A COMPREHENSIVE INVESTIGATION OF THE ROLE OF THE INDIVIDUALS, THE IMMEDIATE SOCIAL ENVIRONMENT, AND NEIGHBORHOODS IN TRAJECTORIES OF ADOLESCENT ANTISOCIAL BEHAVIOR

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FINAL TECHNICAL REPORT

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ABSTRACT

The overall goal of this study was to acquire a greater understanding of the development of adolescent antisocial behavior using data from the Project on Human Development in Chicago Neighborhoods (PHDCN). Two objectives fell under this general goal: (1) *Describe trajectories of substance use and delinquency across the adolescent period* and (2) *Assess important individual and social influences available in the PHDCN in terms of impact on the initial level and continuance of antisocial behavior*. Longitudinal cohort data from the Project on Human Development in Chicago Neighborhoods (PHDCN) were analyzed to assess patterns of substance use and delinquency across three waves for three age cohorts (n=752 [Cohort 9]; 752 [Cohort 12]; 626 [Cohort 15]) and 78 neighborhoods. This analysis of existing PHDCN data used multiple cohort and multilevel latent growth models as well as several ancillary approaches to answer questions pertinent to the development of adolescent antisocial behavior. The first question was: (1) *How are trajectories of substance use and delinquency across adolescence best described?* This involved (a) an assessment of sample-average initial levels (Intercept) and trends (Slope) and their variance estimates; (b) plotting observed and expected trends across ages 9 to 19; and (c) testing group (cohort) differences in latent growth factors (Intercept, Slope). The second question was (2) *To what extent do key individual and social influence measures available in PHDCN (e.g., self control, family influence, peer influence) impact the initial level of substance use/delinquency?* This entails (a) testing the effects of individual, family, and peer covariates on the intercept; (b) assessing relevant interaction effects for individual and family/peers; and (c) examining cohort differences in covariate effects. Third, (3) *To what extent do key individual and social influences impact the progression (slope) of substance use/delinquency over time?* The same process as in question two was undertaken, but the focus was on the slope rather than the intercept. This shifts the emphasis to the enduring impact of

these risk or protective factors. A "launch" perspective was used to frame the analysis around the second and third questions (see Hussong et al., 2008). Fourth, and finally, the analysis considered (4) *Do youth trajectories of substance use and delinquency vary across neighborhoods?* The process for answering this question is: (a) assess neighborhood cluster-level variance components for the Intercept and Slope; (b) assess neighborhood cluster-level variance components for covariate effects (i.e., neighborhood influences) where relevant and; (c) assess neighborhood influences on covariate effects (i.e., cross-level interactions) when variation was identified at the previous stage.

This set of general research questions provided several opportunities to describe trajectories of adolescent antisocial behavior and assess potential conditioning factors, which were among the initial goals of the PHDCN study (Earls & Reiss, 1994). Longitudinal patterns in substance use and delinquency mostly fit with broader population-level trends. Cohort differences in initial level and longitudinal trend as well as relationships with covariates were identified. Individual self control and exposure to antisocial peers tended to be the most robust predictors of values of the growth curve factors. Results from multilevel models find some neighborhood-level variation around the estimated growth factors. Despite some data and analytic limitations, the study found significant variation in several six-year developmental trajectories in antisocial behavior across PHDCN youth and neighborhoods. Some of the plausible individual and social influences captured at the initial stage of PHDCN measurement and neighborhood of residence were helpful in explaining this variation in these developmental trends. These findings offered some useful insights for understanding the processes that may give rise to trends in antisocial behavior in adolescence while simultaneously identifying some points for prevention strategy.

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INTRODUCTION

Adolescent risk behavior is an important public health concern as it possesses the possibility of severe consequences for the youth involved and society more broadly (Albert & Steinberg, 2011; Cohen & Piquero, 2009). While there have been some positive reports on trends in these behaviors in recent years, the data continue to be disquieting, overall. National trends in adolescent substance use suggest some declines in recent years (Johnston et al., 2011), but still nearly 40% of 12th grade students reported using some illicit drug and, for a number of specific types, consumption increased or held steady in recent years (e.g., prescription narcotics, marijuana). Recent national estimates suggest an overall decline in officially-recorded juvenile delinquency cases from 1995 to 2007 (Knoll & Sickmund, 2010). Still, the prevalence of delinquency remains high and data show a flat trend in recent years (2000 to 2007) and juvenile court processing is up 44% over the mid-1980s. Further, Belenko and Logan (2003) found that 70% of arrested youths were drug-involved and McClelland, Teplin, and Abram (2004) indicate that two-thirds of detained juveniles tested positive for recent substance use and 90% reported lifetime use.

Formulating an appropriate response to these problem behaviors first requires an understanding of developmental patterns in substance use and delinquency (throughout adolescence). Using measures at multiple time points in a large urban sample, the current study looks at these trends descriptively and then considers possible points of influence in launching and continuing adolescent antisocial behavior. Specifically, this work draws on data from the Project on Human Development in Chicago Neighborhoods (PHDCN) study for three cohorts of youth and the families and communities where they developed. The PHDCN is a large study of youth, families, and communities in Chicago designed to collect systematic information about youth development and connect that to broader social institutions and settings (Earls & Visher,

1997). Understanding developmental patterns and possible influences on those patterns is important in developing insights around prevention strategy targeted at substance use and delinquency among adolescents.

Developmental and Public Health Perspectives on Antisocial Behavior

Although antisocial behavior has been studied from a variety of perspectives, in recent years, use of a "career" or life course framework has led to improved understanding of several important characteristics of such activity in individuals (Farrington, 2005a, 2006; Hser, Longshore, & Anglin, 2007; Hunt, 1997; Piquero, 2008; Piquero, Farrington, & Blumstein, 2003; Sullivan & Hamilton, 2007). This framework draws on the study of individuals over time, as opposed to just variables, in viewing substance use and offending (Da Agra, 2002; Magnusson & Bergman, 1988) and sets the stage for the development of intervention and treatment based on an understanding of their onset and continuance. This shift in perspectives also informs a number of studies examining delinquent/criminal behavior as it unfolds over time and winds down (Laub & Sampson, 2001, 2003; LeBlanc & Loeber, 1998; Loeber & LeBlanc, 1990; Piquero, 2008; Piquero, Farrington, & Blumstein, 2003). Recently, Hser and colleagues (2007) linked parameters, like drug cessation and criminal desistance, which can be used to frame careers in substance use in a way that is similar to the manner in which delinquent and criminal behavior has been studied in recent years.

During the same time, often in concert with a developmental, life-course approach, some began to take a public-health view of the study and prevention of substance use and delinquency, with an emphasis on primary prevention efforts (i.e., before the behavior initially occurs) and/or secondary prevention (i.e., those that identify at-risk youth and direct services to them) (Moore, 1995; Welsh, 2005). Recent research emphasizes the importance of pursuing prevention efforts

at relatively early developmental stages to stem the exorbitant costs (monetary, social) that come with long-term patterns of antisocial behavior (Cohen & Piquero, 2009). At the same time, a growing body of literature shows support for primary and secondary prevention efforts directed at individuals, families, and communities (Catalano, 2007; Farrington & Welsh, 2007). Still, effective prevention programming requires a thorough understanding of key influences on antisocial behavior at its initial point and across a developmental course (i.e., durability). According to Jenson and Fraser (2010): "understanding the developmental trajectories of children who experience social and health problems must be used to craft more effective policies and programs" (p. 6).

A great deal of work aimed understanding risk and protective factors for the development of antisocial behavior has been sponsored by the Office of Justice Programs (OJP) of the US Department of Justice. The "Causes and Correlates" program, comprised of longitudinal studies carried out in three fairly large cities in different regions of the U.S. (Denver, Pittsburgh, Rochester) (see Thornberry, Huizinga, & Loeber, 2004) and the Project on Human Development in Chicago Neighborhoods (see Liberman, 2007), for example, have both produced a great deal of basic knowledge on risk and protective factors and mechanisms underlying delinquency and substance use in adolescence and beyond. Additionally, other studies funded by the OJP, such as the evaluation of the Gang Resistance Education and Training Program (see Esbensen et al., 2011) and the Seattle Social Development Project (see Hawkins et al., 2008), blend the pursuit of generalized knowledge about youth development with evaluation of specific initiatives designed to prevent antisocial behavior in childhood or adolescence.

This emphasis on understanding and preventing long-term patterns of antisocial behavior first led to the compilation of comprehensive lists of risk factors found to increase the likelihood

of antisocial behavior and, more recently, the linking of those risk factors to processes that may give rise to patterns of antisocial behavior. While a descriptive understanding of career patterns is useful, informed intervention requires solid knowledge of the process by which these risk factors affect antisocial behavior over time (Farrington, 2005a). Developmental theorists have generally tried to draw out mechanisms and processes by which these risk factors may produce antisocial behavior in order to offer a clearer sense of how they arise and continue and, in turn, strategize about response options (Farrington, 2005a; 2006; Catalano & Hawkins, 1996). This approach, which draws on the study of individuals over time in explaining behavior, sets the stage for the development of interventions that are informed by an understanding of the onset and continuance of antisocial behavior (Loeber & Farrington, 2000).

Overview of Risk and Protective Factors for Antisocial Behavior

Individual Propensity and the Development of Antisocial Behavior

Many studies have focused on between-individual differences that may be influential in the onset and continuance of antisocial behavior. Often, these differences are described as some type of behavioral "propensity" or "potential" (Lahey & Waldman, 2005; Wikström, 2005; Farrington, 2005b). Whatever the label used, such factors are believed to vary across individuals and usually comprise aspects of a youth's personality and temperament that are expected to condition their actions in some way. These constitutional factors include self control (Gottfredson & Hirschi, 1990; Pratt & Cullen, 2000), morality (Wikström, 2005), cognitive ability (Catalano & Hawkins, 1996; Catalano et al., 2005; Lahey & Waldman, 2005) and emotionality (Lahey & Waldman, 2005).

Social Context and the Development of Antisocial Behavior

It is clear that there are individual constitutional factors that affect antisocial behavior in adolescence (Sullivan, 2006), but the social environment in which a youth interacts during key developmental stages is also important (McCord, Widom, & Crowell, 2003). Sampson and Laub (1993) note that "knowledge of [individual] childhood propensities is not a sufficient condition for explaining delinquency" (p. 94). Recent studies have begun to consider how individual propensity and proximal social influences interact to produce delinquent behavior (Ousey & Wilcox 2007; Wright et al., 1999; 2001).

The immediate social context, reflected in family and peer interactions, is prominent in theory and empirical research on adolescent antisocial behavior. In particular, families have commanded a great deal of attention in attempts to understand the development of antisocial behavior among youth (Simons, Simons, & Wallace, 2004). Loeber and Stouthamer-Loeber (1986) performed a meta-analysis of studies focusing on the role of families in juvenile delinquency and found a number of factors, such as a lack of parental supervision, inconsistent discipline, and low parent-child involvement, that are strong predictors of delinquency (see also, Ayers et al., 1999; Block, Block, & Keyes, 1988; Cantelon, 1994; Dishion, Capaldi, & Yoerger, 1999; Farrington, 1994; Farrington et al., 2001; Patterson & Yoerger, 1993; Shader, 2001). Similarly, Yoshikawa (1994) found that deficient parenting has direct effects, and family structure (e.g., number of parents in the family) has indirect effects on antisocial behavior. Alternately, Henry, Tolan, and Gorman-Smith (2001) found that youth from families marked by closeness and strong parenting generally had lower delinquency levels than those in struggling families, which were typified by lack of cohesion and weak parenting.

Certain classes of risk and protective factors are likely to take on increased salience at different stages of development (Ayers et al., 1999; Childs, Sullivan, & Gulledge, 2011; Jang, 1999). Peers, for example, become essential social influences for youth as they progress through adolescence and naturally spend more time outside the home building new relationships (Giordano, 2003; Smetana, Campione-Barr, & Metzger, 2006; Steinberg & Morris, 2001). Although there may be some question about the nature of the relationship (Haynie & Osgood, 2005; Warr, 2002), studies generally suggest that peers play a central role in the occurrence of antisocial behavior (Shader, 2001; Warr, 2002). For instance, Dishion, Capaldi, & Yoerger (1999) found that early association with deviant peers was highly predictive of substance use onset and O'Donnell, Hawkins, and Abbott (1995) reached a similar conclusion for delinquency.

In recent years, in part due to the PHDCN study, increased attention has been paid to understanding the impact of communities on youth development (Brooks-Gunn et al., 1993; Leventhal & Brooks-Gunn, 2000; Leventhal, Dupéré, & Brooks-Gunn, 2009; Sampson, 2006; Wikström & Sampson, 2003). Among other problems, children growing up in disadvantaged, socially ineffectual neighborhoods are more likely to engage in substance use and delinquency later on in adolescence (Hawkins, Catalano, & Miller, 1992; Loeber & Wikström, 1993; Wikström & Loeber, 2000). Historically, at the community-level, adolescent antisocial behavior has been studied from social (dis)organization, structural, and cultural perspectives (see review in Bursik & Grasmick, 1993). More recently, developmental researchers have suggested a general typology for community influences comprised of "institutional resources," "norms and collective efficacy," and "relationships and ties" (Leventhal, Dupéré, & Brooks-Gunn, 2009, p. 422). In particular, Sampson (2006) considers the active role that neighborhood collective efficacy may play in development and antisocial behavior in given communities. Furthermore,

Wikström and Sampson (2003) suggest that, while it is clear that communities are influential in development, there is less certainty about the mechanisms that connect them to individual behavior. Overall, communities must be considered among a constellation of factors that condition the initiation and the progression of antisocial behavior (Piquero, Farrington, & Blumstein, 2007), but, to this point, formal empirical study of the role that they may play in the development of antisocial behavior is somewhat limited.

The "Launch" Framework and Antisocial Behavior

A host of developmental perspectives can be put to use in attempting to understand the onset and continuance of antisocial behavior during adolescence and help in defining the way in which social and individual risk factors may influence those processes. The "launch" perspective is among those explanations and it may have particularly important implications in considering the period of time spanning late childhood to late adolescence. The launch model supposes an initial effect of antecedent influences that, in addition to a contemporaneous impact, carries forward to later developmental trajectories of behavior (Hussong et al., 2008; Kinderman & Skinner, 1992). Hussong and colleagues (2008) examined this perspective in the context of substance use and continuing delinquent activity in late adolescence/early adulthood. They found that substance use had a positive impact on the initial level of offending and a negative impact on the slope of that behavioral trajectory, suggesting that there were steeper declines in criminal behavior for those with higher initial levels of symptoms of alcohol and marijuana abuse, although those individuals still generally had higher levels of offending during the observation period than others in the sample. Assessment of this explanatory developmental model at earlier developmental periods is important as it could offer insight into whether there are behaviors that "are open to influence from the environment at one point in time and

subsequently become 'sealed off'" (Kinderman & Skinner, 1992: 166-167) or whether later behavioral trends are relatively malleable and not overly affected by possible launching influences that occur earlier in time.

Study Rationale and Research Questions

Previous applications of the developmental, life-course perspective to substance use and delinquency and research on risk factors offer much insight. Overall, the review above suggests that the development and continuance of antisocial behavior in adolescence may arise from factors emanating from youth, the immediate social environment, and communities. Still, relatively few studies have fully considered how the individual, the immediate social environment, and the community simultaneously affect developmental trends in antisocial behavior. So, while the need for holistic, multisystem intervention is acknowledged and promoted (Henggeler, 1997; Loeber & Farrington, 2000) the process by which antisocial behavior emerges and continues has not been assessed in a way that captures multiple domains (Rutter, 1994).

This study assesses the effects of these key influences as they condition the initial observed level of antisocial behavior (i.e., simultaneous effect) and the potential "launch" of the trajectory (i.e., enduring effect) (Hussong et al., 2008). This is important in understanding the mechanisms by which "risk" leads to antisocial behavior immediately and also its enduring impact across adolescence. The analyses used multiple cohort and multilevel latent growth models as well as several ancillary approaches to answer questions pertinent to the development of adolescent antisocial behavior. The first question was: (1) *How are trajectories of substance use and delinquency across adolescence best described?* This involved (a) an assessment of sample-average initial levels (Intercept) and trends (Slope) and their variance estimates; (b)

plotting observed and expected trends across ages 9 to 19; and (c) testing group (cohort) differences in latent growth factors (Intercept, Slope). Second, (2) *To what extent do key individual and social influences available in the PHDCN data impact the initial level of substance use/delinquency?* This entails (a) testing the effects of individual, family, and peer covariates on the intercept; (b) assessing relevant interaction effects for individual and family/peers; and (c) examining cohort differences in covariate effects. Third, the study considered (3) *To what extent do key influences impact the progression (slope) of substance use/delinquency?* The same process as in question three was taken, but the focus was on the slope rather than the intercept. This shifts the emphasis to the enduring impact of these risk and protective factors. Fourth, and finally, the analysis considers (4) *Do youth trajectories of substance use and delinquency vary across neighborhoods?* The process for answering this question is: (a) assess neighborhood cluster-level variance components for the Intercept and Slope; (b) assess neighborhood cluster-level variance components for covariate effects where relevant (i.e., neighborhood influences); and (c) assess neighborhood influences on covariate effects (i.e., cross-level interactions) when variation was identified at the previous stage.

This set of general research questions provides several opportunities to describe trajectories of adolescent antisocial behavior and assess potential conditioning factors, which were among the chief goals of the PHDCN study (Earls & Reiss, 1994). In outlining some current limitations of developmental, life-course research on offending, Farrington notes that little is known about (a) risk factors in how they condition the continuance of offending and (b) the causal processes by which risk factors impact offending (Farrington, 2005a). This study looked at each of those issues in some fashion. The modeling approach is well-suited to this task as it provides estimates of the presence, degree, and nature of change over time and whether

change/stability can be predicted by information available on PHDCN youth (Singer & Willett, 2003).

METHODS

Data and Sample

Existing data from the Project on Human Development in Chicago Neighborhoods (PHDCN) were analyzed using latent growth curve models to assess patterns of substance use and delinquency across three waves for three age cohorts (n=752 [Cohort 9]; 752 [Cohort 12]; 626 [Cohort 15]). Each of the cohorts was interviewed approximately two years apart (e.g., a Cohort 9 youth was observed at ages 9, 11, and 13) (See Table 1 for summary). Units of observation were selected based on a multi-stage design where a random sample of 343 neighborhood clusters was initially chosen. Eighty of these clusters were then selected based on a stratified sampling strategy that focused on socioeconomic and racial composition. The selection of participants for the longitudinal cohort study followed from that process. Specifically, households and individual youth were randomly chosen from within that set of neighborhoods and in-home, face-to-face standardized interviews were conducted with the youth and a primary caregiver (Earls & Visher, 1997). The interviews were comprised in part of standardized assessments of aspects of youth behavior, routines, and their social environment. Seventy-five percent of those in Cohort 9, 74% in Cohort 12, and 72% in Cohort 15 who were invited to participate in the longitudinal cohort study actually did so (Molnar et al., 2008). Retention levels for the cohorts included here ranged from 83 to 86% at Wave 2 and 71 to 78% at Wave 3.

The analysis was expanded to the neighborhood level (N=78) through use of data from a community survey. Approximately 8700 Chicago residents (25 to 50 per neighborhood) were

surveyed regarding their perception of their neighborhood; the response rate was 78% within the neighborhood clusters used in the current study (Earls & Visher, 1997; Liberman, 2007). On average, there were approximately 30 youth in each neighborhood cluster, which meets with typical standards for statistical power in multilevel modeling (e.g., Hox, 2002). At the same time, while the power benchmarks were met in the aggregate, there were a number of neighborhood units that had fewer than 30 youth (e.g., about 10% had ten or fewer youth and approximately 24% had twenty or fewer youth) and this number is lower in analyses that disaggregate by cohort group.

Study Measures

The PHDCN measures used in this study focused on two major aspects of adolescent antisocial behavior (Substance Use, Delinquency) and a number of domains that have been utilized in explaining them. These outcome variables were measured across three waves for Cohorts 9, 12, and 15. In general, all covariates were measured at Wave 1.

Outcome Measures

Self-reported substance use and delinquency were measured at three waves for each cohort. Both sets of items refer to the frequency of behavior in the last year. In order to ensure similar coverage, only those substance use and delinquency items measured at all three waves across Cohorts 9, 12, and 15 were used in the analyses presented here. Substance use items tap into the use of alcohol, marijuana, cocaine, inhalants, and other illicit drugs (National Institute on Drug Abuse, 1991). The substance use measure comprises the number of self-reports of use for the previous year for alcohol, cocaine, marijuana, and other illicit drugs (e.g., psychadelics, heroin, amphetamines). This is a single summed measure for the four forms of use mentioned here. Maximum likelihood factor analysis found that a single factor was acceptable for each

wave with loadings generally between .30 and .90 for the four items and variance explained values around 50%. Cronbach alpha values ranged from .58 to .61 for the summed substance use scores. A Zero Inflated Poisson distribution was used in the latent growth curve models due to the fact that these measures capture the number of times substances were used and thus have a high concentration of zero values (47 to 82%) (Lambert, 1992).

Self-reported delinquency was measured across three different dimensions: violent offenses (e.g., carried a hidden weapon, arson, stole purse/pickpocket, attack with weapon, used weapon to get money/things), property offenses (damage property, broke into building, stole from home, stole from store, took from car, bought/sold stolen goods); and public order/status offenses (e.g., skipped school, cause trouble in public place, drove without license) (Huizinga, Esbensen, & Weihar, 1991). The specific items were chosen to fit with previous work on self-reported offending using PHDCN data. As in prior studies (see Kirk, 2006, Raudenbush, Johnson, & Sampson, 2003), Item Response Theory (IRT), Rasch modeling procedures were used to develop the measures in the three areas described above (see Andrich, 1988; Bond & Fox, 2001).

The IRT analysis was conducted in MPlus 6.0 following procedures used previously with PHDCN delinquency data outlined in Kirk (2006) and Raudenbush and colleagues (2003). Specifically, like Raudenbush et al. (2003) the different offense types (e.g., violence, property offending) were disaggregated and incorporated into those models as separate entities and as in Kirk (2006) these scores were estimated and then used in further analysis. The Rasch model draws on the analysis of a series of yes/no items to develop a latent score of "severity" of delinquent behavior. The expectation of the model is that a "yes" response to a given delinquency item will vary with the severity of that particular item as well as the individual's

delinquent propensity (i.e., general likelihood of responding affirmatively) (Raudenbush et al., 2003). The scores are additive in nature so that higher values reflect greater individual propensity and "yes" responses to more severe items. As noted above, this approach has been found to be superior to other means of developing delinquency scales (Osgood, McMorris, & Potenza, 2002) and has been used previously with the PHDCN delinquency measures. Still, in order to further assess these IRT scores, they were analyzed for their association with the raw delinquency scores and had moderate positive correlation values (Pearson's r=0.27 to 0.42). Additionally, the longitudinal trends observed later in this report were similar to those identified using an additive summary measure of the frequency of delinquency.

These measures were then treated as continuous, but censored in latent growth models due to the prevalence of values at the lower end of their distributions (see Osgood, Finken, & McMorris, 2002), which were above 12% in all cases and were greater than 50% in some instances. For example, for the sample as a whole, Violent Offense IRT scores were at their lowest value (-0.47) for 65% of the sample at Wave 1. These "floor effects" were also observed at around 74 and 75% for waves 2 and 3, respectively. Property Offense IRT scores were similarly censored across the three waves (75 to 84%) and the Public Order/Status Offense IRT scores, while showing the lowest levels of censoring were still above most commonly observed cutoffs (18% to 60%). This necessitated the alternate estimation procedure in MPlus.

Individual Risk

A self control measure was developed based on the EASI temperament instrument (Buss & Plomin, 1975). Subscales tapping impulsivity ("trouble controlling impulses"), inhibitory control ("says first thing that comes into head"), sensation seeking ("seeks new, exciting experiences"), and persistence ("likes to see things through") were summed and standardized to

create a pooled measure similar to that used in previous analysis of PHDCN data (see Gibson et al., 2010; Zimmerman & Messner, 2011). The Cronbach alpha for this measure was 0.65 in the current study. Higher values on this measure are indicative of lower self control. Measures from the Child Behavior Checklist were used to capture individual externalizing problems in order to assess their correlation with the self control measure derived from EASI (Achenbach, 1991). There were modest positive correlations between the self control measure from EASI and the externalizing score of the CBCL (0.11, $p<.05$). EASI and CBCL rely on parental reports, but the latter is more expansive in tapping relevant aspects of the youth's personality and temperament.

Family/Parental Influences

A series of measures that tap into the youth's family environment and parental management processes are included in the analysis. The items are drawn from the Home Observation for Measurement of the Environment (HOME) Inventory (Caldwell & Bradley, 1984; Leventhal et al., 2004). This instrument is designed to assess the family environment as it contributes to youth development (e.g., provision of prosocial opportunities, parental supervision). *Parental warmth* is measured using nine items derived from interviewer's observations of parents during the in-home interviews of primary caregivers and children at wave one (e.g., "parent encourages child to contribute", "parent mentions skill of child"). Parental lack of hostility consists of several observational items that researchers recorded during the in-home interviews with children/adolescents and primary caregivers. For example, "parent does not shout at child during visit" or "parent does not express annoyance with child" were among the observational items that the interviewer was asked to consider. All items were coded "0" (no) or "1" (yes) and individual responses were summed to create overall scores for both the

parental warmth and parental lack of hostility measures. Higher scores reflect more parental warmth and less hostility. Both of these scales exhibits good reliability (α=.75 to .89), first factor explained variance (34% to 75%), and individual factor loadings (.39 to .87). There was relatively little variation in these results across the three cohorts. Finally, parental monitoring and supervision is a 13-item scale where primary caregivers self reported on how they directly and indirectly monitor their children. This included items like "subject has a set time (curfew) to be home on weekend nights," and "establishes rules for behavior with peers and asks questions to determine whether they are being followed." Higher scores on this scale indicate more supervision (α = .43 to .57). Variance explained for the first extracted component (~13 to 17%) and factor loading values (.08 to .72) are fairly low for this measure across the three cohort groups.

Social Support

The Provision of Social Relationships (PSR) instrument asks questions about the degree to which the youth feels respected and has people (family, friends) whom they can count on if necessary (Turner, Frankel, & Levin, 1983). This perceived social support is potentially important in understanding delinquent and criminal behavior (Cullen, 1994) and has been used to that end in previous PHDCN studies (Molnar et al., 2008). The three subscales of social support from family members, peers, and others (teachers, coaches) each load highly on a single factor that explains 52% of the shared variance among the measures. The factor loadings ranged from .44 to .69 and the Cronbach's alpha value was roughly .50. Items relevant to family members included questions of whether the youth feels that his/her family "has confidence in them" or "helps them find solutions to problems." They were also asked about their peer relationships in this regard, such as whether their friends would take time to talk to them about a problem or they

have a friend that they could "tell anything to." The "other social support" questions asked whether they had nonfamily members that they could go to for help if needed (e.g., coach, teacher).

Antisocial Peers

Peer influence measures were drawn from a set of 15 items that ask about the degree to which a youth's "friends or people [they] spend time with "engage in delinquent activities and substance use, (e.g., "number who purposely damaged property," "number who attacked someone with weapon") (Huizinga et al., 1991). All items use the previous year as a reference period. The counts were summed and then averaged for each individual. Factor analysis indicated that a single factor explained about 35% of the variance in the underlying covariance with individual item loadings ranging from .42 to .69. The Cronbach's alpha was .86. The results were similar across all three cohort groups.

Sociodemographics

In addition to conditioning on study cohort (9, 12, and 15) three key control variables are utilized in the multivariate models. Gender was coded "0" for male and "1" for female. For the current analysis, race was coded "1" for white and "0" for nonwhite. The expanded racial distribution of the sample was as follows: 14.2% white, 35.9% Black, 45.9% Hispanic, and 3.9% other race. Socioeconomic status was constructed by PHDCN investigators and consisted of the principal component of parental caregiver's (a) maximum education level (less than high school to bachelor's degree or more), (b) salary (<$5,000 to >$50,000), and the maximum Socioeconomic Index (SEI) occupational prestige of the parental caregiver and partner's job.

Neighborhood Influence

To be consistent with previous work with PHDCN data (e.g., Sampson, Raudenbush, & Earls, 1997), the main measure used at the community level is collective efficacy. Specifically, social cohesion (e.g., "this is a close-knit neighborhood", "people around here are willing to help their neighbors") and neighborhood social control ("neighborhood residents would organize to keep closest fire station open if it were to be closed down by city for budget cuts", "neighbors would break up a fight in front of your house") were combined to create a measure of collective efficacy as in Sampson et al. (1997). Additionally, two other neighborhood-level composite measures were explored to assess their potential effects on the antisocial behavior growth factors. These were social capital (e.g., "there are adults in this neighborhood kids can look up to", "parents in the neighborhood generally know each other") and social disorder (e.g., "how much of a problem is drinking in public", "how much of a problem is groups of teenagers hanging out and causing trouble").

Data Structure and Analytic Process

The basic analytic approach utilized initially was a latent growth curve model in a multiple cohort framework (See Figure 1 and Table 1). This approach can permit a description of these behaviors across a wider age range than would be available in any one cohort and maximizes the modeling of substance use and delinquency across the age range available in the data set while also considering potential cohort effects. Otherwise, the analyses and, by extension, their implications may be somewhat circumscribed—given the measurement windows within particular cohorts (e.g., 12 to 16 years for Cohort 12). The analytic approach attempted to preserve the advantages of PHDCN's accelerated longitudinal design by creating pooled latent variable estimates across the three cohorts then testing similarity/difference across cohorts.

Models were specified so that the time score parameterization draws only on ages for which data are available (i.e., non-equidistant intervals for some ages).

Table 1. Age by cohort data matrix in PHDCN structure.

Age/ Cohort	9	10	11	12	13	14	15	16	17	18	19
Cohort 9	**X**		**X**		**X**						
Cohort 12				**X**		**X**		**X**			
Cohort 15							**X**		**X**		**X**

Unique Considerations in Accelerated Longitudinal Designs

Accelerated cohort designs, like that used in PHDCN, can potentially offer researchers the ability to observe change or stability over an extended time window—relative to the time it takes to collect data. Bell (1954) presented this method as a means of reducing the number of repeated measurements necessary for longitudinal research through use of overlapping observations of subgroups of different-age subjects. Using height as an example, Bell demonstrated that a composite of shorter data collection intervals in a set of cohorts could approximate a longer trend from a single panel. He also offered that this might provide a means of linking up those separate cohorts so that a fuller picture of the "developmental curve" of the population could be obtained (p. 281). He found that a ten year time span could be captured in three years of data collection by selecting four cohorts (at 10, 12, 14, and 16) and measuring each of them across three overlapping waves. This positioned the accelerated approach as an alternative to cross-sectional studies without some of the inherent difficulties of an exceptionally lengthy longitudinal study, meaning that it might be particularly useful to developmental researchers in an environment with more restricted resources (Duncan, Duncan, & Strycker, 2006). Farrington's (1999) suggested research agenda for a new century argued for the need to understand antisocial behavior from a longitudinal perspective, but also noted its problems, and

positioned accelerated cohort designs as a viable alternative. This was a perceived strength of the PHDCN design in its planning stages as well (Tonry, Ohlin, & Farrington, 1991).

Miyazaki and Raudenbush (2000) note that this design structure can produce "comparably powerful data for studying development" (p. 45). Willett, Singer, and Martin (1998) suggest that this design limits the amount of time necessary for measurement over time by following multiple age cohorts for a shorter duration as opposed to following a single cohort over a lengthy period. Depending on how they are structured, they may also allow for disentangling age, period, and cohort effects that frequently arise in longitudinal research (Menard, 1996). Additionally, such an approach may be necessary when one wishes to make inferences across cohorts (Baltes, Cornelius, & Nesselroade, 1979) which is important for the overall objectives of longitudinal research.

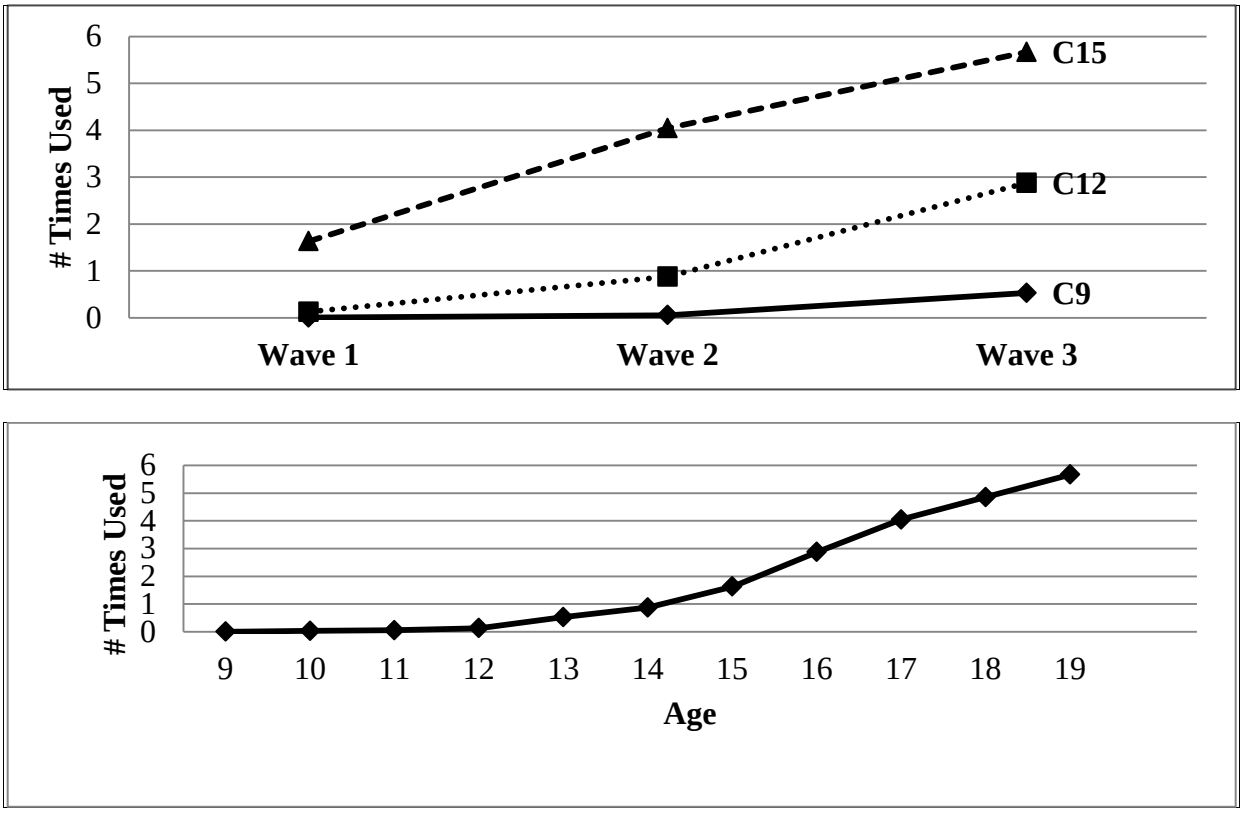
Still, fully capitalizing on these strengths requires formal testing to determine whether the different cohorts follow the same growth trend and, consequently, can be pooled. This creates challenges and requires careful consideration at the first stage of the analysis (estimation of unconditional latent growth curve models). In order to maximize the usefulness of the PHDCN data in understanding developmental trends, the original intent of the study was to describe trajectories of antisocial behavior by pooling the three late childhood/adolescent cohorts used in this study. Singer and Willett (2003) have identified two issues that must be considered in analyzing data from these studies. First, measurement occasions will vary across individuals, which require a modeling approach flexible enough to account for this pattern of observations and missingness at different time points. Additionally, the initial and latter observation points will tend to not have multiple cohort overlap and therefore will have less coverage than others. As Collins (2006) points out, the cohorts must be studied in such a way that for each of them,

there is at least one time point (e.g., age) at which one other is also included in the measurement structure (see Table 1, for example). Problems emerge due to the fact that cohorts are of different ages at each particular historical time point and may also take on different demographic profiles, both of which offer confounds to understanding age-related trends in individual behavior. Thus, it is necessary to ensure that the groups are the same except for their age at the first wave of the study in order to pool the data in a way that allows for analysis of the extended time period (Tonry, Ohlin, & Farrington, 1991). If the average level and the slope are similar during the points at which cohorts overlap, the assumption of a similar developmental trajectory may be tenable (Raudenbush & Chan, 1992). The key substantive question is detailed in Figure 4 (with Substance Use as an example).

Initially, analysis was conducted to determine whether it was possible to integrate the cohorts so that one growth trend could be used to describe the entire population being studied. A structural equation-model based growth modeling approach for studying trajectories of problem behaviors in adolescence was used. In their 2006 study, Duncan and colleagues combined information from four cohorts to form a single growth model that spanned ages 8 to 11. Each of the cohorts has a distinct pattern of missingness across the full time period. McCardle and Hamagami (1991) indicate that, in a pooled cohort approach, there is a strong assumption that the same structural model and individual parameters fit for the separate cohorts, which assumes the same pattern of estimates for each. This assumption can be formally considered with likelihood ratio tests that compare nested models. Each test seeks to assess convergence, or the degree to which cohorts have distinct developmental trends. If the assumption holds and convergence is demonstrated, the latent growth model based on the accelerated cohort data is then used as a proxy for a trend measured in a single cohort across several years (Duncan,

Duncan, & Hops, 1996; Duncan et al., 2006). In the current study that would mean that a single model can be used with the PHDCN cohorts in order to capture change and stability from age 9 to 19.

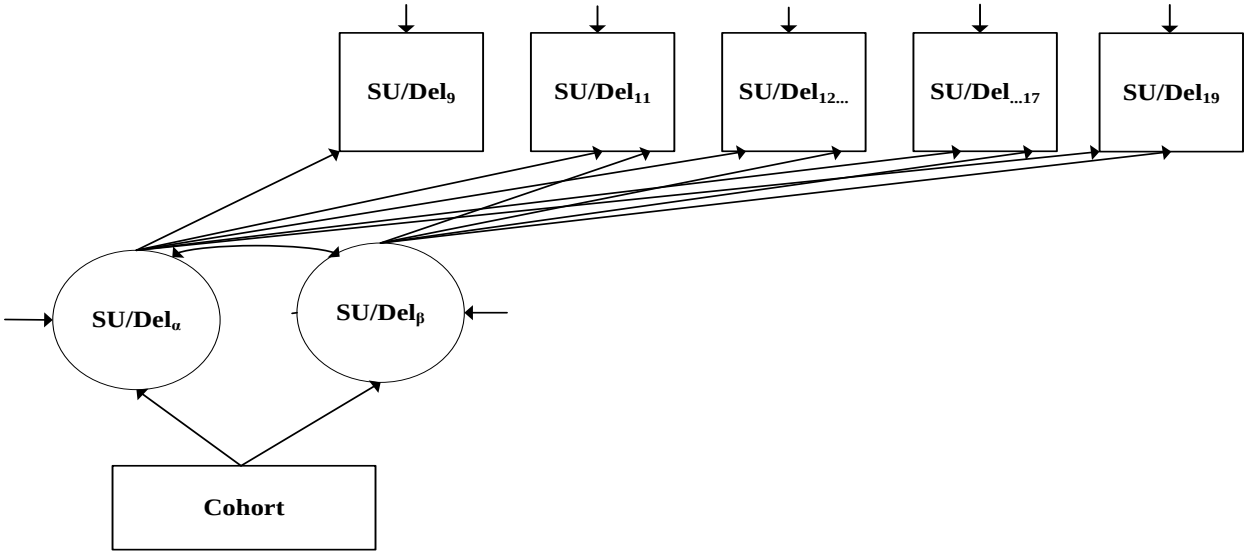
Figure 1a, b. Can cohort trends be pooled (e.g. Substance Use)?



Being mindful of the issues just described several configurations of latent growth curve models were estimated in this study. First, unconditional latent growth curve models for substance use and delinquency were estimated and tested using the multiple cohort procedure (see Figure 1). All models were run using MPlus 6.0 with Full Information Maximum Likelihood Estimation to handle missing data (Muthén & Muthén, 1998-2010; Schafer & Graham, 2002). Models were evaluated in terms of the initial level of the behavior in question (Intercept) as well as its rate of change across the age range (Slope). Five key parameters are estimated in these models: Means for the (a) Intercept and (b) Slope; their respective Variances

(c, d); and their Covariance (e), which captures the relationship between starting point and growth over time (Lawrence & Hancock, 1998; Singer & Willett, 2003). This Intercept-Slope Covariance estimate considers continuity (or discontinuity) in antisocial behavior by capturing the relationship between its initial level and pattern of endurance across adolescence. Within-sample variation in initial starting points and rates of change is expected. Additionally, in the multiple cohort models, group effects (i.e., cohort differences) on the growth factors were tested. Figure 2 depicts this process. The latent intercepts (initial level) and slopes (trend over time) are believed to be associated with the observed levels of substance use or delinquency observed across the PHDCN measurement waves. The covariance between the intercept and slope is estimated as well. The cohort variable (which is a code representing 9, 12, or 15) is also assessed for its effect on the initial level and longitudinal trend and the structure of the models is adjusted according to the results from that process.

Figure 2. Unconditional multiple cohort latent growth curve model (Research Question 1).

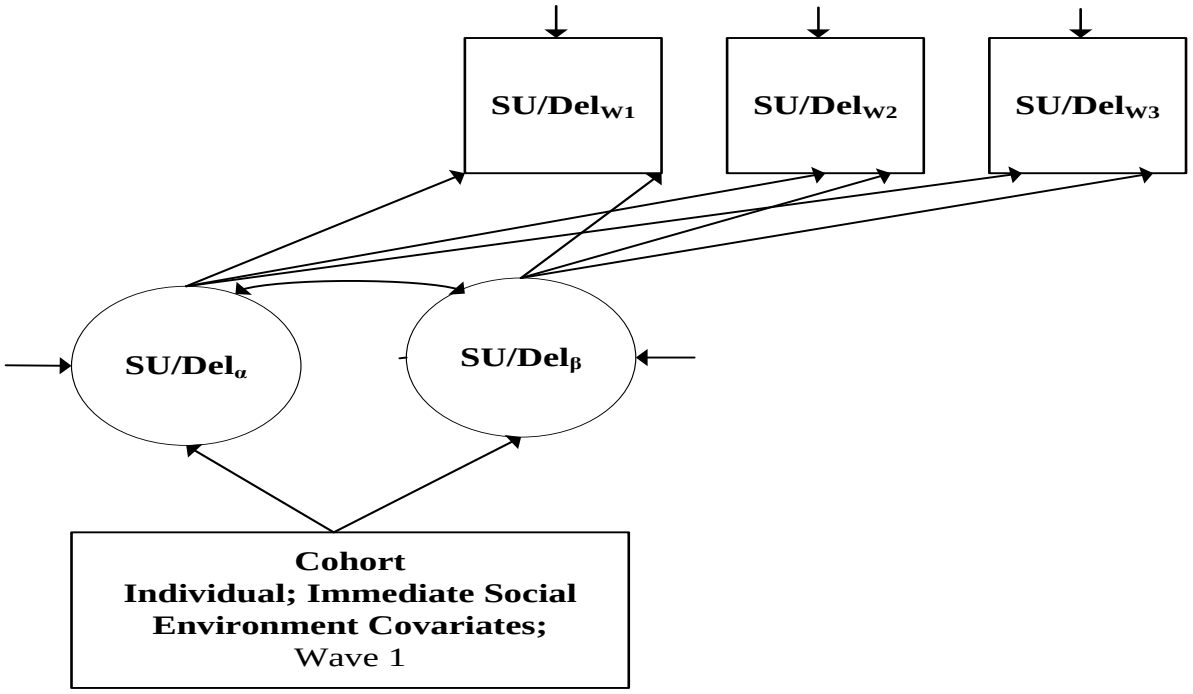


The estimation of the initial models provides a general description of trajectories of adolescent antisocial behavior in the PHDCN sample using the multiple cohort approach to offer insight using the accelerated longitudinal design. Still, they are only a baseline for understanding these behaviors and also require tests for the assumptions around pooling the cohorts. Two sets of estimates were then assessed at the next stage of the process. First, key indicators representing the domains of influence described above, measured at the initial measurement wave, were incorporated. This was undertaken to determine whether these influences have a main effect on the growth factors (Intercept, Slope). Second, interaction terms based on potential interdependence between the individual and the proximal social environment were added to the model to assess potential moderating effects on the initial level and longitudinal pattern of behavior. Interaction terms for the individual and family/peers were considered in an incremental fashion following the entry of main effect variables where pertinent based on the previous stage in the analysis (Aiken & West, 1991; Jaccard & Turrisi, 2003). Specifically, an interaction term for self control and association with antisocial peers was added to models for all cohorts and outcome measures. In addition six variables capturing the interactions between those two measures and the three HOME parenting measures were added to the models. Both the latent intercept and slope were regressed on these interaction variables. The focus was on possible interactive influences in cases where the main effects on the latent intercept and/or slope were statistically significant.

This series of analyses is summarized in Figure 3. Specification of this model captures the effects of individual propensity and social influences on the trajectories. It was expected that both would explain some variance in estimated growth curves. Estimates for the main effects and interactions were obtained from the regression of latent growth factors onto specified

variables (see Figure 2). The models were intended to provide insight into the factors conditioning immediate levels of antisocial behavior and its continuance (or lack thereof). Figure 3 builds on the depiction in Figure 2 by showing that covariates that were measured at Wave 1 are examined for their possible association with the latent intercept and slope for substance use and delinquency. As noted above, the latent growth factors are estimated based on the observed levels of substance use and delinquency in the data.

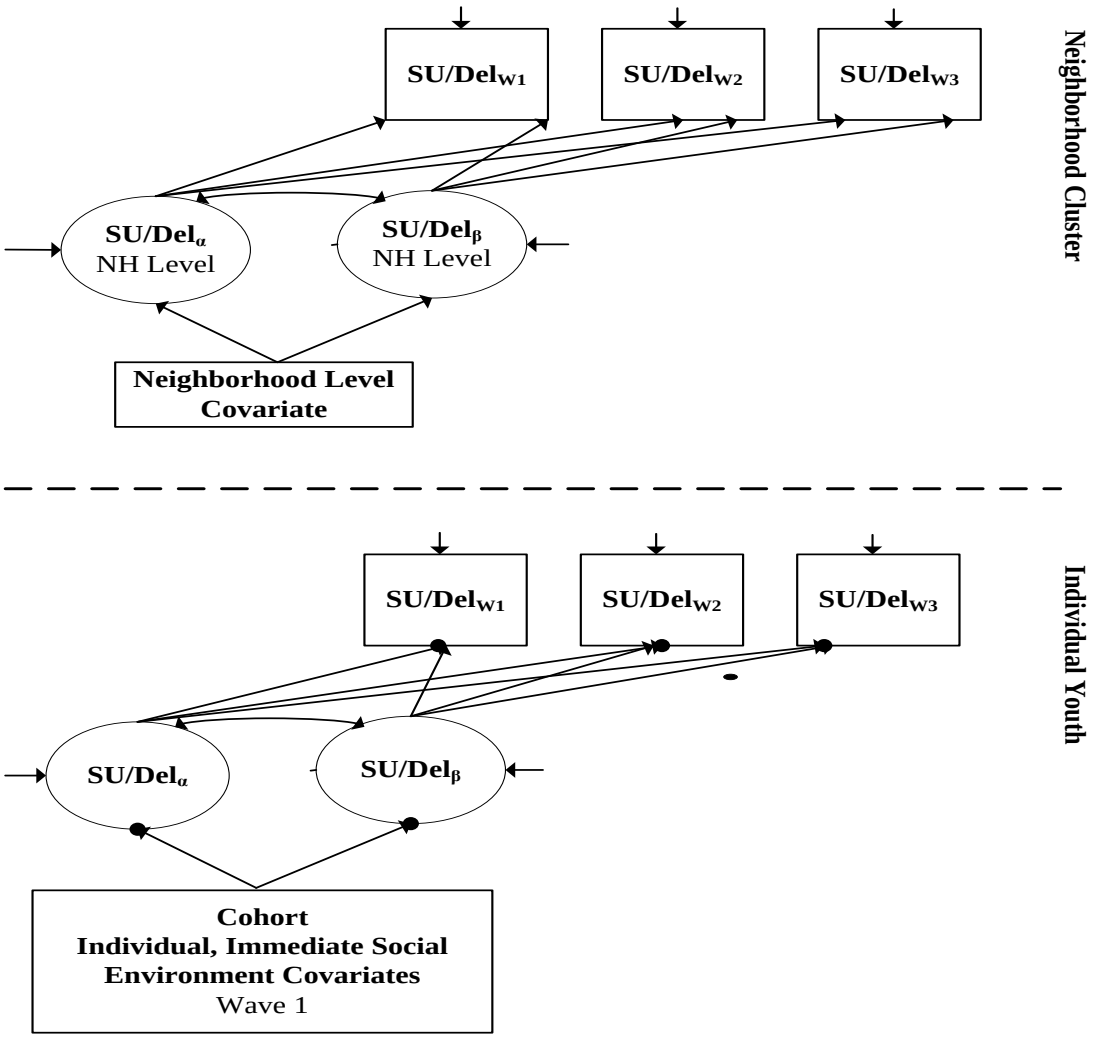
Figure 3. Conditional multiple cohort latent growth curve model (Research Questions 2, 3).



Although typically acknowledged as important in youth development, community context is infrequently incorporated into latent growth curve models of antisocial behavior. In the final phase of the analysis, the models described above are specified in a multilevel framework to (a) assess the degree to which latent slopes and intercepts vary across neighborhood clusters and (b) consider potential differences in the effects of individual and proximal social influences on

growth curves across communities. Figure 4 depicts this process by showing that there are now two units of analysis (Individual, Neighborhood) and the growth trends might vary across individuals, but it is also possible that the initial levels of substance use and delinquency and their trends over time might vary across neighborhoods. Furthermore, if there is variation at the neighborhood level it is possible to examine the degree to which aspects of neighborhoods might help to explain differences in average starting levels and growth trends across places. This builds on the core model described in Figure 2 above but expands the analysis to consider neighborhood variation in the growth factors and possible community-level covariates.

Figure 4. Multilevel, multiple cohort latent growth curve model (Research Question 4).



During this part of the process, the latent growth factors are free to vary across neighborhood cluster, indicating that neighborhoods may have different trajectories. Another random effect can be observed for the regression of the latent growth factors on covariates measured at the initial wave. Specifically, the relationship between a covariate and the growth factors are free to vary across neighborhood cluster (i.e., cross-level interaction). For instance, the question of whether family or peer influence on the initial level and progression of antisocial behavior may vary by neighborhood is considered in this analysis. The neighborhood cluster portion of the model specifies that aggregate, community-level trajectories, as captured by the latent growth factors, may be influenced by neighborhood covariates. Conditional and multilevel models were estimated sequentially to demonstrate the variance in growth factors or covariate effects being accounted for at each stage. Key research questions, data sources, and analytic procedures for the study are highlighted in Table 2.

Table 2. Overview of study questions, measures, and analytic process

Research Question	**PHDCN Data Used**	**Analytic Approach**
1. How are trajectories of substance use and delinquency across adolescence best described?	Longitudinal Cohort Study	Unconditional Latent Growth Curve Models
2. To what extent do key covariates impact the initial level of substance use/delinquency?	Longitudinal Cohort Study	Conditional Latent Growth Curve Models
3. To what extent do key influences impact the progression (slope) of substance use/delinquency?	Longitudinal Cohort Study	Conditional Latent Growth Curve Models
4. Do youth trajectories of substance use and delinquency vary across neighborhoods?	Longitudinal Cohort Study; Community Survey	Multilevel, Conditional Latent Growth Curve Models

RESULTS

This section presents the results pertaining to each of the key research questions in turn. It also considers some key sensitivity tests and ancillary analyses that help to unpack the basic answers to each of these questions and ensure that initial findings are contextualized in key assumptions of the models as well as any data difficulties that emerged in the process.

Descriptive Statistics

Table 3 shows the descriptive statistics for the outcome measures and covariates analyzed here. In general the descriptive results suggest that substance use was fairly limited in Cohort 9, which reached approximately 13 years old in Wave 3 (Mean=0.002 to 0.53). There is, however, a fair degree of variation in that measure at Wave 3 for Cohort 9 (standard deviation [sd]=1.29). Cohorts 12 and 15 show an upward progression on average as well: Cohort 12 reaches an average of 2.86 instances of use in the previous year by Wave 3 (sd=3.91) and Cohort 15 has a mean value of 1.63 (sd=2.97) at Wave 1 with their level of use increasing to 5.68 (sd=5.36) by Wave 3 (~Age 19). A breakdown of the items in the composite just described suggests that alcohol and marijuana tended to be the substances most often used by these respondents. For the sample as a whole at Wave 1, for example, alcohol use had a mean value of 0.29 (sd=0.93) and increased to 0.90 (sd=1.72), and 1.68 (2.18) at the subsequent two waves. Similarly, the mean levels of marijuana use were 0.26 (sd=1.07), 0.54 (sd=1.59), and 1.03 (sd=2.16) for waves 1 through 3, respectively. Use of other drugs had a peak mean of 0.20 (sd=0.99) at Wave 3.

For delinquency, Cohorts 9 and 12 show upward trends in violent delinquency across the three observation points while Cohort 15 shows a drop from Wave 1 to Wave 3 (Means of 0.41, 0.17, and 0.05) on the IRT score. Generally, property and public order status offenses show similar descriptive trends. As is the case for substance use, the standard deviation values for the three delinquency measures exceed their associated mean values. This demonstrates that,

although the scores tended to be fairly low on average, there was a lot of variation around that general trend among the PHDCN youth studied here. For Cohort 9, the mean delinquency frequencies were 4.59, 2.60, and 3.77 for waves 1 through 3, respectively. For Cohort 12 the means were 7.43, 4.80, and 11.17. For Cohort 15 the mean values were 23.72, 22.28, 22.00 for each of the three observation points, respectively. All of the initial aggregated delinquency counts had considerable variation as evidenced by their standard deviation values. Additionally all were positively skewed, such that a few extreme scores inflated the mean values. This further underscores the necessity of using the modeling approach described earlier involving dichotomized component items and IRT procedures to derive scores for further modeling. Unpacking the delinquency measures by type revealed that property delinquency was less prominent in these overall scores than violent offenses.

The bottom panel of Table 3 (under "Covariates") provides some further information about the sample generally. The sample predominantly came from ethnic minority groups (African-American, Hispanic) with a proportion of .15 for White youth. Males have a proportion of .50 indicating that the sample is split evenly by gender. With a possible high value of 3.52 for the SES factor score, the mean value of -0.12 (sd=1.40) indicates that these youth tended to come from relatively low SES families—although there is a good deal of variation around that average in the sample. The mean EASI self control score was 42.9 (sd=10.91). With a possible high value of 80.0 on this measure, this indicates that the PHDCN youth studied here were roughly in the middle of the scale on average. The parenting (lack of hostility, warmth, monitoring) and total social support measures tended to fall toward the higher end of their possible ranges. For example, parental monitoring had a possible high value of 13.0 and the sample mean was 11.63 (sd=1.51), suggesting that parents reported high levels of monitoring their children on average.

The mean level of social support reported by the youth themselves (48.05, sd=5.73) was also high compared to the possible upper end of that measure's range (57). Additionally, the relative level of variation compared to the mean value in these measures was not nearly as high as it was in the outcome variables described above. Somewhat similar to the self control measure described above, the mean level of exposure to antisocial peers fell in the middle of the possible range (mean=1.32, sd=0.29). Descriptives for the neighborhood-level measures that are utilized at the final stage of the analysis are presented at the bottom of Table 3.

Although Kruskal-Wallis tests revealed statistically significant differences across cohort groups, in most cases, there appears to be a number of similarities on the covariates which suggests that these factors are relatively similar in their central tendency and variability across different stages of development for similar youth. Although there are clearly some cohort differences (in expected directions), such as slightly less parental monitoring and warmth moving from cohort 9 to 15 and trends in association with delinquent peers in the opposite direction, these differences are not that drastic and tend to suggest some degree of stability. There are some clear cohort differences in the level of antisocial behavior at each particular wave, however, which is not surprising given the age trends that are typically observed in these behaviors (see Farrington, 1986).

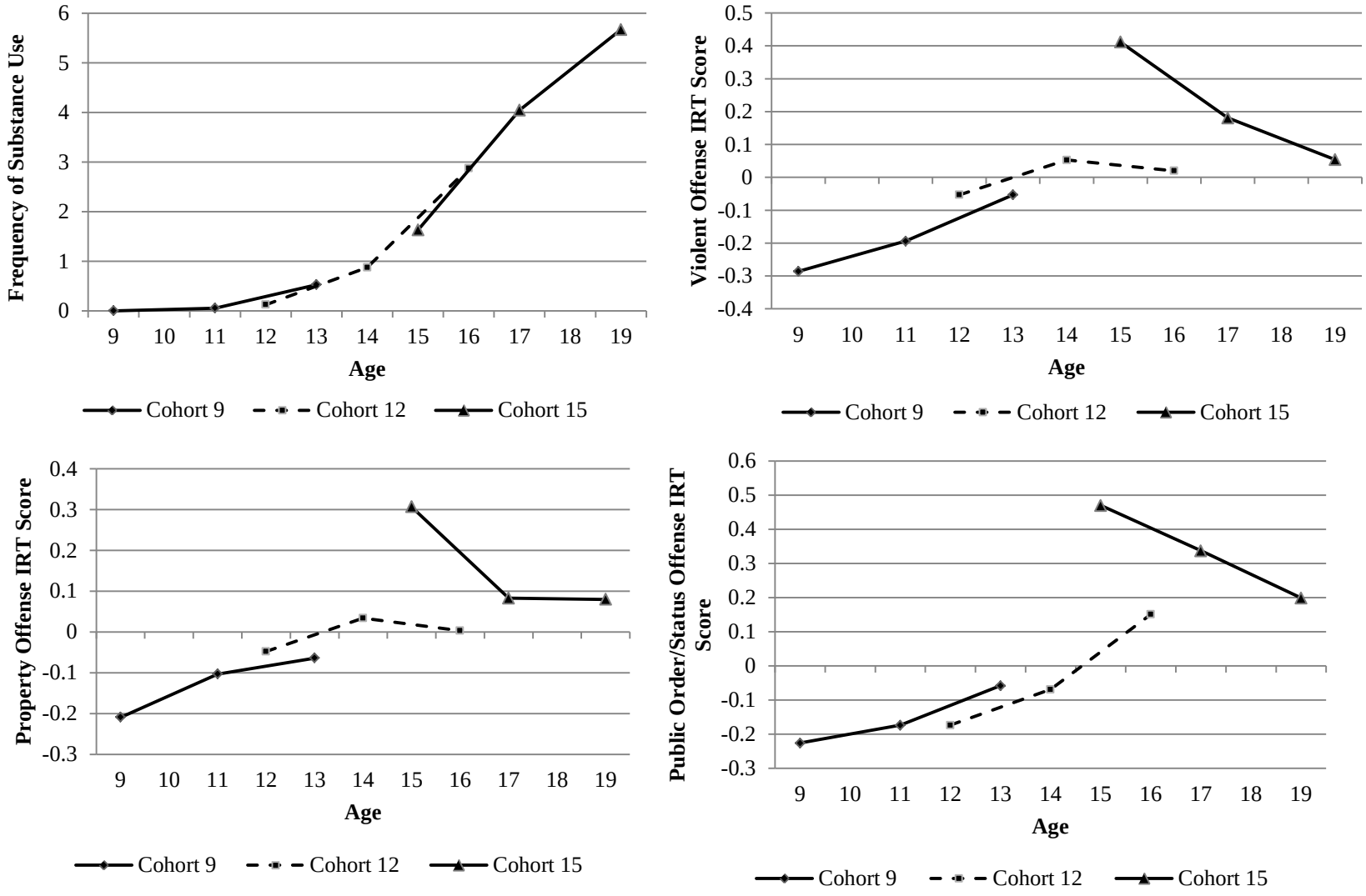
Table 3. Descriptive statistics for key covariates and outcome measures by cohort group.

	Full Sample Mean (sd) Range	**Cohort 9** Mean (sd) n=752	**Cohort 12** Mean (sd) n=752	**Cohort 15** Mean (sd) n=626
Outcome Measures				
Substance Use W1	0.53 (1.80) 0—23	0.002 (.05)	0.12 (.77)	1.63 (2.97)
Substance Use W2	1.51 (3.28) 0—28	0.06 (.35)	0.88 (2.11)	4.04 (4.67)
Substance Use W3	2.85 (4.32) 0—30	.53 (1.29)	2.86 (3.91)	5.68 (5.36)
Violent Delinquency W1	-.0003 (.73) -.47—2.95	-0.29 (.46)	-0.05 (.66)	0.41 (.87)
Violent Delinquency W2	.0003 (.67) -.36—3.47	-0.19 (.45)	0.05 (.69)	0.17 (.79)
Violent Delinquency W3	.0006 (.65) -.33—3.16	-0.06 (.56)	0.02 (.67)	0.05 (.71)
Property Delinquency W1	.0002 (.61) -.32—3.11	-0.20 (.36)	-0.05 (.55)	0.30 (.78)
Property Delinquency W2	.0002 (.51) -.21—3.24	-0.10 (.35)	0.03 (.53)	0.08 (.62)
Property Delinquency W3	.0002 (.48) -.19—3.30	-0.07 (.38)	0.0006 (.49)	0.08 (.57)
PO Status Delinquency W1	-.0001 (.64) -.41—3.41	-0.29 (.33)	-0.12 (.50)	0.49 (.78)
PO Status Delinquency W2	.0001 (.64) -.44—2.83	-0.33 (.31)	-.03 (.53)	0.44 (.76)
PO Status Delinquency W3	.0001 (.61) -.49—2.69	-0.21 (.46)	0.11 (.67)	0.13 (.61)
Covariates				
Race (White=1)	0.14	0.14	0.14	0.15
Gender (Female=1)	0.50	0.47	0.51	0.51
SES (Factor Score)	-0.12 (1.40) -3.16—3.52	-0.09 (1.41)	-0.17 (1.38)	-0.09 (1.42)
Self Control Scale (Raw)	42.93 (10.91) 0—80.0	43.7 (10.3)	42.2 (10.6)	42.9 (11.8)
Parental Lack Hostility	3.71 (.88) 0—4.00	3.66 (.96)	3.77 (.76)	3.70 (.89)
Parental Warmth	6.36 (2.15) 0—9.00	6.49 (2.15)	6.51 (2.06)	6.01 (2.23)
Parental Monitoring	11.63 (1.51) 2.00—13.00	11.87(1.28)	11.74 (1.52)	11.20 (1.67)
Total Social Support	48.05 (5.73) 6.00—57.00	47.80 (6.21)	48.71 (5.21)	47.55 (5.66)
Antisocial Peers	1.32 (0.29) 0.13—2.60	1.23 (0.24)	1.27 (.25)	1.48 (.33)
Community-level Measures				
Collective Efficacy	7.22 (0.60)	7.19 (0.60)	7.21 (0.60)	7.28 (0.60)
Social Disorder	1.85 (0.34)	1.87 (0.34)	1.86 (0.34)	1.82 (0.33)
Social Capital	3.53 (0.27)	3.53 (0.27)	3.53 (0.27)	3.56 (0.26)

Unconditional Latent Growth Curve Models

Figure 5 shows the mean growth curves for each of the outcome variables used in this study. There are both commonalities and differences across the different outcome measures and the three cohorts. Substance use, which includes both alcohol and illicit drugs, shows limited variation for the first two waves of Cohort 9 with very low levels of use reported at both periods. From there, there is an increase in use from age 11 to 13. This upward trend is then picked up in the latter two waves of Cohort 12 and continues through the balance of the observation period. The trends for the public order/status offenses are somewhat similar for the first two cohorts, although the score increases a bit more rapidly from Wave 1 to Wave 2 for Cohort 9. The average score for public order/status offenses starts relatively high for Cohort 15 and then drops in Waves 2 and 3—although it never reaches the same level as at the first wave for Cohort 9 (i.e., there is still some prevalence of this behavior at the later time period). The trends for property and violent delinquency scores are somewhat similar between ages 9 to 19. Like public order/status offenses, both exhibit a slight increase for Cohort 9 and the first two waves for Cohort 12. In both cases, the average scores level off (or decline slightly) between Waves 2 and 3 for Cohort 12. The mean property and violent offense scores at Wave 1 for Cohort 15 are much greater than those observed for any other cohort or measurement wave. The trend then declines precipitously at ages 17 and 19. The fact that Cohort 12 and 15 do not seamlessly overlap as Cohort 9 and Cohort 12 do, suggests possible cohort differences in delinquency levels.

Figure 5. Unconditional growth curves trends by cohort across age 9 to 19.



Estimation of the unconditional latent growth curve models was the initial step in the main analysis. This analysis was directed at research question 1 regarding the descriptive trends for substance use and delinquent behavior. Before proceeding to further analysis, the possibility of pooling the three cohorts in the latent growth curve models to capture lengthier behavioral trends was investigated (See Figure 1). Variants of this approach have been used previously by, among others, Duncan and colleagues (2006) and Raudenbush and Chan (1992). The process entails specification of a model that allows growth parameters to be freely estimated across cohorts and a second model that constrains the trajectories based on those parameters to be equal. This basically assumes that the antisocial behavior trajectories are similar across cohorts.

Formal difference tests for nested models revealed statistically significant differences between cohorts across all four antisocial behavior measures. This test, which follows a Chi-Square distribution, draws on the comparison of the Log-Likelihood values for the free model that allowed the growth factor estimates to vary across the three cohorts and constrained models forcing each group to have the same estimates for the intercept and slope. Using a correction factor for models associated with the statistical estimation approach used here (Asparouhov & Muthén, 2010), differences in the log-likelihood values between the free and constrained models were calculated and then adjusted based on the relevant value provided by the MPlus program. The degrees of freedom for the test was the difference in the number of free parameters between the two versions of the model, which was either six (for substance use) or five (for the delinquency scores) in this case.

Given the degrees of freedom, the critical values for rejection of the null hypothesis that favoring the constrained model (i.e., all cohorts were similar in their growth patterns) were 22.5 and 20.5 for substance use and the delinquency scores respectively. Not surprisingly, the growth

estimates differ somewhat across these age-based cohort groups. With model difference test values ranging from 98.2 to 336.6, the null hypothesis was easily rejected in all four comparisons indicating that the extra parameters included in the full model are useful in fitting the data (see Table 4 for full results). The cohorts can be said to have different growth trends, and, consequently, cannot be pooled to study a single trajectory. This trend in tests is also evident by looking at Figure 5 and considering the estimates shown in the top panels of Tables 5 through 8 as well.

Table 4. Tests for model convergence (i.e., cohort differences in growth trajectories).

	Constrained Model Log Likelihood (p)	**Free Model Log Likelihood (p)**	**Deviance^ (df)**
# Times Substance Use	-3975.03 (11)	-3930.14 (17)	105.2 (6)*
Violent Offense Score	-4999.97 (9)	-4900.16 (14)	156.7 (5)*
Property Offense Score	-3538.72 (9)	-3400.74 (14)	98.2 (5)*
Public Order/Stat Offense Score	-4521.03 (9)	-4312.42 (14)	336. 6 (5)*

Notes: ^H0: Convergence in Cohort estimates;
p= # free parameters; df=difference in free parameters
*Critical values approximately 20.5 (5df) and 22.5 (6df) for p<.001

Given the limitations a finding like this imposes on the use of the data in understanding longitudinal trends and the fact that previous work has utilized a Hierarchical Linear Modeling approach to testing this cohort convergence (or lack thereof) that type of analysis was undertaken here as well in an effort to check the main findings in greater depth. The substance use and violence measures were utilized in these supplemental tests. First, the multilevel approach to longitudinal growth modeling of accelerated cohorts offered by Miyazaki and Raudenbush (2000) was applied to the violence and substance use measures. In both cases, all the likelihood

difference tests were smaller than in the main analysis, but the null hypothesis of convergence was still rejected. Second, given the gap of several years between the Age 9 and 15 cohorts, it was thought that might be partly responsible for nonconvergence. Consequently, analyses were run pairing the 9 and 12 cohorts and the 12 and 15 cohorts (leaving out 15 and 9, respectively). The violence trends did not converge across cohorts in either of those cases. The tests associated with the substance use model were still significant but not quite as large as those observed above. On balance, it appears that the assumptions required for pooling the data from separate cohorts did not hold in the current case. Although less parsimonious, the results presented in the balance of this report accommodate this finding and consider the cohorts separately. This same finding can be inferred visually in comparing Figure 1, which portrays the potential for merging the three separate cohort trends (Figure 1a) into a single curve that covers all three age windows (Figure 1b), with the actual curves shown in Figure 5. In Figure 5, it appears that, in most cases, the growth trends (comprised of initial levels and slopes) are distinct across the three cohort groups. In some cases (e.g., Cohort 12 and 15 delinquency) they clearly do not overlap in a way that would be expected if the same trend was to continue across ages 9 to 19.

Substance Use

A few key patterns emerge from the analysis of each type of antisocial behavior across the three cohort groups (see Table 5). All of the mean estimates for the substance use growth factors are statistically significant suggesting that there was some significant change across the three waves observed in each cohort. Not surprisingly, on average, the estimated initial level on the substance use score gets progressively higher from Cohort 9 (-10.09) to Cohort 15 (0.45). The slope is positive for all three cohorts but the rate of growth is lower in Cohort 15 (0.30) than in the other two cohorts (2.03, 1.02 for Cohorts 9 and 12, respectively). There is significant

variation in both the initial level of substance use and its slope for all three cohorts, suggesting that PHDCN youth differ in terms of their initial substance use and in their longitudinal trends. Finally, the covariance between the intercept and slope is statistically significant and negative for all three cohort groups. This suggests that those who start out with higher levels of substance use at Wave 1 tend to grow more slowly in the subsequent years. To summarize, with one exception, the estimates for the unconditional growth model for substance use were statistically significant in terms of sample variation. The slope values were positive for all three cohorts, which indicates that substance use was increasingly being used among the PHDCN youth.

Table 5. Latent growth curve models with covariates for substance use (zero-inflated Poisson).

	Cohort 9 Est. (se) n=752	**Cohort 12** Est. (se) n=752	**Cohort 15** Est. (se) n=626
Estimates-Unconditional Model			
Intercept	-10.09 (1.41)*	-3.42 (0.29)*	0.45 (0.12)*
Slope	2.03 (0.36)*	1.02 (0.08)*	0.30 (0.03)*
Intercept Variance	14.95 (5.24)*	6.21 (0.97)*	1.32 (0.22)*
Slope Variance	0.48 (0.16)^	0.21 (0.05)*	0.05 (0.01)*
Intercept-Slope Covariance	-2.37 (1.13)*	-1.02 (0.21)*	-0.19 (0.04)*
Estimates-Conditional Model			
Covariates Effects-Intercept			
Race (White=1)	1.29 (0.91)	0.58 (0.31)^	0.37 (0.03)*
Gender (Female=1)	0.99 (0.68)	-0.13 (0.27)	-0.03 (0.12)
SES (Factor Score)	0.17 (0.26)	0.09 (0.09)	0.07 (0.04)
Self Control Scale	0.32 (0.30)	-0.07 (0.11)	-0.03 (0.05)
Parental Lack Hostility	0.10 (0.36)	-0.39 (0.15)*	0.14 (0.01)*
Parental Warmth	-0.30 (0.17)^	0.12 (0.08)	0.01 (0.01)
Parental Monitoring	0.77 (0.41)^	-0.002 (0.06)	-0.01 (0.07)
Total Social Support	-0.10 (0.06)^	0.00 (0.03)	-0.003 (0.001)
Antisocial Peers	0.01 (1.26)	2.38 (0.34)*	1.42 (0.16)*
Covariates Effects-Slope			
Race (White=1)	-0.23 (0.23)	-0.15 (0.07)*	0.03 (0.04)
Gender (Female=1)	-0.27 (0.17)	-0.06 (0.07)	-0.07 (0.03)*
SES (Factor Score)	-0.03 (0.07)	-0.003 (0.03)	0.003 (0.01)
Self Control Scale	-0.06 (0.08)	0.08 (0.03)	0.01 (0.01)
Parental Lack Hostility	-0.01 (0.09)	0.07 (0.04)	-0.03 (0.01)*
Parental Warmth	0.09 (0.04)*	-0.02 (0.02)	0.01 (0.01)
Parental Monitoring	-0.09 (0.10)^	-0.01 (0.02)	-0.01 (0.01)
Total Social Support	0.03 (0.01)^	0.001 (0.01)	0.002 (0.002)
Antisocial Peers	0.03 (0.33)	-0.44 (0.08)*	-0.20 (0.05)*
Key Estimates-Multilevel Model			
Unconditional Model			
Within NH Variance-Intercept	214.2 (9.8)*	1.43 (0.40)*	0.81 (0.13)*
Within NH Variance-Slope	20.4 (1.04)*	0.25 (0.02)*	0.04 (0.02)*
Between NH Variance-Intercept	690.4 (6.97)*	0.84 (0.16)*	0.15 (0.05)*
Between NH Variance-Slope	43.2 (0.003)*	0.05 (0.02)*	0.01 (0.01)

*p<.05, ^p<.10

Delinquency

The results for the unconditional latent growth curve models for the delinquency measures are somewhat different than those just presented for substance use (see Tables 6 to 8). For violence, each of the mean estimates for the intercept and slope are statistically significant. The initial, Wave 1 values for these Item Response Theory scores get progressively higher in each of the three cohorts (Cohort 9=-0.76, Cohort 12=-0.32, Cohort 15=0.35). The latent slope values are positive for Cohort 9 (0.21) and Cohort 12 (0.12), but negative for Cohort 15 (-0.14). The former two slope values reflect an upward developmental progression across the three observation points for the two cohorts. The latter estimate reflects the downward trend in antisocial behavior that is apparent in the later stages of adolescence (age 15 to 19). There is significant variation in the intercepts for each of the three cohorts but the slope and intercept-slope covariance values are not statistically significant in this model.

Table 6. Latent growth curve models with covariates for violent offenses (censored).

	Cohort 9 Est. (se) n=752	**Cohort 12** Est. (se) n=752	**Cohort 15** Est. (se) n=626
Estimates-Unconditional Model			
Intercept	-0.76 (0.05)*	-0.32 (0.05)*	0.35 (0.05)*
Slope	0.21 (0.03)*	0.12 (0.03)*	-0.14 (0.02)*
Intercept Variance	0.06 (0.03)*	0.28 (0.05)*	0.39 (0.05)*
Slope Variance	0.00 (0.00)	0.00 (0.00)	0.001 (0.00)
Intercept-Slope Covariance	-0.01 (0.01)	0.01 (0.01)	0.02 (0.01)
Estimates-Conditional Model			
Covariates Effects-Intercept			
Race (White=1)	0.02 (0.13)	-0.15 (0.13)	-0.20 (0.12)
Gender (Female=1)	-0.23 (0.09)*	-0.17 (0.08)^	-0.18 (0.08)*
SES (Factor Score)	-0.01 (0.01)	0.04 (0.03)	0.08 (0.03)*
Self Control Scale	0.10 (0.05)*	0.15 (0.04)*	0.07 (0.04)^
Parental Lack Hostility	0.00 (0.04)	0.02 (0.06)	0.02 (0.05)
Parental Warmth	0.01 (0.02)	-0.03 (0.02)	-0.003 (0.02)
Parental Monitoring	0.01 (0.03)	-0.02 (0.03)	-0.03 (0.02)
Total Social Support	-0.001 (0.003)	-0.01 (0.01)	0.001 (0.01)
Antisocial Peers	0.88 (0.18)*	1.79 (0.19)*	1.59 (0.13)*

Covariates Effects-Slope			
Race (White=1)	-0.02 (0.06)	0.08 (0.06)	0.11 (0.06)^
Gender (Female=1)	0.11 (0.04)*	0.08 (0.04)^	0.06 (0.04)
SES (Factor Score)	0.01 (0.02)	-0.03 (0.02)^	-0.04 (0.02)*
Self Control Scale	-0.05 (0.02)*	-0.07 (0.02)*	-0.04 (0.02)^
Parental Lack Hostility	-0.002 (0.02)	-0.01 (0.03)	-0.02 (0.02)
Parental Warmth	-0.004 (0.01)	0.02 (0.01)	-0.004 (0.01)
Parental Monitoring	-0.004 (0.02)	0.01 (0.01)	0.02 (0.01)
Total Social Support	0.001 (0.003)	0.01 (0.00)	0.001 (0.004)
Antisocial Peers	-0.40 (0.09)*	-0.79 (0.09)*	-0.65 (0.08)*
Key Estimates-Multilevel Model			
Unconditional Model			
Within NH Variance-Intercept	0.21 (0.12)^	1.10 (0.09)*	0.40 (0.05)*
Within NH Variance-Slope	0.12 (0.03)*	0.37 (0.02)*	0.004 (0.002)^
Between NH Variance-Intercept	0.01 (0.01)	0.82 (0.10)*	0.002 (0.01)
Between NH Variance-Slope	72.78 (0.01)*	0.20 (0.03)*	0.00 (0.00)

*p<.05, ^p<.10

With the exception of the Cohort 12 intercept, the mean estimates for the latent growth factors for property offenses are statistically significant for each of the three cohorts and the pattern of findings across cohorts is similar to that of violent behavior. For Cohort 9, the intercept variance, slope variance, and the intercept-slope covariance are not statistically significant, indicating that youth do not vary significantly across the initial level and longitudinal trend for this measure. For Cohorts 12 and 15, the intercept and slope variance estimates are statistically significant, suggesting that there are reasonably-sized differences in the growth trends in those two cohorts. The intercept-slope covariance estimates are also statistically significant for those cohorts. The negative directionality for these estimates (-0.03, -0.09) reflects the fact that those who start out higher in terms of their property offense scores tend to have more pronounced negative change in that behavior over time.

Table 7. Latent growth curve models with covariates for property offenses (censored).

	Cohort 9 Est. (se) n=752	**Cohort 12** Est. (se) n=752	**Cohort 15** Est. (se) n=626
Estimates-Unconditional Model			
Intercept	-0.20 (0.01)*	-0.03 (0.02)	0.28 (0.03)*
Slope	0.04 (0.01)*	0.02 (0.01)*	-0.06 (0.01)*
Intercept Variance	0.01 (0.01)	0.18 (0.03)*	0.45 (0.03)*
Slope Variance	0.00 (0.00)	0.01 (0.003)*	0.03 (0.001)*
Intercept-Slope Covariance	0.001 (0.001)	-0.03 (0.01)*	-0.09 (0.01)*
Estimates-Conditional Model			
Covariates Effects-Intercept			
Race (White=1)	-0.04 (0.03)	0.004 (0.02)	0.01 (0.04)
Gender (Female=1)	-0.03 (0.03)	-0.01 (0.02)	-0.12 (0.03)*
SES (Factor Score)	0.01 (0.01)	-0.004 (0.01)	0.00 (0.01)
Self Control Scale	0.03 (0.02)^	0.01 (0.01)	0.02 (0.01)
Parental Lack Hostility	-0.02 (0.02)	0.00 (0.01)	0.03 (0.01)*
Parental Warmth	0.01 (0.01)	-0.01 (0.004)	-0.004 (0.01)
Parental Monitoring	0.004 (0.01)	-0.003 (0.01)	-0.01 (0.01)
Total Social Support	-0.003 (0.002)	0.001 (0.001)	0.00 (0.002)
Antisocial Peers	0.21 (0.06)*	0.15 (0.08)*	0.35 (0.07)*
Covariates Effects-Slope			
Race (White=1)	0.01 (0.01)	0.00 (0.01)	0.002 (0.01)
Gender (Female=1)	0.004 (0.01)	-0.001 (0.004)	0.02 (0.01)*
SES (Factor Score)	-0.001 (0.003)	0.00 (0.002)	0.00 (0.004)
Self Control Scale	-0.01 (0.004)*	0.00 (0.003)	-0.01 (0.004)
Parental Lack Hostility	0.01 (0.01)	0.002 (0.003)	-0.01 (0.01)^
Parental Warmth	-0.003 (0.002)	0.00 (0.001)	0.00 (0.002)
Parental Monitoring	-0.002 (0.003)	-0.002 (0.002)	0.003 (0.003)
Total Social Support	0.001 (0.001)	-0.001 (0.00)	0.00 (0.001)
Antisocial Peers	-0.05 (0.02)*	-0.03 (0.02)	-0.08 (0.02)*
Key Estimates-Multilevel Model			
Unconditional Model			
Within NH Variance-Intercept	0.32 (0.03)*	0.43 (0.02)*	0.49 (0.02)*
Within NH Variance-Slope	0.04 (0.002)*	0.05 (0.003)*	0.06 (0.002)*
Between NH Variance-Intercept	0.32 (0.03)*	0.44 (0.03)*	0.00 (0.00)
Between NH Variance-Slope	0.02 (0.002)*	0.05 (0.002)*	0.03 (0.002)

*p<.05, ^p<.10

All of the mean estimates for the public order/status offense intercepts and slopes are statistically significant with higher initial levels as one moves from Cohort 9 (-0.84) to Cohort 15 (0.31) and positive slopes for the first two cohorts (0.17, 0.27) but a negative trend for Cohort 15 (-0.04). The Cohort 9 variance estimates are nonsignificant for both latent growth factors but are

statistically significant for the latter two cohorts. The negative intercept-slope covariance values for Cohort 12 (-0.18) and Cohort 15 (-0.15) indicate that those who start off higher in terms of their score on this measure tend to also change at a less pronounced rate.

Table 8. Latent growth curve models with covariates for public order/ status offenses (censored).

	Cohort 9 Est. (se) n=752	**Cohort 12** Est. (se) n=752	**Cohort 15** Est. (se) n=626
Estimates-Unconditional Model			
Intercept	-0.84 (0.03)*	-0.96 (0.06)*	0.31 (0.05)*
Slope	0.17 (0.01)*	0.27 (0.02)*	-0.04 (0.01)*
Intercept Variance	0.00 (0.00)	1.01 (0.12)*	0.80 (0.09)*
Slope Variance	0.00 (0.00)	0.05 (0.01)*	0.03 (0.01)*
Intercept-Slope Covariance	0.00 (0.00)	-0.18 (0.03)*	-0.15 (0.02)*
Estimates-Conditional Model			
Covariates Effects-Intercept			
Race (White=1)	-0.01 (0.08)	-0.19 (0.16)	0.08 (0.12)
Gender (Female=1)	-0.06 (0.06)	-0.17 (0.10)	-0.29 (0.09)*
SES (Factor Score)	0.03 (0.02)	-0.03 (0.04)	-0.03 (0.03)
Self Control Scale	0.12 (0.03)*	0.15 (0.05)*	0.14 (0.04)*
Parental Lack Hostility	0.01 (0.03)	0.01 (0.07)	0.04 (0.04)
Parental Warmth	-0.003 (0.01)	-0.02 (0.02)	0.001 (0.02)
Parental Monitoring	0.02 (0.02)	0.01 (0.03)	-0.02 (0.03)
Total Social Support	-0.01 (0.004)	-0.01 (0.01)	-0.01 (0.02)
Antisocial Peers	0.53 (0.13)*	1.10 (0.21)*	1.31 (0.20)*
Covariates Effects-Slope			
Race (White=1)	0.01 (0.03)	0.05 (0.04)	0.08 (0.12)
Gender (Female=1)	0.00 (0.02)	0.02 (0.03)	0.01 (0.02)
SES (Factor Score)	-0.01 (0.01)	-0.003 (0.01)	0.01 (0.01)
Self Control Scale	-0.03 (0.01)*	-0.02 (0.01)	-0.04 (0.01)*
Parental Lack Hostility	-0.004 (0.01)	-0.002 (0.02)	-0.01 (0.01)
Parental Warmth	0.001 (0.004)	0.01 (0.01)^	0.00 (0.01)
Parental Monitoring	-0.01 (0.01)	-0.01 (0.01)	-0.004 (0.01)
Total Social Support	0.002 (0.002)	0.002 (0.003)	0.003 (0.002)
Antisocial Peers	-0.12 (0.04)*	-0.18 (0.06)*	-0.27 (0.04)*
Key Estimates-Multilevel Model			
Unconditional Model			
Within NH Variance-Intercept	0.49 (0.06)*	1.26 (0.26)*	0.003 (0.01)
Within NH Variance-Slope	0.04 (0.01)*	0.08 (0.02)*	0.05 (0.003)*
Between NH Variance-Intercept	0.58 (0.06)*	0.03 (0.04)	0.03 (0.02)
Between NH Variance-Slope	0.00 (0.001)	0.002 (0.002)	0.01 (0.002)*

*p<.05, ^p<.10

In summary, a few key findings emerge from the unconditional latent growth curve models for delinquency. First, the initial levels of delinquency get progressively higher across the three cohort groups such that those youth in Cohort 15 generally start at the highest level. Second, the mean slopes are positive for Cohort 9 and 12 but negative for Cohort 15 for all three measures. Third, although there is significant variation for the initial levels of violence, the observed level of variation in slopes (trends over time) is nonsignificant. Fourth, there was variation in the longitudinal trends for property and public order/status offenses—although that was restricted to cohorts 12 and 15.

Latent Growth Curve Models with Covariates

In addition to establishing a baseline pattern of the typical longitudinal patterns and their associated variation to answer *Research Question 1*, the unconditional estimates were used to inform the specification of a series of models that incorporate the covariates described above (*Research Questions 2 and 3*). In general, there are relatively few significant predictors in the four sets of conditional latent growth models (i.e., those incorporating covariates). This is likely attributable in part to the limited variation in some of the latent growth factors discussed above. Given that there might be some association among the predictor variables (esp. the family influence measures), the model was checked and multicollinearity was not found to be a problem.

Substance Use

The latent growth curve model results for substance use are shown in Table 5. The estimates reflect expected changes in the initial level of substance use (Intercept) or its trend over time (slope) based on a given predictor variable, differ somewhat across the three cohorts in terms of the consistency of effects. Several estimates for Cohort 9 are marginally significant.

Parental warmth (b=-0.30) and monitoring/supervision (b=0.77) have some effects on the initial level of substance use, with the latter running contrary to expectations in terms of its direction. Their respective effects on the slopes trended in the opposite direction (parental warmth was positive [b=0.09] and monitoring/supervision [b=-0.09]). Additionally, the social support measure showed a similar pattern of results with a negative effect on the initial level of substance use (b=-0.10) and a positive effect on the latent slope (b=0.03). Parental lack of hostility has a significant effect on the intercept in Cohorts 12 and 15 (-0.39, 0.14) and a negative effect on the slope in Cohort 15 (-0.03). In some cases, the direction of the parental influence variable effects run contrary to expectations at Cohort 15, but the pattern of bivariate and multivariate relationships suggest that this may be due to a suppression effect among the outcome and the parenting measures (McClendon, 2002).

Exposure to delinquent peers begins to exert a significant effect in Cohorts 12 and 15. Specifically, a one unit increase in the level of exposure to antisocial peers suggests higher expected counts for substance use at the initial observation point for Cohorts 12 (b=2.38) and 15 (b=1.42). The effects on their respective slopes indicate that increased antisocial peer association at Wave 1 is associated with less pronounced change in the positive slope over time (b=-0.44, -0.20). The race measure does have a significant effect on the latent growth factors, particularly the intercepts for Cohorts 12 and 15. In both cases, white youth have higher levels of substance use at Wave 1 compared to youth from other races (b=0.58, 0.37). White youth also tend to have more stable patterns of use based on the negative effect on the slope observed in Cohort 12 (b=-0.15). Interestingly, race did not have a significant effect on the slope for Cohort 15, indicating that differences are only apparent at the initial observation point. The coefficient

estimates for the self control measure's effect on the substance use intercepts and slopes were not significant in any of these analyses.

Of those interaction terms that could possibly be added to the model (self control by antisocial peers; parental lack of hostility, parental warmth, and parental monitoring/supervision by self control; parental lack of hostility, parental warmth, and parental monitoring/supervision by antisocial peers), there were no statistically significant effects in the Cohort 9 model. There were three statistically significant effects for the Cohort 12 model. First self control and parental lack of hostility had a negative interactive relationship (-0.02, se=0.01) where the protective effect of the lack of hostility that was just discussed was attenuated some by low self control (i.e., its impact on the initial level of substance use was reduced). A small but significant interaction was also observed for those measures and the slope (0.01, se=0.003). The interaction term for parental monitoring and supervision and antisocial peers was statistically significant as well (-0.92, se=0.39) and it indicated that the increase in the initial level of substance use associated with increased antisocial behavior on the part of peers was attenuated by higher levels of monitoring and supervision. The significant interaction effect between those two measures and the initial level of substance use was also observed for Cohort 15 (0.19, se=0.07). In that instance, however, the effect runs in the opposite direction, suggesting that it is no longer protective. This may be due to the different connotations for parental monitoring and supervision in relation to antisocial peers that might be at work at age 12 as opposed to age 15.

In summary, several covariates have statistically significant effects on the intercepts and slopes for substance use. Peer influence was the most consistent predictor and had a positive effect on the initial level of substance use and generally had a negative effect on the trend over time. The effects of family influence were more inconsistent in terms of their statistical

significance and directionality—both within the domain and across the three cohorts. The individual self control measure did not have any statistically significant effects in model.

Delinquency

The middle panels of Tables 6 to 8 show the covariate relationships with the latent growth factors across cohorts for the three delinquency scores. Only gender and exposure to delinquent peers were uniformly significant across cohorts in their effects on the initial level of violence across cohorts. The negative coefficients indicate that girls started out at a lower level on this measure than boys (b=-0.17 to -0.23). The results suggest that as the number of delinquent peers increased so too did the score on the violence measure at the initial observation period. This effect was somewhat smaller (b=0.88) for Cohort 9 than for Cohorts 12 (b=1.79) and 15 (b=1.59). The self control measure also has a significant effect for Cohort 9 (b=0.10) and Cohort 12 (b=0.15) and is marginally significant for Cohort 15 (b=0.07). This indicates that those individuals with higher values on that measure (reflecting a lack of self control) tend to have slightly higher initial levels of violence as well. There was also a significant, positive effect for SES in the Cohort 15 analysis (b=0.08).

The same measures tended to come up as statistically significant in examining the estimates from the regression of the latent slope on the covariates. Gender, antisocial peers, and self control score show effects that trend in the opposite direction than those for their relationships with the intercepts. This indicates that, although females tend to start lower in terms of violent offending, they have significantly larger slopes (e.g., b=0.11 for Cohort 9), which is indicative of less stability (greater upward change) over time. For antisocial peers, the effect on the longitudinal trends (slopes) is negative (b=-0.40 to -0.79), which reflects greater stability over time for those individuals that have a greater volume of delinquent peers initially

for Cohorts 9 and 12 and a more pronounced negative slope for Cohort 15. The negative effect for the self control slopes (b=-0.04 to -0.07) illustrates that those with lower self control also tend to have more stability (i.e., lower slope values for Cohorts 9 and 12) and more pronounced negative slopes for Cohort 15 in their violent behavior over time. Notably, family influence measures appear to have little impact on either the initial level or trend in behavior in the violence model. There were no significant interaction effects for the violence growth curve models for either Cohort 9 or 15 and only one significant interaction effect emerged for Cohort 12. This involved the antisocial peers and the parental lack of hostility interaction term for the latent slope (-0.25, se=0.10). This suggests that the effect of parental lack of hostility on the stability/change in violence over time can be reduced by higher levels of association with antisocial peers.

For property offenses, the model results reveal somewhat fewer statistically significant covariate effects. The effect of gender on the model intercept is statistically significant only in Cohort 15 (b=-0.12) and indicates that females tend to have lower initial property offense scores. Its relationship with the slope is also significant (b=0.02), which suggests that females tend to have slightly less negative change in their developmental pattern over time relative to boys. The effects of antisocial peers also emerge as statistically significant in Cohorts 9 (b=0.21), 12 (b=0.15), and 15 (b=0.35). In each case, the effects on the initial level of property offending are positive but the effects are negative in terms of the observed relationship with the slope (b=-0.05, -0.03, -0.08), which, taken together, predicts higher initial levels of delinquency but more stability for Cohorts 9 and 12 and greater downward change for Cohort 15. Beyond those two estimates, there are few relationships that are consistently significant (or even marginally so). The self control measure has a small positive effect on the initial level of property delinquency

for Cohort 9 only; its effect on the slope is negative (b=-0.01). There is a slight positive relationship between parental lack of hostility and the initial level of violence (b=0.03); additional analysis suggests, however, that the bivariate relationship between the two is nonsignificant and, consequently, this result is likely the product of a suppression relationship as mentioned in relation to substance use above. There were no statistically significant interaction terms in any of the models for property offending.

As is the case in the other delinquency models, exposure to antisocial peers and self control emerge as statistically significant in the public order/status offense models. In each case, the directionality of the effects across the intercept and slope variables is similar to the violent and property offense. For all three cohorts, as the number of antisocial peers increases, so too does the initial score on public order/status offenses (b=0.53 to 1.31). The low self control measure has a significant effect on the intercept for each cohort (b=0.12 to 0.15) where lower levels of self control tend to suggest higher values on the public order/status offenses score at the initial observation period. The estimates for self control and the latent slope are statistically significant and negative in Cohorts 9 and 15 (b=-0.03, -0.04). In Cohort 15, females have a significantly lower expected public order/status offense score at Wave 1 compared to males (b=-0.29). As in the other delinquency growth curve models, the family influence measures have little impact on the public order/status offense growth factors.

The public order/status offense analysis was inconsistent with respect to the emergence of interactions among individual and social influences. A significant interaction effect was observed for the intercept and slope of public order/status offenses in Cohort 12. Specifically antisocial peers and self control had a positive interactive effect whereby increases in association with delinquent peers enhanced the elevated initial level of delinquency for youth with lower self

control (0.05, se=0.01). The interaction effect for those two measures on the slope (longitudinal trend) was also statistically significant. In that case, higher levels on each of the two measures further lessens the slope of public order/status offenses (-0.01, se=0.004).

A few summary points can be made with respect to the analysis of covariate effects on delinquency growth curves that were described in this section (and presented in Tables 6, 7, and 8). As was the case in the substance use models, the peer influence effect generally emerges as statistically significant in regressions of the latent intercept and the latent slope on covariates. Low self control had positive effects on the initial levels of violent and public order/status offense delinquency. Like delinquent peers, that measure also had negative effects on the slopes in several of the delinquency models. The effects of the parental monitoring, lack of hostility, and warmth measures were generally quite limited across all cohorts and forms of delinquency. Lastly, females had significantly lower initial levels of delinquency in several of the tests presented here, suggesting a protective effect for sex in terms of the forms of antisocial behavior captured in those measures.

Multilevel Latent Growth Curve Models

Once the question of variation in developmental patterns was explored at the level of the individual and their immediate social influences, multilevel growth models were fit to explore the role of the broader neighborhood context in understanding variation in longitudinal patterns of antisocial behavior (see bottom panels of Tables 5 through 8). This was directed toward answering *Research Question 4*. These analyses revealed some neighborhood-level differences in the aggregate growth trends of these youth. Given the relatively low (albeit statistically significant) variation on some of the latent growth factors, it was somewhat challenging to expand the analyses to the neighborhood level. Nevertheless, as this is an important topic that

has not been looked at extensively to this point, this stage of the analytic process was geared toward looking at developmental trends in antisocial behavior with the PHDCN data.

Substance Use

Looking at substance use for Cohort 9, it appears that the limited variation in conjunction with the incorporation of neighborhood clusters leads to some inflation in the variance estimates (see Cohort 9 violence slope as well). So, although both variance components are statistically significant, they may not be trustworthy. The intercept (0.84) and the slope (0.05) variance components for the substance use model are statistically significant for Cohort 12 suggesting that both growth factors vary significantly across neighborhoods. The intercept for Cohort 15 (0.15) varies across neighborhoods as well.

Delinquency

Leaving aside the Cohort 9 model, for violence, the growth factors have significant variance components for Cohort 12 only. For property offenses, the between-neighborhood growth factor variance components are statistically significant for both Cohorts 9 and 12, but nonsignificant for Cohort 15. Only two of the six growth estimates for public order/status offenses vary significantly at the neighborhood level: the Cohort 9 intercept (0.58) and the Cohort 15 slope (0.01).

Multilevel Growth Models with Random Effects, Covariates

Given these findings regarding possible neighborhood-level variation in antisocial behavior trajectories, the next stage of the analysis considered whether any of a few aspects of social structure or process could explain this variance in the growth factors, after controlling for the individual-level factors considered above. As noted above, this analysis can be considered somewhat exploratory given the limited number of youth in some neighborhoods and the limited

variation in some growth factors at that level of the analysis. The most relevant factor from the standpoint of previous research and theory was collective efficacy. Given the high correlations of collective efficacy and some of the other measures (e.g., social capital), both single covariate and multivariate neighborhood-level models were considered. The collective efficacy measure did not have any statistically significant effects–whether it was included in the analysis singly or with the other available community-level covariates (social capital, social disorder). With a couple of exceptions, other PHDCN neighborhood-level covariates such as social disorder and social capital failed to show expected effects on the neighborhood level growth factors as well. Social disorder, for example, had a significant effect on the growth factors for the Cohort 15 property offense delinquency score, but had a limited impact otherwise. Where estimation was possible, random slopes models were run to check for cross-level interactions (see Raudenbush & Bryk, 2002; Snijders & Bosker, 1999); some relationships between the covariates and latent growth factors were identified—particularly for peer effects on substance use and violence in Cohort 12 and substance use in Cohort 15).

Overall, the multilevel latent growth curve models, which were somewhat limited by the interaction of the data and the model structure and therefore can be viewed as exploratory, revealed that, in several cases spanning the three cohorts of interest there was significant neighborhood-level variation in the initial levels and growth trends in substance use and delinquency. Preliminary efforts to explain this variation with three community-level covariates were unsuccessful, however.

Supplementary Analysis

Some supplementary analyses were undertaken in order to probe these results for robustness and/or gain further insight into the mechanisms that might be at work in the study's

main findings. Given the findings that some covariates impacted the intercept and slopes in a differential fashion (in terms of their directionality), the substance use and delinquency measures were broken up into (a) variables for the initial time period and (b) change scores that represent the difference between that observation and the two later periods (Allison, 1990) in an attempt to confirm these results with a somewhat distinct approach. These analyses revealed similar pattern in terms of the significance and direction of the relationships between the covariates and the outcomes. The effects on the initial time point dependent variable tend to follow those for the analysis of the intercept-covariate relationships in direction and the change score models showed effects similar to what was observed for the slope-covariate estimates presented earlier.

Another striking finding in the results that were just presented was that the regression analysis yielded estimates for parenting that were contrary to expectation in their lack of influence on delinquency. Consequently, a series of path regression models were run to probe whether their relationships with antisocial behavior may have been confounded with other measures (e.g., self control, antisocial peers)—suggesting the possibility of more complex mediator effects (Baron & Kenny, 1986). The measures for parental warmth and positive social support were associated with the self control measure, satisfying one part of a mediating relationship, but, with a couple of exceptions, they do not have direct effects on delinquency, even when self control is excluded from the model, which does not fully satisfy the criteria for a mediator relationship. The family and social support variables do appear to have some direct effects on substance use that may be partly mediated once antisocial peers are incorporated into the models, however. Although these covariates were all measured at Wave 1, precluding strong assertions about temporal ordering, this may suggest that these influences may have an impact on

whom youth associate with which in turn has an impact on the developmental trajectories studied here.

Given some of the sample size and variation limitations that preclude full specification of models that allow for interactions across neighborhoods, proximal social influences, and individuals, a series of unconditional, multilevel models was run with some of the key covariates described above. Antisocial peers (Intraclass Correlation [ICC]=0.03), self control (ICC=0.03), parental monitoring and supervision (ICC=0.02), and parental warmth (ICC=0.04) were found to vary significantly across neighborhoods suggesting that, to the extent that they impact antisocial behavior, they may partly explain some of the neighborhood differences in the trajectories of substance use and delinquency identified earlier.

Given the difficulties in incorporating neighborhood covariates into the model, the general possibility of finding effects on the latent growth curve factors at that level was conducted. Specifically, a "perceived delinquency" measure from the PHDCN community survey was incorporated into the multilevel models in an attempt to check whether the limited effects found on the neighborhood-level growth trends for measures like collective efficacy and social capital could be attributable to the general difficulty of estimating those relationships in the present analytic context. Given that the measure is an assessment, albeit a subjective one, of community delinquency problems on the part of neighborhood residents it would seem that it would be the community-level factor that would be expected to have a relationship with the antisocial behavior trajectory measures in these analyses. It did not, however, have a significant influence on the growth factors in these models, which suggests that measurement/estimation difficulties may have had an impact for even the most likely predictors of neighborhood-level

differences in antisocial behavior trajectories. This suggests some need for caution in reading too much into the estimates for neighborhood-level covariates.

CONCLUSIONS

Summary of Key Findings

This analysis of the PHDCN data provides answers to the general questions posed at the start of the study, yielding several important findings that have implications for understanding the development of antisocial behavior which in turn offers some insight on prevention strategy related to antisocial behavior in adolescence.

First, the results of the unconditional models of these behaviors both fit with expectations based on previous research and also offer some departures from it. Specifically, looking at the entire age span, the rise in delinquency and subsequent decline later in the observation window generally follows the expectations set up by the age-crime curve (see Farrington, 1986). Substance use appears to rise across the time window studied here, indicating that there does not appear to be a drop off in this behavior during that period.

Second, cohort differences in initial levels and longitudinal trends in antisocial behavior as well as relationships with covariates were identified both descriptively and in formal tests. This suggests that there are age distinctions in growth patterns, which is not surprising, but also that there may be some differential salience of the various influences investigated here depending on the stage of development where the youth falls.

Third, the models also suggest some gender differences. This is distinct from a simple difference in levels of antisocial behavior in that these gender differences might have an impact on where youth start as well as their degree of change or stability over time.

Fourth, exposure to delinquent peers affects the initial level of antisocial behavior in a number of cases and also has some effects on developmental trends later in adolescence. It is clearly the most consistent predictor in these models. This suggests the need to consider its impact throughout late childhood to late adolescence.

Fifth, individual self control has a significant effect on the latent growth factors in a number of tests for the delinquency measures, but no significant effects in the analysis of substance use. In general where it did have significant effects, lower self control was associated with higher initial levels of delinquency.

Sixth, although the analyses identify some family influence and SES effects, these are inconsistent across cohorts and outcome measures and appear to be somewhat limited. It appears that these measures do not have a strong influence on these antisocial behavioral trajectories—even initial behavioral levels—in this study. Supplementary analysis did show that they may be partially mediated by other factors (e.g., deviant peer association) in the case of substance use.

Seventh, in most cases, the covariate models identified some directional differences in effects on initial levels and trends. These generally signify that a covariate has some influence on the outcome of interest initially (upward or downward) but also has an impact on the level of stability or change of the later trend over the few years that follow. This highlights the importance of disaggregating the effects of risk and protective factors in considering the components of longitudinal trends. It also highlights the need to consider early risk/protection in a framework that captures both immediate and long-term effects on behavior.

Eighth, although sometimes challenging to appropriately estimate (see, e.g., Ousey & Wilcox, 2007), interaction terms for the individual and social influences were included at the final stage of the latent growth curve modeling process. In most cases, these interaction terms

did not have significant influences on the initial level of antisocial behavior or its trend over time. There were a few statistically significant interactions that suggest the importance of considering interdependent relationships across risk and protective factors in terms of how they affect developmental trends.

Lastly, the results from the unconditional multilevel growth curve models suggest that, in more than half of the possible tests (12 of 20 if the Cohort 9 tests for violence and substance use which are significant but questionable are left out), the variation around the estimated growth factors (initial levels, trends over time) was statistically significant. This suggests that these trajectories tend to differ somewhat across neighborhoods. The use of neighborhood-level factors like collective efficacy, social capital, and social disorder to try to explain such variation was not particularly helpful in the present case, however. Nevertheless, the observation of between-neighborhood variation in antisocial behavioral trajectories is somewhat novel in this area of research.

Implications for Understanding the Developmental of Antisocial Behavior

The observed patterns in the delinquency measures mostly fit with expectations based on the "age-crime" curve in terms of a peak in mid-adolescence followed by a pronounced drop as youths move toward early adulthood. The longitudinal behavior of substance use is clearly distinct from the trend in delinquency and that should be kept in mind in thinking about the association between the two and what it means to desist from delinquency or persist later into early adulthood. The fact that alcohol was included in the substance use measure may have had a slight impact on this observed trend, but the sample is nevertheless comprised of underage youth making any substance use as an indicator of problem behavior. Additionally, the basic descriptive trend observed here held when alcohol use was removed from the analysis.

Although the directional differences in effects on the initial levels of these behaviors and their subsequent trends appear to be counterintuitive at first glance, they have important implications for the launch model, which was used as a framework for these analyses and, in turn, for understanding developmental patterns in these behaviors more generally. This set of findings reflects what Hussong and colleagues (2008) found when looking at substance use effects on criminal offending in the transition to adulthood and basically signify that a covariate can have an impact on where a youth starts in terms of their substance use and delinquency, but also may be associated with the stability or change in that behavior over time. So, for example, positive initial effects for association with antisocial peers suggest that those youth who report a greater number of such peers engaged in delinquency/substance use tend to have higher initial levels of delinquency or substance use. The negative effect on the slope suggests that youth could also change more or less markedly, depending on the observed direction of the latent slope and regression estimate, over time as well. For example, when a youth starts high or low initially s/he may get "locked into" a stable path over that time period. Alternately, s/he might have a higher positive or negative slope indicating something of a regression toward the mean.

Similar patterns were revealed for the self control measure, suggesting that a youth's ability to regulate their behavior can have immediate and long-term implications. This partially supports the view that early risk can launch an antisocial trajectory in that it suggests a high starting point and fair amount of stability as opposed to pronounced growth. The findings of the analysis of covariates are also important in that they identify relatively few instances of family or social support influence on immediate levels or long-term trends in the behaviors studied here, which suggests that their impact may be more distal in terms of their impact on other factors at early stages of development that may in turn affect the development of antisocial behavior later

on. Additionally, although the effects with respect to interaction terms revealed few significant effects, there were some interactions that seemed to matter, which indicates that it is important to consider possible interdependencies among individuals and the social environment as well as different domains of social influence in understanding the development of antisocial behavior.

Although the analyses at that level were somewhat limited, the variation in the trajectories of antisocial behavior across neighborhood is important for multiple reasons. First, the community has typically not been looked at as an influence on the onset and developmental trends in antisocial behavior. More importantly, the results of this study seem to support the neighborhood as both a developmental institution and a situational influence on adolescent antisocial behavior (Wikström & Sampson, 2003). The neighborhood cluster variable designates the youth's residence at the initial wave of measurement. The fact that developmental trends (slopes) appear to vary across neighborhoods suggests potential for long-term impacts on these youth as well. At the same time, the strong effect of peers on delinquency, coupled with the fact that the level of exposure to antisocial peers differs somewhat across neighborhoods suggests that a portion of the effect might come from concentration of sources of delinquent peers in these areas. Consequently, youth are subject to early environmental risk that persists over time—albeit through a somewhat different mechanism.

Implications for Intervention with At-Risk and Delinquent Youth

The assessment of developmental trends in antisocial behavior using the approach taken here does offer some insight into prevention efforts in terms of prospects and potential problems. While some factors included in the analysis (Famiy SES, race/ethnicity) are difficult to target with policy interventions, there are several findings that lend themselves to ideas for policy and practice in terms of mitigating risks faced by youth and our enhancing resiliency. In particular, the investigation of a

"launch" perspective on antisocial behavioral development with multiple domains of risk provides a sense of how to prioritize particular leverage points in designing strategies to prevent problem behaviors on the part of adolescents—both among those who are likely to be serious and sustained offenders as well as those youth whose antisocial behavior may be more fleeting. The findings for cohort and gender differences suggest two general sensitizing themes that might be considered in intervention. First, given some identified differences across cohorts, the potential for differential risk/protection relationships by age should be strongly considered in programming. So, while it is important to identify effective prevention strategies, it is also necessary to identify and implement interventions that are appropriately timed in terms of the developmental stage in which youth are situated (Nation et al., 2003) and also are mindful of where the youth is relative to the rest of the population. In general, the identification of normative developmental trajectories for a given age range may be useful for looking at particular types of cases from a comparative perspective to identify opportunities for prevention. Ideally this will involve interventions that span different stages of development, reflect varied levels of involvement from formal agencies, and respond to a number of important domains which may put youth at risk for development and continuance of antisocial behavior.

The mean values for Cohorts 9 and 12 suggest fairly low levels of substance use and delinquency, so youth in those age ranges that exhibit antisocial behavior would seem to warrant some degree of intervention as they are likely to be those who vary from the average shown in the growth curve models. Still, the upward trend over time suggests that some of this behavior may become more normative towards the end of those windows. For Cohort 15, although the initial levels of these behaviors tend to be greater, it is also important to recognize that there is a downward trend for delinquency toward the end of that observation window. Consequently, continued delinquency also

warrants concerted intervention with an eye towards facilitating desistance at the late adolescence/early adulthood stage. For substance use, the average slope across the three waves for Cohorts 12 and 15 moves upward which suggests a need for prevention strategies that span late childhood to early adulthood.

The gender differences suggest more scrutiny of initial levels and developmental patterns of antisocial behavior across boys and girls. The degree to which boys and girls differ in the mechanisms that underlie such behavior has important implications for the need for gendered explanations of behavior and prevention strategies (e.g., Gorman-Smith & Loeber, 2005; Moffitt et al., 2001). In this case, girls tended to start off lower in terms of their levels of delinquency, but gender also had some effects on later developmental trends. It is important to unpack such findings further to determine whether it is the case that, although girls tend to have lower levels of delinquency than boys throughout the observed period, they might reach a point where they are more susceptible to shifts toward antisocial behavior. Gender, of course, is a variable that is not amenable to policy manipulation, but understanding possible differences in mechanisms of risk and protection can be helpful in tailoring prevention strategy to one or both groups.

The findings for individual and social influences on the trajectories for antisocial behavior yield some points of practical relevance as well. Although it was somewhat surprising that self control did not have consistent effects across cohorts and outcomes based on the underlying theory and previous findings, the results suggest that, on balance, individual propensity should be considered in pursuing other intervention strategies (i.e., use of the risk principle) and appropriate measures should be taken to develop and use programming that has demonstrated effectiveness in bolstering skills related to self regulation in children and adolescents. Although, between-individual, "constitutional" factors are often seen as enduring and difficult to change, recent research demonstrates that self

control can be developed through appropriately targeted intervention strategies, particularly if the intervention occurs early on in development (see Piquero, Farrington, & Jennings, 2010). Still, the fact that self control did not have an impact on longitudinal trends in substance use suggests that other mechanisms must be considered in prevention efforts directed at that behavior.

A number of currently recognized best practices directed towards at-risk youth are built around family-based programming (e.g., Functional Family Therapy, Multi-Systemic Therapy). These initiatives are essential and address a salient risk for many substance using and delinquent youth, but consideration of situational/peer risk should be central to prevention and intervention during adolescence as well. The robustness of delinquent peer exposure as a significant influence here—even in the cohort that is observed starting in late childhood—points to the need to develop interventions that can counteract this risk factor (Sullivan & Jolliffe, 2012). Given the importance of peers during this particular stage of development (Giordano, 2003; Smetana, Campione-Barr, & Metzger, 2006) and the influence of group dynamics on the higher observed levels of antisocial behavior within adolescence (Albert & Steinberg, 2011; Warr, 2002) it is surprising that counteracting the risk that may flow from peer influence does not appear to be a more explicit focus of prevention strategy. Though group-based risk behavior may to some extent be endemic to this developmental period and, by extension, difficult to ameliorate, its impact can certainly be tempered.

A recent review by Sullivan & Jolliffe (2012) found that mentoring programs that provide at-risk adolescents with connections to positive social influences and an array of program components that are dedicated specifically toward counteracting the effects of deviant peer influence such as communication skills, problem-solving, decision making, social interactions, and peer refusal skills may be promising in that regard. For example, the Aban Aya program, introduced in the Chicago Area, consisted of a school-based social development curriculum focused on communication skills,

problem solving, decision making, social networking, and refusal skills expected to be related to peer risk. The curriculum was delivered via classroom instruction and role-playing. Flay et al (2004) found sizeable program effects on violence and school delinquency. Going beyond those basic effects, Ngwe and colleagues' (2004) findings suggested that the Aban Aya program had an impact on growth in violence that was mediated by its impact on peer risk. This is important because it focuses on the process by which interventions may impact intervening peer risk and later developmental trajectories. Further research and program development should accommodate the need for more insight and concerted response to peer group risks.

Although they were somewhat exploratory, the identified differences in developmental trajectories across communities also offer useful insights for intervention. First, although the precise neighborhood influences on antisocial behavior were elusive here, it is apparent that not all of the influence on developmental trends in adolescent antisocial behavior rests in individual factors or proximal social influences. This suggests that interventions that do not consider the community as part of the process of the development of antisocial behavior may fall short in terms of redirecting at-risk youth towards prosocial outcomes. It appears that the neighborhood can act as both a source of opportunity and a socialization agent. Consequently, it would seem to be valuable to involve communities in taking stock of those factors that can exacerbate or attenuate the individual and family difficulties that could lead to problematic outcomes. This is the initial stage of the approach taken in the Communities that Care program where residents are asked to report about specific risks and needs with respect to children and adolescents in the area. The process then continues with experts offering some direction on interventions that might be implemented to help with common or unique risks faced by youths in that particular community (see Hawkins, 1999; Hawkins et al., 2008). This type of program can useful in

developing both a broad framework for intervention as well as directing youth, families, and communities toward appropriate programming to prevent and respond to delinquency and substance use. This type of approach may also blend with a broad framework like the Office of Juvenile Justice and Delinquency Prevention's (OJJDP) "Comprehensive Strategy" to structure prevention and remediation across the range of at-risk and delinquent youth (Howell, 2003).

Limitations and Directions for Future Research

While these data and the analytic strategy have a number of strengths which facilitate the investigation of developmental perspectives on antisocial behavior, there are also limitations that provide a boundary around the conclusions reached here and provide some direction for future research as well. The covariate data on behavioral influences were limited to the first wave of observation for each case and cohort. This is not really a hindrance in a standalone assessment of the launch model of antisocial behavior, but it precluded the potential testing of alternative or complementary explanations for the developmental patterns observed in these data and also placed some restrictions on a full understanding of what might impact initial levels of antisocial behavior and stability or change in its trend over time (see Hussong et al., 2008). Future research with risk/protective measures captured over time should help to illuminate the factors that may have contributed to observed stability or change in behavioral trajectories.

Although this study draws on data from multiple age cohorts to illuminate trends across adolescence, model convergence tests indicate that there were cohort effects on the trajectories, which precluded pooling of the data to assess a lengthy single trend over time (Duncan et al., 2006; Raudenbush & Chan, 1992). Additionally, the PHDCN data suffers from the fact that there is not a great deal of overlap across measurement periods for different cohorts, precluding an optimal test of whether these cohorts should in fact be pooled necessitating the conservative

use of models disaggregated across cohorts (see Collins, 2006). In some sense this limits the ability to describe behavior across the full range of adolescence except by piecing together the results from the three cohort groups discursively. On the other hand, the disaggregated analysis does allow for some consideration of factors that may be more or less important at a particular stage of adolescence while simultaneously providing a sense of what may or may not have an influence across the shorter windows that make up that longer period. In this case the cohort differences are instructive in that they signal that different influences may be stronger or weaker at particular stages of development. Further work to identify means of understanding long-term behavioral trends based on accelerated cohort studies like PHDCN should be undertaken. Some preliminary work in association with the initial question related to cohort pooling in this study has looked at the possibility of using contemporary matching procedures to address this problem (Sullivan & Loughran, 2012).

The measures of warmth and hostility in parenting are based on interviewer observations of parent-child interactions that are of a fairly short duration. Clearly, there may have been some social desirability effects at work in how the parent interacted with their child during that time period and this short-duration surely would not encompass their entire relationship with their child. Nevertheless, some researchers have made arguments in favor of this type of parental assessment (e.g., Patterson, 1982) and these measures have been found to be valid and reliable in psychometric testing with the PHDCN data (Leventhal et al., 2004). Still, the factor analysis results and reliability coefficient values suggest that at least the parental monitoring/supervision measure is not particularly strong.

The measure of exposure to antisocial peers used here, which is derived from an individual's reporting of their friend's activities, is restrictive as well. These items are somewhat

limited in that they are drawn from the same source as the substance use and delinquency measure which may inflate their association with individual responses (Haynie & Osgood, 2005; Zimmerman & Messner, 2011) and offer little insight into the specific process by which peers would affect individual behavior. Future studies should consider this influence in more depth– particularly in relation to how various spheres of influence interact to produce the developmental outcomes considered here.

Although the incorporation of the community into this analysis allowed for some useful insights into individual developmental trends, there were measurement and analytic limitations at that level. For example, the neighborhood census measures were not available in the restricted PHDCN data set used here (obtained through the Inter-University Consortium of Political and Social Research [ICPSR]). This is a limitation in terms of fully specifying distal processes at the neighborhood level that may affect outcomes considered here. Still, previous research indicates that the collective efficacy measure used here mediates the relationship between "social composition" variables like concentrated disadvantage and residential stability typically taken from census data in analysis of outcomes similar to those considered in this study (see Sampson, Raudenbush, & Earls, 1997). Additionally, the estimation of some effects became somewhat unstable once latent variable estimation of growth trends, cohort effects, controls for individual and immediate social influences, and neighborhood-level influences were modeled together. Future research might disaggregate some of these tests to look at important remaining questions on the factors that give rise to the trends in antisocial behavior.

Conclusion

A recent monetary-based analysis emphasized the importance of pursuing prevention efforts at relatively early developmental stages to stem the exorbitant costs (monetary, social)

that come with long-term patterns of substance use and offending (Cohen & Piquero, 2009). At the same time, a growing body of research, in a number of related areas, shows support for primary and secondary prevention efforts directed at youth, families, and communities. This support comes from public opinion surveys (Cullen et al., 2007), evaluation of evidence-based programs (Greenwood, 2006; Mihalic et al. 2004), and studies assessing benefits and costs of such approaches (Aos et al., 2004; Karoly, Kilburn, & Cannon, 2005). Yet, effective prevention programming requires a thorough understanding of long-term patterns of antisocial behavior and its relationship to key influences at its onset, or initial observed point, and across its developmental course (i.e., durability of influence).

The understanding of adolescent antisocial behavior has increased markedly in recent years, to the point that recent legal decisions, such as the 2005 U.S. Supreme Court decision in *Roper vs. Simmons*, and policy discussions, such as the possibility of reestablishing a higher age boundary between the adult and juvenile court (Henrichson & Levshin, 2011), have drawn in part on the work of developmental researchers. Nevertheless, more can be done to pinpoint the etiology of antisocial behavioral trajectories to inform prevention strategy and the response to youth substance use and delinquent behavior that has already occurred. This study utilized multi-wave data from the Project on Human Development in Chicago Neighborhoods (PHDCN) on three cohorts spanning ten years (age 9 to 19) to investigate longitudinal trends in adolescent substance use and delinquency along with key individual, social, and community influences. Assessing a contextualized, launch model of antisocial behavioral trajectories, the study found significant variation in six year developmental trajectories in antisocial behavior across individuals and neighborhoods. Some of the plausible individual and social influences captured at the initial stage of PHDCN measurement and neighborhood of residence were helpful in

explaining this variation in developmental trends as well. These findings offered some useful insights for understanding the developmental processes that may give rise to trends in antisocial behavior in adolescence while simultaneously identifying relevant points for prevention strategy.

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DISSEMINATION ACTIVITIES

Presentations (Completed)

Sullivan, C.J. (2010). Trajectories of antisocial behavior with an accelerated, multiple cohort growth modeling approach. *American Society of Criminology* (Poster). San Francisco, CA.

Sullivan, C.J. (2011). Investigating individual and social influences on trajectories of antisocial behavior in adolescence. *National Institute of Justice Annual Conference* (Poster). Arlington, VA. (Emphasis on policy implications)

Sullivan, C.J. (2011). The role of individual propensity and social factors in trajectories of adolescent antisocial behavior. *American Society of Criminology* (Poster). Washington, DC.

Sullivan, C.J., & Loughran, T. (2012). Describing trajectories of adolescent antisocial behavior with accelerated longitudinal data: Analytic and matching methods. *Society for Research on Child Development-Longitudinal Methodology Themed Meeting*. Tampa, FL.

Presentations (Planned)

Sullivan, C.J. (2002) Assessing family, peer, and community influences on the launch of adolescent antisocial behavior: implications for theory and practice. 5th National Research Conference on Child & Family Programs & Policy. Bridgewater, MA
(To be presented in July, Accepted in April 2012-will focus on the implications of results for family-based prevention versus intervention centering around other domains)

Papers

Sullivan, C.J. (2012). Individual, social, and neighborhood influences on the launch of adolescent antisocial behavior. Submitted for review at *Youth & Society.* (Revise and Resubmit decision in 3/2012)