

Testing an Idealized Dynamic Cascade Model of
the Development of Serious Violence in Adolescence

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Abstract

A dynamic cascade model of development of serious adolescent violence was proposed and tested through prospective inquiry with 754 children (50% male; 43% African American) from 27 schools at 4 geographic sites followed annually from kindergarten through grade 11 (ages 5 through 18). Self, parent, teacher, peer, observer, and administrative reports provided data. Partial least squares (PLS) analyses revealed a cascade of prediction and mediation: An early social context of disadvantage predicts harsh-inconsistent parenting, which predicts social and cognitive deficits, which predicts conduct problem behavior, which predicts elementary school social and academic failure, which predicts parental withdrawal from supervision and monitoring, which predicts deviant peer associations, which ultimately predicts adolescent violence. Findings suggest targets for in-depth inquiry and preventive intervention.

Consensus grows that children who are at high risk for later chronic violence can be identified early in life based on conduct problems (called the early-starter model, Moffitt, 1993; Patterson, Reid, & Dishion, 1992), but the processes are less clear through which minor conduct problems in early life get transformed into costly and serious violent behaviors in adolescence. Numerous variables (classified into domains such as context, parenting, and peer relations, Stouthamer-Loeber, Loeber, Wei, Farrington, & Wikström, 2002) are known to predict adolescent antisocial outcomes, but whether these variables increment the prediction beyond dispositional factors in early life is still under debate (reviewed by Dodge, Coie, & Lynam, 2006). A developmental model of conduct disorder (Conduct Problems Prevention Research Group, 1992) has identified some of the major predictor domains and posits that these domains catalyze early conduct problems into new, more serious, chronically violent behaviors in adolescence. Numerous questions remain about the processes through which early variables operate to produce chronic violence (Dodge & Pettit, 2003). It is not clear how predictor domains relate to each other, whether one domain mediates the impact of another domain, whether some domains account for redundant portions of outcome variance, and whether each domain provides unique increments in predicting violence in adolescence. The major alternate hypothesis (Gottfredson & Hirschi, 1990) is that some children are born with, or acquire early in life, a disposition for low self-control and become early starters destined for violent outcomes; all other "predictor" variables represent non-causal markers of the child's impact on the world that do not play any incremental role in that child's development. The goals of the current study were to articulate a dynamic cascade model of the development of chronic violence in adolescence that posits incremental roles of numerous life experience factors and to test key hypotheses from the model through a prospective study of children followed from kindergarten

through late adolescence. We acknowledge that other plausible cascade models could be tested as well.

Predictors of Adolescent Antisocial Behavior

A large body of empirical evidence has established the predictive validity of at least seven domains of predictors of adolescent conduct problems: early adverse social context, early harsh and inconsistent parenting, lack of social-cognitive and cognitive readiness to begin school, early behavior problems, early school social and academic failure, lack of parental supervision and monitoring in adolescence, and adolescent deviant peer associations (Conduct Problems Prevention Research Group, 1992; Dodge, Coie, & Lynam, 2006; Stouthamer-Loeber et al., 2002). Further, it appears that most of these same factors also predict severe interpersonal violence and homicide, the most severe form of conduct problems (Capaldi & Patterson, 1996; Loeber et al., 2005). Other domains are plausible as well, and some of the following domains might be sub-divided into more domains, but we offer the following as a heuristic model.

Early adverse social context. Using multi-level analyses of families residing in different neighborhoods in Chicago, Sampson, Raudenbush, and Earls (1997) found large neighborhood variations in youth violent behaviors that are associated with neighborhood structural characteristics. Beyers et al. (2003) used census-tract data, and Ingoldsby and Shaw (2002) used self-reports, to determine that neighborhood-level scores for the proportions of families characterized by poverty represent a significant risk factor for later individual-level conduct problems. Thus, the neighborhood social context into which a child is born places that child at high (or low) risk for violent behavior many years into the future (Stouthamer-Loeber et al., 2002). None of these scholars proposed that neighborhood context operates directly on a child's behavior, however; the processes through which context exerts influence are not clear.

Adverse context is also indexed by within-family variables during the first five years of life. Family socioeconomic status, which is fairly stable across childhood, exerts broad influence across domains from parenting to later conduct problems (McLoyd, 1990). Maternal depression affects the interactions between the mother and child, which may indirectly affect the trajectory of the child's behavioral development. Numerous other community and family context variables are extremely important but are not reviewed here because the focus of this study is on development during the school years.

It must be noted that the paths between adverse contexts and parenting are likely to be reciprocal. Parents with depression and other problems may suffer outcomes that lead them to migrate toward contexts of greater disadvantage.

Early harsh and inconsistent parenting. Most developmental theories propose a major role for the impact of early parenting strategies, especially during discipline encounters with a child (Patterson, 1986; Snyder, Reid, & Patterson, 2003). Harsh discipline in the first five years of life has been associated with violent behavior outcomes in adolescence (Lansford et al., 2002), especially when applied inconsistently (Patterson, Reid, & Dishion, 1992). The lack of warmth between parent and child is also crucial as a predictor (Pettit, Bates, & Dodge, 1997). Caspi et al. (2004) used a monozygotic twin study that controls for genetic differences and found that maternal verbal statements of negative affect about a child (called expressed emotion) predicted children's antisocial behavior problems.

McLoyd (1990) examined the parenting mechanisms through which a context of poverty might exert its impact. She found that poverty increases single African American parents' psychological distress and impairs their social support systems, which, in turn, diminishes their effectiveness and increases their coerciveness toward their children. Sampson and Laub (1994)

reanalyzed the Glueck and Glueck (1950) longitudinal data set involving 1,000 Depression-era white families and found that the structural variable of family poverty influenced family processes of harsh discipline, low supervision, and poor parent-child attachment, which, in turn, influenced juvenile delinquency. Family process accounted for two thirds of the effect of poverty on delinquency. Likewise, Dodge, Pettit, and Bates (1994) found that harsh physical discipline by parents accounted for about half of the effect of low socioeconomic status on children's aggressive behavior. Numerous scholars have examined parenting processes during the first five years of life in more transactional detail, but the constraints of the design of the current study, which started when children were age 5, prohibited detailed analyses of this era.

Lack of school social and cognitive readiness. Children begin formal schooling with large individual differences in social-cognitive and cognitive skills and biases that have been shown to predict antisocial outcomes. Children who are unable to recognize emotions in others (Eisenberg et al., 2004), who demonstrate a bias to attribute hostile intent to peers' intentions (Dodge et al., 2003), and who are relatively poor at social problem-solving (Dodge et al., 2003) are at risk for later antisocial behavior. Verbal abilities assessed by intelligence tests have also been found to predict later antisocial behavior (Moffitt & Caspi, 2001).

A growing literature has identified antecedents of social-cognitive skills, particularly in previous parenting. Pollock and Tolley-Schell (2003) found that physically abused children demonstrate selective attention to angry faces and reduced attention to happy faces. Dodge, Bates, and Pettit (1990) identified a pattern of hostile attributional bias and social problem-solving skill deficits that emerged following the experience of harsh discipline from parents. Aber et al. (2004) found that witnessing family violence around the time of the September 11th disaster predicted children's tendencies to display hostile attributional biases a year later; and

Cummings and Davies (2002) have argued that emotion dysregulation is the process that mediates the relation between witnessing marital conflict and later child aggression.

Early behavior problems. The continuity of externalizing behavior problems across development is one of the most well-documented findings in longitudinal inquiry in social development (Dodge, Coie, & Lynam, 2006). Although the form of antisocial behavior may change from disobedience and oppositional behavior in early childhood to violence and crime in adolescence, continuity in the rank-ordering of individual differences is the basis for the early-starter model (Moffitt, 1993). It is imperative that a cascade model describe the processes that transform antisocial behavior from one form to another and highlight factors that deflect this trajectory.

School social and academic failure. Deficits in school readiness skills are hypothesized to lead to school failure in peer relations and academic performance, which, in turn, have been linked to later antisocial outcomes. Dodge et al. (2003) found that the experience of social rejection by peers leads to growth in antisocial behavior across elementary school. Academic failure, indexed by grade retention, placement into special education, and failing test scores, represents another predictor of antisocial outcomes (Hinshaw, 1992; Moffitt, Gabrielli, Mednick, & Schulsinger, 1981). Meta-analyses suggest that kindergarten and early grade retention has long-term detrimental effects on behavior outcomes, in spite of temporary academic benefits (Holmes, 1989).

Lack of parental monitoring. As children move into adolescence, the tasks of parenting change, as do the parenting predictors of antisocial outcomes. Parents' lack of monitoring of their child's whereabouts, failure to supervise behavior and time allocation, and lack of engagement with the youth in schooling all have been associated with antisocial outcomes in adolescence

(Dishion & McMahon, 1998). Monitoring is especially important as a protective factor among youth who reside in a social context of danger and risk (Pettit et al., 1999). Dishion, Nelson, and Bullock (2004) used videorecords of parent-adolescent interaction to determine that directly observed parental disengagement predicted growth in the youth's associations with deviant peers and delinquent outcomes. Hill et al. (2004) found that lack of parental involvement in school during the middle school years predicted a youth's later maladjustment.

Although individual differences in parents' lack of monitoring and engagement have been found to increment the prediction of antisocial outcomes beyond the levels that anteceded monitoring, it is plausible that these patterns might be at least partly elicited by the child. Parent-child conflict may well be stressful, and monitoring by parents might intensify conflict when the parent discovers misbehavior. Thus, early school problems might well lead to *lower* levels of parental monitoring in adolescence (Stattin & Kerr, 2000). Laird et al. (2003) found evidence to support a reciprocal-influence model of growth in youth antisocial behavior and parental withdrawal of monitoring over time. Evidence by Larzelere and Patterson (1990) indicates that parent management practices in sixth grade, including monitoring, mediated the impact of prior family socioeconomic status on antisocial behavior measured in seventh grade from police records and self-report. Thus, parents' monitoring activities may well grow out of prior contexts but appear to increment and mediate later outcomes.

Deviant peer associations. The final domain of predictors of adolescent violent behavior is association with deviant peers. This factor has received a wide variety of empirical support as a proximal predictor of adolescent deviant behavior. Patterson et al. (1992) found that involvement with deviant peers in grade 6 (measured by parent, peer, and self descriptions) predicted subsequent delinquency even controlling for prior antisocial behavior. Simons, Wu,

Conger, and Lorenz (1994) also found that association with deviant peers predicted subsequent arrests. Laird et al. (2001) found that deviant peer associations predicted growth in antisocial behavior, and Keenan et al. (1995) found that in the Pittsburgh Youth Study authority conflict was twice as likely to occur among those disruptive boys who had truant or disobedient best friends as among those who did not. Two important features of this study were the fact that onset was the dependent variable, thus controlling for previous disruptive behavior, and the fact that peer influence was tested within a specific type of antisocial activity as a way of examining the extent to which peers truly were models of deviant behavior.

The antecedents of deviant peer associations are varied, but low parental monitoring has been implicated in several studies. Snyder, Dishion, and Patterson (1986) found a strong path relation between low parental monitoring and increases in deviant peer associations. Simons et al. (1994) found that problems in parental discipline practices (including poor monitoring) predicted increased deviant peer associations and later criminal arrests. Thus, it is plausible that the effect of the lack of parental monitoring on antisocial outcomes is mediated through enhanced deviant peer associations.

A Dynamic Cascade Model of Development

The body of empirical evidence reviewed above suggests that predictor domains for adolescent violence may inter-correlate, as in Figure 1. Reducing the paths in this figure to the minimum necessary uniquely contributing components is one goal of efficient longitudinal modeling. We propose the dynamic cascade model represented in Figure 2 to describe this developmental process. We recognize that alternate cascade models could hold as well.

This model begins with a child's birth into an adverse social context, characterized by high neighborhood disadvantage and low neighborhood access to social services. It is

hypothesized that this context places a child at risk for a variety of problem outcomes throughout life, including chronic antisocial behavior in adolescence. Although a comprehensive model would also include the domain of prenatal experience and temperament, which act as biologically-based dispositions to act impulsively and without delay of gratification, the current empirical study began with children at age 5 and could not unambiguously measure this domain. Thus, it is not discussed further.

It is hypothesized that the domain of adverse social context operates on adolescence violence primarily indirectly through impact on life circumstances across childhood, especially early parenting. An adverse social context increases family stress and the rate of maternal depression which makes it more difficult to parent effectively, especially during discipline events. It is hypothesized that harsh and inconsistent discipline practices and lack of parental warmth predict adolescent violence, partially mediate the impact of an adverse social context on later violence outcomes, and increment the prediction of violence outcomes beyond context predictors.

But how does the impact of early parenting practices operate? These discipline practices are hypothesized to reduce the child's opportunities for learning self-regulatory, social-cognitive, and cognitive skills and attitudes that might be called school readiness skills. Deficits in these skills, in turn, are hypothesized to predict adolescent violence, to mediate the impact of parenting practices on violence outcomes, and to increment the prediction of violence outcomes.

How do school readiness skill deficits, in a context of poverty and harsh and inconsistent parenting, lead to adolescent violence? It is hypothesized that these deficits increase the probability that a child will experience failure in peer relations and academic performance. School social and academic failure, in turn, is hypothesized to predict adolescent violence

outcomes, to mediate the impact of school readiness skills deficits, and to increment the prediction of these outcomes beyond the skill deficits themselves.

School failure operates, in turn, partially through its reciprocal impact on the parent-child relationship. School and peer conflict make parenting an even more difficult task that requires intensified monitoring and supervision of a child, enhanced parent-child communication, and enhanced parent involvement at school; however, it is hypothesized that these school problems have a paradoxical effect on *lowering* parental monitoring, supervision, communication, and involvement, in order to reduce conflict or because the parent has begun to give up on exerting an impact on the child. Low parental monitoring is hypothesized to predict adolescent violence outcomes, to mediate partially the impact of school failure on these outcomes, and to increment the prediction of these outcomes beyond school failure.

Finally, a major product of low parental monitoring and school involvement is the youth's tendency to associate with deviant peers. This pattern is hypothesized to have a proximal impact on potentiating adolescent violent behavior, to mediate partially the impact of low parental monitoring on violent behavior, and to increment the prediction beyond low parental monitoring.

The proposed model is a cascade because the six predictor domains are ordered in temporal sequence with each successive stage posited as a partial product of previous stages but also providing added impact on the process (Conduct Problems Prevention Research Group, 1992). It is a dynamic model consistent with that posed by Granic and Patterson (2006) because the steps are not hypothesized to operate only in linear ways at regular time intervals. The model is one in which a high-risk child traverses a deepening stream across development toward a violent outcome, with each stage of development being predicted partially from previous events

and providing growing inevitability toward the violent outcome, but also offering a new opportunity to begin a different tributary toward a nonviolent outcome.

Testing the Model

Beyond identifying the major domains of predictors of antisocial behavior and the specific variables within domains, the developmentalist's task is to understand how these processes operate in tandem to produce antisocial outcomes. Rutter (Rutter & Garmezy, 1983) pioneered the cumulative risk model that posits that prediction is strongest simply by summing the number of risk factors, consistent with the idea that these domains will provide unique increments in predicting youth outcomes. Others have found evidence to support this model (Greenberg et al., 1999; Sameroff et al., 1988). However, such a model does not address the inter-correlations among predictors or begin to explain processes through which the risk factors operate. The proposed dynamic cascade model posits that a domain operates on antisocial outcomes by directly influencing the next domain in the hypothesized temporal sequence. This next domain both mediates the impact of the prior domain and catalyzes further antisocial development in an incremental manner.

Although the full dynamic cascade model posits many hypotheses, the following 21 hypotheses were tested in the current study:

H1a to H1f: Predictor domain x will significantly predict the adolescent violence outcome.

H2a to H2e: Predictor domain x will predict predictor domain $x + 1$.

H3a to H3e: Predictor domain $x + 1$ will mediate (either fully or at least partially) the relation between the previous predictor domain x and the adolescent violent outcome.

H4a to H4e: Predictor domain x will significantly increment the prediction of the adolescent violence outcome beyond the prediction afforded by predictor domain $x - 1$.

Our ability to test hypotheses of the proposed model empirically is limited by the sample being studied, the variables that we measure, and the methods that we apply in analysis. The current study was designed to test key features of this model in a diverse sample of boys and girls from four geographic sites followed from kindergarten through late adolescence. The sample included both the normative and high-risk control samples of the Fast Track Study (Conduct Problems Prevention Research Group, 1992), a randomized controlled trial of the efficacy of a preventive intervention designed following the premises of the proposed model. We over-sampled, and appropriately weighted, early-starting high-risk children by including the high-risk control children in the randomized trial. No child who was assigned to receive intervention was included in the current study.

The outcome variable was an index of serious violent behaviors in grades 10 and 11 of high school. This construct is inherently skewed, with only about a quarter of the sample receiving scores greater than 0. Variation above 0 was considered meaningful, however.

The proposed model does not stipulate that variables within a predictor domain represent indicators of a single latent construct defined by that domain. Rather, within-domain variables represent a collection of manifest factors that are conceptually related, measured at roughly the same time point, and possibly (though not necessarily) correlated with each other. They are aggregated in a weighted index, similar to an index of adverse life events or stressors, rather than a latent trait. Thus, we required a data-analytic method that would preserve these characteristics of each predictor domain but yield a single factor for simplicity of hypothesis testing. We chose to compute partial least squares (PLS) variates for each domain and test hypotheses through model contrasts and significance testing by a bootstrap method.

Impact of Gender

Because males are more likely than females to become seriously violent and because of obvious biological and socialization differences across genders, any comprehensive developmental model must contend with the question of whether developmental pathways vary for males and females. Gorman-Smith and Loeber (2005) found similarity with the prior empirical literature on males in the predictors of violence that emerged in their all-female sample. The current sample includes both genders, with sufficient numbers of high-risk females to test major hypotheses in each gender. With the predictor variables studied here, we had no reason to hypothesize gender-specific pathways. Nonetheless, the gender-interaction hypothesis was tested by contrasting models that allowed paths to differ (or not) for each gender.

Variation by Level of Initial Risk

Although it is often assumed that predictor variables operate similarly across the range of risk in a population, recent reports of interaction effects between level of genetic or biological risk and environmental risk in predicting antisocial outcomes suggest that the impact of environmental variables might differ for children at high and low early risk. For example, Lynam et al. (2000) found that adverse neighborhood context exerted a stronger effect on antisocial outcomes among impulsive adolescents than non-impulsive adolescents. Lengua et al. (2000) found that maternal inconsistent discipline had a stronger impact on externalizing behavior among impulsive toddlers than non-impulsive toddlers. Dodge et al. (2003) found that peer social rejection had a stronger effect on increasing aggressive behavior outcomes among children who had been above the median in aggression initially than children below the median.

Participants in the current study included a community sample of children who represented the normative distribution of risk for antisocial outcomes and a sample of high-risk

children selected on the basis of early conduct problems. These samples afforded the opportunity to test whether developmental models varied across risk groups.

Method

Participants

Participants came from the control schools of a longitudinal, multi-site investigation of the development and prevention of conduct problems in children, the Fast Track Project (Conduct Problems Prevention Research Group [CPPRG], 1992). At each of four sites (Durham, NC; Nashville, TN; Seattle, WA; and central Pennsylvania), high-risk schools were selected and randomly assigned to intervention or control conditions. From among the control schools ($n = 27$), teachers completed ratings of child disruptive behavior in order to identify a within-site stratified sample of about 10 children within each decile of behavior problems. Across the four sites, 387 children were selected to represent the normative population of these schools. In addition, high-risk children were over-sampled in order to measure finer gradations of high risk. A multistage, multi-informant screening process identified three annual cohorts of kindergartners with highest disruptive behavior scores, yielding an additional n of 367, bringing the total number of participants to 754 (see Lochman & CPPRG, 1995, for further details). Of the normative sample, 35% came from single-parent families, 23% of mothers had not graduated from high school, 50% were male, and 43% were African American. Although the high-risk subsample included higher proportions of each of these characteristics, weighting was used in all analyses to reflect the over-sampling of high-risk children.

Procedures

Beginning in kindergarten and lasting through grade 11, annual measurements were collected from multiple sources that included the teacher, the peer group, administrative school

records, the mother, the child, and interviewer ratings. Teacher, peer, and administrative-record measures were collected in the spring, and mother, child, and interviewer measures were collected in the following summer.

Measures

The following measures used in the current study are described in detail at www.fasttrackproject.org. All measures were scored so that higher scores are more negative. Prior to administration, interviewers received extensive training, including reading manuals, observing videotapes, participating in guided practice and role plays, observing trainers conduct home visits, completing pilot home visits themselves, and having trainers supervise home visits until the interviewers achieved a minimum of 70 percent agreement on all ratings. During the spring prior to summer home visits, trainers from each study site attended multi-day teaching sessions designed to ensure project-wide standardization. During the summer data collection periods, these trainers participated in regular conference calls to contain site-specific drift. (Pinderhughes, Nix, Foster, Jones, & CPPRG, 2001).

Adverse social context. Four variables indexed the child's early adverse social context. First, the interviewer who visited the child's home in the summer after kindergarten completed a 4-item assessment of the *neighborhood danger (1a)* immediately after the visit. The scale summed responses regarding the safety of the dwelling, the street, and the neighborhood, and the disruptiveness of noise, on 4-point scales ($\alpha = .83$, scale of 4-16). Second, during the initial interview in kindergarten, the mother was asked to respond to each of 2 items on 10-point scales regarding her satisfaction with neighborhood services for transportation and education. These items were summed to yield a score for *lack of neighborhood services (1b)* ($\alpha = .41$, scale of 2-20). Third, during the interview the parent reported the education level and occupation of the

child's biological father and biological mother. Following Hollingshead (1977), these four responses were scored and combined to form a single score for *family socioeconomic status (1c)*, ranging from 8-66 ($M = 27.8$, $sd = 13$). Fourth, during the interview after grade 1, the mother completed the Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977). Each of 20 items was rated on a scale of 0 to 3, yielding a sum score for *maternal depression (1d)* ($\alpha = .89$, scale of 0-60). It was first administered after grade 1, and it was inferred that it represented a stable construct from early life.

Early harsh and inconsistent parenting. Five scores indexed early harsh parenting. During the first home interview following kindergarten, the interviewer presented the parent with six hypothetical vignettes taken from Dodge, Bates, and Pettit (1990), each depicting a parent-child interaction in which the child misbehaves. The parent responded with the behavioral reaction that she would give, which was scored for physical punishment (0 for not mentioned, 1 for mentioned). The items were averaged to yield a score for *harsh discipline - vignette (2a)* ($\alpha = .60$, scale of 0-1). During the same interview, the parent completed the Conflict Tactics Scale (Straus, 1979), which asks the parent to report on a 7-point scale the frequency with which she displays various discipline tactic toward the child. A scale of *corporal punishment - CTS (2b)* was derived as the mean of 3 items (spank, spank with object, and hit) ($\alpha = .79$, scale of 0-6). During the same interview, the interviewer engaged in an open-ended interview with the parent about discipline of the child, following the protocol defined by Dodge, Bates, and Pettit (1990). Following a discussion about how the parent typically disciplined the child, including a discussion of the most severe episodes, the interviewer made a private 5-point scale rating of the harshness of the discipline received by the child, called *harsh discipline - interviewer rating (2c)*. This measure was adapted from Lansford, Deater-Deckard, Dodge, Bates, and Pettit (2004), who

conducted independent coder agreement checks on 56 randomly selected mothers and found that inter-coder agreement was acceptable ($r = .80, p < .001$).

During the same home visit, the parent and child were asked to complete four interaction tasks taken from Eyberg (1974): a child's game, a parent's game, a Lego task, and clean-up. Interviewers were trained in the administration of this task and coding of behaviors by a supervisor with prior experience with this measure or someone trained by that person until they reached acceptable agreement. This well-validated measure has been used by one of the current study authors (Crnic and Greenberg, 1990) in numerous studies. The interviewer observed the interaction and immediately made 5-point ratings, taken from Crnic and Greenberg (1990). Six items were averaged to yield a scale of *lack of parental warmth - observed (2d)* (e.g., parent's apparent gratification, sensitivity, and involvement during each segment) ($\alpha = .90$, scale of 1-5). Finally, the parent completed the Parent Questionnaire (Strayhorn & Weidman, 1988), which included 7 items asking the parent to report (using a 5-point scale) her use of appropriate and consistent discipline strategies (e.g., "what percent of time do you follow up on your commands?" "How much does your discipline vary with your mood?"). These responses were averaged to yield a score for *inconsistent discipline- parent report (2e)* ($\alpha = .67$, scale of 1-5).

School social and cognitive readiness. Five variables indexed social and cognitive readiness. During the first interview with the child, the child was administered the standardized 57-item Woodcock Johnson Test, which yielded a score for *WJ Letter/Word Identification (3a)* ($\alpha = .88$, scale of 0-57). The child also completed the Wechsler Intelligence Scale for Children (WISC) Vocabulary Sub-Test, which yielded a scaled score for *vocabulary skill (3b)* which has a nationally normed mean of 10 and a standard deviation of 3. The child completed the Social Problem Solving Test, adapted from Dodge, Bates, and Pettit (1990), in which the child was

presented with each of 8 drawings depicting social dilemmas (e.g., “A peer is playing with your bicycle and you want it back; how could you get it back?”) and was asked how he or she could solve the dilemma. Responses were recorded verbatim and categorized later as competent or not. The proportion of responses across vignettes categorized as competent constituted a score for *competent social problem solving (3c)* ($\alpha = .66$, scale of 0-1). The child also completed the Home Interview with Child measure (Dodge, Bates, & Pettit, 1990) which assesses hostile attributional biases. The child responded to each of 8 drawings depicting hypothetical provocation vignettes in which the child imagined being provoked by a peer (e.g., “A peer bumps into you.”) by stating whether the peer had likely acted with benign or hostile intent. The proportion of times that a child responded with hostile intent was scored as a measure of *hostile attributional bias (3d)* ($\alpha = .78$, scale of 0-1). The child also completed the Emotion Recognition Questionnaire, adapted from Ribordy, Camras, Stefani, and Spacarelli (1988), which consists of 16 vignettes depicting a child experiencing an emotion (happy, sad, fear, angry). The child was asked to identify the emotion being depicted. The number of correct responses was scored as a measure of *emotion recognition skill (3e)* ($\alpha = .65$, scale of 0-16).

Child externalizing problems. The child's externalizing behavior problems were assessed using the Child Behavior Checklist (Achenbach, 1991) with parent and teacher reports collected at the end of kindergarten. The highly reliable T Scores for the 50-item externalizing problems scale were log transformed to produce scores for *child externalizing problems - teacher report (4a)* and *child externalizing problems -- parent report (4b)*.

School social and academic failure. Five scores indexed elementary school social and academic failure. During the spring of grade 2, all consenting peers (at least 75% of parents in each classroom for which scores are tabulated provided written informed consent) in a child's

classroom were asked to complete a sociometric interview in which they were asked to nominate children whom they like and whom they dislike. The numbers of nominations received in each category were summed, standardized within classroom, and differenced. A score for *peer social rejection (5a)* (0 = not rejected, 1 = rejected) was computed following the formula by Coie, Dodge, and Coppotelli (1982). *Grade retention (5b)* was scored from the child's official school records in grades 2, 3, and 4 as 0 (never retained) or 1 (ever retained in grade). Placement into *special education (5c)* was scored from the same records as 0 (never) or 1 (ever). Core subject *failing grades (5d)* was scored from the same records as whether the child had ever received a failing grade in a core subject, scored as 0 (never failed) or 1 (ever failed). Finally, *academic competency problems (5e)* was scored based on the child's performance on the three scales of the 158-item Woodcock Johnson test in grade 4 ($\alpha = .87$). A child was given a score of 0 if he or she received a score lower than 1.5 standard deviations below the sample mean on any of three subtests (passage comprehension, letter/word identification, and calculation), and 1 otherwise.

Adolescent parental monitoring. Six scales were collected from parents and children during or after grade 4 to assess parental monitoring and supervision of the child. The first scale, called *parental supervision - child report (6a)* was derived as the mean of 5 items of the Supervision/Involvement Scale of the Pittsburgh Youth Study (Loeber, Farrington, Stouthamer-Loeber, & von Kammen, 1998). For each item, the youth responded no or yes (e.g., "Does your parent know who you are with when you are away from home?") ($\alpha = .62$, scale of 1-5). The second scale, called *parental supervision - parent report (6b)*, was derived from the same source and asked parents the same items from their perspective ($\alpha = .55$, scale of 1-5). The third scale, adapted from the Revised Parent-Adolescent Communication Form of the Pittsburgh Youth Study (see Loeber, Farrington, Stouthamer-Loeber, & Van Kammen, 1998), includes 5 items

(coded on a 5-point scale from almost never to almost always) that assess a child's perceptions of his or her *parent openness to communication (6c)* (e.g., "My parent is a good listener.") ($\alpha = .56$, scale of 1-5). The fourth scale was adapted from the same source as the third scale and includes 5 items that assess the parent's perceptions of his or her *parental communication with child (6d)* (e.g., "I discuss my child's problems with him or her.") ($\alpha = .73$, scale of 1-5). The fifth scale was adapted from the same source as the third scale and includes 5 items that assess the child's perceptions of his or her *communication with parents (6e)* (e.g., "I discuss my problems with my parents.") ($\alpha = .75$, scale of 1-5). The sixth scale, developed for this study, is the *parent involvement in school (6f)*, for which the teacher answered 21 5-point-scale items about the parent's contact, involvement, and comfort with the teacher ($\alpha = .91$, scale of 0-4).

Adolescent deviant peer associations. Two scales indexed this domain after grade 7. For the first scale, the parent completed the Parent Report on Child's Close Friends, consisting of 10 questions developed for the current study that assessed *deviant peer associations - parent report (7a)* ($\alpha = .87$, scale of 4-40), centered around three main topics: the child's best friend, the child's second best friend, and the child's close friends. For each topic, the parent was asked to respond on a 4-point scale to these questions: 1) does this friend get into trouble with teachers, the police, or other adults?; 2) does this friend do things you disapprove of?; and 3) are you concerned about the negative influence this friend has on your child? The tenth 5-point scale question asked parents, "How much does your son/daughter hang around with kids who get into trouble?" For the second scale, the youth completed the Self Report of Close Friends, which included 5 items developed for the Seattle Social Development Project (O'Donnell, Hawkins, & Abbott, 1995) that measured *deviant peer associations - youth report (7b)* ($\alpha = .82$, scale of 1-4). The youth was asked to identify two best friends and answer questions about behaviors by the

friend including delinquency, substance use, school motivation and parental attitudes toward the friend.

Adolescent violent behavior. In the summers after grades 10 and 11, the youth and parent reported the youth's violent behavior in the past 12 months. Six youth-report items each year were taken from Huizinga and Elliot's (1987) Self-Report of Delinquency, and eight items each year were taken from the Guns and Gangs instrument developed for this study (Conduct Problems Prevention Research Group, 1999). Two parent-report items each year were taken from the Parent Report of Delinquency (Conduct Problems Prevention Research Group, 1999). The 32 items (listed in Table 1) were each scored as 0 if no and 1 if yes, with the sum indexing *serious interpersonal violence (8)* ($\alpha = .49$, scale of 0-16).

Modeling Strategy

We developed a two-stage modeling process to accommodate the distinctive characteristics of our measurement model and to evaluate the structural model properly. First, we applied partial least squares (PLS, Chin, 1995) modeling to develop the measurement model for predictor constructs. PLS modeling as applied here is superficially similar to confirmatory factor analysis (CFA) but uses an alternative estimation technique (vs. maximum likelihood) that has its own advantages and disadvantages. In PLS, summary variables are modeled with formative indicators, versus reflective indicators usual for latent variables in CFA. It is also possible to model variables with formative indicators in SEM, but the requirements for model identification are much more stringent. Reflective approaches are appropriate when component variables are presumed to be indicators of a single latent construct (such as a trait), whereas formative approaches make no such assumption (such as indicators of a total stress index or life events index). The formative indicator approach involves each summary variable being modeled

as a linear composite of its components, as in a principal components analysis, rather than being a source of common variance among a factor's indicators. The key difference between a PLS analysis and a principal components analysis is that in the latter, the composites are constructed to maximize the variance of the indicators accounted for by the component, whereas in PLS, the indicators for each composite are weighted to maximize the strength of the relations among the PLS variates (similar to a canonical correlation), resulting in the best possible prediction of the downstream variate. Rather than assume equal weights for all indicators of a scale, the PLS algorithm allows each indicator to vary in how much it contributes to the composite score. Thus, indicators with weaker relations to indicators and the construct are given lower weightings. In this sense, PLS is preferable to techniques such as regression which assume error-free measurement (Lohmoller, 1989; Wold, 1982, 1985, 1989).

Once the PLS weights for the predictors were estimated, we tested our hypotheses about the relations among these blocks of variables in a structural equation modeling (SEM) framework, using standardized scores for the variates to ease interpretation of results. Given our intent in predicting the interpersonal violence outcome, we estimated seven separate PLS models. In each model, one time-block of predictors (social context, early parenting, etc.) formed the PLS variate, weighted to maximize the prediction of the violence score. An alternative strategy would have been to estimate weights for all seven variates in a single PLS model; however, the PLS algorithm would have then also worked to maximize prediction among the seven predictor variates, at the cost of maximal prediction of interpersonal violence. We then retained the individual scores. Weights for the scores are shown in Table 2.

Results

Descriptive Statistics and Treatment of Missing Data

Descriptive statistics (means, standard deviations, missing data rates, and correlations with the adolescent violence score) for the manifest variables used in the analysis, incorporating the sample weights reflecting the over-sampling of higher-risk students, are shown in Table 2. We conducted our PLS modeling in SAS v.9.1.3 (SAS Institute, 2004), which includes the option to accommodate missing data by estimating values for the scores through the EM algorithm. One important component of this modeling is estimation of the standard error in the context of missing data estimation, which we completed in Mplus v.4.1 (Muthén & Muthén, 2006), using its facility for the bootstrap, and accommodating the sample weights. Standard errors for this and all further analysis were based on simple bootstrap of 500 samples. The combination of the EM algorithm and bootstrapped standard errors adjusts for missing data under the assumption of missing at random (MAR). The MAR assumption is that all relations between the probability of a response being missing and the true value of that response are accounted for by other observed variables in the model. The MAR assumption is not logically testable; however, analyzing data that do not meet this assumption by MAR methods has been shown to be preferable to *ad hoc* approaches to missing data such as list-wise deletion (Graham, Hofer, & MacKinnon, 1996). We estimated the correlations among the PLS variates (and the interpersonal violence score) in Mplus v.4.1 (Muthén & Muthén, 2006). Correlations appear in Table 3.

We then tested the cascade nature of the relations among PLS variates. It was hypothesized that each variate would cascade to predict the next variate immediately downstream. We tested each variate (except the first, social context) as a mediator of the relation between the immediately prior variate and the ultimate outcome, interpersonal violence. Mediation was tested by the comparison of the product of the two relevant coefficients (prior to

central, central to posterior) to its bootstrapped standard error, using significance thresholds determined and recommended by MacKinnon et al. (2002). The coefficient is unbiased in testing the statistical significance of at least partial mediation. Whether mediation is full or partial is tested by the coefficient for the predictor variate in predicting the outcome net of the effect of the mediator. All relevant statistics appear in Table 4.

Results of Hypothesis Tests

Adverse social context. Hypothesis H1a was supported: Adverse social context was a significant predictor of adolescent violence, $r = .30$. Hypothesis H2a was supported: Adverse social context was a significant predictor of harsh and inconsistent early parenting, $r = .42$.

Harsh and inconsistent early parenting. Hypothesis H1b was supported: Harsh and inconsistent early parenting was a significant predictor of adolescent violence, $r = .20$. Hypothesis H2b was supported: Harsh early parenting was a significant predictor of lack of school readiness, $r = .33$. Hypothesis H3a was supported: Harsh and inconsistent early parenting partially mediated the prediction of adolescent violence from adverse social context, $Est./SE = 2.21$. Hypothesis H4a was supported: Harsh and inconsistent early parenting significantly incrementally predicted adolescent violence, controlling for adverse social context, $b = 0.099$.

Lack of school social and cognitive readiness. Hypothesis H1c was supported: Lack of school readiness was a significant predictor of adolescent violence, $r = .20$. Hypothesis H2c was supported: Lack of school readiness was a significant predictor of early child externalizing problems, $r = .12$. Hypothesis H3b was supported: Lack of school readiness partially mediated the prediction of adolescent violence from harsh early parenting, $Est./SE = 3.75$. Hypothesis H4b was supported: Lack of school readiness significantly incrementally predicted adolescent violence, controlling for harsh and inconsistent early parenting, $b = 0.147$.

Early child externalizing problems. Hypothesis H1d was supported: Early externalizing problems were a significant predictor of adolescent violence, $r = .25$. Hypothesis H2d was supported: Early externalizing problems were a significant predictor of school failure, $r = .18$. Hypothesis H3c was supported: Early externalizing problems partially mediated the prediction of adolescent violence from lack of school readiness, $Est./SE = 2.01$. Hypothesis H4c was supported: Early externalizing problems significantly incrementally predicted adolescent violence, controlling for lack of school social and cognitive readiness, $b = 0.213$.

School social and academic failure. Hypothesis H1e was supported: School failure was a significant predictor of adolescent violence, $r = .18$. Hypothesis H2e was supported: School failure was a significant predictor of lack of parental monitoring, $r = .22$. Hypothesis H3d was supported: School failure partially mediated the prediction of adolescent violence from early externalizing problems $Est./SE = 2.61$. Hypothesis H4d was supported: School failure significantly incrementally predicted adolescent violence, controlling for childhood externalizing behavior problems, $b = 0.158$.

Lack of parental monitoring. Hypothesis H1f was supported: Lack of parental monitoring was a significant predictor of adolescent violence, $r = .16$. Hypothesis H2f was supported: Lack of parental monitoring was a significant predictor of deviant peer involvement, $r = .20$. Hypothesis H3e was supported: Lack of parental monitoring partially mediated the prediction of adolescent violence from school failure, $Est./SE = 2.53$. Hypothesis H4e was supported: Lack of parental monitoring significantly incrementally predicted adolescent violence, controlling for school failure, $b = 0.139$.

Deviant peer associations. Hypothesis H1g was supported: Deviant peer involvement was a significant predictor of adolescent violence, $r = .26$. Hypothesis H3f was supported:

Deviant peer involvement partially mediated the prediction of adolescent violence from lack of parental monitoring, $Est./SE = 2.30$. Hypothesis H4f was supported: Deviant peer involvement significantly incrementally predicted adolescent violence, controlling for lack of parental monitoring, $b = 0.272$.

Tests of Full Model

The next stage of analysis was to construct a full path model showing the prediction of each construct from all prior constructs. In this model, estimated using Mplus v.4.2 (Muthén & Muthén, 2006), each variate was incorporated predicting each subsequent variate and interpersonal violence. Parameter estimates and bootstrapped standard errors are shown in Table 5. This overall model was saturated, and thus not testable. Tests of paths, however, indicated that each step was significantly predicted from the previous steps taken together, and the best prediction of violence came from multiple steps.

Gender Differences in Means and Developmental Paths

Simple t-tests indicated that males received significantly higher raw adolescent violence mean scores than females ($p < .001$). Males and females did not differ in the adversity of their home context, in early parenting, or in early externalizing problems scores (only because T scores that standardize within gender were used), but males received significantly higher scores than females for lack of school social and cognitive readiness ($p < .02$), school social and academic failure ($p < .001$), lack of parental monitoring and communication ($p < .02$), and deviant peer associations ($p < .001$).

In order to test the hypothesis that developmental paths would differ across gender groups, the full model was contrasted with a model in which path coefficients were allowed to vary across male and female groups. Loosening the constraint that the paths are identical did

significantly increase model fit, $\chi^2(28, n = 462) = 55.73, p = .001$, indicating that the strength of developmental paths differed for males and females. In follow-up analyses, we probed this interaction in each of seven models allowing the paths to differ at each step in the cascade. A significant interaction with gender was found for one of the seven models, predicting school failure, $\chi^2(4, N = 462) = 18.48, p = .001$.

This model predicting school failure freed across gender groups fit the data well, $\chi^2(24, N = 462) = 37.25, p = .041$, CFI = .976, TLI = .943, est. RMSEA = .049 (90% CI: .010, .078). For girls, school failure was significantly predicted by social context, $b = 0.164, SE = 0.067, Est./SE = 2.46, p < .05$, and by early parenting problems, $b = 0.196, SE = 0.082, Est./SE = 2.39, p < .05$, but not by lack of school readiness, $Est./SE = 1.24$, or by early externalizing problems, $Est./SE = -0.84$. The opposite held true for boys, with significant prediction from early externalizing problems, $b = 0.189, SE = 0.046, Est./SE = 4.15, p < .001$, and lack of school readiness, $b = 0.308, SE = 0.054, Est./SE = 5.73, p < .001$, but not by social context, $Est./SE = -0.91$, or early parenting problems, $Est./SE = 1.22$.

Tests of Interaction with Level of Initial Risk

The full model was contrasted with a model in which path coefficients were allowed to vary between the high-risk and normative groups. Loosening the constraint that the paths are identical significantly improved model fit, $\chi^2(28, n = 462) = 112.86, p < .001$, indicating that the strength of developmental paths differed for high-risk and normative groups. Of the seven domains predicting violence outcomes, one (deviant peer associations) yielded a significantly stronger path in the normative than high-risk group ($p < .05$).

Among the other 15 path coefficients tested and depicted in Table 5, 3 yielded a significant interaction involving level of initial risk. All 3 involved early harsh and inconsistent

parenting. The relations between early harsh and inconsistent parenting and school social and cognitive readiness, parental monitoring, and deviant peer associations were stronger in the normative group than the high-risk group.

Discussion

This study reports four major empirical findings that, together, support a dynamic cascade model of how serious violence develops across the life span from early childhood through adolescence. The major contribution is an understanding of how predictor domains operate in concert to predict violent outcomes. Findings indicate that: 1) violent outcomes are multiply predicted from factors in diverse domains spanning early development; 2) these domains are inter-correlated and each domain predicts the next domain in development across childhood; 3) each succeeding domain partially mediates the effect of the immediately precedent domain; and 4) although domains inter-correlate and mediate each other, domains play unique and incremental roles in predicting later violent behavior.

Toward a Dynamic Cascade Model of the Development of Violent Behavior

Each of the seven predictor domains (early adverse context, harsh and inconsistent discipline, school social and cognitive readiness, early externalizing behavior problems, school social and cognitive failure, parental monitoring and communication, and deviant peer associations) was significantly related to adolescent violence. Consistent with the literature reviewed earlier, these findings also extend the literature to the relatively severe outcome of violent behavior and generalize these patterns across both male and female groups. The field's confidence in these domains as risk indicators is enhanced by these findings.

The current study provides the most detailed description to date of how these seven temporally distinct predictor domains are inter-correlated. All temporally adjacent domains were

significantly related to each other, suggesting that they might provide partially redundant information in predicting violence outcomes. Indeed, each succeeding domain partially mediated the impact of the prior domain on violence outcomes. The redundancy is only partial, however. Each succeeding domain not only mediated the preceding domain, it also provided a significant increment beyond the previous domain in enhancing the prediction of violence outcomes.

This patterned sequencing is consistent with dynamic systems models (e.g., Granic & Patterson, 2006), and it provides a coherent developmental story of how violent behavior grows across childhood and adolescence in a dynamic cascade. The story involves reciprocal impact of parenting on peer relations and peer relations on subsequent parenting. It also involves reciprocal influences between the self and the environment. It explains how early risk is realized across time but also how each new developmental era affords new risk.

The theoretical model that has been supported here starts with children who are born into an adverse neighborhood or disadvantaged family context. This context places children at risk for adolescent violence, partly because features of the context (perhaps stress, lack of resources, lack of support, McLoyd, 1990) make it difficult for parents to avoid harsh and inconsistent discipline with their young child. These harsh discipline styles not only account for part of the effect of adverse context on outcomes, they also enhance risk for violence outcomes.

In turn, a partial mechanism through which harsh and inconsistent discipline operates on later violence outcomes is by preventing the child from acquiring social and cognitive skills that are necessary for school social and academic success. These skill deficits include vocabulary deficits, poor social problem solving, hostile attributional biases, and emotion recognition deficits. They partly account for how early dysfunctional parenting leads to adolescent violence. These deficits are more proximal to the phenomenon of adolescent violence (both temporally and

theoretically), and they enhance children's risk beyond that afforded by adverse contexts and early parenting. They also predict the child's display of externalizing conduct problems at the time of school entry, which becomes the path leading toward later adverse outcomes.

Externalizing conduct problems at school entry signals the "early-starter" in Moffitt's (1993) model of life course persistent antisocial behavior and is an important part of the proposed cascade. Methodologically, it is important that this domain is included in the model because a primary alternative hypothesis to the proposed cascade is simply within-child consistency of behavior (from early conduct problems to later violence). Inclusion of this domain enabled testing of this alternative hypothesis, which was empirically rejected by tests that indicated that other domains provide significant increments in the prediction of adolescent violence beyond the prediction afforded by early conduct problems.

Next in the cascade is the role of school social and academic failure, which follows from early externalizing conduct problems. Not surprisingly, conduct problems lead to peer social rejection and academic failure, which account for some of the effect of conduct problems on long-term outcomes. Failure experiences with peers and academic subjects enhance risk for violence in adolescence and increase the likelihood of problem outcomes.

According to the theoretical model, one mechanism through which childhood school failure leads to adolescent violence is through its impact on the parent-child relationship and interaction during early adolescence. Just at a time when youths need monitoring, supervision, and communication with parents, the youths who are at greatest risk suffer from the least amount and poorest quality parenting in these tasks. Parenting during early adolescence not only mediates the impact of the child's previous school failure, it enhances the prediction of adolescent violence. Finally, one way that parental lack of monitoring and communication with a

youth leads that youth toward violence is by allowing the youth to interact with deviant peers. Deviant peer associations are the most proximal factor in adolescent violence. They partially mediate the impact of poor parental monitoring, and they enhance this risk as well.

The reciprocal influences between the child and parent over time are especially noteworthy. The parent's early discipline strategies have an impact on the child's social and cognitive readiness for school, which affect conduct problem behavior. In turn, the child's experiences at school cycle back to exert an impact on parenting behavior in early adolescence, which then affects the youth's interactions with peers during adolescence. Bidirectional relations between domains of parenting and child-peer functioning across development have been hypothesized by transactional theorists such as Sameroff and Mackenzie (2003), but rarely have they been empirically demonstrated in longitudinal inquiry.

An important implication of the current findings is that it is premature to conclude that an early-starting antisocial five-year-old is unequivocally destined for a life-persistent path toward violent outcomes. Although the risk is substantial, it is by no means certain. The findings reported here indicate that trajectories can be deflected at each subsequent era in development, through interactions with peers, school, and parents along the way. The theory of the early-starting antisocial child must account for the deflections in trajectories (e.g., positive outcomes in the face of early risk factors) that have been observed here.

Opportunities for Preventive Intervention

The reciprocal side of the finding that each new developmental era provides enhanced risk for violent outcomes is that each era also provides an opportunity for a change in the youth's developmental trajectory. Even though a child may be at risk due to being born into an adverse neighborhood context, that risk can be lessened by subsequent life events, most proximally the

quality of parenting that the child receives during early childhood, especially during discipline encounters. In turn, even though the experience of harsh and inconsistent parenting places a child at risk for violent outcomes, that risk can be lessened by success at school in cognitive and social realms. Likewise, a difficult early school experience which places a child at risk for adolescent violence can be partially offset by parents who closely monitor and supervise their child and communicate with him or her. Finally, risk that is raised by parents who fail to monitor can be lessened if the youth's exposure to deviant peers is limited.

The implications for prevention are many. First, each era affords a new opportunity for targeted intervention in a specific domain that had not been encountered previously. The current findings provide specific targets for prevention at specific eras in development (e.g., during preschool, parenting interventions focused on discipline strategies should be targeted; during the early school years, child-focused intervention directed at enhancing cognitive and social skills and school success should be emphasized) . Second, because new risks arise with each new developmental era, preventive intervention cannot be deemed "over" until the child has passed through adolescence. Third, it appears that the most effective preventive interventions will address multiple aspects of a child's family and school life across multiple eras of development. It is not surprising that, indeed, the most effective preventive intervention programs comprehensively address multiple domains (e.g., Conduct Problems Prevention Research Group, 2003; Dishion & Kavanagh, 2005; Henggeler et al., 1998; Tremblay, et al., 1995).

Contribution to Knowledge of Antisocial Development in Girls

Very few studies have included sufficient numbers of high-risk girls to make conclusions about developmental pathways toward violence in girls. The findings support the hypothesis that violent outcomes in girls follow largely similar developmental pathways as those for boys. Only

one significant difference in pathways was detected, indicating that school failure was more a function of adverse context and parenting for girls than boys, whereas school failure was more a function of externalizing problems for boys than girls. Context, parenting, skills, and peer relations all operate to predict antisocial outcomes in girls in the same way that they do in boys.

Contribution to Methods in Longitudinal Inquiry

Sameroff and Mackenzie (2003) lamented the dearth of longitudinal studies and sophisticated methods that are available to test complicated hypotheses of transactional effects and reciprocal influences across time. Dodge, Coie, and Lynam (2006) cautioned that the diverse array of variables that have been correlated with antisocial outcomes beg for an integrated theory. The current study offers a novel approach to combining variables in a coherent manner that goes well beyond the simple (though powerful) approach of cumulating risk factors in a summative fashion. The approach requires clearly articulated hypotheses, data collected across multiple non-overlapping time points, and a sufficient sample size. Variables have been combined into “domains” that represent coherent sets, but the method of combining variables differs critically from the traditional approach of latent variables analyses and structural equation modeling which assume that variables are indicators that are “caused” by a latent construct. Instead, the current approach assumes that manifest variables can be aggregated into an “index” without assumptions of a single latent construct. The data-analytic methods are not new but are newly applied to social development. Dodge et al. (2006) have applied similar methods with different domains of variables to understand how children grow into users of illicit substances.

Findings that Provide a Basis for Future Inquiry

Two findings provide the basis for further inquiry. First, findings of partial, rather than full, mediation indicate that precedent stages continue to predict later violence. It might be that

risk induced by a prior stage imparts risk that endures in spite of subsequent events, or it might be that the current study simply failed to identify the processes that fully mediate later violence outcomes. Future studies should test hypotheses about other developmental pathways at each stage that might mediate violence outcomes. These other pathways might involve new variables within the same domains that were tested here (e.g. executive cognitive functions such as inhibitory control might be added to the cognitive readiness domain), or they could assess new domains altogether (e.g., quality of preschool experience, after-school contexts). Furthermore, the categorization of mediation decisions into “full” or “partial” or “no” groups ignores quantitative differences in the magnitude of mediation. Future studies might employ alternate methods of quantifying mediation, using proportion of variance measures or new methods.

Second, it was found that the strength of factors in developmental pathways differed according to level of initial risk. Although not numerous or large, these findings suggest that future inquiry might focus on models of development that apply specifically to high-risk youth.

Finally, a third focus of future inquiry might be to address possible interaction effects among risk domains. That is, it is plausible, even likely, that the impact of one domain is altered (e.g., exacerbated, magnified, mitigated, muted) by variables in another domain. These hypotheses would be tested by interaction effects analyses that were not conducted here.

Limits of the Study

The limits of this study are substantial. They begin with the inescapable fact that these data while longitudinal, are correlational and are subject to alternate interpretations of third-variable causation, selection factors, and spuriousness of relations. It is still plausible that child factors lead to each of the environmental factors measured here, although the unique increments afforded by different environmental variables suggests that multiple child factors would likely be

involved. It is also plausible that each environmental factor is merely a proxy for an unmeasured other environmental factor that causes both the measured variable and its downstream correlates. Further, it may be the some effects that are ascribed to parenting or other environmental factors may be partially the result of genetic effects or gene X environment interaction. No data-analytic method can escape this possibility, but only randomized intervention experiments come closer to parsing cause from spuriousness.

A second limit is that these analyses do not rule out other plausible cascade models that include additional domains and variables. The findings reported here support a cascade model over a simple continuity-of-behavior model, but future studies will need to test competing cascade models against each other. A particular limit is that measurement began when children were aged 5; thus, reciprocal relations among adverse context, parent characteristics, and very early behavior problems have not been tested. The current model is *a* cascade model, not necessarily *the only* cascade model.

The partial least squares modeling (PLS) applied here has been subject to criticism that it makes assumptions about the aggregation of variables into index scores that operate as a unitary whole (Chin, 1995). This aggregation method departs from traditional latent variables approaches and is theoretically defensible in cases when the constituent variables clearly do not represent a uni-dimensional construct but have heuristic (and temporal) coherence nonetheless. A second concern about the PLS approach is that it may capitalize on chance through its optimization of weighting variables in predicting the downstream outcome. This criticism is the same at that cast toward canonical correlation. The PLS approach is indeed subject to that criticism in the tests of prediction of violent outcomes; however, the abundance of significant bivariate correlations between predictors and the violence outcome in the current study suggest

that the conclusions made are not biased by the PLS approach. Furthermore, the tests of relations across PLS variates and the tests of mediation are not at all biased in this manner. They are as rigorous as tests in a structural equation model framework.

The complexity of the dynamic cascade theory suggests methods of data analysis that have not been followed in the current study, such as analyses of accelerating change and non-linear relations among variables and person-centered approaches to testing hypotheses. The theory also suggests that numerous other variables and other points in time might have been selected for analysis instead of the ones that were chosen. The sequencing of domains for analysis required that any variable be located within a single time point, but realities of social development indicate that these same variables could be located at multiple time points. Furthermore, the arbitrariness of the unit of time as one year is obviously flawed. Dynamic development, transactional exchanges, and reciprocal influences undoubtedly occur within shorter time intervals than those measured here. Although the findings support the transactional nature of the relationship between child and parent, undoubtedly these transactions are far more frequent and powerful than could be captured by the current design, which limited measurement time lags to a one-year unit. Future studies might well employ time units that are theoretically selected to represent the unit of hypothesized change in a developmental sequence, even allowing for unequal time units if theory dictates.

Conclusion

Even with these numerous caveats, the current study offers a novel dynamic cascade model of the development of serious violent behavior in adolescence, innovative use of methods of aggregating and analyzing developmental data, and empirical findings that inform developmental theory as well as preventive intervention. These methods await application to

other developmental phenomena.

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References

- Aber, J.L., and Gershoff, E. , Ware, A., & Kotler, J. (2004). Estimating the effects of September 11th, 2001, and other forms of violence on the mental health and social development of New York City's youth: A matter of context. *Applied Developmental Science, 8*(3), 111-129.
- Achenbach, T.M. (1991). *Manual for the Child Behavior Checklist / 4 – 18 and 1991 Profile*. Burlington, VT: University of Vermont Department of Psychiatry.
- Beyers, J.M., Bates, J.E., Pettit, G.S., & Dodge, K.A. (2003). Neighborhood structure, parenting processes, and the development of youths' externalizing behaviors: A multilevel analysis. *American Journal of Community Psychology, 31*, 35-53.
- Capaldi, D.M., & Patterson, G.R. (1996). Can violent offenders be distinguished from frequent offenders: Prediction from childhood to adolescence. *Journal of Research in Crime and Delinquency, 33*, 206-231.
- Caspi, A., Moffitt, T. E., Morgan, J., Rutter, M., Taylor, A., Arseneault, L., Tully, L., Jacobs, C., Kim-Cohen, J., & Polo-Tomas, M. (2004). Maternal expressed emotion predicts children's antisocial behavior: Using MZ-twin differences to identify environmental effects on behavioral development. *Developmental Psychology, 40*, 149-161.
- Chin, W. W. (1995). Partial Least Squares is to LISREL as principal components analysis is to common factor analysis. *Technology Studies, 2*, 315-319.
- Coie, J.D., Dodge, K.A., & Coppotelli, H. (1982). Dimensions and types of social status: A cross-age perspective. *Developmental Psychology, 18*, 557-570.
- Conduct Problems Prevention Research Group. (1992). A developmental and clinical model for the prevention of conduct disorders: The FAST Track Program. *Development and Psychopathology, 4*, 509-527.
- Conduct Problems Prevention Research Group. (1999). Initial impact of the Fast Track Prevention

- Trial for Conduct Problems: I. The high-risk sample. *Journal of Consulting and Clinical Psychology, 67*, 631-647.
- Conduct Problems Prevention Research Group. (2004). The effects of the Fast Track Program on serious problem outcomes at the end of elementary school. *Journal of Clinical Child and Adolescent Psychology, 33*, 650-661.
- Crnic, K., & Greenberg, M. (1990). *Interaction Ratings Scale*. Unpublished technical report. Pennsylvania State University.
- Cummings, E. M., & Davies, P. T. (2002). Effects of marital conflict on children: Recent advances and emerging themes in process-oriented research. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 43*, 31-63.
- Dishion, T.J., & Kavanagh, K. (2000). A multilevel approach to family-centered prevention in schools: Process and outcome. *Addictive Behaviors, 25*, 899-911.
- Dishion, T.J. & McMahon, R.J. (1998). Parental monitoring and the prevention of child and adolescent problem behavior: A conceptual and empirical formulation. *Clinical Child and Family Psychology Review, 1*, 61-75.
- Dishion, T.J., Nelson, S.E., & Bullock, B.M. (2004). Premature adolescent autonomy: Parent disengagement and deviant peer process in the amplification of problem behavior. *Journal of Adolescence.*
- Dodge, K.A., Bates, J.E., & Pettit, G.S. (1990). Mechanisms in the cycle of violence. *Science, 250*, 1678-1683.
- Dodge, K.A., Coie, J.D., & Lynam, D. (2006). Aggression and antisocial behavior in youth. In W. Damon (Series Ed.) & N. Eisenberg (Vol. Ed.), *Handbook of child psychology: Vol. 3. Social, emotional, and personality development* (6th ed., pp. 719-788). New York: Wiley.

- Dodge, K.A., & Pettit, G.S. (2003). A biopsychosocial model of the development of chronic conduct problems in adolescence. *Developmental Psychology, 39*(2), 349-371.
- Dodge, K.A., Pettit, G.S., & Bates, J.E. (1994). Socialization mediators of the relation between socioeconomic status and child conduct problems. *Child Development, 65*, 649-665.
- Dodge, K. A., Pettit, G.S., McClaskey, C.L., & Brown, M. (1986). Social competence in children. *Monographs of the Society for Research in Child Development* (Serial No. 213, Vol. 51, No.2).
- Dodge, K.A., Malone, P.S., Lansford, J.E., Miller-Johnson, S., Pettit, G.S., & Bates, J.E. (2006). Toward a dynamic developmental model of the role of parents and peers in early onset substance use. In A. Clarke-Stewart & J. Dunn (Eds.), *Families count: Effects on child and adolescent development* (pp. 104-134). NY: Cambridge University Press.
- Dodge, K.A., Lansford, J.E., Burks, V.S., Bates, J.E., Pettit, G.S., Fontaine, R., & Price, J.M. (2003). Peer rejection and social information-processing factors in the development of aggressive behavior problems in children. *Child Development, 74*, 374-393.
- Eisenberg, N., Spinrad, T. L., Fabes, R. A., Reiser, M., Cumberland, A., Shepard, S. A., Valiente, C., Loyosa, S.H., Guthrie, I.K., & Thompson, M. (2004). The relations of effortful control and impulsivity to children's resiliency and adjustment. *Child Development, 75*, 1-22.
- Eyberg, S. M. (1974). *Manual for the coding of parent-child interactions of children with behavior problems*. Unpublished manuscript. Oregon Health Sciences University.
- Glueck, S., & Glueck, E. (1950). *Unraveling juvenile delinquency*. Cambridge: Harvard University Press.
- Gorman-Smith, D., & Loeber, R. (2005). Are developmental pathways in disruptive behaviors the same for girls and boys? *Journal of Child and Family Studies, 14*, 15-27.

- Gottfredson, M. R., & Hirschi, T. (1990). *A general theory of crime*. Stanford, CA: Stanford University Press.
- Graham, J. W., Hofer, S. M., & MacKinnon, D. P. (1996). Maximizing the usefulness of data obtained with planned missing value patterns: An application of maximum likelihood procedures. *Multivariate Behavioral Research, 31*, 197-218.
- Granic, I., & Patterson, G. R. (2006). Toward a comprehensive model of antisocial development: A dynamic systems approach. *Psychological Review, 113*, 101-131.
- Greenberg, M.L., Lengua, L.S., Coie, J., Pinderhughes, E.E., & the Conduct Problems Prevention Research Group. (1999). Predicting developmental outcomes at school entry using a multiple-risk model: Four American communities. *Developmental Psychology, 35*, 403-417.
- Henggeler, S.W., Schoenwald, S.K., Bourduin, C.M., Rowland, M.D., & Cunningham, P.B. (1998). *Multisystemic treatment of antisocial behavior in children and adolescents*. New York: Guilford.
- Hill, N.E., Castellino, D.R., Lansford, J.E., Nowlin, P., Dodge, K.A., Bates, J.E., & Pettit, G.S. (2004). Parent-academic involvement as related to school behavior, achievement, and aspirations: Demographic variations across adolescence. *Child Development, 75*(5), 1491-1509.
- Hinshaw, S.P. (1992). Externalizing behavior problems and academic underachievement in childhood and adolescence: Causal relationships and underlying mechanisms. *Psychological Bulletin, 111*, 127-155.
- Hollingshead, A.B. (1975). *Four Factor Index of Social Status*. Unpublished manuscript. New Haven, Connecticut: Yale University.

- Holmes, C.T. (1989). Grade level retention effects: A meta-analysis of research studies. In L.A. Shepard & M.L. Smith (Eds.), *Flunking grades: Research and policies on retention* (pp. 16-33). Philadelphia: Falmer Press.
- Huizinga, D., & Elliott, D. S. (1987). Juvenile offenders: Prevalence, offender incidence, and arrest rates by race. *Crime and Delinquency*, *33*, 206–223.
- Ingoldsby, E.M. & Shaw, D.S. (2002). Neighborhood contextual factors and early-starting antisocial pathways. *Clinical Child and Family Psychology Review*, *5*, 21-55.
- Keenan, K., Loeber, R., Zhang, Q., Stouthamer-Loeber, M., & Van Kammen, W. B. (1995). The influence of deviant peers on the development of boys' disruptive and delinquent behavior: A temporal analysis. *Development and Psychopathology*, *7*, 715-726.
- Laird, R.D., Jordan, K.Y., Dodge, K.A., Pettit, G.S., & Bates, J.E. (2001). Peer rejection in childhood, involvement with antisocial peers in early adolescence, and the development of externalizing behavior problems. *Development and Psychopathology*, *13*, 337-354.
- Laird, R.D., Pettit, G.S., Bates, J.E., & Dodge, K.A. (2003). Parents' monitoring-relevant knowledge and adolescents' delinquent behavior: Evidence of correlated developmental changes and reciprocal influences. *Child Development*, *74*, 752-768.
- Lansford, J.E., Dodge, K.A., Pettit, G.S., Bates, J.E., Crozier, J., & Kaplow, J. (2002). A 12-year prospective study of the long-term effects of early child physical maltreatment on psychological, behavioral, and academic problems in adolescence. *Archives of Pediatrics and Adolescent Medicine*, *156*, 824-830.
- Lengua, L. J., Wolchik, S. A., Sandler, I. N., & West, S. G. (2000). The additive and interactive effects of temperament and parenting in predicting adjustment problems of children of divorce. *Journal of Clinical Child Psychology*, *29*, 232-244.

- Larzelere, R. E., & Patterson, G. R. (1990). Parental management: Mediators of the effect of socioeconomic status on early delinquency. *Criminology*, 28, 301-323.
- Lochman, J.E., & the Conduct Problems Prevention Research Group. (1995). Screening of child behavior problems for prevention programs at school entry. *Journal of Consulting and Clinical Psychology*, 63, 549-559.
- Loeber, R., Farrington, D. P., Stouthamer-Loeber, M., & van Kammen, W. B., (1998). *Antisocial behavior and mental health problems: Explanatory factors in childhood and adolescence*. Mahweh, NJ: Erlbaum.
- Loeber, R., Pardini, D., Hornish, D. L., Wei, E. H., Crawford, A. M., Farrington, D. P., Stouthamer-Loeber, M., Creemers, J., Koehler, S. A., & Rosewnfeld, R. (2005). The prediction of violence and homicide in young men. *Journal of Consulting and Clinical Psychology*, 73, 1074-1088.
- Lohmoller J.-B. (1989): *Latent variables path modeling with partial least squares*. Physica-Verlag, Heildelberg.
- Lynam, D.R., Caspi, A., Moffitt, T.E., Wikström, P.O., Loeber, R., & Novak, S.P. (2000). The interaction between impulsivity and neighborhood context on offending: The effects of impulsivity are stronger in poorer neighborhoods. *Journal of Abnormal Psychology*, 109, 563-574.
- MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A comparison of methods to test the significance of the mediated effect. *Psychological Methods*, 7(1), 83-104.
- MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2006). Frequency distribution, 10,000 replications, no mediated effect, all continuous variables

[on-line]. Accessed November 22, 2006,

<http://www.public.asu.edu/~davidpm/ripl/freqdist.pdf>

- McLoyd, V. (1990). The impact of economic hardship on black families and children: Psychological distress, parenting, and socioemotional development. *Child Development, 61*, 311-346.
- Moffitt, T. E. (1993). Adolescence-limited and life-course-persistent antisocial behavior: A development taxonomy. *Psychological Review, 100*, 674-701.
- Moffitt, T.E., & Caspi, A. (2001). Childhood predictors differentiate life-course persistent and adolescence-limited antisocial pathways among males and females. *Development and Psychopathology, 13*, 135-151.
- Moffitt, T.E., Gabrielli, W.F., Mednick, S.A., & Schulsinger, F. (1981). Socioeconomic status, IQ, and delinquency. *Journal of Abnormal Psychology, 90*, 152-156.
- Muthen, L. K., & Muthen, B. O. (2006). *Mplus User's Guide, v.4*. Los Angeles, CA: Muthen & Muthen.
- O'Donnell, J., Hawkins, J. D. & Abbott, R. D. (1995). Predicting serious delinquency and substance use among aggressive boys. *Journal of Consulting and Clinical Psychology, 63(4)*, 529-537.
- Patterson, G. R. (1986). Performance models for antisocial boys. *American Psychologist, 41*, 432-444.
- Patterson, G. R., Reid, J. B., & Dishion, T. J. (1992). *A social learning approach: Volume 4, Antisocial Boys*. Eugene, OR: Castalia Press.
- Pettit, G.S., Bates, J.E., & Dodge, K.A. (1997). Supportive parenting, ecological context, and children's adjustment. *Child Development, 68*, 908-923.

- Pettit, G.S., Bates, J.E., Dodge, K.A., & Meece, D.W. (1999). The impact of after-school peer contact on early adolescent externalizing problems is moderated by parental monitoring, neighborhood safety, and prior adjustment. *Child Development, 70*, 768-778.
- Pinderhughes, E.E., Nix, R., Foster, E.M., Jones, D., and the Conduct Problems Prevention Research Group (2001). Parenting in context: Impact of neighborhood poverty, residential stability, public services, social networks, and danger on parental behaviors. *Journal of Marriage and the Family, 63*(4), 941-953.
- Pollak, S.D., & Tolley-Schell, S.A. (2003). Selective attention to facial emotion in physically abused children. *Journal of Abnormal Psychology, 112*, 323-338.
- Radloff, L S. (1977). The CES-D scale: a self-report depression scale for research in the general population. *Applied Psychological Measurement, 1*, 385-401.
- Ribordy, S.C., Camras, L.A., Stefani, R., & Spaccarelli, S. (1988). Vignettes for emotion recognition research and affective therapy with children. *Journal of Clinical Child Psychology, 17*, 322-325.
- Rutter, M., & Garmezy, N. (1983). Developmental psychopathology. In P. H. Mussen & E. M. Hetherington (Eds.), *Handbook of child psychology: Vol. 4. Socialization, personality and social development* (pp. 775-911). New York: Wiley.
- Sameroff, A. J., Bartko, W. T., Baldwin, A., & Baldwin, C. (1988). *Families, risk, and competence*. Mahweh, NJ: Lawrence Erlbaum.
- Sameroff, A. J., & Mackenzie, J. (2003). Research strategies for capturing transactional models of development: The limits of the possible. *Development and Psychopathology, 15*, 613-640.

- Sampson, R. J., Raudenbush, S. W., & Earls, F. (1997). Neighborhoods and violent crime: A multi-level study of collective efficacy. *Science, 277*, 918-924.
- Stouthamer-Loeber, M., Loeber, R., Wei, E., Farrington, D., & Wikström, P.H. (2002). Risk and promotive effects in the explanation of persistent serious delinquency in boys. *Journal of Consulting & Clinical Psychology, 70*, 111-123.
- Sampson, R.J., & Laub, J.H. (1994). Urban poverty and the family context of delinquency: A new look at structure and process in a classic study. *Child Development, 65*, 523-540.
- SAS Institute. (2004). *SAS User's Manual, v.9.1.3*. Cary, NC: SAS Institute.
- Simons, R.L., Wu, C.I., Conger, R.D., & Lorenz, F.O. (1994). Two routes to delinquency: Differences between early and late starters in the impact of parenting and deviant peers. *Criminology, 32*, 247-276.
- Snyder, J., Dishion, T.J., & Patterson, G.R. (1986). Determinants and consequences of associating with deviant peers during preadolescence and adolescence. *Journal of Early Adolescence, 6*, 29-43.
- Snyder, J., Reid, J., & Patterson, G. (2003). A social learning model of child and adolescent antisocial behavior. In B.B. Lahey, T.E., Moffitt, & A. Caspi (Eds.), *Causes of conduct disorder and juvenile delinquency* (pp. 27-48). New York: Guilford.
- Stattin, H., & Kerr, M. (2000). Parental monitoring: A reinterpretation. *Child Development, 71*, 1072-1085.
- Strayhorn, J. M. & Weidman, C. S. (1988). A parenting practices scale and its relation to parent and child mental health. *Journal of the American Academy of Child and Adolescent Psychiatry, 27*, 613-618.

Tremblay, R. E., Pagani-Kurtz, L., Masse, L. C., Vitaro, F., & Pihl, R. O. (1995). A bi-modal preventive intervention for disruptive kindergarten boys: Its impact through mid-adolescence. *Journal of Consulting and Clinical Psychology, 63*, 560-568.

Wold, H. (1982). Soft modeling: the basic design and some extensions. In K.G. Joreskog & H. Wold (Ed.), *Systems under Indirect Observation: Causality, Structure, Prediction (Vol. 2, pp. 1-54)*. North-Holland, Amsterdam.

Table 1. Variables Used in Index of Adolescent Violent Behavior

#	Variable	Source	Wording
	<i>Self Report of Delinquency</i>		
1	C11AD26a	Self	In the past year, have you attacked anyone with the intent to hurt or kill?
2	C11AD27a	Self	In the past year, have you hit someone with the idea of hurting them?
3	C11AD28a	Self	In the past year, have you used a weapon to get money from people?
4	C11AD29a	Self	In the past year, have you thrown objects at people?
5	C11AD30a	Self	In the past year, have you been involved in any gang fights?
6	C11AD32a	Self	In the past year, have you had sex with someone against their will?
	<i>Guns and Gangs</i>		
7	C11AW2d	Self	In the past 12 months, have you ever pulled a small pocket knife on another person?
8	C11AW2e	Self	In the past 12 months, have you ever hurt someone with a small pocket knife?
9	C11AW3d	Self	In the past 12 months, have you ever pulled a switchblade, razor, or other big knife on another person?
10	C11AW3e	Self	In the past 12 months, have you ever hurt someone with a switchblade, razor, or other big knife?
11	C11AW4e	Self	Guns in your home that your parents own for their protection or for hunting- In the past 12 months, have you ever pulled it on another person?
12	C11AW4f	Self	Guns in your home that your parents own for their protection or for hunting- In the past 12 months, have you ever hurt some one with it?
13	C11AW5d	Self	A gun that is not for hunting-In the past 12 months, have you ever pulled one on another person?
14	C11AW5e	Self	A gun that is not for hunting-In the past 12 months, have you ever hurt someone with it?
	<i>Parents' Report of Delinquency</i>		
15	P11AG11	Parent	How often has your child attacked someone with a weapon with the idea of seriously hurting them?
16	P11AG16	Parent	How often has your child carried a weapon?

Table 2. Means, Standard Deviations, Percent Missing, Partial Least Squares Variate Weights, and Correlations with Violence Outcome

<i>Variable</i>	<i>Mean</i>	<i>SD</i>	<i>% miss</i>	<i>PLS</i>	<i>r w/ viol</i>
Early adverse social context					
1a Neighborhood danger (age 0-5)	8.47	2.37	4.1	0.080	.08
1b Lack of neighborhood services (age 0-5)	14.92	4.35	0.4	0.144	.25*
1c Family SES (age 0-5) (R)	37.8	54.6	0.0	-0.077	-.14*
1d Maternal depression (age 6)	11.97	9.39	0.0	0.128	.18*
Early harsh and inconsistent parenting					
2a Harsh discipline – vignette (age 1-5)	0.19	0.21	0.2	0.042	.03
2b Corporal punishment – CTS (age 1-5)	1.30	1.30	0.0	0.074	.16*
2c Harsh discipline – interviewer rating (age 1-5)	2.20	0.80	0.0	0.061	.05
2d Lack of parental warmth - observed (age 1-5)	3.86	0.74	2.2	0.020	.12*
2e Inconsistent Discipline – parent report (age 1-5)	2.82	0.55	1.3	0.076	.15*
School social and cognitive readiness					
3a Woodcock-Johnson Letter/Word Iden (gr k) (R)	13.83	4.68	0.0	0.065	.11*
3b Vocabulary skill (gr k) (R)	9.41	3.55	0.0	0.028	.00
3c Competent social problem solving (gr k) (R)	0.72	0.16	0.6	0.011	.08
3d Hostile attributional bias (gr k)	0.59	0.30	0.0	0.089	.22*
3e Emotion recognition skill (gr k) (R)	11.48	2.74	0.9	0.078	.10*
Early child externalizing behaviors					
4a Teacher report – TRF (log) (gr x)	4.18	0.44	66.5 ^a	0.047	.07

4b Parent report – CBCL (log) (gr x)	3.94	0.82	6.9	0.015	.25*
School social and academic failure					
5a Peer social rejection (gr 2-4)	.15	0.89	22.7	0.118	.21*
5b Grade retention (gr 1-4)	.11	1.29	0.0	0.034	.00
5c Special education (gr 1-4)	.243	1.77	0.0	0.072	.06
5d Failing Grades (gr 1-4)	.06	0.98	0.0	0.031	.00
5e Academic competency problems (gr 1-4)	.23	1.75	0.0	0.044	.03
Adolescent parental monitoring					
6a Parental supervision – youth report (after gr 4) (R)	4.22	1.10	10.4	0.073	.09
6b Parental supervision – parent report (after gr 4) (R)	4.79	1.15	12.3	0.047	.06
6c Parent openness to communication (after gr 4) (R)	1.84	0.76	14.5	0.074	.11
6d Parental communication with child (after gr 4) (R)	3.88	0.65	9.3	0.062	.15*
6e Communication with parents (after gr 4) (R)	3.72	1.00	11.9	0.021	.03
6f Parent involvement in school (after gr 4) (R)	1.42	0.58	11.9	0.059	-.04
Adolescent deviant peer association					
7a Deviant peer association - parent report (after gr 7)	15.23	5.62	18.1	0.143	.27*
7b Deviant peer association - youth report (after gr 7)	1.34	0.60	21.4	0.114	.14*
Index of Adolescent Violence (gr 10-11)	.544	6.21	19.2		

Note: *n* ranges from 280 to 462; * $p < .05$.

^a Not administered to normative sample

Table 3. Correlations among PLS variates and violence.

	<i>Adv context</i>	<i>E. harsh parenting</i>	<i>Soc/cog deficits</i>	<i>Ext. behavior</i>	<i>Soc/acad failure</i>	<i>Low monitor</i>	<i>Deviant peer</i>
<i>Early harsh parenting</i>	.42*						
<i>Social & cog deficits</i>	.34*	.33*					
<i>Ext. behavior</i>	.36*	.36*	.12*				
<i>School soc & acad fail</i>	.22*	.28*	.30*	.18*			
<i>Low parent monitor</i>	.28*	.35*	.26*	.26*	.23*		
<i>Deviant peer assoc</i>	.31*	.22*	.20*	.25*	.15*	.20*	
<i>Violence</i>	.30*	.20*	.20*	.25*	.18*	.16*	.26*

$N = 463.$

* $p < .05.$

Table 4. Tests of Direct and Indirect Effects in Predicting Violence Outcome

<i>Source</i>	Adverse Context	Early Parenting	Social/cog Readiness	Ext. Behavior	School Failure	Parental Monitoring
<i>Mediator</i>	Early Parenting	Social/cog Readiness	Ext. Behavior	School Failure	Parental Monitoring	Deviant Peer Association
<i>H1: Source -</i>	0.301	0.182	0.215	0.277	0.163	0.152
<i>> Violence</i>	(0.077)*	(0.044)*	(0.044)*	(0.073)*	(0.041)*	(0.044)*
<i>H2: Source -</i>	0.384	0.382	0.122	0.147	0.234	0.198
<i>> Mediator</i>	(0.040)*	(0.049)*	(0.046)*	(0.034)*	(0.046)*	(0.050)*
<i>(α)</i>						
<i>H4:</i>	0.099	0.147	0.213	0.158	0.139	0.272
<i>Mediator -></i>	(0.044)*	(0.037)*	(0.058)*	(0.048)*	(0.050)*	(0.087)*
<i>Violence (β)</i>						
<i>H3: Indirect</i>	0.0138	0.056	0.026	0.023	0.033	0.054
<i>Effect ($\alpha\beta$)</i>	(0.017)*	(0.015)*	(0.013)*	(0.009)*	(0.013)*	(0.023)*

“Source” indicates the predictor variable. Figure is coefficient. Standard error is in parentheses.

N = 463. * $p < .05$.

Table 5. Prediction between PLS Variates and Violence in Full Model

	<i>Step 1:</i>	<i>Step 2:</i>	<i>Step 3:</i>	<i>Step 4:</i>	<i>Step 5:</i>	<i>Step 6:</i>	<i>Step 7:</i>
	<i>Adverse</i>	<i>Early Harsh</i>	<i>Soc/cog</i>	<i>Early Ext.</i>	<i>School Soc/</i>	<i>Adol Parent</i>	<i>Deviant</i>
	<i>Context</i>	<i>Parenting</i>	<i>Readiness</i>	<i>Problems</i>	<i>Acad Fail</i>	<i>Monitor</i>	<i>Peer Assoc.</i>
<i>Step 2: Early</i>	0.384						
<i>HarshParenting</i>	(0.040)*						
<i>Step 3:Soc/cog</i>	0.262	0.264					
<i>Readiness</i>	(0.048)*	(0.049)*					
<i>Step 4: Early</i>	0.294	0.331	-0.062				
<i>Externalizing</i>	(0.051)*	(0.055)*	(0.046)				
<i>Problems</i>							
<i>Step 5: School</i>	0.042	0.159	0.191	0.065			
<i>Soc/acad Fail</i>	(0.045)	(0.056)*	(.044)*	(0.037)			
<i>Step 6:</i>	0.079	0.216	0.108	0.106	0.093		
<i>Adol Parent</i>	(0.047)	(0.053)*	(0.041)*	(0.035)*	(0.048)		
<i>Monitor</i>							
<i>Step 7:</i>	0.187	0.032	0.068	0.117	0.029	0.071	
<i>Deviant Peer</i>	(0.048)*	(0.060)	(0.038)*	(0.043)*	(0.048)	(0.050)	
<i>Association</i>							
<i>Violence</i>	0.174	0.000	0.071	0.116	0.083	0.017	0.171
	(0.066)*	(0.066)	(0.031)*	(0.048)*	(0.047)	(0.057)	(0.075)*

$N = 463$. Figure is path coefficient. Standard error is in parentheses.

* $p < .05$.

Figure Captions

1. Hypothesized correlations among domains in the development of violence.
2. Hypothesized dynamic cascade model of the development of violent behavior.



