

## A. SPECIFIC AIMS

### Introduction

Researchers have identified a number of factors across a variety of domains (e.g., individual, family, school, peers, and community) that increase the risk that youth will engage in violent acts, as well as protective factors that decrease the risk (Hawkins et al., 1998). Not only is it becoming clear that individual factors across affect children's risk of violent behavior, it also is evident that the presence of multiple risk factors results in a dramatic increase in risk (Herrenkohl, 2000). The identification of factors that alter the trajectory toward violent behavior and that are potentially malleable holds great promise for the design of targeted preventive interventions. An important step in fulfilling this promise is to further our understanding of the interactions between children's individual susceptibility and factors in their social environment. It also is becoming clearer that these factors should be considered in a developmental context. Further, pathways to violent behavior occur in a community context, which has emerged as an increasingly important influence on violence. Guided by the conceptual model in Figure 1, in the proposed research, we set out to integrate these perspectives analyzing data from ongoing longitudinal studies of community based samples in Baltimore. As described in our Core Application, the Hopkins Youth Violence Prevention Center is working with a consortium of agencies and service providers. The goal of this effort is to utilize our understanding of the epidemiology and etiology of youth violence so that preventive interventions and clinical services can most effectively reduce the prevalence of youth violence in Baltimore. This research project will refine the indicators used to target interventions, both in terms of identifying children at risk for violent behavior at whom intervention should be targeted, as well as specific risk factors that are potential targets for intervention.

The availability of longitudinal data from three community-based samples of children in Baltimore provides a unique opportunity to conduct analyses that can guide the development and implementation of interventions designed to prevent violent behavior. A unique strength of these studies is that longitudinal observational data were collected in the context of a school-based prevention trial (for two samples) and together the samples span the developmental period from birth to young adulthood. In this project, we address three specific aims, focusing on factors at the level of the individual, social environment, and community, respectively.

**Specific Aim 1.** To identify patterns of behavior occurring throughout childhood, as well as other child characteristics, that signal high risk of violent behavior in adolescence. Early aggression has been shown to be a predictor of later violent behavior, although not all children with early aggression become violent. In this aim, we seek to identify specific individual characteristics that are indicators of high risk for violence, either alone, or in combination with early aggression. Specifically, we seek to test whether ADHD, drug use, as well as other behavior problems, might act independently or synergistically with aggression to increase children's risk of violent behavior. The successful development of models that can accurately identify children at high risk of later violent behavior will have multiple benefits. First, it will enable more effective targeting of concentrated interventions towards those children most in need. Second, the use of modern regression approaches, such as tree-based regression, can shed light on a hierarchy of risk factors for violence, which can guide the deployment of services necessary to target these behavior problems.

**Specific Aim 2.** The second aim tests whether factors in the social environment might alter children's trajectories toward violent behavior with the goal of identifying potential targets for intervention. Additionally, we will test whether specific interventions implemented in childhood can reduce violence later in adolescence.



## **B. BACKGROUND AND SIGNIFICANCE**

The research proposed in this application is driven by two strategies recommended in prevention research. One of these strategies stresses the importance of identifying those at early risk for violence and other problem behaviors so that the effectiveness of universal interventions can be examined for those at high risk and that targeted interventions can be focused at a relative small group of children who are likely to engage in violence. The other strategy is the development of interventions that reduce identified risk factors, and simultaneously enhance potential protective factors (OJJDP, NIMH 1995; Mrazek and Haggerty 1995). Importantly, the development of successful interventions hinges on research that can effectively identify risk and protective factors that are likely to have a causal impact on youth violence and are malleable (Lipsey and Derzon, 1998). Thus, despite growing evidence that there might be genetic influences on aggression and violence (Volavka, 1999), it is not likely that interventions could be developed to target genes identified for violent behavior in the foreseeable future. On the other hand, there is mounting evidence pointing to specific environmental risk and protective factors that have an etiologic influence on violence and are potentially malleable targets of intervention.

In this project, we propose to build on findings from two major lines of research on youth violence. The first line of research consists of prospective, longitudinal research studies in which individual children have been followed over time for the identification of risk and protective factors (Cairns & Cairns 1994; Capaldi & Patterson 1994; Cohen, Cohen, & Brook 1993; Farrington 1994; Herrenkohl et al. 2000; Loeber et al. 2000). The second line examines community-level influences on violence, typically involving analyses of aggregate level analyses (Sampson et al., 1997b; Simcha-Fagan & Schwartz 1986). Although there is a significant body of empirically-based research pointing to risk and protective influences across a variety of domains (Hawkins et al., 1998; Herrenkohl, 2000), there are significant gaps that need to be filled. First, less emphasis has been placed on identifying protective factors and we need to better understand those individual, family, school, and neighborhood characteristics that enhance children and youth's opportunities for better adaptation. Second, we need to understand how these risk and protective factors work together to increase or decrease risk of violence. In particular, the search for protective factors that reduce the risk of violence among individual who are at high risk (e.g., aggressive children), could yield important clues for the design of effective intervention strategies. Further, although the importance of the influence of neighborhood characteristics on violence is becoming more evident,

there is a great deal to be learned about the role of the community in the causal pathways leading to youth violence (Sampson, 1997b; Simcha-Fagan et al., 1986).

We also seek to improve on the ability to identify children at significant risk for youth violence. Although it has been clearly established that children who exhibit high levels of aggression through childhood are likely to commit violent acts, many children who are identified as aggressive early do not go on to become violent (Robins & Ratcliff 1979). There remains an important need to increase our ability to identify with a reasonable degree of precision (in terms of both sensitivity and specificity) aggressive children who will go on to engage in youth violence (Lipsey and Derzon, 1998; Mrazek & Haggerty 1994). One of highest research priorities of the National Research Council's report *Understanding and Preventing Violence* (Reiss and Roth, 1994) was placed on the need to identify the relevant characteristics of communities, families, and persons that distinguish between young aggressive children who become violent adults and those who do not.

### Risk and Protective factors

In terms of individual characteristics, early aggressive behavior emerges as one of the most important predictors of later violent behavior (Robins, 1966; Werner & Smith 1977; Ensminger, Kellam, Brown 1983; McCord 1983; Stattin & Magnusson 1989; White, Moffitt, Earls et al. 1990; Farrington 1994; Reiss and Roth 1994; Loeber and Hay 1997; Moffit, Nagin and Tremblay, 1999). Several studies also show that the impact of early aggressive behavior is enhanced when it is combined with shy or withdrawn behavior. While shy or withdrawn behavior without aggression is a protective factor for later delinquency and violence, when it is combined with aggressive behavior it predicts higher levels of delinquency and violence than just aggressive behavior alone (McCord 1988; Ensminger et al. 1983; Kerr, Tremblay, Pagani, & Vitaro 1997). Further, the course or trajectory of aggressive behavior through early childhood might be an even more important predictor for violence than the presence of aggression at early ages (Moffit, Nagin and Tremblay, 1999).

There are some important examples of work that has examined how risk factors work together. Raine et al. (1994) examined the impact of a mother's rejection of her child at birth and of birth complications on criminal violence at age 18. There was no difference in risk of criminal violence among children who were not rejected, who were rejected but who had no birth complications, and those who had birth complications but were not rejected. The combination of mother's rejection and the presence of birth complications, however, doubled the risk of criminal violence over that in the other three groups. An example of how one risk factor may mediate another risk factor was found by Kellam et al. (1998). Poverty increased the likelihood of children being aggressive; in turn, early aggressive children were more likely to exhibit aggressive behavior later. An important next step in the studies on the etiology of violence is to examine how risk factors operate in the presence of one another. Such will be a major focus of the proposed work. They may enhance the impact (e.g. the combination of shy and aggressive behavior); they may only operate if both risk factors are present (e.g., rejected children with birth complications); or one may mediate the impact on later violence (e.g., poverty and early aggressive behavior).

Risk factors for violence have been found in several domains. We have cited above how early behavior signals risk for later aggressive and violence. Raine et al. (1994) found how early birth complications when accompanied by maternal rejection increases the risk of later violence. Sex differences have been found consistently with boys at considerably higher risk of aggressive behavior and later violence than girls (Hawkins et al., 1998; Herrenkohl et al., 2000). The family domain has also been examined with regard to later antisocial and violent behavior. Poor supervision and parental monitoring has been found in a number of studies to be a risk for later violence (Patterson 1982; Farrington & Loeber 1998; Herrenkohl et al. 2000). Schools and classrooms have also been recognized as important contexts for the development of antisocial behavior (Kellam et al. 1998; Kershaw 1992). These studies

found that the concentration of aggressive behavior within classrooms or the tracking of students according to ability were risks for later aggressive behavior. One of the strongest predictors of violence across studies is involvement with antisocial peers (Hawkins et al. 1998; Lipsey & Derzon 1998). We review later the evidence regarding neighborhood and community predictors of violence. The studies over the last few decades have demonstrated that the etiological factors in violence come from a variety of domains including biology, individual behavior, the family, schools and classrooms, peers, as well as the neighborhood and community. The next stage of research must seek to examine the interrelationships in risk factors across these domains.

There are two different definitions of protective factors (Reiss and Roth 1994). Protective factors have often been conceptualized as processes that interact with risk factors in reducing the probability of a problem outcome such as violence (Rutter 1985). However, others (e.g., Loeber et al. 1998) suggest that a protective factor may be the opposite end of the continuum to a risk factor. Rutter and Giller (1983) reported that changes in the peer group, leaving school, moving away from home, and marriage are all associated with reductions in delinquency and crime. Farrington et al. (1988) and Kellam et al. (1983) found protection with shy or withdrawn behavior (if it does not co-occur with aggressive behavior). Huesmann and Eron (1988) found that aggressive children who do not go on to become criminal were distinguished from those who did by having a higher IQ and by having parents who attended religious services. Within the violence area, relatively little attention has been paid to protective factors, and even less to how protective factors might interact with risk factors in reducing the likelihood of violence. In the proposed research, a major aim will be to identify those factors in the individual, in the schools and families, and in the communities that distinguish between those children at risk for later violence who go on to become violent from those who do not. Such knowledge is very important in trying to design prevention and intervention programs.

An important aspect of the proposed project is that an early prevention program focusing on aggressive behavior was implemented in the first and second grades (Kellam and Rebok 1992; Kellam et al. 1994). While a major aim of the prevention program was to reduce aggressive behavior, a second aim was to use the intervention as a way to better understand aggressive behavior. Is it malleable? If it is changed does that reduce the risk for later problem outcomes? Are there crossover effects, e.g., if aggressive behavior is changed, does it affect other outcomes such as school performance? The answers to these questions are important for the design of further prevention and intervention programs and also for the further understanding of aggressive and violent behavior (Kellam and Rebok 1992; Kellam et al. 1994; Reiss and Roth 1994).

### Youth violence within a community context

Our understanding of youth violence would be incomplete without consideration of the communities in which young people and their families live. Given that ethnic minority youth are much more likely than white non-Hispanic youth to live in socioeconomically disadvantaged neighborhoods (Duncan 1994), research on the community context (e.g. neighborhoods, schools, religious organizations) may be particularly informative about racial and ethnic differences in rates of youth violence. Peeples and her colleagues (1994), for example, found that the greater neighborhood disadvantage experienced by urban African-American compared to white boys largely explained the higher delinquency rates found for African-American boys.

Community context research focused on young people is primarily informative about the behavioral precursors to serious youth violence such as delinquency and fighting. Findings from these studies indicate that youth living in communities characterized by low socioeconomic status, residential mobility, and family instability engage in more behavioral precursors to serious violence than do other young people (Brooks-Gunn, Duncan, & Aber 1997;

Coulton & Pandey 1992; Elliot et al. 1996; Jencks & Mayer 1990; Peeples & Loeber 1994; Sampson 1988, 1997a, 1998; Sampson & Groves 1989; Simcha-Fagan & Schwartz 1986). Ethnically homogeneous communities are also related to higher levels of youth problem behaviors when such homogeneity emanates from the concentrated disadvantage and social isolation associated with racial segregation (Wilson 1987). Neighborhood conditions have been found to be more salient to the behaviors of adolescent males than females (Crane 1991; Ensminger, Lamkin, & Jacobson 1996).

The link between neighborhood demographic attributes and precursors to serious youth violence may be explained, in part, by the extent to which communities are characterized by high levels of social capital, or "...resources that emerge from one's social ties" (Portes & Landolt 1996, p. 26). Social capital facilitates individuals' "achievement of certain ends that in its absence would not be possible" (Coleman 1990, S98). The mechanisms through which social capital operates include the communication, behavioral norms, and trust that develop from shared social ties (Coleman 1988, 1990). Communities characterized by high levels of social capital, indicated by dense social networks, resident participation in organizations and institutions, and a collective supervision of youth, have been associated with lower levels of youth delinquency, aggression, and violence (Elliot et al. 1996; Sampson 1988, 1997, 1998; Sampson and Groves 1989; Simcha-Fagan and Schwartz 1986).

The concept of community social capital bears a close resemblance to Robert Sampson's notion of "collective efficacy." Collective efficacy refers to a community's social cohesion and shared "willingness to intervene for the common good" (Sampson 1997, p. 919). It is differentiated from social capital in that it refers to the human actions entailed in *using* social ties as opposed to the social relationships themselves (Sampson 1998, 1999). Among a sample of over 300 Chicago neighborhoods, Sampson (1998, 1999) found that collective efficacy was associated with multiple measures of violence and largely mediated associations between neighborhood disadvantage and violence.

Finally, individuals' subjective appraisals of their communities are also related to youth behavior. Youth living in neighborhoods perceived as socially cohesive, safe, and in good physical condition report fewer problem behaviors than do other youth (Aneshensel & Sucoff 1996; Mason et al. 1994; Seidman et al. 1998).

## Summary

The proposed study to examine the developmental trajectory of aggressive behavior to later violence provides a unique opportunity to advance the understanding of youth violence. The proposed project includes data from studies designed to focus on early aggressive behavior (Kellam and Rebok 1992); there are multiple reporters of early aggressive behavior; there was a well-designed, randomized trial focused on early aggressive behavior in multiple schools (Kellam and Rebok 1992); there are multiple cohorts for replication of results; there have been multiple waves of data collection in order to observe the developmental progression of aggressive behavior; many of the protective and risk factors hypothesized to moderate or mediate aggressive behavior and later violence have been measured. Further, the study is set within the City of Baltimore, a city with high rates of violence, and findings can be used to guide the development of implementation of prevention programs in Baltimore, as well as informing the broader research community.

## **C. PRELIMINARY STUDIES**

The research team for the proposed project has extensive experience in the conduct of epidemiologic research with a focus on developmental and etiologic issues. The team brings together a high level of expertise in substantive

and methodologic research, including: risk and protective factors, delinquency and aggression, child development, preventive interventions, psychiatric epidemiology, community context, and development of biostatistical methods. Here, we highlight prior research carried out by members of our team that is relevant to the proposed project. Much of this research has been conducted using data from the Baltimore Prevention Center samples, which are the source of data for the proposed research.

The PI of this project (Dr. Chilcoat) has conducted a number of studies on the etiology of children's drug use and behavior problems. Given the suspected importance of family behavior management on the development of violence, the PI's prior studies on the role of parent monitoring in children's drug initiation are particularly relevant to the proposed research. Dr. Chilcoat's research on parent monitoring has focus attention on the importance of family-level risk factors in the pathway to drug use. This research was based on analyses of data from one of the samples to be used in the proposed project. Another relevant line of research tests the role of ADHD and early externalizing problems (delinquency and aggression) in the developmental pathway to drug use and related problems.

### Parent Monitoring

This line of research was stimulated by the research carried out by Patterson and colleagues (see Patterson, 1992), which identified family behavior management strategies as a potential target for interventions designed to reduce the risk of drug use and related problems. Using prospective data from a well-defined cohort of inner-city and urban children, starting when the children were 8 to 10 years old and reassessing them each year thereafter, we tested whether higher levels of parent monitoring signaled decreased risk of drug initiation.

At baseline, there was a strong association between level of parent monitoring and children's drug use (Chilcoat, 1992). Children in the lowest level of parent monitoring had four times greater odds of drug sampling than those at the highest level (prevalence was 19% versus 5% in the lowest and highest quartiles, respectively; Relative Odds [RO] = 4.0, 95% Confidence Interval [CI] = 2.4 - 6.8, adjusted for age, sex, and race). To gain greater control over the temporal sequencing of parent monitoring and drug sampling, we carried out an analysis of prospectively gathered data (Chilcoat et al., 1995), comparing the one-year incidence of drug initiation in poorly- versus well-monitored children. High levels of parent monitoring signaled subsequent lower risk of drug sampling (Lowest versus highest quartiles: RO = 4.39, 95% CI = 1.5 - 13.0). Children with intermediate levels of monitoring were at the intermediate risk. This relationship changed little when controlling for suspected confounders (sex, age, race, peer drug use, and antisocial behavior) and the association did not vary *by family structure*. To account for shared aspects of school or neighborhood environment, we carried out a parallel analysis, grouping children into risk sets defined by their elementary school classrooms. We obtained nearly identical estimates for the effects of parent monitoring as those estimated using the unconditional model. In an additional analysis, we also found that children with greater *decreases* in parent monitoring were at increased risk for initiating drug sampling during the observation interval.

To test whether parent monitoring might have a sustained impact on risk of drug use later in childhood and early adolescence, children were followed up for an additional two years, through 1992, when the children were 11 to 13 years old (Chilcoat and Anthony, 1996). The cumulative incidence of drug use was examined in relation to level of parent monitoring at baseline in 1989, using Kaplan-Meier estimates and indicated a 2-year delay in the onset of drug-taking for the highest versus least monitored youths. The impact of parent monitoring on *any* drug use, including tobacco and self-initiated alcohol use, appeared to diminish as children approached adolescence and drug sampling became less rare. However, when we excluded alcohol and tobacco use, and focused on use of marijuana, inhalants, or cocaine, higher levels of parent monitoring signaled lower risk of initiation of these drugs,

regardless of age (lowest versus highest quartiles: incidence, 11% and 4%, respectively; RO = 3.15, 95% CI = 1.35 - 7.39). A more detailed examination of combinations of levels of peer drug use, antisocial behavior, and parent monitoring indicated that the risk of initiating marijuana, cocaine, and/or inhalant use increased in an essentially additive fashion. For example, among those children in the lowest quartile of either peer drug use or antisocial behavior who were also in the highest quartile of parent monitoring, none initiated use of illicit drugs (i. e., marijuana, cocaine, or inhalants) in the two-year follow-up interval. Conversely, 22% of those in the highest quartile of peer drug who were in the lowest quartile of parent monitoring had started use of these drugs in the follow-up period.

Extending this research, we tested whether children with ADHD were at increased risk of drug use, and the role of externalizing problems (delinquency and aggression) in this pathway (Chilcoat and Breslau, 1999). We also tested whether parent monitoring exhibited the same protective effect for children with ADHD as had been shown for children in general. Using data from 717 children originally assessed at age 6 and followed up at age 11, we found that ADHD signaled increase risk of drug use. Further, ADHD was linked strongly with externalizing problems at age 6. These factors interacted so that there was no difference in risk of drug use by ADHD status at high or low levels of externalizing. At moderate levels of externalizing, however, children with ADHD more than twice as likely to initiate drug use in childhood. Regardless of ADHD status, high levels of parent monitoring signaled reduced risk of drug use, suggesting that parent parenting might be a useful target for intervention for children at risk of drug use due to ADHD.

### Race/ethnicity and crack use

In two related studies that used data from the National Household Survey on Drug Abuse (NHSDA), Dr. Anthony and colleagues (Lillie-Blanton et al., 1993) and Dr. Chilcoat (Chilcoat and Schutz, 1995) tested whether neighborhood factors might account for racial/ethnic differences in crack cocaine use. Using data from the 1988 and 1990 NHSDA, respectively, each study found that once neighborhood of residence was taken into account using conditional logistic regression, there were no differences in the odds of crack use for African-Americans, Whites, and Hispanics. In addition, Chilcoat and Schutz (1995) found that the prevalence of crack use was highest for African-Americans in the 25-35 year old group and differences with other groups remained, even after neighborhood was taken into account.

### Intervention Research

Summary of Findings from the Initial (1985-86) JHU PRC Trials. The Baltimore Prevention Center (Dr. Sheppard Kellam, original PI) including Drs. Ialongo and Anthony, has investigated the impact of two interventions on children's social adaptation status and psychological well-being. The first intervention, the Good Behavior Game (GBG) targeted aggressive and shy behavior and the second, Mastery Learning (ML) targeted reading achievement. The results of the initial trial confirmed that **(1)** the proximal antecedent risks behavior of early aggression and poor achievement--which represent two of the salient social task demands faced by children in the early elementary school years--are malleable (Dolan et al., 1993) and that change in these proximal targets is associated with change in their distal outcomes of later social adaptational status, psychological-well being and early substance use (Kellam, et al., 1994a; 1994b; Kellam & Anthony, in press); **(2)** Intervention impact varied as a function of the pretest or baseline level of the early antecedent risk behaviors targeted, such that children who demonstrated mild to moderate levels of risk benefited the most; **(3)** Though there was little evidence of cross-over effects from improving aggression to improving achievement, there was evidence of a crossover effect from improved academic achievement to aggression. The effect was a moderate one and suggested a need to target

directly both aggression and academic achievement in future preventive interventions; (4) Children's concentration problems were found to have a central role in the development of aggressive and shy behavior as well as poor achievement. In addition, concentration problems played a significant role in moderating the intervention impact of the GBG, thus, suggesting the need for preventive intervention components aimed at concentration problems; and (5) variation in intervention response and/or developmental course was associated with a number of family processes and characteristics as well as the initial and evolving characteristics of the child, classroom, peer group, and neighborhood community social fields. These results pointed to the family as a further target for intervention, along with the need for continuing universal interventions in the classroom and peer group. (6) In terms of impact on substance use, survival analyses revealed that boys in GBG classrooms in both cohorts were at reduced risk at age 14 for initiating tobacco use relative to control children (Kellam & Anthony, 1998).

## PROGRESS TOWARD THE EVALUATION OF THE 1993-94 JHU PIRC INTERVENTIONS

Dr Ialongo and colleagues (1999) assessed the immediate effects of two universal, first-grade preventive interventions on the proximal targets of poor achievement, concentration problems, aggression, and shy behaviors, known early risk behaviors for later substance use/abuse, affective disorder, and conduct disorder. The classroom-centered (CC) intervention was designed to reduce these early risk behaviors by enhancing teachers' behavior management and instructional skills, whereas the family-school partnership (FSP) intervention was aimed at improving parent-teacher communication and parental teaching and child behavior management strategies. Over the course of first and second grades, the CC intervention yielded the greatest degree of impact on its proximal targets, whereas the FSP's impact was somewhat less. The effects were influenced by gender and by preintervention levels of risk. Analyses of implementation measures demonstrated that greater fidelity to the intervention protocols was associated with greater impact on behavior ratings and on achievement scores, thus providing some evidence of specificity in the effect of the interventions.

### Delinquent and Violent Behavior

Within the Woodlawn Longitudinal Study of an African American cohort, risk and protective factors for problem behaviors in adolescence and young adulthood have been examined. Dr. Ensminger and colleagues have focused on the importance of aggressive behavior and shy aggressive behavior and the protectiveness of social bonds for later adolescent substance use (Ensminger, Brown & Kellam 1982) delinquent behaviors, including violence (Ensminger, Kellam & Rubin 1983), adult interpersonal aggression and substance use (Ensminger and Juon 1998). McCord and Ensminger (1997) examined the differences in the early predictors of depression, violence and alcoholism and found early aggressive behavior, lower intelligence test performance in first grade, frequent school absences in first grade, leaving home before the age of 16, and self reported exposure to racial discrimination were all related to later violence as indicated in official criminal records. Criminal violence was identified through official criminal justice records. People were considered violent if they had been arrested for robbery, assault, battery, threat, weapons charges, kidnapping, manslaughter, domestic violence, rape, murder or attempted murder. Some violent people are never arrested and some people are arrested when they are not guilty. However, many studies have shown that criminal records identify roughly the same people as those who confess to frequent or very serious crime (Elliott & Ageton 1980; Farrington 1989; Gold 1966; Hindelang et al. 1979). Ensminger and colleagues are continuing to analyze this prospective data that has both self-reports and criminal records documenting violent behavior to age 32-34. Interpersonal aggression in this study was measured by self-reports based on the frequency of aggressive acts toward others within the past year, such as carried a gun or other weapon, got into a serious fight, used a weapon in a fight, used threats to get someone to give them something, purposely injured someone physically, engaged in a gang fight (see Ensminger and Juon 1998).

## Impact of neighborhood attributes on fighting

Through multilevel analyses of data on about 600 7<sup>th</sup> through 10<sup>th</sup> grade males who participated in The National Longitudinal Study of Adolescent Health, Dr. Roche and her colleagues have conducted studies that examine the direct and modifying influences of neighborhood attributes on boys' delinquent and fighting behaviors. In one study, the authors considered the impact of extrafamilial social capital on family-level social processes. Findings from this study indicated that positive parenting practices had a stronger association with boys' delinquent and fighting behaviors when families lived in communities with greater social capital (i.e. collective monitoring of youth; school family involvement) than when they did not (Roche, Alexander, Astone, & Bandeen-Roche, 2000). A second study examined the impact of neighborhood demographic and perceived attributes on boys' fighting and on the association between parenting and fighting. Perceived social resources in the neighborhood magnified the beneficial impact of parental control on lower fighting, and neighborhood economic disadvantage increased the need for parental control in order to deter boys' fighting. Neighborhood influences on fighting were stronger for white than black, non-Hispanic adolescents (Roche, Webster, Alexander & Ensminger, 1999).

## SES and Delinquency

Dr. Miech and his colleagues have examined the influence of SES on delinquent behavior through analysis of approximately 1,000 youth who participated in the longitudinal Dunedin Multidisciplinary Health and Development Study. Their analyses focus on the different pathways that lead to delinquency for youth from different SES backgrounds (Wright et al. 1999). For example, youth from lower SES backgrounds are at risk for delinquent behavior as a result of higher levels of aggression and alienation and lower levels of occupational aspirations, while youth from higher SES backgrounds are at risk for delinquent behavior as a result of increased risk taking and lowered conventional values (e.g. lower moral standards). Dr. Miech will extend this line of research by focusing specifically on violent delinquent behavior and examining how antecedent pathways differ for youth from different SES backgrounds

## Latent Transition Analysis

Reboussin et al. (1998) analyzed data from the Baltimore Prevention Research Center to determine if there were states of weapon-carrying behavior, and if so, what factors determined transitions between states over time. By assessing the correlation among six weapon-carrying behaviors, a useful heuristic emerged for both boys and girls indicating various states of weapon use. Specifically, a state where youths do not carry weapons, a state involving carrying sticks or other weapons for defense, and a state involving carrying more serious weapons such as knives for defense and sticks and other weapons to hurt someone provided an interesting comparison. Risk factors such as age, race, and feeling safe in one's neighborhood (boys only) were found to be important predictors for transitioning between states of weapon-carrying. According to our study, as a youth gets older, if they have no recent history of weapon carrying behavior, they are less likely to start initiating the behavior than a younger youth also without a recent history. However, an older youth who has already been involved in such behaviors as carrying sticks for defense is more likely to transition into more serious forms of weapon carrying behaviors than a younger youth. These results indicate the need for primary prevention programs and the ability to intervene early in the developmental pathway before youths begin initiating even mild forms of weapon-carrying behavior in order to prevent later weapon carrying behavior. These results also emphasize the importance of a youth's neighborhood over interpersonal factors, at least for boys, as a risk factor for weapons carrying behavior and suggest the need perhaps for more community based violence prevention programs.

## Relationship of violence with parent monitoring and deviant peers – a preliminary analysis of data from the proposed study

Using cross-sectional data from one of the samples to be used in the proposed research, we tested whether two suspected factors in the child's social environment, parent monitoring and association with deviant peers were linked with children's reports of violent behavior. There were 1416 children from the initial Baltimore PRC sample interviewed when they were in 7<sup>th</sup> and 8<sup>th</sup> grades, who had complete data on violent behavior, parent monitoring, and deviant peers. A child was coded positive for violent behavior if they reported any of the following happened 3 or more times in the past year: hurt others physically, started physical fights, or used a weapon in a fight. Prevalence of violent behavior was 17.4%. As shown in Table 2 there was a strong relationship between each of these risk factors and violent behavior.

Table 1. Prevalence of violent behavior by quartile of parent monitoring and association with deviant peers.

	Quartile				$\chi^2$ (d.f. = 3)	p-value
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>		
Parent monitoring	33.1%	18.1%	11.8%	7.7%	142.4	<.001
Deviant peers	6.0%	9.2%	16.9%	37.7%	86.2	<.001

## **D. RESEARCH PLAN**

This project consists of analysis of longitudinal data from two studies of interventions targeting

community-based samples of children in Baltimore City Public Schools, as well as a study of children born in Baltimore who were followed from birth to young adulthood. The intervention studies were conducted by the Baltimore Prevention Research Center, a collaborative venture between the Johns Hopkins University and Baltimore City Public Schools, which was established by Dr. Sheppard Kellam. These classroom interventions, originally funded by the National Institute of Mental Health, took place when the children were in first grade and targeted shy and aggressive behavior, as well as reading achievement. The first intervention study consists of two cohorts (Cohorts 1 and 2) of approximately 1000 children each, who entered first grade in the fall of 1985 and 1986, respectively. Children were assessed directly on an annual basis through grade 8, and school records, as well as juvenile justice records, are available through high school. Currently, one wave of assessment of these children is being completed, as the children enter young adulthood (ages 20-21) and another wave of assessment on these cohorts is starting. The second study consists of one cohort (Cohort 3) of nearly 700 children entering first grade in the fall of 1994. Currently, children are completing grade 7. Assessments are ongoing on an annual basis, with current funds available to assess the children through grade 10. A description of the design and sample for each study is provided below. The third sample consists of over 4000 children participating the JHU Collaborative Perinatal Study (JHCPS) and the Pathways to Adulthood Study (PATHWAYS).

### Samples

Baltimore Prevention Research Center -- Cohorts 1 and 2

Beginning in 1985, two successive cohorts ( $N_{I}=1196$ ;  $N_{II}=1115$ ) of urban first-graders were recruited from 43 classrooms in 19 elementary schools located in 5 socio-demographically distinct areas in eastern Baltimore. The five geographic areas in which the participating schools are located were defined by census tract data and vital statistics from the Baltimore City Planning Office. As described in Werthamer-Larsson (1988), these areas vary by ethnicity, type of housing, family structure, income, unemployment, violent crime, suicide and school drop out rates. Area 1 is predominantly comprised of middle income, married, two-parent families of Greek-, German-, Polish-, or Italian-American descent. These families live in well-maintained row houses in close proximity to extended family members. Area 2 is a predominantly African-American area, characterized by very low- to low-income, multi-generational families living in large public housing projects. The majority of these families receive public assistance. Area 3 is a totally African-American area characterized by middle income, multi-generational families living in well-maintained row houses. Area 4 is a racially integrated area, characterized by middle income, married, two parent families living in well-maintained detached frame houses. Area 5 is a predominantly Italian-, Irish-, and German-American area, characterized by moderate income, married, two parent families. The majority of families live in small, well-maintained detached or semi-detached homes. The overall-characteristics of the sample are presented in Table 2. Nearly two-thirds of the sample was African-American. The remainder of the sample was white, except for approximately two percent of each cohort, which was divided among Asian-, Hispanic-, and Native American children.

	Cohort 1 (n = 1196)	Cohort 2 (n = 1115)	Cohort 3 (n = 678)
Male	49%	50%	53%
African-American	66%	65%	87%
Euro-American	32%	34%	13%
Other	2%	1%	0%
Age (sd)	6.6 (.5)	6.5 (0.4)	6.2 (0.3)

Initial Intervention Design

An Overview of Design of the Two PRC Preventive Intervention Trials. The intervention design involved the evaluation of two universal classroom-based interventions, which were implemented over first and second grades for each cohort. Three or four schools were selected in each of the five urban areas described above. Within these clusters of schools, one school was randomly assigned to receive the Mastery Learning (ML) intervention, one the Good Behavior Game (GBG) intervention, and one school served as a control school (to provide protection against within-school contamination). Within each intervention school, children were randomly assigned to classrooms. Classrooms not receiving any interventions were included as internal controls, thus holding constant school, family, and/or community differences such as the effect of the principal on the school environment.

The GBG was directed at improving classroom aggressive behavior, and the ML at improving school achievement. The GBG (Barrish, Saunders, & Wolf 1969) represents the systematic use of behavioral analysis in

classroom management. The GBG was selected because of its demonstrated efficacy and acceptability to the schools and the community. ML is a teaching strategy with demonstrated effectiveness in improving achievement. The theory and research upon which ML is based specifies that under appropriate instructional conditions virtually all students will learn most of what they are taught (Bloom, 1976; Bloom, 1982; Block & Burns, 1976; Dolan, 1986; Guskey, 1985).

### Sample Attrition

Of the 1196 Cohort I students, 1084 (91%) were available for data collection at baseline in the fall of 1985. Of these 1084, 871 (80%) remained enrolled in project schools through grade 1; 96% of the 871 completed the second year of their assigned intervention or control. Of the 835 receiving the entire 2-year intervention, 71% (593) remained enrolled in BCPS through grade 9. In Cohort II, 910 of 1115 (82%) were available for data collection at baseline. Of these 910, 96% (878) completed two years in their respective assigned intervention or control conditions; 579 of these (70%) remained enrolled in BCPS through the 1993-1994 academic year. Departure from BCPS or transfer from a project to non-project school was unrelated to assigned condition initially and from grade 1 through the 1993-1994 academic year. Of the 2311 children originally enrolled in Cohorts I and II, 1431 remained enrolled in BCPS at the end of the 1993-1994 year.

### Baltimore Prevention Research Center (PRC): Cohort 3

#### Participants

A total of 678 children and families, representative of the entering first graders in nine Baltimore City public elementary schools, were available for participation. The majority of the children were African-American (Table 2). Nearly 2/3 (62.3%) of the children received free or reduced lunch. Of the 678 children available for participation in fall of first grade, written parental consent was obtained for 97% of the children. Three percent of the children's parents or guardians refused to allow their children to participate or refused to respond to the consent request despite repeated attempts at obtaining consent. There were no significant differences in terms of sociodemographic characteristics between those children for whom we had received consent versus those for whom we did not receive consent.

#### Design

Three first grade classrooms in each of nine, urban elementary schools were randomly assigned to one of the two intervention conditions or a control condition. Teachers and children were randomly assigned to intervention conditions. The interventions were provided over the first grade year, following a pretest assessment in the early Fall. Intervention impact was assessed in the spring of first through 6th grades.

Two interventions were implemented. The Classroom Centered Intervention (CC) consisted of three components: (1) curricular enhancements; (2) improved classroom behavior management practices; and (3) supplementary strategies for children not performing adequately. In this latest (1993-94) set of JHU PIRC field trials, we refined the GBG to include a focus on off-task and inattentive behaviors in line with the results of Rebok et al.(1996). The family-school partnership intervention (FSP) was designed to improve achievement and reduce early aggression and shy behavior by enhancing parent-school communication and providing parents with effective teaching and child behavior management strategies. The major mechanisms for achieving those aims were (1) training for teachers/school mental health professionals and other relevant school staff in parent-school communication and

partnership building (Canter & Canter, 1991), (2) weekly home-school learning and communication activities, and (3) a series of 9 workshops for parents led by the first grade teacher and the school psychologist or social worker.

Attrition Analyses. Of the 653 children with consent to participate in the evaluation, 597 or 91.3% completed the fall and spring of first grade assessments and remained in their assigned intervention condition over the first grade year. Five hundred and seventy-eight, or 88.5%, completed spring of second grade assessments. There were no significant differences between the intervention conditions in terms of rates of attrition. Nor were there any between-group differences with respect to the socio-demographic characteristics of the children with missing data

## Assessments

A summary of assessments for Cohorts 1 and 2 is presented in Table 2. Measures of children's behavior were obtained from multiple sources: child reports (grades 1-8); teacher reports (grades 1-8); parent reports (Cohort 1: grades 4 and 6; Cohort 2: grades 3 and 6); peer ratings (Cohort 1: grades 1-2 and 4-5; Cohort 2: grades 1 and 3); direct observation (grades 1 and 2); and official records (school and juvenile justice: through all school years). Cohort 3 assessments were carried out in a similar way using multiple sources (Table 3). Teacher assessments (grades K-3 and grades 6-7); child reports (grades K-3 and 6-7); peer ratings (grade 1); parent reports (Grades 1,6, and 7); School records (through grade 7); juvenile justice records (to be collected). Assessment instruments relevant to this project are presented below.

### Outcome measures of violence:

There are three primary sources of data that will serve as indicators of a youth's involvement in violent behavior. The first is self-report of violent behavior reported by children in the longitudinal assessments. The other two sources are official records of school removal obtained through Baltimore City Public Schools and juvenile arrest records obtained through the Maryland Department of Juvenile Services.

Baltimore Conduct Problems and Delinquency Scale (Cohort 1 Grades 6-8 & Cohort 2 Grades 5-8). Beginning in year three of the study we employed an adaptation of a self-report measure of delinquent and antisocial behavior developed by Elliott and Huizinga for National Survey of Delinquency and Drug Use (Elliott, Huizinga & Ageton, 1985). Cronbach alphas have ranged from .67 to .74 in the middle school years. One-year test-retest reliability coefficients have consistently been above .60. The following items specifically assessed violent behavior: During the past 12 months, was this never true for you, or did it happen once, twice, three times, or more than that: 1) hurt others physically; 2) started physical fights with other youths; 3) used a weapon in a fight.

Another set of items in the same assessment session asked children about weapons carrying, including use of a stick or club, knife, or other weapons to 1) protect or defend themselves or 2) to get back or strike at someone.

Diagnostic Interview Schedule for Children-Youth Report (DISC IV; Cohort 3 Grades 6 & 7, future assessments). The DISC IV-Y's Conduct Disorder module was employed to assess socially maladaptive behavior and disorders. The DISC IV is a fully structured interview that generates DSM-IV diagnoses as well as the number of diagnostic criteria met and *symptom counts* for discrete diagnostic entities. The interview specifies the exact wording and sequence of questions and provides a complete set of categories for classifying respondents' replies. It is also designed to be administered by lay interviewers. Specific items in the DISC used to assess violence include: bullies, threatens, others; initiates physical fights; used a weapon; physically cruel to people; forced sex.

## School Suspensions and Removal (Cohorts 1,2, &3)

School records of disciplinary removals and suspensions (and the associated offenses) were obtained by electronic data file transfer, both with error and reliability checks. The school removal data were obtained from the Baltimore City Public School Systems (BCPS) main office. BCPS ID numbers were collected at the start of first and were used to match up to later records collected over time from the schools and relayed back to the school system. For the Cohort 1 & 2 sample, there were 595 occurrences of school removal, 66% of these involved a single occurrence per child, and the remainder involved recurrent removals. There were 153 removals for attacking a student, 53 for attacking a teacher, 9 for threatening a student, 45 for threatening a teacher, and 114 removals for weapons carrying.

## Juvenile Justice Records (Cohorts 1 &2; cohort 3 to be obtained)

The juvenile justice data were obtained through the mainframe system at the Clarence M. Mitchell Jr. Courthouse in Baltimore. Last Name, First Name, DOB and gender were used to determine a match. Each name was entered into the mainframe system separately for the search. If a match was found, the historical record for the case was printed and is currently being entered. Of the 2,311 children in Cohort 1 & 2, 547 (23.7%) had a juvenile justice record. These paper records are currently being entered into a computerized database. Upon completion of data entry, each record will be coded as a violent or non-violent event, depending on the nature of the offense. Juvenile Justice records will be obtained for the Cohort 3 sample in years 3-5 of the proposed study period, when the children are in high school and further into the risk period for a juvenile offence.

## Coding of Violent events

For most analyses, we will treat violence as a dichotomous outcome. School and juvenile justice records capture discrete events occurring over time. Children's self-reports provide a year-by-year record of whether a child engaged in violent behavior. These can be single or recurrent events. There are distinct advantages to considering violence as a dichotomous outcome from a public health standpoint. Prospective studies using dichotomous outcomes enable direct estimation of risk and comparison of risk across groups (or levels of a risk factor). It is also possible to use estimates of attributable risk and etiologic fraction to estimate the potential impact of interventions that target specific risk or protective factors.

## Predictors of Violence

### Individual level factors:

#### Drug Use

### Baltimore Substance Use Scale (Cohort 1 Grades 4-8 & Cohort 2 Grades 3-8)

To assess drug use in Cohorts 1&2 (Chilcoat et al., 1995; Chilcoat & Anthony, 1996; Kellam & Anthony, 1998), we employed an adaptation of Elliott and Huizinga's measure of substance use, which they developed for use in the National Survey of Delinquency and Drug Use (Elliott, Huizinga & Ageton, 1985). This scale uses children's self-reports to measure their use of tobacco, alcohol, marijuana, crack cocaine, heroin, inhalants and stimulants. This scale measures quantity and frequency of use of these drugs, age of onset, exposure to opportunities to use, and problems related to use.

National Household Survey on Drug Abuse (NHSDA, 1995; Cohort 3 Grades 6+). Reports of lifetime, last year and last month substance use will be obtained through the use of NHSDA interview. Use of the following substances will be assessed with the NHSDA: tobacco, alcohol, marijuana, cocaine, crack, and inhalants. We will also administer the NHSDA subscales tapping the components of dependence and past-year problems associated with substance use.

### Behavior Problems

Teacher Observation of Classroom Adaptation-Revised (TOCA-R; Werthamer-Larsson et al., 1991; Cohorts 1 & 2 Grades 1-8; Cohort 3 Grades 1-3 & 6+). The TOCA-R is a brief measure of each child's adequacy of performance on the core tasks in the classroom as defined by the teacher. It is a structured interview administered by a trained member of the assessment staff. The interviewer records the teacher's ratings of the adequacy of each child's performance on a six-point scale (never true to always true) on six basic tasks: accepting authority (aggressive behavior); social participation (shy or withdrawn behavior); self-regulation (impulsivity), motor control (hyperactivity), concentration (inattention) and peer likeability (rejection). In addition, the teacher reports on youths academic performance ("Overall, would you say (child's) grades in your class are excellent, good, fair, barely passing, or failing?"), overall behavior, and the educational, substance abuse, and mental health services s/he perceives each child needs or is receiving. Test-retest correlations over a four month interval with different interviewers were .60 or higher for each of the TOCA-R subscales and the coefficient alphas were .80 and higher for each of them as well.

Parent Observation of Child Adaptation (POCA; Cohort 1 Grades 4 & 6 & Cohort 2 Grade 3 & 6; Cohort 3 Grades 1 & 6+). The POCA was designed as a counterpart to the Teacher Observation of Classroom Adaptation-Revised (Werthamer-Larsson et al., 1991) for use as a measure of the child's success in meeting the developmental task demands of the family social field.

Baltimore How I Feel (Cohorts 1 & 2 Grades 1-8; Cohort 3 Grades 1 & 6+). The BHIF is a 30-item, youth self-report scale of depressive and anxious symptoms. Children report the frequency of depressive and anxious symptoms over the last two weeks on a three-point scale. Items were keyed for the most part to DSM-III-R criteria for major depression, and overanxious and separation anxiety disorders. A pool of items was drawn from existing child self-report measures, including the Children's Depression Inventory (Kovacs, 1983), the Depression Self-Rating Scale (Asarnow & Carlson, 1985), the Hopelessness Scale for Children (Kazdin et al., 1986) and the Revised-Children's Manifest Anxiety Scale (Reynolds & Richmond, 1985).

### Direct Observation

Direct Observation of Classroom Behavior (DOCB; Cohort 1 Grades 1 & 2 & Cohort 2 Grade 1). In grades 1 and 2 in Cohort 1 and grade 1 in Cohort 2, we employed a behavior coding system based on observation by independent classroom observers, who rated children's social interactions, aggression, and concentration/on task behavior. Each item was defined by accepted behavioral definitions (Kent et al., 1974; O'Leary et al., 1971). An interval-time sampling method of observation yielded ten minutes of observation on each child per day of observation. The method was employed just before, during, and after TOCA-R in the fall, and just before, during, and after TOCA-R in the late spring. Forty minutes of observation were done per child per year. Current analyses confirm aggression, social interaction, and concentration as factors.

### School Achievement

The California Achievement Test (CAT, Forms E & F; Cohort 1 Grades 1-4 & Cohort 2 Grades 1-3). The CAT represents one of the most frequently used standardized achievement batteries (Wardrop, 1989). Subtests in CAT-E and F cover both verbal (reading, spelling, and language) and quantitative topics (computation, concepts, and applications). Internal consistency coefficients for virtually all of the subscales exceed .90. Alternate form reliability coefficients are generally in the .80 range.

The Comprehensive Test of Basic Skills (CTBS; Fourth Edition, 1990; Cohort 1 Grade 5 & Cohort 2 Grades 4-5; Cohort 3 Grades K-2 & 6+). The CTBS represents one of the most frequently used standardized achievement batteries in the U.S. Subtests in the CTBS cover both verbal (word analysis, visual recognition, vocabulary, comprehension, spelling, and language mechanics and expression) and quantitative topics (computation, concepts, and applications). The CTBS was standardized on a nationally representative sample of 323,000 children from kindergarten through grade 12.

## Family Characteristics

### Child Report

Structured Interview of Parent Management Skills and Practices--Youth Version (SIPMSP, Capaldi & Patterson, 1989; Cohort 1 Grades 3-8 & Cohort 2 Grades 4-8; Cohort 3 Grades 6+). Patterson and his colleagues developed this interview as a counterpart to their parent interview. The youth version assesses the parenting constructs integral to the Patterson et al. (1992) model of the development of antisocial behavior and social survival skills, which were the caregiver disciplinary practices targeted in the family-school partnership program in first grade (Cohort 3). The relevant parenting constructs assessed are: parental monitoring, discipline, reinforcement, rejection, problem solving, and involvement in learning and behavior. Chilcoat et al. (1995) found that youth reports of parent monitoring on this scale predicted early initiation of drug use.

Parent Report (Cohort 1 Grades 4 & 6 and Cohort 2 Grades 3 & 6; Cohort 3 Grades 1 & 6+).

Household Structure and Demographics. A number of family sociodemographic characteristics were obtained for each of the members (only adult members in grade 6) of the household: level of education, occupational status, marital status, ethnicity, employment status, age, and relationship to target child. We also obtained total family income, the child's country of origin, the biological father's and mother's involvement in the child's caregiving, and the number of moves the family has made since the child was born.

Who Shares in Parenting and What Kinds of Parenting Do They Engage In? We constructed a scale to identify which of the adults in and outside of the household share in child caregiving for the target child and what roles they play.

Has Child Experienced A Death and/or Divorce/Separation of a Caregiver(s)? Parents were asked to enumerate the number of divorces and parental separations the child experienced, as well as the number of deaths of caregivers. The child's age at which these events occurred was also obtained.

Structured Interview of Parent Management Skills and Practices--Parent Version (SIPMSP, Capaldi & Patterson, 1989; Cohort 1 Grades 4 & 6 and Cohort 2 Grades 3 & 6; Cohort 3 Grades 6+).

Peers

Peer Nomination Inventory (Cohort 1 Grades 1, 2, 4, & 5 & Cohort 2 Grades 1 & 3; Cohort 3 Grade 1). The Peer Nomination Inventory is a first stage measure of SAS that assesses all children in each classroom using classmates/peers as raters. It is a classroom administered modified version of the Pupil Evaluation Inventory (PEI, Pekarik, Prinz, Leibert, Weintraub, & Neale, 1976). Ten items were selected from the original PEI the basis of their relevance to three SAS constructs: authority acceptance/aggression (e.g., "Which children get into trouble a lot?"), social participation/shy behavior (e.g., "Which children play alone a lot?"), and likeability/rejection ("Which children don't you like?") and an additional four items were developed to tap psychological well-being [anxiety ("Which children worry a lot?") and depression ("Which children are sad a lot?").

Exposure to Deviant Peers (Capaldi & Patterson, 1989; Cohort 1 Grades 3-8 & Cohort 2 Grades 4-8; Cohort 3 Grades 6+). Youths were asked in forced choice format to indicate how often their peers have engaged in antisocial behavior and/or substance use. Coefficient alphas ranged from .78 to .81 in the 1985-86 JHU PIRC cohorts during the middle school years.

Neighborhoods

Neighborhood Environment Scale (NES, Elliott, Huizinga, & Ageton, 1985; Cohort 1 Grades 3-8 & Cohort 2 Grades 4-8; Cohort 3 Grades 6+). This scale consists of 18 true-false items and was used to assess exposure to deviant behavior in the neighborhood, including violent crime, drug use and sale, racism, and prejudice, as well as positive attributes tapping collective efficacy. Previous research shows that this scale strongly predicts the probability that youth will be offered cocaine (Crum and Anthony 1993), and this project will examine its utility to predict individual youths' exposure to and participation in violent activities

To augment items in the Neighborhood Environment scale, we plan to add items to future assessments of the Cohort 3 sample that measure other community attributes relevant to youth violence. These attributes and an example of each include the following: collective efficacy (e.g. neighbors' willingness to intervene with problem youth; Sampson et al., 1999, 1997); community organizational involvement (e.g. family involvement in schools; attendance at religious institutions); and community support (e.g. reliance on neighbors for help with childcare, etc.; Chavis & Wandersman, 1990; Elliot et al., 1996). The development of study instruments will be informed by findings from the Baltimore City study of neighborhood influences on adolescent health-risk behaviors in which Drs. Ensminger and Roche are currently involved.

In addition to providing measures of collective efficacy for individual children, it will also be possible to obtain aggregate measures of collective efficacy for the individual census tracts in which children live. For the Cohort 3 sample, children were originally in nine schools in the city, whose catchment areas covered 23 census tracts. There are, on average 26 children per census tract at the start of the study. Mean level and standard deviation of collective efficacy can be estimated for each of these census tracts. We expect a reduction in the number of census tracts with sufficient number of children necessary for obtaining an aggregate level measure of collective efficacy due to some migration out of these census tracts to others where there are few other children from this sample. This will not affect our ability to use children' individual reports of collective efficacy.

Description of coding and use of community level indicators.

Using geographic information systems software (GIS), children's addresses will be mapped to census tracts, and

community-level indicators will be merged with individual-level data using census tract as the linking variable. The surveys contain substantial variability at the census tract level; Cohorts 1 and 2 contain 1<sup>st</sup> and 2<sup>nd</sup> grade youth from 121 different neighborhoods census, while Cohort 3 contain 1<sup>st</sup> grade youth from 23 census tracts. Basic demographic information that is available for the analyses and that is relevant to social, economic, and demographic neighborhood dimensions (Duncan & Aber, 1997) includes:

% family households with children headed by females	% families with income < \$15,000
% black	% families with income >= \$50,000
% white	% children < 18 who are poor
% Hispanic	% housing units that are owner occupied
% foreign born	% housing units vacant
% population unemployed	% individuals 25+ with college degree or more
% females > 16 years of age in labor force	% individuals 25+ with no high school diploma or equivalency
% males unemployed	% of population < age 18
% workers in laborer, operator, fabricator occupations	% of persons residing in the same household within the previous 5 years

We will also incorporate measures provided to us by the Baltimore City Data Collaborative including the following: Housing Code Violations; Job Starts; Liquor Licenses; Section 8 Housing.

Although it is possible to include individual indicators of community attributes in our models, there is a high likelihood of multicollinearity when multiple indicators are included in the same model. Thus, we will consider approaches that enable multiple indicators to be combined. One approach is cluster analysis, which enables us to develop typologies of communities based on dimensions of socioeconomic status, racial/ethnic composition, and administrative data indicators of health and social well-being (Aldenderfer & Balshfield, 1984). Another approach is to combine indicators using factor analysis (Sampson et al., 1997), although this approach assumes that indicators are multivariate normal in their distribution.

### **The Pathways study**

We intend to carry out an ancillary analysis of data from the Pathways Study, which focused on the Baltimore sample of children who were born 1960-1963 and who met certain criteria (n=2694) and followed them when they were in their late-20s to early-30s. This study is included in our research plan (Years 1 and 2) to fill a developmental gap left by the PRC studies, which did not assess children until they entered school. The PATHWAYS study includes extensive assessments of children from birth to age 8 years. However, no data were

collected after this age until the children were adults (ages 27-33) and, as a result, there were no prospective measures of risk factors and outcomes in the important developmental period from mid-childhood to adolescence. Although there were no direct measures of youth violence, the study does include Criminal Justice Information System (CJIS) records for criminal offences in *adulthood*. Thus, the Pathways study provides an opportunity to examine factors in early child development that predict later violent behavior. In addition, the PATHWAYS study includes geocoded data based on children's residence at each assessment.

The Pathways Study complements the Prevention Research Center samples by providing in depth information on the developmental pathway from the prenatal period through early childhood. Analytic files containing many risk and protective factors of interest have been created in carrying out studies of trajectories to other adult outcomes --- early childbearing, intergenerational poverty, and poor mental health in adulthood as well as successful transition to adulthood. CJIS files of criminal offense records will be coded into files for analysis. Once the measures of youth violence have been established, we will be able to estimate the relationship of violence with: 1) major maternal prenatal and perinatal risk factors; 2) family demographics; 3) community environment; 4) mother's interaction with the subject as a child; 5) developmental history through age eight; 6) school performance through high school; and 7) involvement in sport and church activities during adolescence.

Because the data contained in the PATHWAYS study do not allow us to explicitly address *youth violence*, we do not describe it in detail here, but it a more detailed description is included in the Appendix. Despite its limitations with respect to youth violence, the results from analyses of the PATHWAYS data could help guide future research on the relationship between early child developmental factors and violence.

### **Plan for Data Analysis:**

In the plan for data analyses, basic frequency distributions and contingency table analyses will be used as a point of departure for the more advanced analyses to estimate the strength of association between suspected predispositions and to examine possibly mediating and moderating relationships. For example, the cross-tabulation of levels of parent monitoring and occurrence of violence yields both relative risk and odds ratio estimates that serve as a point of departure for logistic regression modeling. These estimates can be reproduced exactly via a logistic regression model with parent monitoring status as the only covariate in the model.

Nearly all of the proposed analyses can be completed within the framework of logistic regression and survival analysis models. Members of the research team in prior research activities have used these models extensively (e. g., Chilcoat and Anthony, 1996, Ensminger, etc.). Further, biostatistical co-investigators on our team (Liang and Chang) have developed important extensions of these models, for example, generalized estimating equations, Liang and Zeger (1986) and survival analysis for recurrent events (Wang and Chang, 1999), which can be used to shed greater light on our understanding of factors that influence children's risk of violence. This modeling framework for dichotomous outcomes can be extended to recently developed latent variable regression models. One of our consultants (Reboussin, 1998; 1999) has developed latent class transition regression models. These models can used to estimate the degree to which specified risk/protective factors influence the progression through levels of aggressive behavior to violence.

Further extensions of these models include random effects models, including hierarchical linear models. These models are necessary for modeling of multi-level data, such as effects at the level of the individual and neighborhood in relation to violence. Other models derived from the random effects framework, as applied to latent variables, include latent growth curve and generalized growth mixture modeling (Muthen). The GGMM

approach combines growth curve and latent class modeling approaches, with particular relevance to the research proposed in this application.

The logistic regression model can be summarized in relation to the following equation:

$$\text{logit}(Y) = \alpha + \beta X$$

When these models include a single covariate (x-variable), the resulting estimate provides an ‘unadjusted’ or crude estimate of the strength of association between the covariate and the outcome of interest. Statistical adjustment for the possibly distorting influence of other variables can be accomplished by extending the unadjusted model to include terms for the other variables. These additional covariates are retained on the basis of improvements in the fit of the logistic model (e.g., as shown via goodness-of-fit tests) or on other grounds (e.g., evidence of confounding, as discussed by Breslow & Day, 1980; Hosmer & Lemeshow, 1989).

The *logistic model* provides evidence on possible moderating relationships and mediation as well. For example, consider the hypothesized relationship between early aggression and risk of engaging in violent behavior in adolescence, with an allowance that higher levels of parental supervision and monitoring might delay or prevent the onset of violence among children with higher levels of aggression even more than parental monitoring prevents violence among other youths. Extending the regression model to include either product terms or dummy coded indicators for the early aggression-monitoring interaction can test this possibility. The resulting estimates allow for tests of interaction as a departure from a simple multiplicative relationship or as a departure of a simple additive relationship (e.g., see Rothman, 1985).

*Generalized estimating equations* (GEE, Zeger and Liang, 1986; Liang and Zeger, 1986) can be used as an extension of the logistic regression model (and other forms of the generalized linear model) when observations are not independent. Thus, these models can accommodate clustering of outcomes due to repeated measures in longitudinal studies (e.g., Breslau et al., 2000), multiple reports of behavior from different informants (e.g., Chilcoat and Breslau, 1997), multiple symptoms in the same individual (e.g., Andrade et al., 1994), or multiple respondents within the same household or neighborhood (e.g., Katz et al., 1993; Petronis and Anthony, 2000; Bobashev, 1998). GEE uses a working correlation structure to account for the dependence across observations and produces two sets of standard error estimates: 1) naïve standard errors are estimated based on the assumption that the working correlation structure is correct and 2) robust estimates, which are efficient even if the working correlation is misspecified. The flexibility of these measures makes them extremely useful in the proposed research. For example, using these models it is possible to test whether involvement in drug use in a one-year interval increases the risk of violence in the following interval, controlling for early levels of aggressive behavior. Further interactions with age can be added to test whether the potential impact of drug use on violence varies as children get older. GEE enables reports of violence from various sources to be used simultaneously in models to test whether associations of risk/protective factors with violence varies according to the source of outcome data as demonstrated by Chilcoat and Breslau (1997).

*Generalized additive models* (GAM) (Hastie and Tibshirani, 1990) are non-parametric models that use a scatterplot smoother to provide a graphical depiction between an outcome and covariates. This approach minimizes the possible bias resulting from mis-specification of a parametric model using continuous covariates (for example, linear or polynomial terms). In addition, these models also maximize precision otherwise lost when ordinal or continuous variables are divided into categorical variables. This approach can shed light on relationships that might otherwise be missed using linear models (e.g.; Chilcoat and Schutz, 1996).

*Survival analysis* is a field in statistics that encompasses techniques particularly appropriate for analyzing time-to-event data. When age-at-onset is treated as the failure time variable, testing and regression analysis will be employed for analyzing the data. Testing techniques developed in this field, such as the class of weighted log-rank statistics (Kalbfleisch and Prentice, 1980) can be used to detect the difference over time between groups, which is an attractive feature not possessed by the standard chi-square test or t-test. To identify predictors for early onset of violence, the proportional hazards model (Cox, 1972) and the accelerated failure time model (Kalbfleisch and Prentice, 1980) will be useful tools for analysis. A particular advantage of the proportional hazards model is its ability to incorporate time-dependent covariates. Thus, for example, periodic drug use can be treated as a time-dependent covariate for predicting instantaneous risk of violence. These survival analysis regression models also provide for statistical adjustments (e.g., for suspected confounding variables such as sex or neighborhood characteristics), and allow testing of hypotheses about possible interactions (e.g., see Kalbfleisch & Prentice, 1980). Proportional hazards models with time-dependent covariates, using age of onset information, have been extremely useful in our prior research testing causal pathways. For example, this approach provided support for the hypothesis that post traumatic stress disorder (PTSD) increased the risk of drug use disorders, over alternative pathways (e.g., from drug use disorders to PTSD) (Chilcoat and Breslau, 1998). Survival analytic strategies can also be used to shed light on developmental processes that might otherwise be unobserved using other analytic approaches, as indicated in our prior research on parental monitoring, which showed an estimated two-year lag in initiation of subsequent drug use for youths who had been better-monitored at age 8-9 years of age (Chilcoat & Anthony, 1996).

*Analysis for recurrent event data:* Statistical methods will be employed for the analysis for recurrent event data (e.g., repeated occurrences of violence). Two kinds of models will be useful:

- I. Marginal models - Models of this kind are considered as 'population-average models' where the focused interest is to explore marginal association between risk factors and outcome. In such a model, the dependence among repeated measurements of violent events within children is not of interest and is therefore not modeled. Marginal models are generally considered as the more appropriate models, when compared with the conditional models described below, for identifying risk factors such as intervention indicators and demographic variables. Existing techniques include estimation methods for marginal survival function (Wang and Chang, 1999) and for regression analysis (Andersen and Gill, 1982; Lin et al., 2000).
- II. Conditional models - In contrast with marginal models, conditional models for recurrent event data include the event history as part of the covariates for predicting violence and it provides 'updated information' about pattern-changes of violence over the observation period. The popular proportional hazards model was first extended from single event data to recurrent event data by Prentice, Williams and Peterson (1981). The semiparametric conditional models were further explored by Chang and Wang (1999) for a broader class of models.

*Latent Class Regression and Latent Transition models.* We will consider methods for modeling transitions between empirically defined violent behavior states over time when multiple indicators of violent behavior are available. Multiple measures of behavior are common in studies that utilize questionnaires and surveys involving a series of self-report questions. While each question on its own is an imperfect measure, together the questions can describe variation in a profile of violent behaviors. Using latent transition models, we can define mutually exclusive groups of youths possibly in different stages of violent behavior based on patterns of responses to various questions. The latent transition model of Reboussin et al. (1998, 1999) will be applied as an alternative to approaches that analyze indicators separately or use summative indices. These approaches ignore both the

correlation between indicators and the possibly multidimensional structure of violent behavior. Transitions between latent violent behavior states over time will be modeled using a logistic regression model for nominal responses. A two-stage estimation procedure that is an estimating equations analogue of the pseudo-likelihood method will be applied so that the complexity of full maximum likelihood is avoided and standard error calculation is straightforward.

*Muthen's Mplus models* (Muthen and Muthen, 1998) allow for a flexible and comprehensive latent variable approach in the study of mediating relationships. The Mplus framework readily incorporates highly skewed dichotomous outcomes (e.g., the proportion of children who have started drug use by age 11), as well as manifest indicators of varying levels of measurement (nominal, ordinal, and continuous). This is an important feature of MPLUS because some of the hypothesized mediating variables are nominal and ordinal (e.g., stage of drug use), while others are more continuous (e.g., achievement scores). Some exciting new models with potential application to the study of transitions to violence are latent growth curve and general growth mixture models. Latent growth curve models allow estimation of the initial level (intercept) as well as growth (slope) in a latent construct, such as aggression, using categorical or continuous manifest indicators of that latent construct (Muthen, in press). In these models, both the intercept and slope are conceptualized as dimensional variables. However, in many applications, it might be advantageous to group individuals into different classes of growth patterns, such as persistent high levels of aggression, persistent low levels, and changing from high to low and low to high. General growth mixture models enable such classification. Further, it is possible to test associations between these classes and predictor or outcome variables.

*Hierarchical linear models* (hereafter HLMs) are a statistical technique to analyze nested data, such as multiple observations of the same children followed over time, and/or children nested within schools or neighborhoods. Across different literatures these models appear under different names, including multi-level linear models in sociology, mixed-effects and random-effects models in biometric applications, random-coefficient regression models in the econometrics literature, and covariance components models in the statistical literature. We use the term hierarchical linear models to emphasize that this proposed project uses a nested data structure to investigate links between the social environment and individual children. In brief, HLMs address methodological and statistical issues in the analysis of nested data by modeling regressions within nested groups. For example, in a sample of children nested within neighborhoods, an HLM estimates a regression equation with intercept and coefficient terms for children within each neighborhood and, in turn, also models these intercepts and coefficients across neighborhoods as dependent variables in another linear model. Thus, an HLM model might simultaneously model the influence of parenting style on children's behavior problems, and also the influence of community resources on the relationship between parenting style and children's behavior problems. HLMs improve upon traditional linear regression techniques in three ways. First, they explicitly address problems of aggregation bias, which occurs when a variable has different meanings – and possibly different effects – at different levels of analysis. For example, an individual parent's attitude toward neighborhood crime may have little effect on the neighborhood crime rate, but the aggregate of a neighborhood's attitude toward crime may significantly deter or foster criminal behavior. Second, HLMs address correlation between error terms, an issue that biases traditional OLS regression analysis of nested data. For example, children within the same neighborhood will be more similar to each other than children from different neighborhoods, and HLMs address this problem by incorporating into the model a unique random effect for each group nested within the sample. Finally, HLMs also address the issue of heterogeneity of regression, which occurs when relationships between individual characteristics and outcomes vary across nested groups such as neighborhoods and schools. HLMs take this heterogeneity into account by estimating separate coefficients within each nested group and then modeling variation in coefficients across nested groups.

*Tree-based regression* is an exploratory technique for uncovering structure in data (Clark and Pregibon, 1992). They provide an alternative to linear logistic and additive logistic models for classification problems. Using a single response variable and a set of predictor variables, decision or classification rules are determined from the data. The result is a classification "tree", which is collection of many classification rules determined by a procedure known as recursive partitioning. These prediction rules are very different from those produced in logistic regression models in which relationships are expressed as linear combinations of predictor variables. As opposed to the parametric approach used in logistic regression, these models are non-parametric. In logistic regressions, interactions are allowed only if they are prespecified in the analysis whereas in tree-based models combinations of predictors make up the decision rules. In the case of violent behavior, tree-based models can be used to classify children as violent or non-violent based on their early behavior problems and later violence status. The classification rules generated by these models can be applied to other datasets to classify children. The predicted and actual violence statuses can be compared, generating estimates of sensitivity and specificity of these rules, as well as the positive and negative predictive values.

### **Using data from multiple sources**

There are three primary sources of data that will serve as indicators of a youth's involvement in violent behavior. The first is self-report of violent behavior reported by children in the longitudinal assessments. The other two sources are official records of school removal obtained through Baltimore City schools and juvenile arrest records obtained through the Maryland Department of Juvenile Services. As discussed by Loeber et al. (1998), each of these data sources has its own advantages and disadvantages. Official records of violence are less likely to be affected by response bias than are self-reports. However, official records will only capture a fraction of the overall number of violent acts committed in a sample of children. Some children might be more likely than others to be arrested for violent offenses or to be suspended for a given school violation. To the extent that differential arrest or suspension is linked to specific risk or protective factors under consideration, there is potential for bias in estimates of associations between these risk factors and violence, as measured by official records. A major advantage of self-reports of violence is that the child is the only informant or data source with complete knowledge of the child's behavior. However, youth reports are subject to unreliability, as well as bias in the form of under- or over-reporting. As was the case for official records, estimates of associations with risk or protective factors will be biased if these factors are linked to under- or over-reporting.

Agreement between official records and self-reports of violence appears to be low, with a tendency for official records to under-report relative to self-reports (Huizinga, Ebsensen, et al., 1996). Nonetheless, the respective strengths of each of these sources of information about violent behavior make it essential to consider each source. Certainly, the selection of self-reports versus official records can lead to very different estimates of the prevalence of youth violence in a population. However, estimates of associations (the focus of this project) might be less dependent on the source of information about violence as an outcome. For example, Chilcoat and Breslau (1999) found that although there was only moderate agreement between diagnoses of alcohol use disorders based on two different instruments, the estimates of associations of each of these measures with risk factors and other psychiatric disorders were very similar. There has been a great deal of debate about how to combine data in analyses from multiple sources. A regression strategy using GEE, which has been applied by our research group (Chilcoat and Breslau, 1997), avoids many of the limitations of other approaches. In this approach, there is a separate record for a child's outcome based on each informant. A dummy indicator for type of informant is added as a term in the model. In this way, interactions between risk factors and informant type can be tested to see if the magnitude of the association of the risk factor with the outcome varies by type of informant.

### **Analytic plan for addressing specific aims**

For the sake of simplicity, the following analyses refer to violence as a dichotomous outcome based on a single source of information, unless otherwise noted. Analyses will be repeated using violence as an outcome based on each data source. When relevant, we will combine indicators of violence from multiple sources using the GEE strategy applied by Chilcoat and Breslau (1997). Since juvenile justice and school removal records record discrete events occurring at a specific point in time, data from these sources can be treated in a similar way in the analyses. Self-reports of violence are based on yearly interviews about violence that occurred at some time in the year prior to the interview. These yearly reports provide repeated measures of violent behavior.

Given the sex differences in youth violence, each of the following analyses will be stratified by sex. If associations of risk and protective with violence appear similar for boys and girls, then we will consider combining both sexes, and include a term to control for sex in our models. Also intervention status will be controlled in analyses for risk and protective factors, and community context.

**Specific Aim 1:** To identify patterns of behavior and characteristics in childhood that signal high risk of violent behavior in adolescence.

- a. ***To test the degree to which early onset and persistence of aggressive behavior in childhood signal increased risk of later violent behavior.*** Separate contingency tables will test whether high levels of aggression (e.g., quartiles) in first grade based on the TOCA, as well as in later grades, signal increased risk of violent behavior, as measured by a single indicator, such as self-report. This analysis will be extended using the logistic regression model to estimate the odds of violent behavior in each quartile of aggressive behavior relative to the lowest quartile, controlling for suspected confounders. GAM will test whether there is a linear vs. non-linear relationship between aggression, as a continuous measure (TOCA scale score) and violence. The effect of early aggression on age of onset and recurrence of violent events can be modeled simultaneously using survival analysis for recurrent events. In another stage of modeling, General Growth mixture models will be used to 1) ascertain different classes of "growth" in aggression and 2) estimate the association between each of these classes and later violence.
- b. ***Using reports from different informants (teacher, parent, child), to test whether children who exhibit high levels of externalizing problems in different settings (school, home, peers) in childhood are at increased risk for later violent behavior. In addition, this aim will test whether externalizing problems that occur in different settings signal different levels of risk.*** In our prior work, we found that children with high levels of delinquency and aggression in first grade, according to both teachers and mothers, were at very high risk of drug use, whereas those with high aggression/delinquency according to only one informant had no increase in risk relative to those with low levels as reported by mothers and teachers (Chilcoat and Breslau, 2000). We will carry out parallel analyses, first conducting separate analyses to estimate the association of teachers', and then mothers', reports of aggression with violence, using contingency tables, logistic regression, and GAM. We will then stratify children into 4 groups based on teachers' and mothers' reports on the TOCA and POCA, respectively (highest quartile of aggression is the cut-off): low/low, low/high, high/low, and high/high. We will estimate the association with violent behavior, using contingency tables and logistic regression. Kaplan-Meier curves will provide a graphical depiction of the relationship of aggression by informant with age of onset of violence. Survival analysis for recurrent events will test the relationships of aggression group with onset and recurrence of violent behavior.
- c. ***To test whether presence of other childhood behavior problems or psychiatric symptoms, such as anxiety, depression, or ADHD, signal increased risk of violent behavior. Further, we will test whether these problems act independently or synergistically with early externalizing problems, or whether they***

*attenuate any risk due to high levels of externalizing problems.* We will estimate the association of ADHD, as measured by the DISC (Cohort 3), with violent behavior using contingency tables, logistic regression, and survival analysis. Terms for early aggression will be added to these models to determine whether ADHD signals increased risk of violence, independent of aggression. Finally, interaction terms for ADHD x Aggression will be added to test whether these behavior problems might act synergistically to increase children's risk of violence.

- d. *To test the whether specific patterns of illicit drug use (including age of onset and escalation of use) increase the risk of violent behavior, holding constant early levels of aggressive behavior.* Analyses parallel to those for ADHD (described above) will be carried out initially using any drug use in the lifetime (tobacco, alcohol without parents' permission, inhalants, marijuana, cocaine) as a predictor. Because drug use can vary over time, we will also use two statistical approaches that accommodate the time-varying nature of this variable. Using age of onset (and recurrence) of violence as an outcome, we will use Cox proportional hazards models, with drug use as a time-dependent covariate. Models will be constructed in which drug use is a dichotomous variable that "switches on" at the age of first use. In this way, a child's drug use contributes to the risk of violence only for the time during which he was a drug user. Time-dependent covariates for varying levels of drug use will be used in additional models. Another strategy is to use GEE to estimate marginal associations of children's yearly reports of drug use with concurrent or subsequent self-reports of violent behavior. In these models, children's reports for each year of follow-up form separate records, which are combined in a single model. An overall estimate of the association between drug use and violence can be estimated. Indicators of time can be added to the model and interactions between time and drug use can test whether the relationship between drug use and violence varies over time. Because drug use is linked strongly with early aggression (refs), it will be necessary to add to the preceding models terms for early aggression, as well as interactions with drug use.
- e. *To develop prediction models of violent behavior, based on children's early behavior problems and to test the sensitivity and specificity of predictions based on these models.* Tree-based regression models will be used to predict risk of violence based on combinations of individual level characteristics identified as predictors of violence in the analyses described above. Children will be assigned to a "violent" or "not violent" group based on these models. Concordance between predicted and actual violence categories will be assessed, producing estimates of sensitivity, specificity, positive predictive value, and negative predictive value.

**Specific Aim 2.1:** To test whether specific factors in the social environment alter children's trajectories toward violent behavior.

- a. *To estimate the degree to which specific factors in the child's social environment signal increased (or decreased) risk of violence.* In this aim we will estimate the relationship of suspected risk and protect factors in family, school, and peer domains with violent behavior. Using parent monitoring as an example, we will use the following analytic plan. Following the strategy described above, we will use contingency tables, logistic regression, and GAM, as well as survival analysis for age of onset and recurrence to estimate the relative risk of violence by level of parent monitoring.
- b. *To test whether impact of risk or protective factors on violent behavior might vary by developmental stage.* For example, we plan to test whether impact of parent monitoring on violence changes over time. Using logistic regression or survival analysis, we will test whether a decrease in parent monitoring signals a subsequent increase in risk of violence. Additionally, using GEE models with interaction terms for time, we can test whether the magnitude of the association of parent monitoring with violence varies over time. Results from these models could provide clues about the timing of interventions that would target parent monitoring.

- c. **To identify factors in the social environment that have a protective effect in the presence of risk.** We plan to test whether factors such as parent monitoring can have a protective impact on violence among children at high risk due to the presence of early behavior problems. We will stratify children by level of early aggression (and other factors identified in Aim 1) and estimate the association between suspected protective factors and violence using contingency tables, logistic regression and survival analyses.

**Specific Aim 2.2:** To test the impact of existing interventions on aggressive and violent behaviors.

- a. **To test whether the impact of interventions targeting aggressive and violent behaviors varies in relation to specific individual-level characteristics.** A series of logistic regression and survival models will 1) test the relationship of intervention status to later violence; 2) add main effects terms for early aggression status; and 3) add interactions terms for aggression x intervention status.
- b. **To test whether the impact of interventions varies in relation to factors in the child's social environment.** Interaction terms for factors in the child's social environment, such as parent monitoring and deviant peer affiliation, will be added to logistic and survival models with terms for intervention status

**Specific Aim 3:** To estimate the association of youth violence with a variety of characteristics of Baltimore neighborhoods

- a. **To test whether increasing level of neighborhood disadvantage signals increased risk of violent behavior.** To account for the clustered sampling design (i.e. kids within communities), we will employ a mixed effects model in which covariates are included as fixed effects and the intercept for each community is modeled as a random effect (Bryk & Raudenbush 1992; Singer 1998). The two-level model will take the following basic form:

$$\text{Logit}(Y_{ij}) = \pi_{00} + \beta_{pj}X_{ij} + r_{ij} + u_{0j}$$

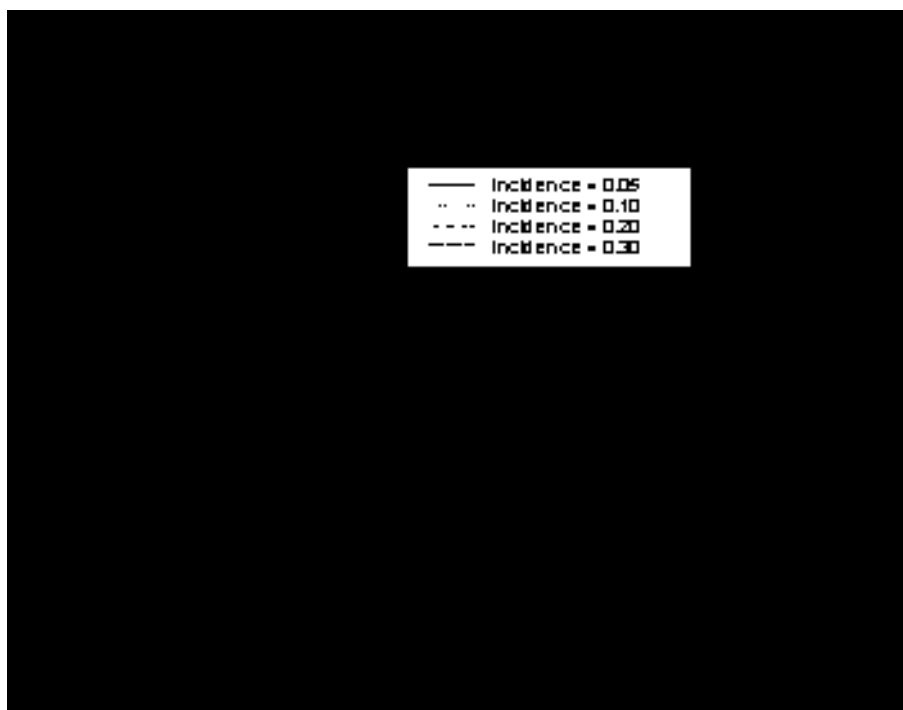
where  $Y_{ij}$  is a dichotomous indicator for violence for subject "i" in community "j";  $\pi_{00}$  is the log odds of violence across the population of communities;  $\beta_{pj}X_{ij}$  are the coefficients and covariates for main and interaction effects;  $r_{ij}$  is the deviation of subject "ij"'s violence score from the community mean; and  $u_{0j}$  is the unique deviation from the intercept associated with community "j." Terms for neighborhood disadvantage based on the aggregate level data can be added as covariates to test its association with violence.

- b. **To test whether indicators of social capital might account for any observed relationships of neighborhood disadvantage with violence.** Terms for social capital will be added to the previous model to see if coefficients for neighborhood disadvantage are reduced in magnitude.
- c. **To test whether the direction and magnitude of between risk or protective factors and youth violence vary by level of neighborhood disadvantage.** First, main effect terms for risk and protective factors will be added to the model specified in Aim 3a. Then interactions between risk factors and indicators of neighborhood disadvantage will be added.
- d. **To test whether the impact of interventions on youth violence varies by level of neighborhood disadvantage.** Main effect terms for intervention status and interaction terms with neighborhood disadvantage will be added sequentially to test whether the magnitude of intervention effects varies across levels of disadvantage.

In addition to being guided by the Specific Aims for our analyses, we will also seek input from our Community Advisory and Youth Advisory Boards about factors that would be of interest to them. In this way we can carry out analyses directly relevant to the community, in addition to analyses necessary for research to be submitted to peer-reviewed publications. Members of our research team will meet regularly with these Boards to disseminate findings and solicit input.

## Sample Size and Power

Figure 2 depicts the estimated sample size necessary to detect a specified relative odds for varying estimates of violence incidence in a "non-exposed" or reference group. Even for relatively low incidence of violence (.05), the sample size will be adequate to detect moderate to large effects ( $OR > 2$ ).



## Potential Limitations and Offsetting strengths

A major strength of the proposed research is the availability of longitudinal data from multiple samples, which include a rich array of measures from multiple domains (individual, family, peer, school, community) spanning children's development from birth to early adulthood. These longitudinal data measured at multiple time points provide multiple advantages. They provide information about the temporal sequencing of predictors and outcomes, a necessary, but not sufficient, condition for causality (Rothman, 1998). Separation of responses over time diminishes the potential for bias due to patterns of responding within the same interview (Chilcoat et al., 1995). Longitudinal data also provide information on how changes in risk and protective factors over time might influence violent behavior.

The measures used in these studies include state-of-the-art standardized instruments that assess children's behavior and important factors in their social environments, as well as extensive indicators of community characteristics. However, it is very possible that key factors were not included among the measures available in these studies. For example, we did not consider the role of genetic factors and neurotransmitter systems in the

pathway to violence, as well as factors such as child abuse, which have been linked to violent behavior (Volavka, 1999; Oliver, 1993). Nonetheless, the broad array of measures available in these studies provides ample opportunity to identify *malleable targets for intervention* and to identify *children at high risk* for youth violence.

A potential concern in the proposed research is missing data. This can occur due to loss of follow-up, or because of missing assessments for children who remain in the study. In the PRC Cohort 1&2 sample, children were assessed only if they remained enrolled in Baltimore City Public schools. Children who moved out of the BCPS school districts were not followed up. As a result, dropout in this was not random and there was differential retention for African-American versus white children. It might be necessary to use techniques that deal with data missing at random (Rubin, 1976), as well as non-random missing data (Brown, 1990; Brown & Zhu, 1994). We will also employ a multiple imputation approach for survival analysis to account for missing data due to children who miss one or multiple assessments but return to the study for later assessments (Bacik et al., 1998).

A unique advantage of carrying out the proposed analyses in the context of the Youth Violence Prevention Center is that it provides a vehicle for informing providers of prevention and intervention services within Baltimore about recent research developments relevant to their work. In addition, this collaborative relationship provides an opportunity for Center researchers to seek guidance from the community in the search for relevant risk and protective factors. Another advantage of these samples of Baltimore youth is that the samples are well-defined geographically, with extensive measures of community-level indicators available. A potential limitation of the proposed research is the generalizability of the results beyond these samples of urban youth growing up in Baltimore. Nonetheless, although Baltimore is distinct in many ways, it shares many similarities with other major urban centers with high rates of violence. We also plan to collaborate with researchers from other CDC Youth Violence Prevention Centers to compare findings.

## **E. HUMAN SUBJECTS**

1) Source of Study Population and characteristics. This study proposes to analyze existing data with the exception of future waves of data for the PRC Cohort 3 sample, which will be collected as part of NIMH and NIDA sponsored studies on which Dr. Ialongo is PI. The subject populations for each sample consist of children growing up in Baltimore. The PRC samples were participants in NIMH sponsored prevention trials starting when the children were in first grade (ages 5 to 6 years) with follow-up through adolescence. The PATHWAYS study followed children from birth to adulthood. There were 1196 children in Cohort 1; 1115 in Cohort 2; 678 in Cohort 3; and 2694 children in the PATHWAYS study. Each of the samples is primarily African-American (PRC Cohort 1: 66%; Cohort 2: 65%; Cohort 3: 87%; PATHWAYS: 77%). Other minorities were minimally represented, as their proportion in Baltimore City is small. There was equal representation of boys and girls.

2) Source of Research Material. This study will use existing data from 3 samples of children. Data were obtained through self-report questionnaires, interviews with teachers, peers, and parents, school records, juvenile justice and Criminal Justice Information System (CJIS) records. All data have been collected previously, with the exception of future assessments of Cohort 3. All existing data was collected with Committee on Human Research approval with consent forms signed by parents and assent forms signed by children. Juvenile justice records will be collected for this cohort in year 3 of the proposed project, when the children are 15-16 years old.

3) Recruitment. No additional subjects will be recruited for this study. Parent consent forms for future assessments of the Cohort 3 sample will be amended to include permission to access the child's juvenile justice records. Originals of the written consent forms will be stored in locked file cabinets in the Prevention Research Center.

4) Potential Risks. These potential risks to participants will be minimal. Given the sensitive nature of the data, possible loss of confidentiality of the data is a concern.

5) Protection of Subjects. All data files used by Center researchers will contain no identifying information, with the exception of a subject ID number necessary for merging files. Juvenile justice records will contain identifying information and will be stored in locked file cabinets at the Baltimore Prevention Research Center. Information from these hard copy records will be coded to computer files and stored using no identifying information with the exception of the subject ID number.

6) Potential Benefits. There are no direct benefits to the study participants. However, the data used in the analyses should enhance our understanding of the etiology of youth violence. This information could lead to the development of effective intervention strategies for reducing youth violence.

## **F. VERTEBRATE ANIMALS. Not Applicable**

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**H. CONSORTIUM/CONTRACTUAL AGREEMENTS.** None.

## **I. CONSULTANTS**

Beth A. Reboussin, Ph.D. will provide consultation on the use of latent transition models.

Beth E. Vanfossen, Ph.D. will provide consultation on analyses of the relationship of community context to youth violence.