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Modeling Protective Factor Growth Curves to Predict Intervention Outcomes and Test

Developmental Theories of Antisocial Behavior

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Abstract

Risk and resilience theories specify a range of relevant personal, environmental, and developmental factors that can work to either increase or buffer risk of antisocial behavior. This study uses a developmental psychopathology framework and hierarchical linear modeling to evaluate risk reduction and processes of change in the context of a preventive antisocial behavior intervention. The Early Risers intervention is designed to prevent antisocial behavior (e.g., violence, substance abuse, etc.) among high-risk families by building three particular protective factors: social competence, academic competence, and parental investment. In addition to reporting intervention/control comparisons on reduction of risk, this paper demonstrates how hierarchical linear modeling can be used to model the growth curves of the protective factors and to examine how change in protective factors is related to intervention outcomes. The protective factor growth curves are also discussed in relation to intervention response predictors such as gender, SES, IQ, and baseline protective factor scores. Implications for finetuning resilience theories and planning future preventive interventions are also discussed.

Modeling Protective Factor Growth Curves to Predict Intervention Outcomes and Test
Developmental Theories of Antisocial Behavior

Of the many intervention programs targeted at preventing antisocial behavior, few are rigorously evaluated. Even fewer have moved beyond efficacy tests and developed into second generation research programs, in which the theories underlying the intervention are tested (Farrell, Meyer, Kung, & Sullivan, 2001; Vitaro, Brendgen, & Tremblay, 2001). The Early Risers prevention project (August, Realmuto, Hektner, & Bloomquist, 2001) is designed around the tandem goals of moving both intervention best practices and developmental theory forward. Toward that goal, this paper will demonstrate how growth in protective factors can be modeled using HLM (hierarchical linear modeling) and how those protective factor growth curves can be used as predictors of proximal intervention outcomes and as a test of developmental theories.

Preventive mental health interventions require the translation of risk and resilience theories into practices that optimize developmental outcomes. The iterative phases of prevention science are listed below (modified from Mrazek & Haggerty, 1994, and Kellam, Koretz, & Moscicki, 1999):

Pre-intervention tasks

Identify the problem.

Identify risk and protective factors.

Design intervention.

Intervention tasks

Implement intervention.

Assess change in risk and protective factors.

Post-intervention tasks

Evaluate the reduction of risk.

Evaluate processes of change (against existing developmental theories).

Each of the tasks in this translation process has some degree of potential for error (i.e., mistaken theoretical links). Thus, it is critical to monitor success and accuracy at each of these levels of analysis. The pre-intervention tasks and intervention tasks for the Early Risers prevention program are reported by August et al. (2001) and summarized below. This paper will report the results of the post-intervention tasks for Early Risers and will revisit the pre-intervention tasks in the context of the results.

Pre-Intervention Tasks: Outline of the Intervention Strategy

Identify the problem. The Early Risers program was designed to prevent serious antisocial behavior (e.g., drug abuse, theft, assault, etc.) among aggressive children. Though there is no single, clear explanation for antisocial behavior, a number of developmental theories converge as they describe a developmental risk trajectory that starts with early disruptive behavior and failed skill acquisition, eventually spiraling into a pattern of academic failure, peer rejection, and disengagement from social structures like school, and in turn, leading to antisocial behavior including the early starter model of antisocial behavior (Patterson, 1986; Patterson, DeBaryshe, & Ramsey, 1989; Moffitt, 1993; Loeber, 1988; Zucker, 1994).

Identify risk and protective factors. Developmental risk and resilience theories of antisocial trajectories specify a range of relevant processes that can work to either buffer or increase risk for antisocial behavior. Social scientists began studying risk factors for antisocial behavior decades before budding resilience theories led researchers to broaden their scope to

include protective factors. Numerous sources, including the U.S. Surgeon General's Report on Youth Violence, identify childhood aggression, peer rejection, academic difficulties, low socioeconomic status, antisocial parents, and poor parent-child relations as predictors of antisocial behavior (Centers for Disease Control and Prevention, 2001).

In terms of protective factors, several different theoretical models of antisocial trajectories point to the critical importance of social, academic, and parental competence. These convergent theories include the early starter model of antisocial behavior (Patterson, 1986; Patterson, DeBaryshe, & Ramsey, 1989), the life-course persistor model of antisocial behavior (Moffitt, 1993), the aggressive-versatile pathway (Loeber, 1988), and the model of antisocial alcoholism (Zucker, 1994).

Design intervention. The Early Risers prevention intervention consisted of the following components:

- six-week summer school program with academic, social skills, and sports/arts components, based on Pelham's (1994) Summer Treatment Program for Children with Disruptive Behavior
- year-round teacher consultation with family advocates
- year-round student mentoring with family advocates
- biweekly child social skills groups, based on Webster-Stratton's (1996) model
- biweekly parent education and skills training groups, also based on the Webster-Stratton model.
- flexible support for families from family advocates

The intervention design included core components that every child received (e.g., participation in the summer school program) in addition to flexible components that adapted to

the needs of each child and his/her family throughout the program duration. Social competence was targeted in the summer school social skills training program. Academic competence was targeted in the academic portion of the summer school. Both social competence and academic competence were followed up in the year-round teacher support system, but utilization of this support varied. Parental investment was targeted in the biweekly family night meetings and by the family advocates' ongoing support throughout the program.

Intervention Tasks: Delivery of the Intervention

Implement intervention at each site. The implementation of the intervention included 149 boys and 71 girls from ten demographically similar elementary schools at each of two semirural sites. At these 20 sites, all kindergarteners were screened for aggression and participants were recruited from among those who scored in the top 15th percentile. Within each site, schools were randomly assigned to either the program or control conditions.

Assess change in risk and protective factors. Across four years, longitudinal, multi-trait, multi-method, multi-informant assessments of social competence, academic competence, and parental investment were conducted.

Post-Intervention Tasks: Program Evaluation

Evaluating the reduction of risk. Although most of the Early Risers intervention was administered during the four year period between ages five and nine, the program's distal (i.e., long-term) goal of preventing antisocial behavior cannot be truly assessed for years, perhaps even a decade or more. At the conclusion of the Early Risers intervention the participants are 10-11 years old, still well below the typical peak or even onset of serious antisocial behavior (Rutter, Giller, & Hagell, 1998). How can we evaluate whether the risk of falling into an

antisocial trajectory is being attenuated? It seems appropriate to identify a more proximal (i.e., short term) prevention goal that is appropriate for middle childhood, based on the salient risk factors in this developmental period. In a review of over two hundred studies, Parker & Asher (1987), found that the single best predictor of antisocial behavior is childhood aggression and later work showed that the combination of childhood aggression and peer rejection provides an even more powerful predictor (Coie, Lochman, Terry, & Hyman, 1992; Coie, Terry, Lenox, & Lochman, 1995; Kupersmidt & Coie, 1990; Ollendick, Weist, Borden, & Greene, 1992; Coie & Dodge, 1997; Laird, Jordan, Dodge, Pettit, & Bates, 2001). Aggression and rejection are highly related and experimental studies of group formation support a developmental sequence in which aggression precedes the outcome of rejection (Coie, Dodge, Terry, & Wright, 1991). All of the Early Risers participants displayed early onset aggression and most maintain some degree of continuity (e.g., 60% of them are at least .5 SD above the normative population mean even now, four years after initial screening). Thus, the presence or absence of the additional risk factor of peer rejection in middle childhood can serve as a yardstick for assessing the program's progress in buffering these children from risk of later antisocial behavior (Miller, 1994; Coie & Koepl, 1990).

Evaluating processes of change. Beyond performing a simple efficacy test of the intervention, the assessment of peer rejection in this sample can also aid in testing the developmental theories upon which the intervention was built. The theoretical mechanisms described above link social competence, academic competence, and parental investment to less antisocial outcomes (Rutter et al., 1998). In Rutter's review, peer status is one of the important factors proposed to mediate the relation between accumulation of these protective factors and reduced probability of antisocial outcomes. Whether or not the overall intervention proves to be

effective in attenuating risk, we need to know whether the protective factors worked in the manner that the developmental theories predicted (Maggs & Schulenberg, 2001; Robins, 1992). Were social competence, academic competence, and parental investment actually affected by the design elements targeted at those domains? If the intervention components targeting the protective factors were effective *and* risk was reduced for those individuals who showed change in the protective factors, then we can draw conclusions about the soundness of the developmental theories as well as effectiveness of the intervention (Bryant, West, & Windle, 1997; Rutter, Giller, & Hagel, 1998; Kellam & Rebok, 1992). If the intervention components were effective in their target domains, but risk *failed* to be reduced, then we have to question the developmental theories and the manner in which they were applied to this intervention (Maggs & Schulenberg, 2001). If none of the components are effective, then prevention strategies need to be reconsidered. This relation between proximal and distal factors should be the central inquiry of a prevention trial (Rutter et al., 1998; Kellam et al., 1999). Finally, as recommended by Kellam et al. (1999) and Lochman (2001), an analysis of intervention response predictors (e.g., gender, socioeconomic status, IQ, and baseline protective factor level) will identify the degree to which different children benefited from the intervention.

Constructing Hypotheses That Will Evaluate Reduction of Risk and Evaluate Processes of Change

To summarize the rationale in the previous section, a series of progressively specific hypotheses will be tested:

1. Antisocial behavior indicators (peer rejection and aggression) are lower for intervention participants than for control participants. (This addresses the first post-intervention task,

evaluating reduction of risk while the remaining hypotheses address the second task, evaluating processes of change.)

2. Growth curves in the three protective factors improved linearly over time.
3. Growth patterns in social competence predict level of antisocial behavior.
4. Growth patterns in parental investment predict level of antisocial behavior.
5. Growth patterns in academic competence predict level of antisocial behavior.
6. The intervention promoted protective factor growth in some children more successfully than in others (when children are differentiated by gender, SES, IQ, and baseline protective factor scores).

Theoretical and Empirical Support for the Protective Factors Tested

To summarize the developmental pathways reviewed earlier, the antisocial risk factors for children ages 6-11 include childhood aggression, peer rejection, academic difficulties, low socioeconomic status, antisocial parents, poor parent-child relations, and weak social ties (Centers for Disease Control and Prevention, 2001). Research on protective factors is somewhat newer, having gained prominence in the second half of the twentieth century, accompanying the rise in scientific interest in resilience. One might argue that the three protective factors examined here are simply the negation of risk factors for antisocial behavior. However, there is great utility, both semantic and pragmatic, in conceptualizing protective factors separately from risk factors (Jessor, Van Den Bos, Vanderryn, & Costa, 1995; Reiss & Roth, 1993; Wasserman & Miller, 1998). Protective factors are conceptually distinct from an absence of risk in their ability to interact with other risk factors and counter those risk factors' influence on the developmental trajectory (Garmezy, 1985; Rutter, 1985; Stattin & Magnusson, 1996). Also, from the perspective of the high-risk child, a positive framework is less stigmatizing. Families of at-risk

children are more likely to seek help from an agency or program that seeks to help their child rather than merely control them (Lerner, 2001; Roth, Brooks-Gunn, Murray, & Foster, 1998). From the perspective of the practitioners, positively framed projects encounter less resistance and more support from the community, along with more positive attributions of program success (as opposed to the approaches that are oriented toward punishment and deterrence).

Social competence as a protective factor. The protective nature of social competence is particularly potent in regard to the risk factor of childhood aggression. Cairns, Cairns, Neckerman, Gest and Garipey (1988) found that aggressive children who are competent at developing and maintaining a social support network are less likely to be rejected. Most theoretical models relating social competence to antisocial behavior share an emphasis on communication and problem solving. Beginning in preschool, oppositional and noncompliant behavior is related to difficulties in language comprehension (Kaler & Kopp, 1990) and interpersonal problem-solving (Spivack & Shure, 1974). At-risk youth who have had antisocial problems from an early age tend to be particularly poor in language and communication skills related to self-regulation (Warr-Leeper, Wright, & Mack, 1994). Dumas et al.'s (1999) coping-competence model identifies language-related skills as the critical mechanism by which prosocial coping replaces antisocial coping strategies in the developing child's active repertoire.

The logic that flows from these findings suggests that improving interpersonal problem solving skills of aggressive children should lead to better peer relations and thus, to less antisocial behavior. In addition to the acquisition of social skills, children are also buffered from risk by a prosocial orientation. In most cases, "behaving well" is most adaptive for the kids who stand to lose something as a result of antisocial behavior. Disconnected children who lack the skills and/or motivation to maintain relationships have very little to lose (Hawkins et al., 1992).

The positive modification of this critical sense of connectedness and social support has been demonstrated in previous intervention studies. Eggert and colleagues (2001) targeted connectedness from several angles in their Reconnecting Youth intervention. Structural equation modeling was used to link social support with a number of positive outcomes, including decreases in substance use, school dropout, suicide, depression, and stress.

Parental investment as a protective factor. Two distinct models describe how parenting can theoretically buffer children from antisocial risk (Dishion, 1988). In one model, the parent-child bond is viewed as a template for all future relationships, implying that a weak relationship with parents limits the child's capacity to trust and experience intimacy (Rubin, LeMare, & Lollis, 1990). The other, more indirect model has a history in the social learning approach and proposes that parents model either positive or negative styles of communication and social problem solving. Patterson and Reid (1984) describe a coercion model in which coercive and negative strategies are modeled and reinforced by parents. The child's behavioral repertoire becomes dominated by these coercive strategies, which alienate peers and lead to peer rejection. Additionally, parents can indirectly influence their children's orientation toward either positive interactions or negative, avoidant interactions (Putallaz & Heflin, 1990).

Elder, Caspi, & Nguyen (1985) suggest that poor parenting skills amplify the effect of other risk factors for antisocial behavior. The protective power of strong parenting in high-risk families has been documented in several rigorous random allocation studies, particularly when intervention is in infancy or early childhood (Tremblay & Craig, 1995). The effectiveness in parenting interventions appear to lie in reduced abuse, neglect, and behavioral difficulties, as well as improved cognitive functioning. Few of these programs have followed the children into adolescence, but Lally, Mangione, & Honig (1988) found a lower rate of delinquency for those

participants whose parents were in the intervention group. Bank, Patterson, & Reid (1987) and Dumas (1989) report improvements in conduct problems and school performance of elementary-aged children who participated in parent training programs.

Academic competence as a protective factor. The link between antisocial behavior and school problems is fairly well documented (Lynam, Moffitt, & Stouthamer-Loeber, 1993; Hinshaw, 1992). While juvenile delinquents typically score about 8 IQ points lower than nondelinquents (Wilson & Herrnstein, 1985), school failure is a stronger predictor of antisocial behavior than IQ (Hinshaw, 1992). The Hawkins et al. (1992) model of social development describes the buffering role that school bonding can serve in attenuating other risk factors for antisocial behavior. Commitment to school and the values of the school community engender a personal stake in behavior. Antisocial behavior threatens the child's standing within the community, and thus, would be avoided if the child wants to maintain the sense of belonging.

While antisocial behavior and peer rejection are consistently linked to academic problems, the direction of causality is unclear. In a meta-analysis of peer status categories, rejected and average children differed significantly in general cognitive abilities (Coie et al., 1992). In addition, rejected children are more likely to be retained in school and have general problems in adjustment to middle school. Patterson et al. (1989) recognize the causal influence of academic failure on later antisocial trajectories but argue that childhood antisocial behavior helps set off the academic failure in the first place.

Intervention research has begun to clarify this relationship, though not without some controversy. Coie & Krehbiel (1984) found that academic skills training in 4th grade was related to improved social preference ratings of rejected children. Early childhood interventions like Head Start show short-term IQ gains that fail to persist over time (Lazar & Darlington, 1982;

McKay, Condelli, Ganson, Barnett, McCouley, & Plantz, 1985). There were, however, long term effects in both scholastic progress and social development. Later in adolescence, children in the Head Start group had fewer lifetime arrests, lower teenage pregnancy rates, higher high school graduation rates, less utilization of social services, and were more likely to own their own home. Berrueta-Clement, Schweinhart, Barnett, Epstein, & Weikhart (1984) report improved academic competence for the participants in their early childhood education program, in addition to improved social competence and reduced crime rates in adolescence. In contrast to the findings above, Wilson & Herrnstein (1985) report that few academic interventions have reduced antisocial behavior.

Method

Participants

149 boys and 71 girls participated in this longitudinal study at some point between kindergarten and fourth grade and contributed protective factor data that were used in these analyses. A subsample of 78 boys (42 experimental and 36 control) and 38 girls (25 experimental and 13 control) participated in the peer assessments at the final timepoint (Grade 4) and completed the full battery of protective factor assessments at baseline and at least one other timepoint in the study.

Recruitment

Ten demographically similar elementary schools at each of two semirural regional sites agreed to screen all kindergarten students for aggressive behavior, using the 25-item aggression scale of the Child Behavior Checklist (Achenbach, 1991). Permission to screen was based on a passive parental consent procedure (approximately 5% did not consent). Within each site, schools were randomly assigned to either the program or control conditions, yielding a grand total of ten intervention schools and ten control schools. Children who had an aggression *T* score greater than or equal to 58 or who scored above the 85th percentile relative to the school's other kindergarteners (but no less than 55) were identified as high-risk. Of the 1840 students screened, 341 (19%) met the high-risk criteria (173 from intervention schools and 168 from control schools). These children were then invited by social workers and teachers representing Early Risers to participate in the study. Project staff made home visits to share more information about the longitudinal study and ask for informed consent. Baseline assessments were conducted near the end of the kindergarten school year, with parents receiving \$50 and teachers receiving \$25 for each completed assessment. The participants' socioeconomic status ranged across all five

levels classified by Hollingshead (1975). Of the 220 children who participated in the first year, 125 (57%) are still in the program now, five years later, and 82% were retained through year three. All intervention and control participants were assessed annually in social competence, academic competence, and parental investment. An additional comparison group was also recruited from the following year's kindergarten classes of both program and control schools, in order to obtain population data for standardization of the annual assessments.

Independent Variables: Annual Assessments of Protective Factors

Growth in protective factors is examined using a multilevel modeling procedure in the Hierarchical Linear Modeling software package (HLM[™] 5, Raudenbush, Bryk, Cheong, & Congdon, 2000). HLM techniques were selected because they handle longitudinal panels with missing data particularly well (Raudenbush & Bryk, 2002). All participants with at least two longitudinal datapoints for the protective factors ($N = 220$) were included in the analyses for the second hypothesis, testing for general linear effect. A subsample with $N = 116$ (who had data for the baseline and final timepoints as well as at least one other timepoint) was used in the remaining analyses.

Each of the protective factors was assessed annually across informants (teacher/parent/child) using multiple measures. Children were assessed individually at school while teachers and parents completed packets following explicit instructions. All scale scores were standardized to a normative population sample with a mean of 0 and SD of 1. This means that the coefficients reported in these analyses can be interpreted in terms of one unit equaling one standard deviation. Confirmatory factor analysis was used to test three latent constructs that represented the protective domains of interest: social competence, academic competence, parental investment. Upon confirmation of these models (Hektner, August, & Realmuto, 2000),

composite scores were created for the first and second order constructs of each protective factor using unweighted scale means in the following configurations.

Social Competence. Three scales were used from the teacher and parent forms of the Behavioral Assessment System for Children (Reynolds & Kamphaus, 1992): Social Skills, Leadership, and Adaptability. Internal consistencies for parent forms were .86, .78., and .73. Teacher form internal consistencies were .91, .81, and .75. The six-item peer acceptance scale of the Teacher's Scale of Child's Actual Competence and Social Acceptance (Harter, 1985) was also used ($\alpha = .92$).

Academic Competence. The Broad Reading and Applied Problems scores from the Woodcock-Johnson Tests of Achievement (Woodcock & Johnson, 1990) served as performance measures of academic competence. Academic competence within a daily learning context was assessed using the Learning Problems scale from the teacher form of the BASC, the Cognitive Competence scale from the Teacher's Scale of Child's Actual Competence and Social Acceptance (Harter, 1985), and the Concentration Problems scales from the teacher and parent forms of the Observation of Classroom Adaptation (Werthamer-Larsson, Kellam, & Wheeler, 1991). Internal reliabilities are as follows: Learning Problems = .83, Cognitive Competence = .85, TOCA Concentration Problems = .92, and POCA Concentration Problems = .85.

Parental Investment. Parent nurturance was assessed using the Involvement and Positive Parenting scales of the Alabama Parenting Questionnaire (Shelton, Frick, & Wooten, 1996), the Involvement scales of the teacher and parent forms of the Parent-Teacher Involvement Questionnaire (CPPRG, 1999a, 1999b), and the Cohesion scale of the Family Relations Scale (Gorman-Smith, Tolan, Zeli, & Huesman, 1996). Internal reliabilities were .75, .80, .68, .65, and .75, respectively. Parent well-being was assessed using the Depression ($\alpha = .79$), Isolation ($\alpha =$

.77), and Health ($\alpha = .70$) scales of the Parenting Stress Index (Abidin, 1986), as well as the Family Support ($\alpha = .76$) scale of the Family Relations Scale. Also included were the Inconsistent Discipline ($\alpha = .73$) scale of the Alabama Parenting Questionnaire and the Effect of Discipline ($\alpha = .81$) scale from the Parenting Practices Questionnaire (Tolan, Gorman-Smith, Huesmann, & Zeli, 1997).

Dependent Variables: Peer network resilience levels

Peer relations data were collected within entire classrooms in the spring of Grade 4 (Time 5). Data collection in the spring allowed children to have a chance to become familiar with all classmates prior to data collection. Full parental consent and child assent was necessary to put the non-program children's names on the class list for nomination. However, if Early Risers children failed to assent but brought consent from their parents, there were kept on the class list. Children who did not participate completed homework in a different room. Out of the 1706 children in these classrooms, 297 did participate in the peer nominations (101 did not have parental consent, 87 did not return the form, 53 did not assent, and 56 were absent that day). Students who were absent were still eligible to be chosen.

Peer Rejection. In evaluating the risk factor of peer rejection in middle childhood, several issues should be considered. First, adults' waning accuracy in assessing peer relations is recognized. As children approach middle childhood, teachers and parents are less privy to the frequency and circumstances of peer rejection (Newcomb, Bukowski, & Patee, 1993). Thus peer reports provide unique information (Dygdon, 1988). Secondly, previous reviews of peer rejection research have discussed the advantages and disadvantages of categorical variables such as rejected status, popular status, and so forth (Kazdin, 1997; Coie, Lochman, Terry, & Hyman, 1992; Boulton, 1999; Brendgen, Vitaro, Bukowski, Doyle, & Markiewicz, 2001). Terry & Coie

(1991) advise that the continuous variable of social preference, which is a combination of positive and negative peer nominations, performs better than other categorical or continuous peer status variables in terms of psychometric properties (e.g., reliability).

Thus, reversed social preference was used as a measure of peer rejection. Data collection consisted of two sociometric items that asked students to nominate 3 classmates they liked to play with (acceptance) and 3 classmates they did not like to play with (rejection). Acceptance and rejection scores for each child were calculated by summing “like to play with” and “don’t like to play with” nominations, respectively. Following procedures developed in past research (Coie, Dodge, & Coppotelli, 1982), scores were standardized within classrooms and gender to adjust for unequal class sizes and then social preference was calculated as the difference between acceptance and rejection scores.

Aggression. A variation on the Revised Class Play (Masten, Morison, & Pellegrini, 1985) was used to assess peer-rated aggression. Students were asked to imagine that they were directors of a play, casting members of their class for particular roles. They cast all roles using a list of girls’ names and again with only boys’ names. Masten et al.’s RCP measure was modified by adding five victimization items, only four of which were retained in the factor scores. All items were standardized by classroom and gender before scale scores were constructed. The four resulting factors were leadership, aggressive-disruptive, rejected-isolated, and social etiquette. Cronbach’s alpha for these factor scores ranged from .85 to .95 in this sample.

Results

Group equivalence and differential attrition

There were no significant differences between intervention and control groups for gender, age, mean IQ, single parent status, SES, or level of aggression at screening. There was a higher percentage of ethnic minorities in the intervention group (15.3 percent compared with 6.6 percent) at the time of recruitment.

Attrition was 49% over 5 years across both groups, and Control children were more likely to drop out than Intervention children (59% compared to 40%). Dropouts in both groups tended to be low SES, low IQ, minority participants with single parent status. However, since the Intervention group had more minority children at the start of the study, the percentage of minorities who actually participated did not differ between groups. Completers did not differ from dropouts in terms of age, gender, or baseline aggression.

Testing Hypothesis 1: The risk factors of peer rejection and aggression are lower for intervention participants than for control participants.

An Intervention (2) by Gender (2) ANOVA on the continuous dependent variable Time 5 peer rejection revealed significant main effects for Intervention status, $F(1,112) = 4.848, p = .03$, and, Gender, $F(1, 112) = 9.025, p = .003$, as well as an interaction between the Intervention and Gender, $F(1, 112) = 4.171, p = .043$. Girls in the intervention group had significantly lower peer rejection than girls in the control group, $t(36) = 2.728, p = .010$ (see Figure 1). The same ANOVA on Time 5 aggressive-disruptive reputation (from the Revised Class Play) yielded no significant main effects or interactions.

Testing Hypothesis 2: Growth curves in the three protective factors improved linearly over time.

Growth curves were modeled separately in the Intervention and Control groups for each of the protective factors. Growth curve modeling can include two or more simultaneous levels of modeling and hypothesis tests can be undertaken at any level. The Level 1 equation is an intra-individual regression model of the i^{th} subject's response at j^{th} timepoint while the Level 2 equations make up a group level, inter-individual model. In other words, the Level 2 equations estimate the mean and variation of the Level 1 parameters (e.g., treat Level 1 intercept and slope as response variables). Level 3 equations sometimes model differences between groups.

The test for this hypothesis involves comparing Level 1 models with and without linear and non-linear trends. The Level 1 equation for a model with a linear trend would be $\gamma_{ij} = \beta_{0i} + \beta_{1i} \text{lin}_j + e_{ij}$, which states that each observed response on the outcome variable, Social Competence (γ_{ij}), is a function of an intercept (β_{0i}), a linear effect (β_{1i}), and a residual (e_{ij}). The fit of this linear model is tested against a baseline intercept-only model, with no linear trend, $\gamma_{ij} = \beta_{0i} + e_{ij}$. The deviance of each model is used to evaluate which model fit the data best. The deviance of a model is based on the likelihood ratio statistic (multiplied by negative two) comparing the model being fitted to the saturated (comparison) model. For models with the same number of parameters, the deviances can be directly compared to evaluate which model fit the data best. When the number of parameters differs, then the difference between the deviances is distributed as a chi-square with degrees of freedom equal to the difference in the number of parameters. Then one can use a chi-square table to determine whether the additional parameters significantly improve model fit.

Social Competence. Figure 2 shows the social competence growth curves for the intervention and control groups. As Table 1 shows, the linear model for the intervention group (with *lin* as the only predictor) shows a significant reduction in deviance over the baseline intercept-only model. While the model including quadratic as well as linear components also yielded a reduced deviance, it tested a larger number of parameters. The fit statistics support the adoption of a linear model as the most parsimonious model with a good fit.

In the linear model adopted, the mean intercept for the social competence composite was -.56. This value represents the mean starting point of the participants at baseline and is significantly different from zero, $t(114) = -10.180, p < .001$. The variance of the intercept, β_0 , was also significantly different from zero, $\chi^2(114, N = 115) = 322.75, p < .001$. Intervention and control groups are equivalent on baseline assessments and demographic variables (August et al., 2001) so intercept variance will not be further investigated in the covariate models.

The mean slope value of the linear model is .07, which is significantly different from zero, $t(114) = 4.048, p < .001$. This linear slope indicates that the average development in social competence was .07 standard deviations per year. Quadratic and cubic trends are mathematically possible in data with four or more timepoints, but they were not significant once the alpha values were adjusted to account for the number of tests being performed.

The control group had a different overall growth curve shape from the intervention group. While the intervention group showed significant linear change, the control group did not. To test whether this difference in linear effect was statistically significant, experimental condition was entered as a Level 2 predictor of the linear effect in a linear model with intervention and control groups combined. Experimental condition was indeed a significant predictor of the strength of the linear effect, $\beta = .05, t(218) = 2.363, p = .018$.

Parental Investment. Figure 3 shows the parental investment growth curves for the intervention and control groups. In the intervention group, the best fitting model for parental investment growth is a simple linear model. The mean intercept for parental investment is $-.39$, and this was significantly different from zero, $t(114) = -7.152, p < .001$. The variance of the intercept, β_0 , was also significantly different from zero, $\chi^2(114, N = 115) = 787.73, p < .001$. The mean slope was $.02$, which is marginally significant, $t(114) = 1.73, p = .083$. This slope indicates that, on average, parental investment improved at a rate of $.02$ SD per year. There was a significant amount of slope variance left unexplained, $\chi^2(114, N = 115) = 189.52, p < .001$. Even though the coefficient was marginally significant, the linear model was retained as the most parsimonious due to the significant fit of the overall model, in combination with the significant amount of variance left unexplained in the linear parameter (which implies that covariates of the linear parameter might explain additional variance).

Once again the linear effect was nonsignificant in the control group. To test whether this difference in linear effect was statistically significant, experimental condition was entered as a Level 2 predictor of the linear effect in the combined group linear model. Experimental condition was not a significant predictor of the linear effect, $\beta = -.00, t(218) = -.003, p = .998$.

Academic Competence. Figure 4 shows the academic competence growth curves for the intervention and control groups. The model including both linear and quadratic trends was the best fit for the intervention group data. The fourth model, which included a cubic trend as well, was an extremely poor fit to the data. The mean intercept for academic competence is $-.86$ and this is significantly different from zero, $t(114) = -12.783, p < .001$. The variance of the intercept, β_0 , was also significantly different from zero, $\chi^2(114, N = 115) = 411.22, p < .001$. The mean linear slope is $.54$, which is significantly different from zero, $t(114) = 8.105, p = .001$. The

variance of the linear slope, β_0 , is significantly different from zero, $\chi^2(114, N = 115) = 156.50, p = .005$, which indicates that there is considerable linear variance left unexplained in this model. The quadratic slope, with a mean of $-.11$, was also significant, $t(114) = -5.711, p = .001$. The model with linear and quadratic trends will be retained since it is the most parsimonious. Intervention children were more likely to have linear gains in academic competence with a slight inverted U shape (see Figure 4).

The linear and nonlinear trends for the control group are nonsignificant ($\beta = -.08, p = .239$, and $\beta = .02, p = .293$). Again, to test the predictive power of experimental condition on linear trend (and quadratic also, in this case), it was added as a Level 2 covariate in the combined groups sample. Experimental condition was a strong predictor of both the linear growth, $\beta = .30, t(218) = 3.109, p = .002$, and quadratic growth, $\beta = -.08, t(218) = -2.916, p = .004$.

Patterns across the three protective factors. Positive linear change was significant for all three protective factors in the intervention group but not in the control group. In addition, intercepts (baseline scores) of the protective factor growth curves indicate that both intervention and control groups were significantly sub-normal (compared to a normative population) in social competence, academic competence, and parental investment at the start of the intervention.

Testing Hypothesis 3: Growth in social competence predicts peer rejection in children who displayed early onset aggression.

The results from the test of Hypothesis 2 suggest that growth in social competence over the four year period is best characterized by the following linear Level 1 equation.

$$\gamma_{ij} = \beta_{0i} + \beta_{1i} \cdot \text{lin}_j + e_{ij} \quad (1)$$

which states that each observed response on the outcome variable, Social Competence (γ_{ij}), is a function of an intercept (β_{0i}), a linear effect (β_{1i}), and a residual (e_{ij}).

The Level 2 equations can be used to examine covariates of the linear growth curve, since they take the intercept and linear effect from the level 1 equation and treat them as outcome variables. Peer rejection and aggressive-disruptive reputation can then be entered as covariates of linear slope (β_{1i}).

$$\beta_{0i} = \gamma_{00} + u_{0i} \quad (2)$$

$$\beta_{1i} = \gamma_{10} + \gamma_{11}rej_i + \gamma_{12}agg_i + u_{1i} \quad (3)$$

The fit of this model (consisting of both the Level 1 and 2 equations) will then be compared to the baseline linear model. If the fit is better than the baseline model with no covariates, then we can examine the significance of the covariates' coefficients, γ_{11} and γ_{12} . To identify a significant relation between the linear growth curve and peer rejection, for example, the following hypotheses is tested: $H_0: \gamma_{11} = 0$. Similarly the relation between linear growth and aggressive-disruptive reputation is tested by evaluating whether the corresponding coefficient is different from zero, $H_0: \gamma_{12} = 0$.

To find out whether change in social competence across timepoints 1 through 4 is related to time 5 risk factors of peer rejection and aggressive-disruptive reputation, both risk factors were entered as covariates in the growth model. They were simultaneously entered into the model and thus, the resulting coefficients indicate each variable's independent contribution to the growth curve. Table 4 displays the results of the linear social competence models with peer rejection entered as a covariate, controlling for aggressive-disruptive reputation.

When the covariates are added to the social competence growth model for the intervention group, the overall fit of the model is improved, $\chi^2(2, N = 67) = 8.47, p = .056$ and γ_{11} is

significantly different from zero, $\beta = -.05$, $t(64) = 2.342$, $p = .019$, indicating that positive change in social competence is related to lower peer rejection scores for children who were identified as aggressive in kindergarten. When the control group was similarly modeled, the overall model fit poorly, $\chi^2(2, N = 49) = 3.93$, $p = .561$.

Testing Hypothesis 4: Growth in parental investment predicts peer rejection in children who displayed early onset aggression.

There was no relation between Grade K-3 growth trajectories in parental investment and peer rejection in Grade 4. Adding the aggressive-disruptive reputation and peer rejection covariates did not explain any additional variance beyond the simple linear model for the intervention or control groups.

Testing Hypothesis 5: Growth in academic competence predicts peer rejection in children who displayed early onset aggression.

When time 5 peer rejection and aggressive-disruptive reputation are added to the academic competence growth model for the intervention group, the overall fit of the model is improved, $\chi^2(4, N = 67) = 13.49$, $p = .046$, and both γ_{11} and γ_{21} are significantly different from zero, $\beta = -.20$, $t(64) = 3.209$, $p = .002$, $\beta = .04$, $t(64) = 2.046$, $p = .040$, respectively. This indicates that the intervention group's peer rejection in Grade 4 is related to their degree of change in academic competence over the previous 4 years. The negative effect of γ_{11} indicates that positive linear change in academic competence is related to lower peer rejection scores and the positive effect of γ_{21} on the quadratic trend suggests that there was a rise and subsequent fall in academic competence for the children with the least peer rejection while very rejected children tended to just decline. The fit of the overall covariate model was poor for the control group, $\chi^2(4, N = 49) = 10.44$, $p = .168$.

Testing Hypothesis 6: The intervention promoted protective factor growth in some children more successfully than in others.

Finally, intervention response predictors (Lochman, 2001) are examined in relation to the growth curves of the protective factors. The question is, in other words, for whom did the intervention work? How can we characterize the high improvement children in terms of gender, socioeconomic status (SES), IQ, and baseline protective factor scores? These four covariates were entered simultaneously into each growth model as Level 2 predictors of linear trend.

The social competence growth trajectory for the experimental group is modeled in Table 7. When gender, IQ, SES, and baseline social competence were added to the model as predictors, all covariates were significant, $\beta = .09$, $t(106) = 2.654$, $p = .006$, $\beta = .003$, $t(106) = 2.170$, $p = .030$, $\beta = .003$, $t(106) = 2.016$, $p = .043$ and $\beta = -.058$, $t(106) = -2.393$, $p = .017$, respectively. Interestingly, addition of these covariates reversed the direction of the linear effect, $\beta = -.51$, $t(106) = -2.798$, $p = .006$.

When the same predictors were entered into the parental investment growth model (see Table 8), the overall fit of the model was marginally significant, $\chi^2(4, N = 111) = 8.61$, $p = .071$, but SES and baseline were highly significant covariates, $\beta = .003$, $t(106) = 3.097$, $p = .002$, and $\beta = -.074$, $t(106) = -3.213$, $p = .002$, respectively. So the model was rerun with only SES and baseline parental investment as covariates, which yielded a significant fit statistic for the overall model and significant t values, showing the effects of SES and baseline parental investment on growth over time was significantly different from zero, $\beta = .004$, $t(108) = 3.263$, $p = .001$, and $\beta = .004$, $t(108) = -2.809$, $p = .005$. None of the covariates explained variability in the linear or quadratic trends of academic competence growth, as the fit of the overall covariate model was very poor, $\chi^2(8) = 10.52$, $p = 1.00$.

Discussion

Examining hypothesis 1: Was the intervention related to reduced risk for antisocial behavior?

The intervention was related to a lower level of peer rejection as indicated by 4th grade peer nominations, particularly for female participants. Since peer rejection is the best predictor of antisocial behavior and poor adjustment in this aggressive sample, the main effect for intervention status suggests that the children who participated in the intervention are at lower risk for antisocial behavior than the children who did not participate in the intervention. The main effect for gender also indicates that boys and girls were significantly different on peer rejection scores in this sample, with boys being lower.

Examining hypothesis 2: Did the protective factors improve linearly over time?

The growth curves for all three protective factor composite variables showed fairly strong linear trend and some degree of quadratic trend for the intervention group. However, the quadratic trend was only statistically significant for academic competence. It is not uncommon for growth curves in intervention studies to show a bit of a U-shape due to a placebo/halo effect early in the assessment schedule, which becomes more modest as the teachers' and parents' perceived novelty of the intervention wears off (Walker, Kavanagh, Stiller, Golly, Severson, & Feil, 1998; Dupaul & Eckert, 1994).

In comparing the growth curves of the intervention and control groups, linear growth in all three protective factors was statistically significant for the intervention group and nonsignificant for the control group. In order to say more about linear trend in the control group without simply accepting the null hypothesis that there is no linear trend, omnibus tests were conducted using intervention status as a covariate in the combined sample. These tests were able to discern whether the difference in linear trend between intervention and control groups is significant. We

found that it is significant for social competence and academic competence but not for parental investment. The quadratic trend in academic competence was also related to intervention status.

Examining hypotheses 3-5: Which protective factors were related to reduced risk for peer rejection?

Social competence and academic competence trajectories in the intervention group were related to better peer relations while parental investment was not. This implies that within the intervention group, children with higher levels of positive linear change in social and academic competence from kindergarten to 3rd grade tended to have lower levels of peer rejection in 4th grade. In other words, intervention children were more resilient, considering their high risk status in kindergarten. These relationships were nonsignificant in the control group.

Examining hypothesis 6: Which children benefited most from the intervention?

The predictors gender, IQ, SES, and baseline protective factor score were entered into each of the intervention group's protective factor growth models. They explained variability for social competence and parental investment but not academic competence. For both social competence and parental investment, children with higher SES and lower scores at baseline made the most improvements. Patterson et al. (1989) suggest that it is family management practices that mediate the relation between social class and antisocial behavior but patterns have been inconsistent thus far in the literature. Given this dataset's extensive parenting and child behavioral data, it may be fruitful to explore this relationship further, especially as the children enter adolescence.

We might expect that some of the lower baseline scores were due to chance errors in measurement and that these would regress to the mean over time. In consideration of this sample's initial high-risk status, it is important to acknowledge that regression effects are inevitable influences upon longitudinal data collected from samples "selected for their

extremity" (Campbell & Stanley, 1963). Examination of protective factor variances across time suggests that the relation between baseline scores and degree of improvement is likely an artifact of regression effects due to measurement error (imperfect reliability) and the related issue of the sample's relatively low range of baseline scores within the context of a normative population.

It also appears that girls and children with higher IQ improved in social competence significantly more than boys and lower IQ children. While the validity of intelligence tests is hotly debated in the context of high-risk samples (Wachs, 1999; Gordon, 1999; Jones & Herndon, 1992; Valencia & Salorzano, 1997), we can recognize that the measures of intelligence used (Woodcock & Johnson, 1990) reflect aptitude in a combination of abilities required for survival and advancement within a particular culture (Anastasi, 1992). By this definition, then, it may be that for some of these children, an IQ "deficit" actually reflects a cultural difference, which can certainly be impacted by an intensive tutoring program such as that provided by the Early Risers family advocates (Levinson, 1961). Thus, while IQ is often viewed as a relatively stable attribute (Gengerelli, 1940; Thompson & Molly, 1993), in a high-risk sample such as this one, it is important to recognize its enmeshment within cultural and social class frameworks.

Conclusions Regarding Post-intervention Tasks

Evaluating the reduction of risk. For girls in particular, the intervention appears to be effective in reducing risk for antisocial behavior. This does not appear to be due to a gender difference favorable to girls (e.g., it is not the case that girls are less likely to be rejected anyway.) In this sample, girls are, on average, more rejected than boys (social preference means of -1.05 compared to -.59). However, additional factors must be considered in light of this gender effect. First, there has been some controversy regarding the generalizability of peer rejection as a predictor of antisocial behavior. Miller-Johnson, Coie, Maumary-Gremaud, Lochman, & Terry (1999) found that their predictive models for antisocial behavior fit best when boys and girls were modeled separately. They predicted 6th, 8th, and 10th grade delinquency using 3rd grade peer rejection and aggression in 327 African-American children, and found that the combination of peer rejection and aggression predicted delinquency in boys but aggression alone best predicted delinquency in girls. Further work with other samples will clarify whether this pattern holds across various demographics. Secondly, girls only account for 31% of the Early Risers sample. So, despite the promising effects for girls, risk was attenuated to a lesser degree for boys, who make up the remaining 69% of the sample.

Evaluating processes of change. Two of the three targeted protective factors proved to be related to lowered risk for antisocial behavior in the intervention group. The lack of these patterns in the control group are consistent with the theoretical resilience framework (Rutter, 1985), which implies that we would not expect spontaneous reduction of group risk levels without the interactive effects of protective factors. As predicted by a number of developmental theories, growth curves in the intervention group's social competence and academic competence were related to level of peer rejection and, by extrapolation, to level of risk for antisocial

behavior. However, growth curves in parental investment did not follow this hypothesized pattern. There was positive change in parental investment in the intervention group but the children's degree of change was not related to level of peer rejection. Several possible reasons for the lack of an empirical relationship should be considered and further investigated.

One possible reason is the problem of measurement. Even though substantial literature links parental investment to quality of peer relations, many of those studies were conducted by sampling parenting quality at one timepoint and then assuming a level of continuity across time (based upon the single sampled timepoint). In other words, that particular methodology assumes that a high score on parental investment reflects a continuously high level of investment across time. The methodology of the present study specifically tries to foster and measure improvements in parental investment. This creates a disparity, in itself, between the time-invariant interpretation of parenting scores used in other studies and the time-specific interpretation used in this study. In addition, given the repeated administrations of these measures, there is a possibility that the experience of previous testing might affect later testing. It does not necessarily change parents' behavior, but might cause them to respond in a manner different from the assumed "pure" and unbiased response (e.g., the way they would respond if it were the first time they were ever assessed). Boyle, Offord, Racine, Szatmari, Sinford, & Fleming (1997) documented a systematic tendency for these types of scores to drop with repeated measures. In addition, participation in the study (either intervention or control group) is likely to heighten parents' sensitivity to parental investment issues, which also would affect the way they rate themselves and their child in regard to parenting issues.

The second possibility is a "sensitive period" explanation. The theories linking parental investment to peer relations and later antisocial behavior rely largely on social learning patterns.

Even behavior therapy implemented by mental health professionals has limited impact on children's behavior once certain behaviors have been socialized (Patterson & Reid, 1984; Kazdin, 2000; Friedman, 1970; Wahlroos, 1976). Parents' degree of influence in middle childhood has been polarized in recent years (Harris, 1998; Borkowski, Ramey, & Bristol-Power, 2002; Collins, Maccoby, Steinberg, Hetherington, Bornstein, 2000), but the full range of theoretical positions recognizes the critical influence of parenting during and prior to early childhood. Early Risers targeted the period of middle childhood and thus did not have the opportunity to influence formative parenting behaviors during infancy and early childhood. In this sense, Early Risers was less of a selective prevention effort (which targets individuals with some risk) and more of an indicated intervention (which targets high-risk individuals who are already showing signs of disorder). Empirical data show that the greatest successes in prevention programs geared toward positive parenting are those that begin during early infancy (Olds & Henderson, 1989; Lally, Mangione, & Honig, 1988; Seitz, 1990; Erickson, Korfmacher, & Egeland, 1992; Hill, 1999).

The final possible explanation is an interaction between child behavior and parental investment. It may be that children who are benefiting most from the other protective factors change their own behavior to a degree that parents' perceptions of their child's behavior is normalized. For example, if a child was aggressive in kindergarten and began participating in the Early Risers study, the summer school program might be effective in boosting academic and social competence. When the child returns to school for the first grade, the new teacher reports a high engagement in schoolwork and peers to the parents. The parents may then perceive that their child may not have problems after all, and as a result, not feel a need to change their parenting habits.

The three influences outlined above should be further examined in terms of understanding potential strategies of reducing risk via parenting interventions. We might find that prevention projects like Early Risers would be well served by further addressing problems regarding measurement of parental investment across time, timing of parenting interventions, and/or keeping intervention parents on track in continuing to improve their parental investment. All of these issues were considered to some degree during the design of the Early Risers program, but the lack of empirical relation between parent investment growth and reduced risk suggest a need for revision in this area. Revisions should incorporate these and other results into new strategies for effecting change in parental investment. Then the cycle of assessing protective factor growth and risk attenuation can begin again.

Revisiting Pre-intervention Tasks in Light of Post-Intervention Results

Identify the problem. These results suggest that gender should be carefully considered in defining and addressing the problem of antisocial behavior. The work begun by Miller-Johnson et al. (1999) in developing separate antisocial behavior predictive models for girls and boys should be seriously considered in future prevention and research designs. Unfortunately, this sample was not adequately gender-balanced to undertake a serious examination of differences between male and female developmental trajectories.

The findings regarding socioeconomic status are a cause of some concern. Regarding SES, children with the highest risk (low SES) were the very ones who responded the least to the social competence and parental investment intervention components. This frustrating pattern runs rampant in child and family interventions (Katz, El-Mohandes, Johnson, Jarrett, Rose, & Cober, 2001; Tarnowski, Brown, & Simonian, 1999; Institute of Medicine, 2001) and it is critical to continue refining prevention programs as we learn about these predictors of intervention

response (Lochman, 2001). From an empirical standpoint, low SES is not only a risk factor for developing antisocial behavior, it is also a risk factor for poor response to preventive interventions! From a pragmatic standpoint, we should consider redefining antisocial risk within low SES contexts as being uniquely resistant to change and thus, requiring preventive strategies that go above and beyond what works for higher SES children.

Redefining antisocial risk *within* the context of socioeconomic status will also help us refrain from conceptualizing low-SES and antisocial as synonymous. It is our ethical responsibility to avoid the tacit conclusion that low socioeconomic status is a deterministic pathway to deviant behavior. Unfortunately, U.S. sociocultural norms implicitly foster stereotypes of our poorer populations as also being “dangerous” or “troublesome,” so it is crucial that prevention researchers and practitioners maintain a conceptualization in which low-SES and antisocial are distinct as statistical risk factor and outcome. The field of prevention struggles with a challenge similar to that of criminal/terrorist profilers. Although low SES and minority individuals have statistically been overrepresented in adolescent and adult antisocial populations, we strive to maintain a respectful system for identifying risk in childhood without profiling, labeling, or stigmatizing those individuals solely on the basis of their racial, ethnic, or socioeconomic status.

Identify risk and protective factors. The results suggest that social competence and academic competence are, indeed, serving in some protective function for these children who were identified as at-risk for antisocial behavior based on kindergarten ratings of aggression. The results also suggest that the mechanisms by which parental investment is theorized to reduce risk for antisocial behavior should be examined more closely. Developmental resilience frameworks provided several strong mechanisms by which parental investment could theoretically affect peer

rejection: bonding to prosocial family/school goals, modeling and reinforcement of positive social interactions, parent-child relationship serving as a template for other relationships, and parents providing opportunities for positive social interactions. Reflection on the processes of change made evident by data analysis, combined with a critical examination of the theoretical mechanisms proposed, suggests that the parenting component of the intervention should begin earlier and with more intensity. It may be that positive parenting is a protective factor only when it is in place long before the transition to school. The exact timing is an empirical question to be investigated.

As we re-examine the conditions under which parenting may function as a protective factor, parental stress should be further investigated as a critical mechanism in reducing child antisocial risk. Exploratory analyses in this dataset indicate a marginally significant relationship between parent's stress trajectory and child's level of peer rejection in Grade 4, $\beta = .04$, $t(64) = 1.885$, $p = .059$ (overall model fit, $\chi^2(2, N = 67) = 5.8$, $p = .053$). It is also anticipated that with the collection of alcohol, tobacco, and other drug usage data from this sample in upcoming years, the previously collected data on parental investment may very well reveal important links between middle childhood parenting and substance use in early adolescence.

The models presently examined still contain a good deal of unexplained variance, which implies that additional developmental mediators have yet to be identified. In addition, Hawkins, Guo, Hill, Battin-Pearson, & Abbott (2001) demonstrate the importance of long-term follow-ups for prevention participants. Even though their short term prevention effects appeared to diminish within two years after intervention, the prevention group's trajectory began to show a significant departure from that of the control group five years after the intervention ended. The pattern continued to differentiate dramatically in following years.

Design intervention. Which components of the intervention were most successful in reducing risk? The growth curve models indicate that better peer relations were related to improvements in social and academic competence, particularly parent and teacher reported social skills, teacher-reported social acceptance, performance on academic achievement tests, parent and teacher reported concentration problems, and teacher reported cognitive competence. All of these domains were primarily targeted in the summer schools that occurred between kindergarten and 3rd grade. With adequate funding, this portion of the intervention could be strengthened in future implementations by offering the summer program in additional years as well. The school bonding mechanisms proposed by Hawkins et al. (1992) would be well-served, in theory, by additional positive experiences in a school setting. This would, in effect, increase the dosage of the current design. All of the intervention components could be further explored with a dosage manipulation technique in order to find the most cost-effective level of intervention.

Microgenetic studies of development in each protective factor over the course of several months could also provide useful information in learning about optimum dosage levels. For example, daily or weekly assessment of concentration problems could be modeled using HLM to better understand change over time in relation to the intervention dosage provided and also in relation to other child variables, family stress, social status, and so on. In addition to dosage manipulation, future designs can vary and test the timing of intervention components to determine the optimum timing of prevention components (as previously discussed with the parenting component).

All of the intervention components should be revisited with the goal of improving the low levels of response among low socioeconomic participants. Higher levels of stress and insularity (lack of social support) make both parental and child participation less coherent, in addition to

raising the likelihood of attrition (Katz et al. 2001; Dumas & Wahler, 1983). Thus every effort should be made to integrate service delivery within the immediate community and to employ staff who are from the community they serve or at least very familiar with the community. The current design places responsibility on the child's classroom teacher to seek help from the family advocates. Perhaps an even more integrated support system would increase utilization of academic resources. Additionally, parent commitment to academic competence has not been examined here, but would also be a purposeful cross-domain connection for the child.

Conclusions

Statistical techniques such as hierarchical linear modeling allow prevention researchers to see more deeply into their longitudinal data due to the full maximum likelihood estimation procedures employed by the HLM software (Raudenbush, Bryk, Cheong, & Congdon, 2000), which allow for conservative estimates of data missing on longitudinal datapoints. Analyses with traditional linear models require assumptions of linearity, normality, homoscedasticity and independence (Raudenbush & Bryk, 2002). Upon close examination of any longitudinal prevention dataset, it can be seen that the last two assumptions are rarely met, and yet we have been forcing these data into analyses of variance with repeated measures for decades. While HLM still requires the assumptions of linearity and normality, it allows the researcher to specify levels of heteroscedasticity and interdependence of measurements. Thus, advantages of multilevel modeling of growth curves include: a) allows general linear and non-linear trend testing; b) yields interpretable individual and group intercepts; c) yields interpretable individual and group slopes; d) allows model comparison; and e) allows testing for effects of covariates on linear trends.

Traditional analyses of variance allowed us to determine that risk had been lowered for the intervention group, but hierarchical modeling allowed evaluation of the processes of change. We learned that two of the three protective factors were significantly improved as a result of the intervention, we learned that individuals who most improved on those protective factors showed the lowest risk in 4th grade for developing later antisocial behavior, and we learned that girls, high SES children, high IQ children, and those with the lowest baseline social competence had the greatest degree of positive change in social competence while children with high SES and low baseline scores improved the most in parental investment. The children who participated in the Early Risers project showed high risk of entering into a lifelong antisocial trajectory by the time they were in kindergarten (Moffitt, 1993; Loeber, 1988; Patterson et al., 1989), and now a good portion of those in the intervention group have been deflected off that pathway as a result of the investments poured into building their protective factors of social and academic competence. Data from the control group tells us that these improvements would not have occurred on their own. Lessons from this round of prevention research encourage similar implementations regarding social and academic competence and fresh ideas on building parental investment. Multilevel modeling methods combined with patient revision and reframing of developmental risk and resilience theories have the potential to pull prevention science and general developmental science forward jointly in the hands of practitioners and researchers.

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Table 1

Social Competence Growth Modeled Over Time

	Predictors			Test of model fit				
	γ_{00}	γ_{10}	γ_{20}	Parameters	Deviance	χ^2	<i>df</i>	adjusted <i>p</i>
Level 1	Intercept	Linear	Quadratic					
<hr/>								
Intervention								
None	-.45			3	745.59			
lin	-.56*	.07*		6	727.72	17.87	3	.002
lin,quad	-.60*	.20*	-.04	10	722.91	4.81	4	1.00
<hr/>								
Control								
None	-.60*			3	576.53			
Lin	-.62*	.02		6	572.29	4.24	3	.950

Note. This reads like a hierarchical regression table in that, within each group, each line represents a model that is compared to the model above it. A low deviance reflects a well-fitting model and the decreases in deviance for successive models are tested for significance, similar to “change in R squared.” Adjusted *p* reflects Bonferroni adjustment.

*reject null that the given coefficient is equal to zero at .05 alpha level

Table 2

Parental Investment Growth Modeled Over Time

	Predictors			Test of model fit				
	γ_{00}	γ_{10}	γ_{20}	Parameters	Deviance	χ^2	<i>df</i>	adjusted <i>p</i>
Level 1	Intercept	Linear	Quadratic					
<hr/>								
Intervention								
None	-.35*			3	483.67			
Lin	-.39*	.02		6	468.97	14.70	3	.010
Lin,quad	-.40*	.07	-.02	10	466.80	2.16	4	1.00
<hr/>								
Control								
None	-.25*			3	380.53			
Lin	-.27*	.01		6	378.70	1.83	3	1.00

Table 3

Academic Competence Growth Modeled Over Time

	Predictors				Test of model fit				
	γ_{00}	γ_{10}	γ_{20}	γ_{30}	Parameters	Deviance	χ^2	df	adj p
Level 1	Intercept	Linear	Quadratic	Cubic					
Intervention									
None	-1.02*				3	868.18			
Lin	-1.08*	.04			6	840.13	28.05	3	.001
Lin,quad	-.86*	.54*	-.11*		10	828.98 [781.00]	59.09	4	.001
Lin,quad,cub ¹	-1.14*	.20	-.04	-.00	14	[780.98]	.02	4	1.00
Control									
None	-1.11				3	802.40			
Lin	-1.09*	-.01			6	792.56	9.84	3	.100
Lin,quad	-1.07*	-.08	.02		10	764.85	27.71	4	.001

¹ This is a saturated model (i.e., tests the maximum number of parameters possible with 4 timepoints), and thus requires a slightly different model comparison procedure. Hierarchical multivariate linear modeling with an unstructured covariate matrix was used to obtain the bracketed parameters and deviances.

Table 4

Social Competence Growth in Relation to Peer Rejection

	Predictors				Test of model fit				
	γ_{00}	γ_{10}	γ_{11}	γ_{12}	Parameters	Deviance	χ^2	df	adj p
Level 1	Intercept	Linear							
Level 2			Rejected	Aggressive					
Intervention (67)									
Lin	-.49*	.09*			6	410.07			
Lin, rej, agg	-.49*	.13*	-.05*	-.02	8	401.60	8.47	2	.056
Control (49)									
Lin	-.49*	.02			6	264.32			
Lin, rej, agg	-.49*	.05*	-.04*	.01	8	260.39	3.93	2	.561

Table 5

Parental Investment Growth in Relation to Peer Rejection

	Predictors				Test of model fit				
	γ_{00}	γ_{10}	γ_{11}	γ_{12}	Parameters	Deviance	χ^2	df	adj p
Level 1	Intercept	Linear							
Level 2			Rejected	Aggressive					
Intervention (67)									
Lin	-.30*	.01			6	281.79			
Lin, rej, agg	-.30*	.01	-.03	.02	8	279.13	2.67	2	1.00
Control (49)									
Lin	-.28*	.01			6	157.87			
Lin, rej, agg	-.28*	.01	.01	-.02*	8	154.84	3.03	2	1.00

Table 6

Academic Competence Growth in Relation to Peer Rejection

	Predictors							Test of model fit			
	γ_{00}	γ_{10}	γ_{20}	γ_{11}	γ_{12}	γ_{21}	γ_{22}	Parameters	Deviance χ^2	df	adj p
Level 1	Int	Lin	Quad	Lin Cov		Quad Cov					
Level 2				Rej	Agg	Rej	Agg				
Intervention (67)											
lin,quad	-1.05*	.21*	-.06*					10	464.06		
lin,quad,rej,agg	-1.05*	.37*	-.10*	-.20*	-.07	.04*	.02	14	450.57	13.49	4 .046
Control (49)											
lin,quad	-.96*	.07	-.03					10	310.69		
lin,quad,rej,agg	-.96*	.18	-.07	-.27*	.17*	.08*	-.04*	14	300.25	10.44	4 .168

Table 7

Gender, IQ, SES, and Baseline Social Competence as Predictors of Social Competence Growth

EffectsCov	Predictors						Test of model fit				
	γ_{00}	γ_{10}	γ_{11}	γ_{12}	γ_{13}	γ_{14}	Para	Deviance	χ^2	df	p
Level 1	Int	lin									
Level 2			gen	iq	ses	baseline					
lin	-.55*	.07*					6	684.70			
lin,gen,iq, ses, baseline	-.55*	-.51*	.09*	.00*	.00*	-.06*	10	671.42	13.27	4	.010

Table 8

Gender, IQ, SES, and Baseline Parental Investment as Predictors of Parental Investment Growth

	Predictors						Test of model fit				
	γ_{00}	γ_{10}	γ_{11}	γ_{12}	γ_{13}	γ_{14}	Para	Deviance	χ^2	df	p
Level 1	Int	lin									
Level 2			gen	iq	ses	baseline					
lin	-.38*	.03					6	444.98			
lin,gen,iq, ses, baseline	-.38*	-.18	.03	-.00	.00*	-.07*	10	436.37	8.61	4	.071 ²
lin, ses,base	-.38*	-.15*			.004*	-.06*	8	437.23	7.75	2	.020

² Before Bonferroni adjustment

Figure Captions

Figure 1. Peer rejection scores by gender and intervention group.

Figure 2. Social competence growth curves for intervention and control groups.

Figure 3. Parental investment growth curves for intervention and control groups.

Figure 4. Academic competence growth curves for intervention and control groups.

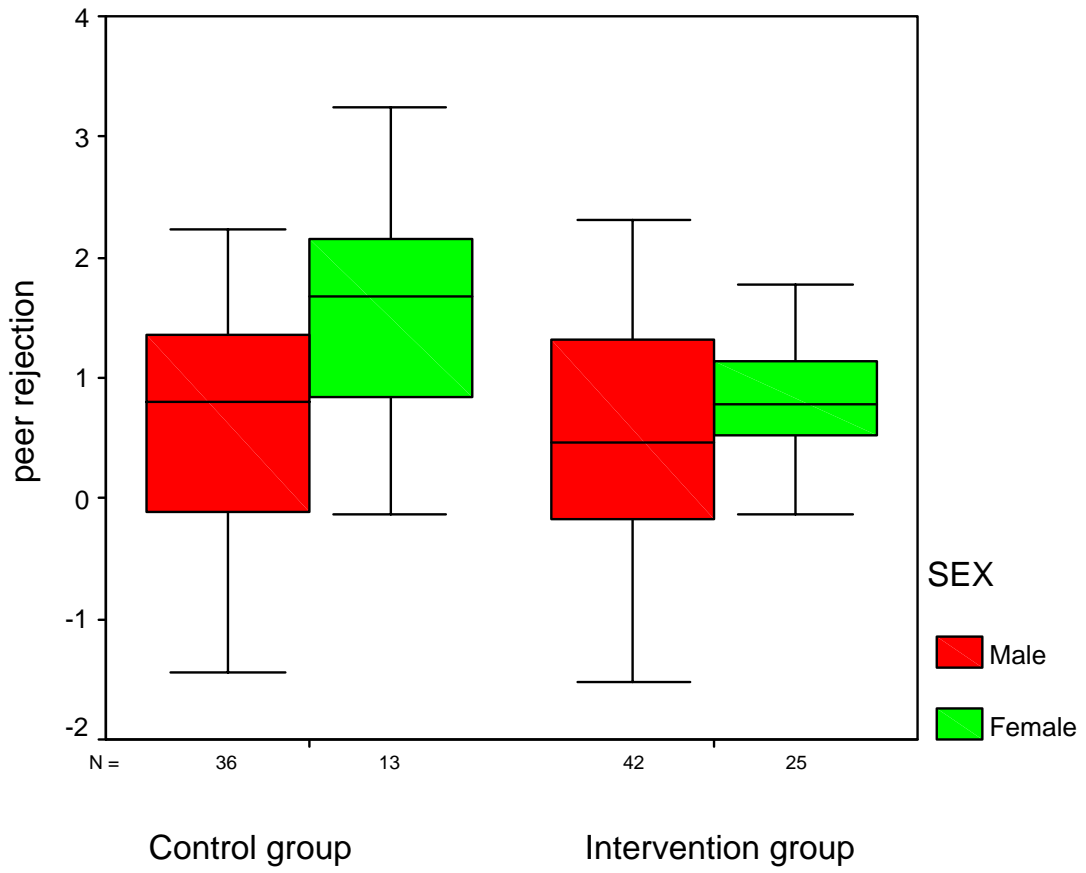


Figure 1. Peer rejection scores by gender and intervention group.

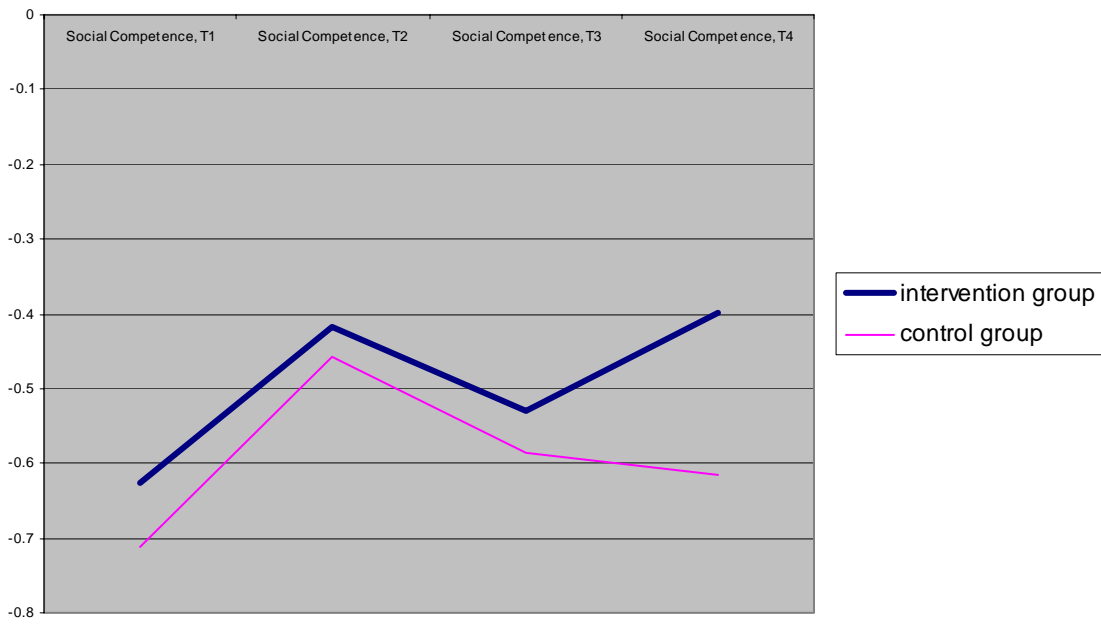


Figure 2. Social competence growth curves for intervention and control groups.

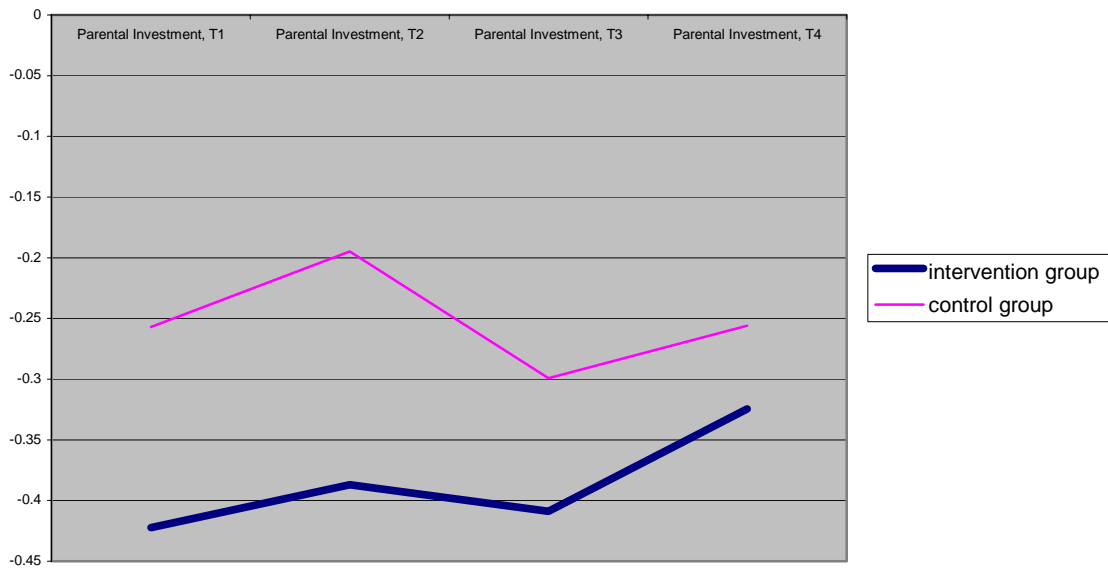
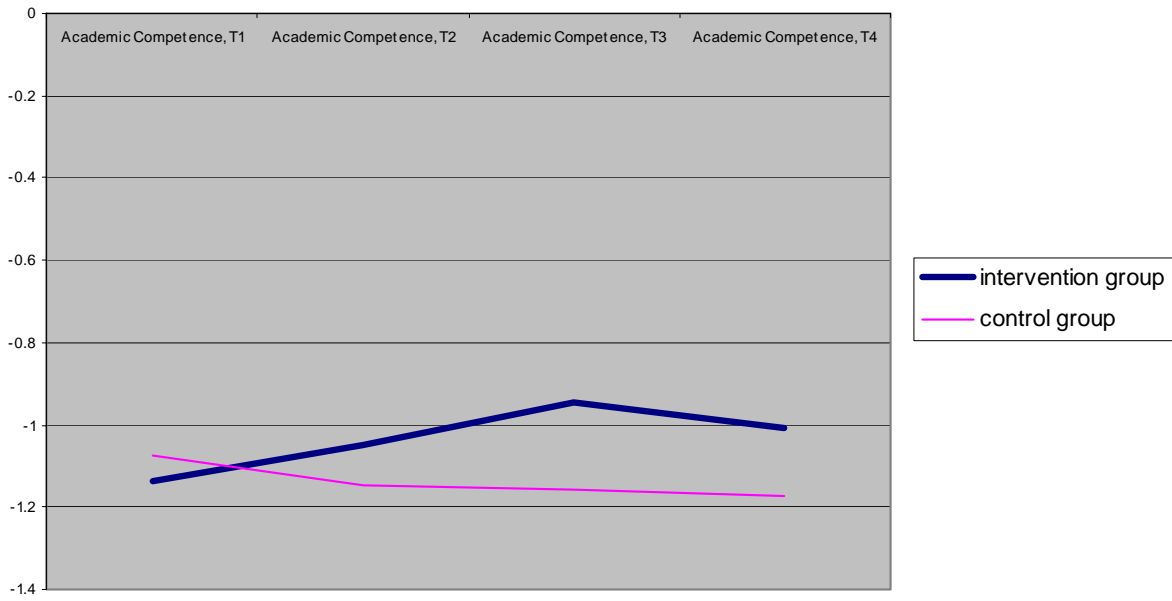


Figure 3. Parental investment growth curves for intervention and control groups.



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Figure 4. Academic competence growth curves for intervention and control groups.