were averaged likelihood of using physical ( $\alpha = .75$ ) or verbal ( $\alpha = .77$ ) aggression across situations, measured on a 5-point scale. Scores on *Use of prosocial strategies* were calculated by averaging likelihoods of verbal assertion ( $\alpha = .62$ ), compromise ( $\alpha = .63$ ), yield/withdrawal ( $\alpha = .70$ ), and seeking help ( $\alpha = .78$ ) in the same situations.

*Student's value for achievement* was assessed by parent ( $\alpha = .92$ ) and youth ( $\alpha = .78$ ) reports on the 9-item Personal Value of Achievement scale (Jessor & Jessor, 1977). Due to modest correlations across sources ( $r = .22$ ) we did not create a composite scale.

#### **Parenting and family relationship characteristics targeted by selective intervention.**

Analyses evaluating the potential for creating parent-child composites indicated that composites were appropriate for *Parent Involvement in School* (Eccles & Harold, 1993; 7 items;  $\alpha = .77$  for child, .81 for parent), and *Parental Monitoring* (Gorman-Smith, Tolan, Zelli & Huesmann, 1996; 12 items;  $\alpha = .66$  child/.82 parent). The *Discipline Practices* measure (Gorman-Smith et al., 1996; 5 items;  $\alpha = .76$ ) was collected only from parents. However, the subscales of the Family Relationships Scale (Tolan, Gorman-Smith, Huesmann, & Zelli, 1997), *Family Organization* (12 items;  $\alpha = .70$  child/ .74 for parent) and *Family Cohesion* ( $\alpha = .87$  child/ .84 for parent), did not have sufficient between-source correlations to support combining them ( $r = .28$ ).

*Demographics.* Information about participants' gender, race, ethnicity, and family structure were assessed in the parent and child interviews.

## **Results**

Analyses of attrition showed no significant differences across conditions or cohorts in the amount of parent-, teacher-, or student-report data available. The amount of missing data was not related

to gender, family structure, race/ethnicity, or site, with one exception. A single teacher in Chicago refused to complete pretest BASC student ratings, yielding a statistically significant difference between sites on completion of this scale.

Mixed-effects models used to select variables for inclusion in the mediated analyses were random regression models fit through SAS PROC MIXED (SAS Institute, 2004) that used all non-missing waves of data to estimate group trends (Gibbons, Hedeker, Elkin, Waternaux, Kraemer, & Greenhouse, 1993). The models testing mediated relations were fit using full information maximum likelihood (FIML) and the robust maximum likelihood estimator (MLR) through MPlus (Muthén & Muthén, 2007). This approach allowed inclusion of cases with missing data, even within wave of measurement, and provided standard errors and chi-square tests of model fit that are robust to deviations from normality.

### **Outcome Analyses**<sup>2</sup>

Our overall analytic strategy was first to test the effects of the intervention on outcomes and family mediators using both an intent-to-treat (i.e., unweighted) approach and analyses weighted by degree of participation in the intervention. These models included random intercepts representing schools. We considered, but did not include, family interventionist as a level of clustering in these analyses because family interventionists were assigned to lead groups for entire schools ( $kappa = .97$  between school and interventionist). Based on evidence from these analyses, we then fit covariance structure models of the mediated relations wherein intervention assignment affected outcomes through effects on a theoretical family mediator.

**Intent-to-treat (unweighted) estimates of effects.** We used mixed model analysis of covariance (ANCOVA) models with random intercepts to model the clustering of students within schools<sup>3</sup>. Posttest scores on the outcome variables were predicted by their pretest values in order that intervention effects might be interpreted as effects on pre-post change in the variable. Effect codes

representing gender, ethnicity, and cohort were included as covariates so that effects could be interpreted at average values of these variables. A dummy code for assigned intervention condition and an interaction between condition and cohort tested intervention effects and modeled variation by cohort. Effect codes representing the study site were included to control for differences in policies and site differences in implementation of the intervention. These analyses found no significant intervention effects either on outcomes or on the family mediators.

**Weighted estimates of effects.** Because of the common problem of less than full recruitment of families and less than full participation of those agreeing to participate (Spoth et al., 2007), there is good reason for concern that intent-to-treat analyses might underestimate effects for those who were exposed to the intervention (Dishion, Shaw, Connell, Gardner, Weaver, & Wilson, 2008). To address this problem, we used weighting by predicted dosage to incorporate participation into the analysis. As was noted above, 45% of participants attended at least one family intervention session, and there was considerable variation within that 45% in the number of sessions attended. This distribution argued against dividing the sample into complier and noncomplier groups (Yau and Little; 2001), and was not appropriate for analyzing within quintiles or other strata defined by propensity scores (Rubin & Thomas, 1990; Rubin, 2010). Instead, we imputed predicted dosage among those not assigned to the family intervention (cf., Jin & Rubin, 2009) and used predicted and actual dosage as weighting in the analysis. We used the Expectation-Maximization (EM) algorithm (Dempster, Laird, & Rubin, 1977; Jin & Rubin, 2009) implemented in SAS PROC MI to impute dosage in those not assigned to intervention. Predictors for the imputation were demographic covariates (gender, ethnicity, adult male in home) and pretest values on measured variables. To evaluate the validity of this method, we chose a 50% random subsample of those who received intervention, imputed a predicted dose for them, and tested the correlation of actual dose and predicted dose based on this algorithm for the subsample of participants in the conditions assigned to receive intervention. This yielded a significant correlation ( $r = .41$ ,  $n=288$ ,  $p$

< .01). Using the predicted dose for controls and the actual dose for intervention conditions, we weighted cases in proportion to actual or predicted participation in the intervention.

The weighted models found that students who received the selective intervention showed significantly lower adjusted *Aggression* scores ( $d = -0.16, p < .05$ ), reported relatively less *Use of Aggressive Strategies* ( $d = -0.14, p < .05$ ) and were rated significantly higher on *Parental Report of Student's Value for Achievement* ( $d = +0.14, p < .05$ ) than did students not receiving the intervention. The weighted analyses also produced significant and positive effects on *Discipline Practices*, ( $d = +0.14, p < .05$ ) and *Student Reports of Family Cohesion*, ( $d = +0.15, p < .05$ ), compared to those not randomly assigned to receive the intervention.

### **Mediation Analyses**

The main aim of this study was to assess the extent to which significant intervention effects on outcomes and student social cognition might be mediated by change in the affected family mediators. Using the family mediators and student outcomes found significant in the weighted analyses, we evaluated mediated relations by fitting a series of covariance structure models through MPlus 5.2 (Muthén & Muthén, 2007), which uses full information maximum likelihood estimation. As was noted above, mediated models were only fit for outcomes where a significant intervention effect had been found. Thus we fit models for *Aggressive Behavior*, *Use of Aggressive Strategies*, and *Value for Achievement*, evaluating the role of each potential mediator on which significant intervention effects had been found (*Discipline and Family Cohesion*). The type of model is consistent with the two-wave regression model of mediation described by MacKinnon (2008, p. 199-200) and used by Murry and colleagues (Murry, Berkel, Brody, Gibbons, & Gibbons, 2007) to test mediation of intervention on change in youth self-pride by change in targeted parenting practices. The initial variable was the whether or not the individual was in a condition randomly assigned to receive the selective intervention.

Posttest scores on the outcome and mediator were conditioned upon pretest scores of both, thus, the intervention-to-mediator (*a*) effect represents the effect of random assignment to intervention on change in the mediator, and the mediator-to-final (*b*) effect represents the effect of change in the mediator on change in the outcome. Both pretest and posttest scores on the outcome and mediator were conditioned upon ethnicity (two effect codes) and gender. Using the complex sample capabilities in MPlus these models accounted for clustering of observations within schools. We used the product tests of specific indirect effects, implemented in MPlus to test the significance of mediated effects. Confidence intervals shown are from the Mplus analyses. As with the main analyses we fit both intent-to-treat (ITT) and weighted models for mediation.

Tables 1 and 2 report the ITT and weighted tests of mediated effects, and Figures 2 and 3 illustrate these effects. As can be seen in the tables, all of the models to test the mediated effects fit the data reasonably well. As is illustrated in the top panel of Figure 2, there were significant indirect effects of the intervention on aggression through discipline practices in the ITT analysis,  $ab = -.07$ ,  $SE = .03$ ,  $Z = 2.15$ ,  $p < .05$ , and in the weighted analysis,  $ab = -.09$ ,  $SE = .04$ ,  $Z = 2.29$ ,  $p < .05$ . The ITT mediation analysis also produced a significant indirect effect of the intervention on aggressive strategies through discipline practices,  $ab = -.01$ ,  $SE = .005$ ,  $Z = 1.99$ ,  $p < .05$ , but this was not found in the weighted analysis,  $ab = -.004$ ,  $SE = .003$ ,  $Z = 1.29$ , *ns*. These effects are illustrated in the bottom panel of Figure 2. On value for achievement, both the ITT and weighted analyses found significant indirect effects through discipline practices, ITT:  $ab = -.01$ ,  $SE = .01$ ,  $Z = 2.38$ ,  $p < .05$ ; Weighted:  $ab = -.07$ ,  $SE = .03$ ,  $Z = 2.15$ ,  $p < .05$ . Parental discipline practices increased among those in schools assigned to intervention,  $a = 0.06$ ,  $SE = .02$ ,  $Z = 2.41$ ,  $p < .05$  for the ITT analysis and  $a = 0.08$ ,  $SE = .03$ ,  $Z = 2.64$ ,  $p < .05$  for the weighted analysis.

In addition to the significant family intervention effects on cohesion already reported, there were significant effects of family cohesion on aggressive strategies,  $b = -0.17$ ,  $SE = .08$ ,  $Z = 2.22$ ,  $p < .05$  in the ITT analysis and  $b = -0.10$ ,  $SE = .04$ ,  $Z = 2.49$ ,  $p < .05$  in the weighted analysis. No significant indirect effects for the intervention on aggressive strategies were found either in the unweighted or weighted analyses. Nevertheless, the joint significance of the intervention to cohesion and cohesion to aggressive strategies relations provides some evidence supporting mediation. This can be seen in the bottom panel of Figure 2.

On Value for Achievement, there were significant product tests of indirect effects through discipline practices in both ITT,  $ab = 0.01$ ,  $SE = .005$ ,  $Z = 2.31$ ,  $p < .05$ , and weighted analyses,  $ab = 0.01$ ,  $SE = .005$ ,  $Z = 2.34$ ,  $p < .05$ . On tests of mediation through family cohesion, there were significant intervention-to-mediator and mediator-to-outcome effects, in the weighted analyses, as can be seen in Table 2 (the intervention-to-mediator effect was marginal in the ITT analysis) and in Figure 3. However, the product test of the indirect effect was marginal in the ITT analysis,  $ab = 0.005$ ,  $SE = .003$ ,  $Z = 1.65$ ,  $p < .10$ , and non-significant in the weighted analysis,  $ab = 0.006$ ,  $SE = .004$ ,  $Z = 1.58$ ,  $ns$ .

Because evidence consistent with mediation was found for both potential mediators of effects on Value for Achievement, we fit a final model in which both mediators were included in the same analysis (cf., MacKinnon, 2008, page 105). The results are illustrated in Figure 3. This model fit the data reasonably well ( $\chi^2(4, N=984) = 23.49$ ,  $p < .01$ ,  $CFI = .98$ ,  $RMSEA = .07$ ). Evidence consistent with mediation was found in the joint significance of the  $a$  and  $b$  relations for both mediators. In addition, the product test of the indirect effect  $ab$  was significant for mediation through change in Discipline, but not for change in Cohesion.

A final set of analyses explored the patterns of mediated change. Specifically, we divided the sample by levels of aggression, discipline, and cohesion, and investigated whether change in aggression

was associated with increases or decreases in the mediators. Using two standard errors of the mean as a criterion for change having occurred, we coded aggression, discipline, and cohesion as increased ( $x > \text{mean} + 2 \text{ SEM}$ ), decreased ( $x < \text{mean} - 2 \text{ SEM}$ ) or unchanged ( $\text{mean} - 2 \text{ SEM} < x < \text{mean} + 2 \text{ SEM}$ ). Cross-tabulating these scores revealed that in families whose discipline increased, 60.8% of youth showed decreased aggression and 31.8% of youth had increased aggression. In families with unchanged discipline, 39.5% had decreased aggression and 51.2% had increased aggression. In families with decreased discipline, 34.8% had decreased aggression and 53.0% had increased aggression. For the relation between cohesion and aggression, relatively equal proportions of youth changing aggressive behavior across levels of change in family cohesion. Thus, the pattern of change was nearly identical in families with unchanged and decreased discipline, but was more likely to be in a desirable direction among families whose use of consistent and effective discipline practices increased.

### **Discussion**

This test of the family-level mediators of outcome effects of the GREAT Schools and Families selective intervention suggests that the intervention shows some benefits for key outcomes of student aggression perpetration and student valuing of achievement (as rated by parents). These effects are mediated through impact on parental discipline quality and family cohesion, with somewhat stronger evidence for mediation through discipline. These analyses and findings provide partial support for the theoretical contention that the selective intervention would reduce aggression perpetration and victimization, stem cognitive social processes associated with aggression and violence, and increase school engagement by affecting parenting practices and improving family relationships (Lochman & Wells, 2002).

Intent-to-treat analyses were conducted to follow the initial analytic plan built on the strengths of the random assignment by school and to provide a conservative estimate of experimental effects. As is

often the case with preventive intervention trials with families, engagement is challenging and may limit the extent to which assignment to an intervention condition corresponds to intervention exposure, thus decreasing the validity of the test of the interventions' potential and the meaning of theoretical links of targeted processes to outcomes of interest (Dishion, Shaw, Connell, Gardner, Weaver, & Wilson, 2008). By applying a method that considered actual or estimated exposure in analyzing effects, we could retain many of the strengths of the original random assignment but provide a more sensitive estimation of the intervention effects and the mediation of intervention effects by the targeted family processes. This more sensitive estimate of intervention effects showed significant effects on three key outcomes for high-risk youth: aggression perpetration, aggressive strategies, and value for achievement. In addition, this analysis provided the basis for tests of mediation of the affected outcomes by immediate family-related targets (Tolan, Hanish, McKay, & Dickey, 2002).

We expect that when true intervention effects are present, weighting by dosage should return more robust effects than an ITT analysis that includes families assigned to intervention who did not receive it. When the opposite is found, as in our analyses of aggressive strategies, we believe it reasonable to conclude that the ITT effect may have been spurious. Without the ITT analysis, the weighted analysis may return significant effects because of nonrandom factors such as selection bias. Without a weighted analysis, the ITT analysis may incorrectly conclude that an intervention is ineffective. Thus, we believe that a weighted analysis will be of greatest value when dosage is not uniformly distributed (permitting division into meaningful segments) and when ITT analysis returns marginal results. Both were true in this study.

Although dosage is used as a weighting factor in studies of medication (e.g., Perry et al., 2005), we could find no examples of dosage weighted analyses in prevention studies. We believe that the inclusion of dose-weighted analyses provides a needed perspective on the results of this trial. In the

absence of the weighted analyses, the results of this study raise the question of why mediated effects might be present when direct intervention effects are not found. Such results are reminiscent of a study reported by Murry and colleagues (2007) in which a family intervention had the intended effects on parenting and family mediators, and the mediators had their intended effects on the outcomes, but there was little evidence of a direct intervention effect on the outcomes. Discussing those results, Beadnell (2007) suggested that such a pattern might indicate that the strength of the intervention effect diminished as it passed through the mediators, resulting in no detectable direct effect. The fact that direct effects were found on outcomes in the weighted analyses but not in the intent-to-treat analyses in this study suggests another possibility, namely that low participation rates blunt the direct impact of the intervention, but that such impact becomes visible when evaluating more proximal mediating variables.

Specifically, these analyses suggest that intervention exposure was related to greater reliance on discipline practices such as consistency, reinforcing positive behavior, and contingencies for misbehavior. Increasing discipline was associated with higher likelihood of decreased aggression and lower likelihood of increased aggression. Additionally, changes in aspects of family cohesion such as emotional support during times of challenge and valuing of the family in responding to stress appear to be associated with change in student aggression prevention of deteriorating value of achievement that otherwise occurs (cf., MVPP, 2010). Thus, there is a linkage between change in both parenting and family relationship processes and several key aspects of child behavior, social-cognitive features that are empirically tied to risk for violence, and school engagement that are associated with problems such as school dropout and substance use (Dishion, et al., 2008; Tolan et al, 2002). As such, these results support the contention that affecting these family processes in early adolescence is valuable in modifying the risk of youth who have elevated aggression early in middle school. As in prior mediation tests, these results suggest focusing on parenting and the family relationship in preventive intervention

reduces problem-behavior and presumably will decrease risk for later violence, particularly in comparison to non-intervention counterparts (Patterson et al., 2004). The consistency of such findings and the relatively strong impact of family-focused interventions for high-risk youth bolster the contention guiding this initial work that such family approaches are particularly useful for high-risk youth (Aos, Lieb, Mayfield, Miller, & Pennucci, 2004; Tolan, 2002).

### **Limitations**

This study has several limitations. First, as is often the case in family interventions, the level of participation and therefore exposure to the intervention was limited, affecting how informative simple intent-to-treat analyses might be despite the many advantages of random assignment. The approach used here, like other methods of incorporating information to identify intervention effects more precisely, helps to overcome that limitation for analyses. Incorporating actual and predicted participation into statistical analyses may compromise the ability of such analyses to contribute to causal inference (Jin & Rubin, 2009), because of nonrandom elements that may produce the effects or because the additional tests inflate experimentwise error probabilities. However, in complex prevention studies such as this, even intent-to-treat analyses may not produce the binary treatment comparisons that allow strong causal inference. Nesting of individuals within schools and processes of social influence may violate the stable unit treatment value assumption (SUTVA; Rubin, 1980; 2010). Additionally, in this study, participants were selected because of their high levels of social influence, perhaps creating additional interference between participants within schools. As we note above, we believe that neither approach is sufficient by itself. Because the approaches can act as correctives to each other, the two allow stronger inference than either alone.

Although dosage weighted analyses may help clarify results, such methods also do not solve the practical issue of the utility of family interventions and the challenges that arise in their implementation.

If family interventions are only reaching half of a high-risk population, the impact overall may not be enough to affect prevalence sufficiently to warrant implementation at scale.

Second, because the selection criteria included youth with elevated aggression and social influence, this group differed from the selection basis for most other violence prevention efforts in high-risk group selection. Thus, the results here may not generalize when the more typical and simpler method of elevated pre-test aggression is used.

Third, the family measures were not from sources blind to the intervention and or to participation levels. Teachers were blind to intervention participation so we included teacher data wherever possible to increase the validity of our interpretations of scores unreliability of measures by using multiple sources (Kraemer et al., 2001). However, parents and their children were the only sources available for the family measures.

A fourth limitation is that some of the measures had low internal consistency ( $< .7$ ). All of these were child scales, most with fewer than five items, and all of the low reliabilities were derived from data collected when the children were entering sixth grade. We note that significant results, in the main analyses and mediation tests, were obtained for parent versions of the measures that had higher internal consistencies.

This study leaves unanswered several related questions of importance, particularly when a developmental-ecological approach to understanding the preventive processes is taken. For example, the analyses do not address how affecting these high-risk socially influential youth translates to lower risk in the general population. There is some suggestion that the family intervention seems to improve parental discipline and family cohesion, which may reduce aggression and retain school engagement of high-risk youth, particularly those operating within a high-risk/high-stress life circumstance, and evidence that the selective intervention had positive effects on the general student population (MVPP, 2009). Thus, it could be that the intervention impact on high risk youth is limited to the high risk youth

whose aggressive behavior is reduced by the intervention. However, it may also be that reduced aggression is accompanied by undiminished social influence. In that case the benefit is extended because these less aggressive but still influential youth influence others to be less aggressive. Although this notion is consistent with the theoretical formulation undergirding the study (Henry, Farrell, and MVPP, 2004), measurement and analyses to test such an assertion are beyond the scope of the current study.

Similarly, these analyses do not test for multiple links in mediation. For example, our approach in this study posits that family intervention impacts both family functioning and youth violence in the near term. However, that impact on other theorized mediators of long-term outcomes found in this study (e.g., child social-cognition and school engagement) may be part of more complex mediated pathways that improve school functioning over a longer term (Dishion, et al., 2008). The present analyses are one step in understanding such linkages (Tolan et al., 2002; 2004).

### **Implications for Prevention**

The present findings support the value of family-focused prevention and suggest that the impact can be traced to some of the key processes thought to be targeted by the intervention and to mediate risk for proximal markers of later youth violence risk. These findings, however, are not strong or consistent. Thus, the implications of the study apply less to decisions regarding the use of this particular program or this particular method of selecting the targeted population and more to the value of focusing on family relationships and parenting to improve outcomes for high-risk youth. In particular, the results are consistent with the developmental-ecological framework with its emphasis on aiding parenting, supporting strong family cohesion, and using multiple family groups that can support and normalize developmental and ecological challenges. These results, those with significance as expected and those without, suggest there is value in refining the focus of these interventions and perhaps deepening the connection to school engagement and supportive family relationships that facilitate consistent and

measured discipline methods. Perhaps this focus helps lessen the developmentally typical decline in family relationships and deterioration in school engagement as well as the increased susceptibility towards violence. Testing of elaborations of the present approach, as well as more tests of mediation of competing models, is needed to bolster potential impact for greater public health gain.

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Footnotes

<sup>1</sup>The universal intervention consisted of a 20-session student curriculum and a teacher intervention that included training and ongoing consultation in violence prevention. The student portion emphasizes social-cognitive skills thought to reduce risk for violence perpetration, acceptance, and victimization (see Meyer et al., 2004 for detailed description). The teacher component focused on classroom management, support for stress in teaching, and problem-solving groups (see Orpinas, Horne, & MVPP, 2004 for detailed description).

<sup>2</sup> A table of descriptive statistics for this study is available from the corresponding author.

<sup>3</sup> Tables containing the full results of the unweighted and weighted mixed models are available from the corresponding author.

Table 1

*Intent-to-Treat Models of Mediated Relations*

Family Mediator	Model Fit			Intervention-Mediator ( <i>a</i> )		Mediator-Final ( <i>b</i> )		Indirect Effect ( <i>ab</i> )	
	$\chi^2$ (1)	CFI	RMSEA	B (SE)	95% CI	B (SE)	95% CI	B (SE)	95% CI
<b>Aggression</b>									
Discipline	3.55	0.98	0.05	0.06 (.02)*	[0.01, 0.12]	-0.16 (.03)**	[-1.48, -0.73]	-0.07 (.03)*	[-0.14, -0.01]
Cohesion	<1	1.00	0.00	-.01 (.04)	[-0.08, 0.07]	0.22 (.16)	[-0.53, 0.08]	0.00 (.01)	[-0.02, 0.02]
<b>Use of Aggressive Strategies</b>									
Discipline	< 1	1.00	0.00	0.07 (.03)*	[-0.24, -0.03]	-.15 (.05)**	[0.02, 0.12]	-.01 (.005)*	[-.02, -.001]
Cohesion	1.05	1.00	0.01	0.05 (.03)+	[-0.004, 0.10]	-0.17 (.08)*	[-0.31, -0.02]	-.01 (.005)	[-.02, .002]
<b>Student's Value for Achievement</b>									
Discipline	2.65	0.99	0.04	0.07 (.03)*	[0.11, 0.23]	0.17 (.02)**	[0.02, 0.12]	.01 (.003)*	[0.002, 0.02]
Cohesion	< 1	1.00	0.00	.05 (.03)+	[-0.002, 0.10]	.09 (.03)**	[0.08, 0.24]	.01 (.005)+	[-0.001, 0.02]

Effects: a = intervention assignment to family or parenting mediator; b = family or parenting mediator to outcome; ab = intervention effect

+  $p < .10$ . \*  $p < .05$ . \*\*  $p < .01$

Table 2

*Weighted Models of Mediated Relations*

Family Mediator	Model Fit			Intervention-Mediator ( <i>a</i> )		Mediator-Final ( <i>b</i> )		Indirect Effect ( <i>ab</i> )	
	$\chi^2$ (1)	CFI	RMSEA	B ( <i>SE</i> )	95% <i>CI</i>	B ( <i>SE</i> )	95% <i>CI</i>	B ( <i>SE</i> )	95% <i>CI</i>
<b>Aggression</b>									
Discipline	5.75*	0.99	0.07	0.08 (.03)*	[0.02, 0.14]	-0.15 (.03)**	[-0.21, -0.08]	-.09 (.04)*	[-0.17, -0.01]
Cohesion	<1	1.00	0.00	0.06 (.03)+	[-0.004, 0.12]	-0.03 (.03)	[-0.10, 0.03]	-0.002 (.002)	[-0.01, 0.003]
<b>Use of Aggressive Strategies</b>									
Discipline	< 1	1.00	0.00	0.09 (.03)**	[-0.24, -0.03]	-0.05 (.03)	[-0.10, 0.01]	-.004 (.003)	[-.10, .01]
Cohesion	<1	1.00	0.00	0.06 (.03)+	[-0.003, 0.10]	-0.10 (.04)*	[-0.18, -0.02]	-.006 (.004)	[-.01, .002]
<b>Student's Value for Achievement</b>									
Discipline	1.89	1.00	0.03	0.09 (.03)*	[0.03, 0.15]	0.12 (.03)**	[0.07, 0.19]	.01 (.005)*	[0.002, 0.02]
Cohesion	6.30*	0.99	0.07	0.06 (.03)*	[0.001, 0.13]	0.10 (.03)**	[0.03, 0.16]	.006 (.004)	[-0.001, 0.01]

Effects: *a* = intervention assignment to family or parenting mediator; *b* = family or parenting mediator to outcome; *ab* = intervention effect on outcome through mediator

+  $p < .10$ . \*  $p < .05$ . \*\*  $p < .01$

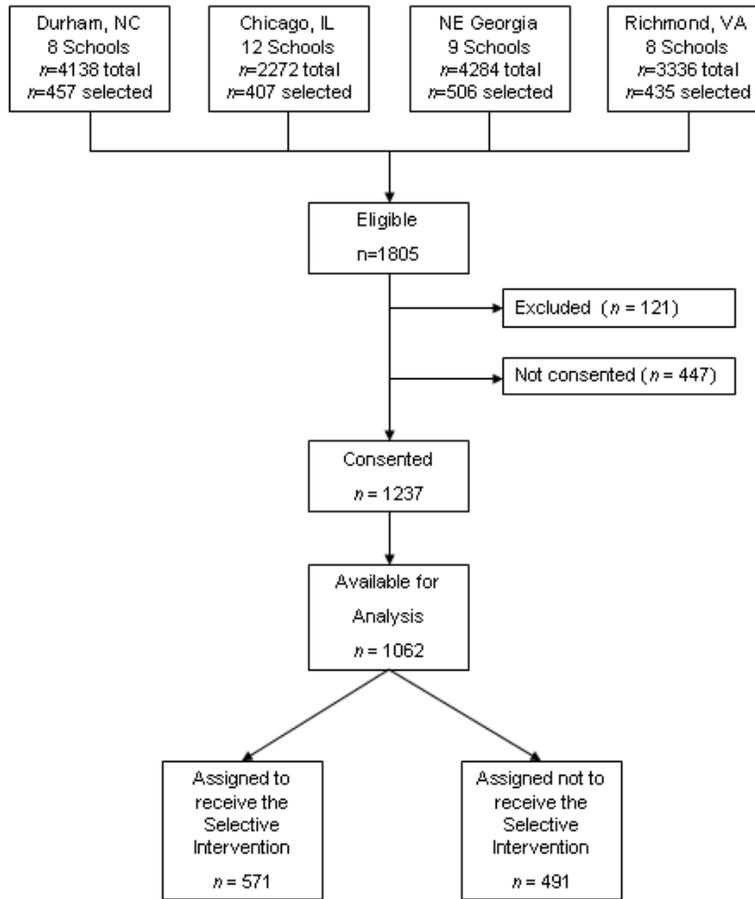


Figure 1. CONSORT Chart of Targeted Sample Recruitment and Retention.

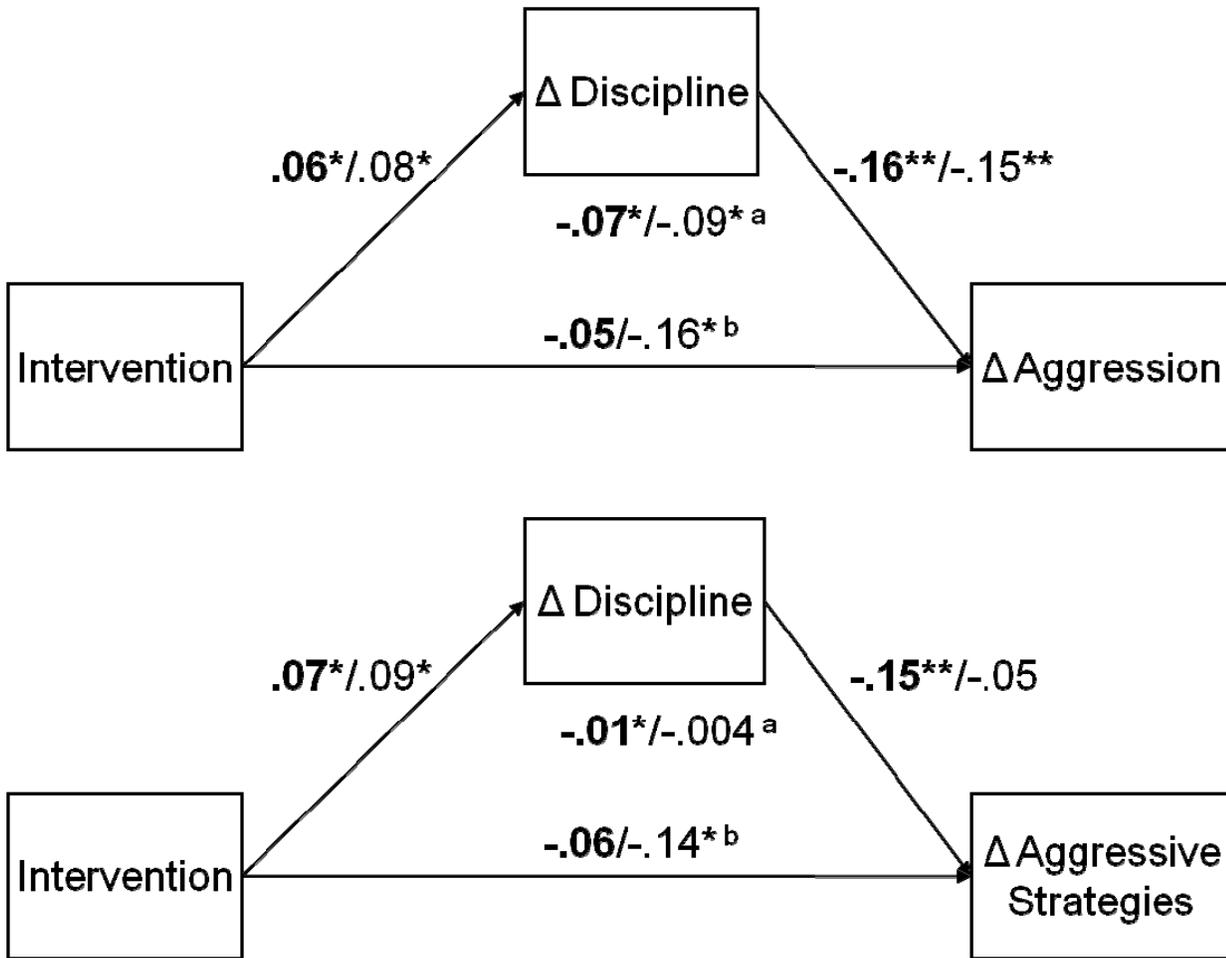


Figure 2: Mediated intervention effects on variables related to aggression. Notes: Intent-to-treat effects are in bold.

Δ indicates posttest score conditioned on pretest score

<sup>a</sup> Indirect effect

<sup>b</sup> Intervention main effects pictured are *d* coefficients from proximal outcome analysis

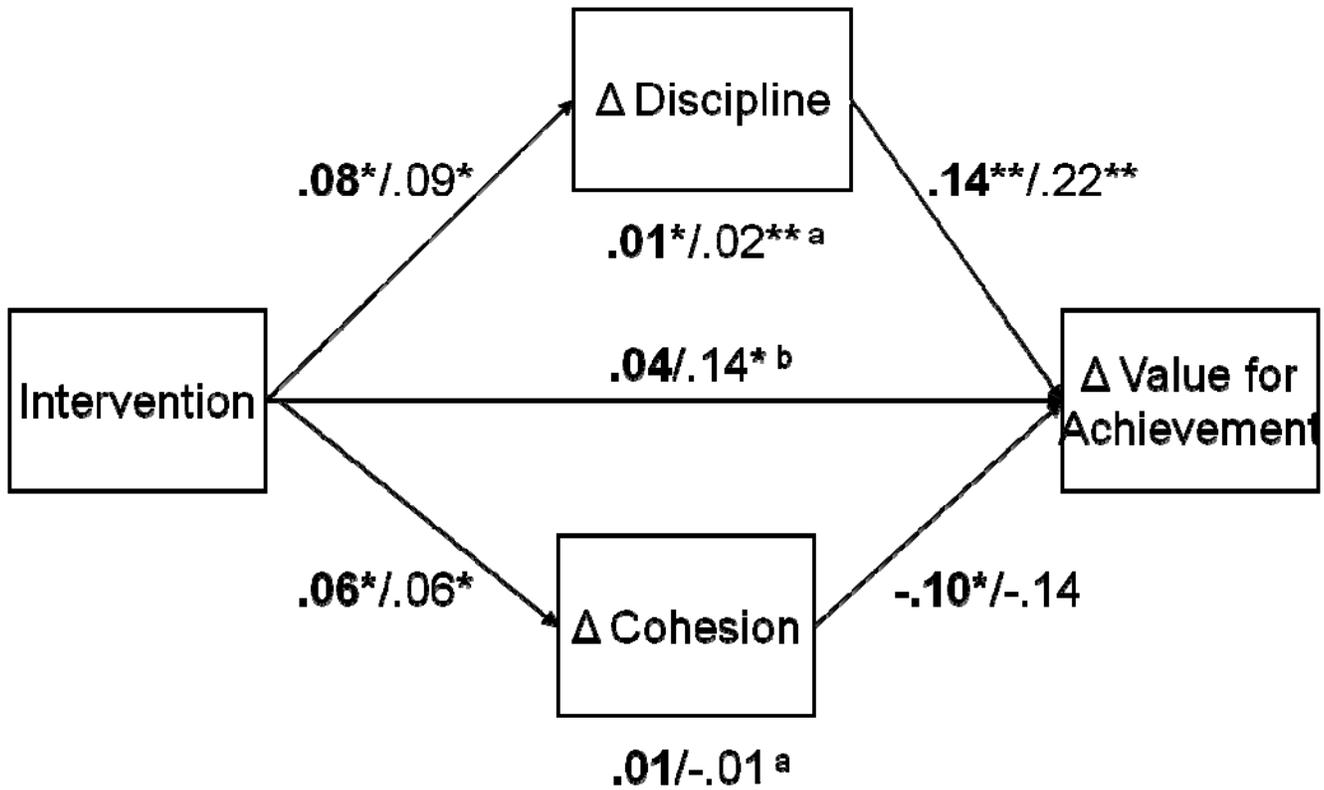


Figure 3. Model of intervention effects on Value for Achievement moderated by Discipline and Cohesion, Notes: Intent-to-treat effects are in bold.  $\Delta$  indicates posttest score conditioned on pretest score <sup>a</sup> Indirect effect <sup>b</sup> Intervention main effects pictured are *d* coefficients from proximal outcome analysis