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Effects of Alcohol on Trajectories of Physical Aggression Among Urban Youth: An Application of Latent Trajectory Modeling

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Abstract

Several studies have investigated factors associated with physical aggression during adolescence. Yet, little is known about the longitudinal relationship between drug use, particularly alcohol use, and physical aggression among minority youth. The present study examined the effects of alcohol and substance use at age 11 on trajectories of physical aggression over time (ages 12–14) among urban adolescents from Chicago, IL. Data from the Project Northland Chicago (n = 3038, 49.4% female) was used. The current study sample included 1,160 Black, 1,015 Hispanic and 863 White/other adolescents for a total of 3,038 adolescents. Four trajectories of physical aggression were identified: Non-aggressive (16%), Desistors (9%), Escalators (20%) and Chronic Aggressive (55%). After adjusting for physical aggression behaviors, delinquent friends, lack of supervised time, demographic variables, smoking and marijuana use, past year alcohol users at age 11 were 2.1 times more likely to be "Escalators" and 1.9 times more likely to be in the "Chronic Aggressive" group. Gender and ethnic differences were also observed in the trajectories of physical aggression. Black youth were 2.5 times more likely to be in the "Chronic Aggressive" group. Findings highlight the importance of targeting alcohol prevention to reduce physical aggression among urban young adolescents.

Keywords

Physical aggression; Group-based; Longitudinal; Urban; Adolescents; Alcohol

Introduction

Youth violence is an important public health problem. Violence and physical aggression among adolescents often results in unintentional injuries and homicide, two leading causes of death among adolescents (Centers for Disease Control and Prevention 2009). Aggressive behaviors

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are also associated with drug use, unsafe sex, dangerous driving, other mental health problems, across gender and ethnic groups (Brook et al. 1998; Hawkins et al. 1992). Differential rates of violence and physical aggression are predicted by child, familial, genetic, and environmental factors (Chung et al. 2002; Loeber and Farrington 1998). Minority adolescents, particularly African American and Hispanic youth, are disproportionally at risk for behavioral problems and they often live in neighborhoods with increased opportunity for drug use, greater exposure to violence and weaker economic conditions (Farrington et al. 2003; Piquero et al. 2006). Yet, little is known about the longitudinal relation between drug use, particularly alcohol use, and violent behaviors among African American adolescents. Longitudinal studies of physical aggression among children and adolescents provide an opportunity to distinguish offender trajectories and to identify risk and protective factors associated with its progression or curtailment over time (Loeber and Farrington 1998).

When examining trajectories of aggression among children and adolescents, several considerations need further research. First, examining trajectories of aggression among urban adolescents, particularly Hispanic and African Americans, is important because they are disproportionately at risk for behavioral problems (including substance use and greater exposure to violence in their neighborhoods). For instance, living in an urban environment is often characterized by neighborhood disorder, concentrated poverty, racial heterogeneity, family instability, increased opportunity for drug use, weaker economic conditions and fewer neighborhood resources (Arkes 2007; Duncan et al. 2002; Elliott et al. 1996b). Evidence also suggests that youth who live in socially disadvantaged contexts report higher rates of delinquent behaviors, exposure to violence, and neighborhood problems (Piquero et al. 2006; Tobler et al. 2009a). As such, urban minority youth are disproportionately at risk for maladaptive behavioral and emotional outcomes, drug use, and greater exposure to violence in their neighborhoods.

Several studies have examined trajectories of delinquency and crime during late adolescence and among young adults. Previous research indicates that by the end of adolescence, most trajectories of criminal activity show a decline (regardless of the outcome being assessed) (Piquero 2008). Studies have also shown that the number of trajectories of criminal activity has been consistent across different studies, between three to five groups, independent of the methodologies used to measure criminal behavior (Piquero 2008). Similarly, a recent study examined trajectories of offending among young adults and revealed four distinct offending paths: Rare/Non-offending, Low-Chronic, Low-Rising, and High-Chronic (Colman et al. 2009). In sum, research shows an adolescent-peaked pattern, a chronic offending pattern (which declines in most studies), and a late-onset chronic pattern (begins offending in mid and late adolescence and continues offending at a steady rate into adulthood) (Piquero 2008). Thus, it is important to examine how trajectories of delinquency and physical aggression during early and middle adolescence compare to trajectories of these behaviors among late adolescents and early adults.

Last, and more importantly, there is need to investigate the influence of risk and protective factors on the development and progression of physical aggression over time among urban minority youth during early to mid- adolescence. While the role of individual characteristics in the patterns of antisocial and offending trajectories has been investigated among adolescents (Bird et al. 2001; Piquero et al. 2007; van Lier et al. 2009), few studies have examined the effects of risk and protective factors on trajectories of physical aggression over time (Fontaine et al. 2009; Wiesner and Windle 2004). In addition, while many studies have examined the association between drug use and delinquency among adolescents (Costello et al. 2008; D'Amico et al. 2008), and many more have examined the relation between alcohol and violence among adults (Lipsey et al. 1997; NIAAA 2000; Roizen 1993), few have examined the effects of alcohol use and substance use during early adolescence on trajectories of physical aggression

over time from early to middle adolescence (Fontaine, et al. 2009; Piquero 2008). Thus, it is important to examine factors associated with progression of physical aggression and violence over time.

Risk and Protective Factors: A Theoretical Framework for the Study of Physical Aggression

Several theoretical frameworks provide support for the study of risk and protective factors associated with aggressive behaviors during adolescence. Expanding on social learning theory (Akers 1985), Jessor and colleagues provided a framework for understanding risk behaviors in adolescence (Jessor 1991; Jessor et al. 1995). The problem-behavior theory provides a framework to the study of risk factors associated with adolescent problem behaviors (Jessor 1991; Jessor et al. 1995). According to this theory, risk factors are those conditions associated with a higher likelihood of negative outcomes or behaviors that can compromise health and well-being (Jessor et al. 1995). Problem-behavior theory is focused on the role of psychosocial and behavioral factors associated with adolescent risk behaviors, including problem behaviors (alcohol and illicit drug use, delinquency, drunk-driving), health-related behaviors (e.g. unhealthy eating, tobacco use) and school behaviors (e.g. truancy, dropout, drug use at school). Thus, when examining risk factors of physical aggression, it is important to examine the effects of these risk factors as a set of behaviors associated with negative consequences during adolescence.

In addition to Jessor's problem behavior theory, Hawkins et al. (1992) provided a framework to examine risk and protective factors for alcohol and other drug related problems during adolescence, including delinquency and physical aggression (Hawkins et al. 1992). Their work focused on indentifying conditions that increase or decrease the probability of children and adolescents manifesting behavioral problems. Using Hawkins and colleagues framework, Szapocznik and Coatsworth (1999) proposed an ecodevelopmental model of risk and protection for understanding contextual factors within various domains for children and adolescents: family, peer, school and neighborhood (Szapocznik and Coatsworth 1999). Therefore, when examining risk and protective factors associated with physical aggression among youth, it is important to include factors beyond the individual and examine the influence of family, peer, and other social factors.

In addition to these general theories of risk and protective factors (e.g. Jessor's problem behavior theory, Hawkins's risk and protective model, Szapocznik's ecodevelopmental model), the theory of unstructured socializing (Osgood et al. 1996) can also provide a framework to the study of parental/adult supervision and peer influences associated with physical aggression and other behavioral problems during adolescence. According to this theory, an individual's likelihood for aggression and delinquency is increased in the absence of an adult authority figure's supervision and when an adolescent spends a significant amount of time without adult supervision and in the company of peers, then they will be more likely to engage in delinquency when an opportunity arises (Haynie and Osgood 2005; Osgood and Anderson 2004). Thus, reviews of these theories suggest that when examining risk and protective factors associated with physical aggression among adolescents, it is important to account for various contextual factors, including individual, family, and peer influences on physical aggression over time.

Although there is strong evidence for the role of risk and protective factors associated with physical aggression during adolescence, prior studies examining the relation between physical aggression, alcohol and drug-related behaviors among youth have reported mixed findings. Previous research suggests that (a) early alcohol and drug use are associated with later violent behaviors (Dembo et al. 2007; Ellickson et al. 2003; Kaplan and Damphousse 1995); (b) early violent behaviors predict later alcohol use and drug related problems (Farrington 1995; White et al. 1993; White and Hansell 1996); or (c) the relation between alcohol, drug-related and

violent behaviors is bidirectional or reciprocal (Huang et al. 2001; Newcomb and McGee 1989; White and Hansell 1996; Windle 1990; Xue et al. 2009) and that these behaviors can be explained as part of the general problem behavior syndrome (Jessor 1991; Jessor et al. 1995). Although several studies have examined the relationship between alcohol use and physical aggression during adolescence, little is known about the longitudinal relation between alcohol use and physical aggression among minority adolescents, primarily African American and Hispanic youth (Xue et al. 2009). Thus, it is important to examine the effects of alcohol, drug use, and physical aggression among minority adolescents by using longitudinal data, while accounting for other risk factors.

Theoretically, there are several reasons for investigating whether the developmental processes are invariant or variant across groups of individuals. For example, it is important to understand the extent to which a common set of risk and protective factors identified in primarily and predominantly white, US-based samples replicate among urban youth (particularly African American and Hispanic adolescents). This is important with respect to the extent to which general or race/ethnic/cultural-specific theories of delinquency and crime are warranted. On this score, Agnew's general strain theory presents one specific hypothesis wherein strains are expected to vary across race/ethnicity/culture, which in turn will generate unique adaptations with respect to crime and non-crime outcomes (Agnew 2001, 2006). Focusing on race/ethnic/cultural differences also affords the opportunity to pay specific attention to risk/protective factors that are uncommon in the more general, US-based delinquency research tradition.

It is also important to examine whether factors associated with trajectories of physical aggression differ across individuals. Trajectories of physical aggression and delinquency may vary across individuals for several reasons. First, black and Hispanic children living in the United States are exposed to some unique risk factors (e.g. greater exposure to neighborhood violence) that white children are not exposed to (Farrington et al. 2003; Piquero et al. 2006). Second, some risk factors, especially poverty and residence in disadvantaged communities, may be found at higher levels among black and Hispanic children. Third, risk factors may have longer duration and/or have interactive effects among black and Hispanic children. Fourth, protective factors may be less common among black and Hispanic children (Farrington et al. 2003). With regard to the second through fourth reasons, Farrington et al. (2003) examined reports of violence among whites and blacks (no Hispanics were available in the Pittsburgh Youth Study data) and found that predictors of violence included black race, poverty and single-parent families, young maternal age, physical punishment, a bad neighborhood, and poor school achievement. Moreover, even after controlling for the various risk factors, the relationship between race and violence was reduced but not eliminated. Additionally, Piquero et al. (2005) used data from the Baltimore Perinatal Project and found that, while similar risk factors related to chronic offending among whites and blacks, blacks had higher levels of the risk factors than whites (Piquero et al. 2005). Finally, McCord et al. (2001) have noted that compared to whites, blacks (and to a somewhat lesser extent Hispanics) are subject to higher rates of poverty and lengthy residence in disadvantaged environments, both of which have been found to be related to offending (McCord et al. 2001).

In a recent study, Maldonado-Molina and colleagues examined trajectories of delinquency behaviors among Hispanic adolescents living in two different cultural contexts (Bronx, NY and San Juan, Puerto Rico) (Maldonado-Molina et al. 2009). They found that adolescents living in the Bronx had a higher rate of delinquency and sensation seeking and exposure to violence and that these factors strongly discriminated offender trajectories. Thus, while the youth lived in different contexts, and the nature and level of delinquency varied across the sites, the effects of most risk factors were more similar than different.

Finally, there is also an accumulating body of literature that has demonstrated the importance of gender and how it relates to trajectories of delinquent behaviors. For instance, a number of recent applications of group-based trajectory models have indicated that the number of trajectory groups is similar among males and females, although the frequency of offending among the trajectory groups is often greater among the males (D'Unger et al. 2002; Odgers et al. 2009; Piquero et al. 2005). In addition, other studies have noted that there is less evidence of the continuity of problem behavior among females (Broidy et al. 2003).

The Current Study

The focus of the current study is to examine the effects of risk and protective factors at age 11 on trajectories of physical aggression over time (ages 12–14) among urban adolescents. Specifically, two research questions will be addressed. First, how many distinct patterns of physical aggression best represent the heterogeneity in physical aggression among young adolescents living in an urban context? Second, what are the effects of alcohol and substance use at age 11 on trajectories of physical aggression over time (ages 12–14) after controlling for other known risk factors? Based on prior research, it is hypothesized that between three to five classes will adequately represent the heterogeneity in trajectories among adolescents. It is expected that a least four trajectories will emerge: non-aggressive, increased aggression, decreased aggression, and a consistent high-rate of physical aggression. We also expect gender and ethnic differences in the trajectories of physical aggression in that the proportion of African American males will be higher in the trajectories associated with higher levels of physical aggression. It is hypothesized that substance use (particularly alcohol use), in addition to peer and family risk and protective factors (e.g. delinquent peer, lack of supervised time, prior contact with the police) will be positively associated with higher levels of physical aggression.

The present study uses a group-based approach to examine the effects of alcohol and substance use at age 11 on trajectories of physical aggression over time (ages 12–14) using self-report and longitudinal data from urban, mostly ethnic minority adolescents living in Chicago, IL. Our study addresses several gaps in the literature, as identified by Fontaine et al. (2009) in a recent review of the literature (Fontaine et al. 2009). First, instead of an aggregate portrait of aggressive behaviors, the current study uses a group-based trajectory procedure to empirically identify the number of trajectories of physical aggression. Using this approach is important because it permits the use of longitudinal data and minimizes the subjectivity in the identification of distinct trajectories of physical aggression and delinquency (Fontaine et al. 2009). Second, our study includes self-report data from a large sample of urban youth. Studies examining trajectories of offenders are often based on official crime data, which can underestimate the number of youth and young adults following a chronic aggressive trajectory; and self-report data have the advantage of providing information not identified by the police or official crime data or records (Fontaine et al. 2009). Third, our study uses longitudinal data to assess monthly physical aggression during early and mid-adolescence. This is an important contribution because it uses specific measures of physical aggression during early and mid-adolescence rather than global measures of delinquency, permitting identification of distinct trajectories and the evaluation of how risk and protective factors are associated with the development of distinct delinquent behaviors over time (Fontaine et al. 2009). Fourth, our study also uses longitudinal data from a large sample (over 3,000 adolescents ages 11–14 living in Chicago, IL) of an ethnically diverse and at-risk population (rather than a clinical or normative sample). In sum, using a group-based methodological framework provides the opportunity to study how physical aggression changes over time by investigating whether there are different groups of adolescents, examine whether trajectories of physical aggression exhibit different shapes at different developmental stages, and test the influence of personal, familial, social and environmental factors on the development of physical aggression over time.

Methods

Research Design

Data were from Project Northland Chicago (PNC), a randomized trial to test the efficacy of an alcohol preventive program for multi-ethnic urban youth (Komro et al. 2004, 2008). A cohort of youth enrolled in 61 public schools in Chicago participated in the study (29 schools assigned to the intervention, 32 to the comparison group) and completed self-report questionnaires when in 6th to 8th grade. Response rates ranged from 91 to 96% each year. Details on the research design, sample characteristics, and measures can be found elsewhere (Komro et al. 2008). Parental consent and student assent procedures were approved by the University of Minnesota's Institutional Review Board for the Protection of Human Subjects and the Chicago Public Schools' Law Department. University of Florida's IRB approved secondary data analyses. A Certificate of Confidentiality was obtained from the US Department of Health and Human Services to further protect the confidentiality of the student responses.

Participants

The PNC study sample included 5,766 adolescents (who completed surveys in 6th, 7th or 8th grade). Of these adolescents, 5,433 responded to the physical aggression questions, including 3,038 students who participated in the control group. The current project included only those students in the control condition: 1,160 Black, 1,015 Hispanic, and 863 White/other adolescents for a total of 3,038 adolescents (49.4% females and 50.6% males). The majority of adolescents had lived in the US their entire life (84.6%), spoke English in their homes (66.5%), lived in two-parent households (55.9%), and were low-income (80.2% receiving free or reduced-price lunch). Adolescents included in this study ranged from age 12 to age 14: mean age in 6th grade (mean = 12.31, SD = 0.56), 7th grade (mean = 13.26, SD = .49) and 8th grade (mean = 14.24, SD = .46). Table 1 include details of study participants.

Measures

Physical Aggression—A physical aggression index was created using four items measuring physical aggression during the past month. This index was created for each time point (including physical aggression at age 11 and three additional repeated measures over time (6th, 7th, and 8th grade; ages 12–14). Four items were included: During the last month, how many times have you: (1) told someone you were going to hit or beat them up? (2) Pushed, shoved, pulled someone's hair, or grabbed someone?; (3) kicked, hit, or beat up another person?; and (4) taken part in a fight, where a group of your friends were against another group? Responses to each of these four items included: "Never, 1–3 times, 4 or more times". An index was created by a composite of these four items and scores ranged from 0 to 8 (0 = "Never" to 8 = "4 or more times" to each of the physical aggression behaviors). The standardized Cronbach coefficient alpha of the physical aggression measure ranged from .81 to .84.

Alcohol and Substance Use—To measure alcohol, smoking and marijuana use, three items were used. Each item assessed past year (or ever use) alcohol, smoking and marijuana use.

Alcohol: Past year alcohol use was assessed with one item: "During the last 12 months on how many occasions, or times, have you had alcoholic beverages to drink?"

Smoking: Smoking was measured with one item: "Have you ever smoked a cigarette?" The current study did not measure past year cigarette use, and because past year smoking was not available, a measure of lifetime cigarette use was instead included.

Marijuana: Marijuana use was assessed with an additional item: "During the last 12 months, how many occasions, or times, if any, have you used marijuana (other names of marijuana are: pot, grass, weed, reefer, blunt, or hashish)?" Response options for each item were dichotomized to reflect "Never" or "1 or more occasions".

Demographic Variables and Other Covariates—Demographic variables included age, gender (1 = male, 0 = female), race/ethnicity, natural parent household, socioeconomic status, and nationality.

Race/Ethnicity: Race and ethnic background were assessed with one self-report item. Students were asked: "How do you describe yourself?" Responses included: Black or African American; Latino, Hispanic, or Mexican–American; White, Caucasian, or European American; Asian American; Native American; and Other. A dummy variable for "Hispanic" was coded as 1 if the youth reported that they were Latino, Hispanic, or Mexican–American and 0 if the youth reported being Black or African American or White, Caucasian, or European American or other. Similarly, a dummy variable for "Black" was coded as 1 if the youth reported that they were either Black or African American and 0 if the youth reported being Latino, Hispanic, or Mexican–American or White, Caucasian, or European American or other.

Nationality: Nationality was assessed with one item: "How long have you lived in the United States?" Responses were coded "All of your life" vs. "Foreign-born".

Socioeconomic Status: Reduced lunch, an indicator of socioeconomic status, was assessed with one item: "Do you receive free or reduced-price lunches at school?" Responses were coded as "Yes" vs. "No or don't know"

Natural Parent Household: Natural parent household was assessed with one item: "Who do you live with most of the time?" Responses were coded as "Mother and Father together" vs. Other.

Police Contact: Prior police contact was measured with one item: "During the last month, how often had you gotten into trouble with the police" Responses included "Never, 1–3 times, and 4 or more times".

Lack of Supervised Time: Lack of supervised time was assessed with one item: "About how many hours a day, do you usually spend without an adult around?" Responses included: None, <1, 1–2, 3–4 h, and 5 or more hours.

Delinquent Peers: Delinquent peers were measured with one item: "How many of your friends drink alcohol" Responses ranged from 0 to 4: "0 = None, 1 = A few, 2 = Some, 3 = Many, 4 = Almost All".

Analytical Strategy

To examine how many distinct trajectories of physical aggression best represent the heterogeneity in physical aggression, our first research question, we used mixture or group-based modeling. Mixture, or group-based methods are often used to model unobserved heterogeneity in a population, and this is especially the case for physical aggression where it is believed that there are subpopulations differing in their offending over the life-course (Nagin 2005; Piquero 2008). We employed the group-based procedure developed by Nagin and Land (1993) and programmed into the SAS computer package by Jones et al. (2001) (Jones et al. 2001; Nagin and Land 1993). This procedure, referred to as PROC TRAJ, is available from the web site of the National Consortium on Violence Research (www.ncovr.org).

Because the dependent variable was count data (number of delinquent events during the past month), we used the zero-inflated Poisson, or ZIP model (Jones et al. 2001), which takes into consideration the over-representation of zero-cell counts in the data. To evaluate model fit, we followed extant research and used the Bayesian Information Criterion (BIC). BIC (Schwartz 1978) tends to favor more parsimonious models than likelihood ratio tests when used for model selection. For a given model, BIC is calculated as: $BIC = \log(L) - 0.5k\log(N)$, where L is the value of the model's maximized likelihood, N is the sample size, and k is the number of parameters in the model (Nagin 2005). We used an iterative procedure to identify meaningful groups. The approach involved starting with one-group model and continued modeling with two, three, four, five, and six groups, until we maximized the BIC. We also examined trajectories using different types of polynomials (constant only, linear, quadratic, and cubic) in order to determine which approach best characterizes physical aggression in the PNC sample.

Then, we used the maximum posterior probabilities to evaluate the model's ability to sort individuals into the trajectory group to which they have the highest probability of belonging (the 'maximum probability' procedure). Based on the model coefficient estimates, the probability of observing each individual's longitudinal trajectories of physical aggression was computed conditional on his/her being, respectively, in each of the latent classes. The individual was assigned to the group to which he/she had the highest probability of belonging. This procedure, of course, does not guarantee perfect assignments (i.e., posterior probability assignments equal to 1.0 for each individual). Nevertheless, the mean assignment probabilities for each group were relatively high, suggesting that the large majority of individual trajectories can be classified to a particular group-based trajectory with high probability, and that the model had relatively little ambiguity when making these assignments.

To determine the effects of alcohol use, substance use and other covariates (at age 11) on the trajectories of physical aggression (ages 12–14), we used multinomial logistic regression. We used analysis-of-variance to examine baseline covariates associated with trajectory group membership and to compare the means of the risk factors across the different trajectories. Then, we used multinomial logistic regression to compare the ability of the risk/protective factors to differentiate among the groups. In all models, the non-aggressive trajectory served as the reference group to which we compare each of the physical aggression trajectories. We adjusted the standard error by calculating robust clustered standard error (to account for multilevel nature of the data, since participants were nested within 32 schools). Analyses were conducted in STATA 10 (StataCorp 2007).

To evaluate trajectories of physical aggression, adolescents who responded to any surveys at the end of 6th, 7th, or 8th grade were included ($n = 3038$); and all available data was used to determine the number of trajectories of physical aggression. We conducted the analyses using Proc TRAJ, a procedure in SAS to examine group-based latent trajectory models. Specifically, in the proc TRAJ estimation software, maximum likelihood parameter estimates are used to estimate the variance–covariance matrix (Nagin 2005). This analytical approach estimates the trajectories using all available observations on the dependent measure; and therefore, participants are included in the analyses if they have at least one valid observation of the dependent variable (in our study, the aggression outcome).

To examine the effects of risk and protective factors at age 11 on trajectories of aggression, only students who completed a survey at the beginning of 6th grade (age 11) were included ($n = 2136$). Therefore, $n = 882$ cases were excluded from the multinomial logistic regression analyses because no data was available for any of the covariates at age 11. Differences were observed at the end of 7th grade (age 13) ($F = 10.25$, $p = .01$); unexpectedly, a higher level of physical aggression was observed among those without missing data ($X = 3.37$, SD = 2.44) when compared with those with missing data at age 11 ($X = 2.98$, SD = 2.41). No significant

differences in physical aggression were observed between those with missing data at age 11 and levels of physical aggression at the end of 6th grade (age 12; $F = 2.63$, $p = .11$) or 8th grade (age 14; $F = .83$, $p = .36$).

Results

Trajectories of Physical Aggression Among Urban Adolescents Ages 12–14

Four trajectories of physical aggression behaviors were identified to represent the heterogeneity in aggressive behaviors among young adolescents living in an urban context. A model with four trajectories of physical aggression reported the lowest BIC (BIC = −13,597.1) when compared with models with three- (BIC = −13,662.8) and five- (BIC = −13,599.5) trajectory groups. Four trajectory groups included: Non-aggressive, Desistors, Escalators, and Chronic Aggressive. Figure 1 shows trajectories of physical aggression over time (Fig. 1).

The first trajectory, the “Non-aggressive group”, represented 16 percent of the sample (n = 485); and this group included the non-aggressive individuals who abstain from physical aggression across the three time periods (ages 12–14). The second trajectory, the “Desistors” represented 9 percent of the sample (n = 274) and reported a higher (non-zero) physical aggression rate at age 12, but then drops to low aggression at ages 13–14 (during 7th and 8th grade). The third group, the “Escalators” represented 19.8 percent (n = 601) of the adolescents; and they were initially a low aggression group (6th grade) but rapidly increased their physical aggression in 7th and 8th grade. Finally, the fourth group, the “Chronic Aggressive” trajectory represented the majority of the sample (55.2%; n = 1678). This group began at an initially high-rate of physical aggression and it remained consistently high across all waves (ages 12–14; 6th to 8th grade).

In addition, we found similarities in the number of trajectories, interpretation and prevalence when comparing results from the study sample (n = 3038) and those who only had data at baseline (n = 2136). Specifically, we tested for a 3-, 4-, and 5-class trajectory solution and findings indicated that, similar to the trajectory analysis with the full sample, the best fitting model with those present at baseline also supported a four-class solution: 16 percent (Non-aggressive), 11 percent (Desistors), 24 percent (Increasing), and 49 percent (Chronic-Aggressive). Thus, the number of trajectories, the interpretation, and prevalence were similar when comparing a subsample of those present at baseline to those the full sample included in the current study.

Risk and Protective Factors: One-Way Analysis of Variance

The results of the series of one-way analysis of variance tests are presented in Table 2. Overall, the non-aggressive trajectory group (group 1) included more females, and younger adolescents; a higher proportion of adolescents living with their mother and father, were Hispanic youth, and foreign-born adolescents. Non-aggressive also included a lower proportion of Black youth, had less delinquent peers, less unsupervised time, and less prior policy contact. In contrast, the “Chronic Aggressive” group, Group 4, reported the highest average physical aggression score and tended to have the highest score on most risk factors. This group contained slightly older adolescents; and a higher proportion of Black youth, US born youth, males, youth with delinquent peers, lack of supervised time, and prior contact with police.

Effects of Alcohol Use at Age 11 on Trajectories of Physical Aggression (Ages 12–14)

Past year alcohol use at age 11 discriminated among trajectories of physical aggression (Table 2). For instance, the rate of past year alcohol use was higher among the trajectories including physical aggressive adolescents (e.g. Desistors, Escalators, and Chronic Aggressive; ranged from 16 to 19%) and lower among Non-aggressive (11%). However, cigarette smoking and

marijuana use were not associated with trajectories of physical aggression. Other significant predictors that discriminated among trajectory groups included: age, natural parent household, race/ethnicity, US-born, gender, delinquent peers, lack of supervised time, prior contact with the police and physical aggression at baseline (Table 2).

After adjusting for baseline physical aggression, delinquent friends, lack of supervised time, several demographic variables, and smoking and marijuana use (Table 3), past year alcohol use at age 11 was a significant risk factor for "Escalators" and "Chronic Aggressive" physical aggression trajectories. For instance, past year alcohol users at age 11 were 2.1 times more likely to belong to the "Escalators" trajectory group (i.e. to increase their level of physical aggression behaviors over time (ages 12–14) (OR = 2.14, 95% = 1.31–3.49) and 1.9 times more likely to belong to the "Chronic Aggressive" group (who showed stable high levels of monthly physical aggression behaviors) (OR = 1.9; 95% = 1.18–3.00) when compared to the non-aggressive trajectory. In contrast, alcohol use was not a significant predictor among "Desistors"; and cigarette smoking and marijuana use were not associated with any of the trajectories of physical aggression.

To assess the hypothesis that alcohol use might be masking the predictive power of marijuana use, we estimated models including alcohol and marijuana separately. First, when including past year alcohol use (and removing marijuana use in past year from the model), results indicated that alcohol users were at higher risk for membership in the "Escalators" trajectory (OR = 2.3, $p < .05$) and the "Chronic Aggressive" trajectory (OR = 1.9, $p < .05$) when compared to membership in the "Non-aggressive" trajectory). In contrast, when excluding the alcohol use item and including only the marijuana use item, the findings suggested that marijuana use did not significantly distinguish group membership. Second, we examined whether marijuana use was a significant discriminator of trajectories of aggressive behaviors (at the bivariate level). Results indicated that, at the bivariate level, marijuana use at baseline differentiated between the "Chronic Aggressive" and the "Non-aggressive" trajectory group (OR = 3.5, $p < .01$), but after controlling for baseline aggression, this effect is no longer significant ($p = .56$). Finally, we estimated that among alcohol users at baseline ($n = 337$), only 22% ($n = 73$) also reported marijuana use in the past year at baseline, suggesting that a low percentage of adolescents reported having tried both alcohol and marijuana during the past year at baseline.

Gender and Ethnic Differences in Trajectories of Physical Aggression (Ages 12–14)

Gender and ethnic differences were also observed in the trajectories of physical aggression among urban adolescents. Males were more likely to be "Escalators" (OR = 1.52, 95% = 1.04–2.22) and in the "Chronic Aggressive" group (OR = 1.52, 95% = 1.05–2.22). In addition, after adjusting for several demographic, individual, peer and family factors, Black adolescents were 2.5 times more likely to be in the "Chronic Aggressive" group when compared to the "Non-aggressive" trajectory group (OR = 2.52, 95% = 1.24–5.14). A trend was also observed in that Black youth were at increased risk to be "Escalators" (OR = 1.81, 95% = 0.95–3.47; p = .08). No significant differences were observed across gender among "Desistors"; and no significant differences were observed among Hispanic youth across trajectories of physical aggression.

Discussion

The current study examined trajectories of physical aggression among young adolescents (ages 12–14) from an urban context and examined the effects of alcohol and substance use at age 11 on the trajectories of physical aggression over time while controlling for demographic factors and other known risk factors. Four trajectories best described the heterogeneity in physical aggression behaviors among young and urban adolescents. Trajectories of physical aggression included: Non-aggressive, Desistors, Escalators, and Chronic Aggressive. The number of trajectories of physical aggression was consistent with other studies. Our study found four

trajectories of physical aggression; and a review of the literature on developmental trajectories of criminal activity over the life course (Piquero 2008) found between three to five groups, independent of the methodologies used to measure criminal activity. Prior research has shown an adolescent-peaked pattern, a chronic aggressive pattern (which declines in most studies), and a late-onset chronic pattern (begins offending in mid and late adolescence and continues offending at a steady rate into adulthood). Our study, however, found an early onset chronic aggressive pattern (rather than a late-onset), an early adolescent-peaked pattern (which declines during mid adolescence) and rapid increased pattern. In addition, eight out of 10 adolescents had engaged in physical aggression behaviors between ages 12 and 14, including nearly six out of 10 adolescents who were in the "Chronic Aggressive" group. In sum, the current study is consistent with prior research in the number of trajectories of physical aggression; however, the prevalence of physical aggression in the trajectories differed from previous studies.

The current study included data from a high-risk sample of adolescents living in inner city Chicago between 2002 and 2005. The literature provides strong support that youth living in high-risk contexts, such as Chicago, are exposed to higher levels of violence and crime and demonstrate greater levels of involvement in violence and crime compared to more normative samples of youth in less disadvantaged areas (Center for Disease Control and Prevention 2009; US Department of Justice 2008). Thus, it is not surprising that these Chicago youth reported substantially higher rates of physical aggression when compared to more normative samples of adolescents (where most research has been conducted and where findings suggest that the majority of adolescents fall into the "non-aggressive" or "desistors" groups).

It is important to acknowledge that the results from this study are not necessarily generalizable to the general population of normative adolescents. When compared with studies using general samples, our study identified a similar number and interpretation of trajectories. However, our study findings are not entirely consistent with prior research in the estimates of the prevalence of these trajectory groups. As described above, one possible explanation for why these differences in the prevalence are observed may be the result of the differential exposure to and involvement in violence among youth situated in a high-risk and disadvantaged urban area. As such, we believe that this divergence represents a unique contribution of our study. Overall, our findings provide support for similarities in the developmental processes related to aggressive behaviors, while acknowledging significant differences in the prevalence of aggression because of the higher exposure to and involvement in violence and crime in a high-risk and disadvantaged urban area, such as Chicago, IL.

Findings suggest that, after controlling for age and baseline physical aggression, several individual, peer, and familial factors were relevant to the study of trajectories of physical aggression over time. These factors included: race, gender, US born, natural parent household, alcohol use, and delinquent peers. For instance, black youth were 2.5 times more likely to report consistently high levels of physical aggression behaviors between ages 12–14. These findings are consistent with previous research suggesting that even after controlling for various risk factors, the relationship between race and violence was reduced but not eliminated (Farrington et al. 2003). Our findings are also consistent with studies showing ethnic and racial differences in exposure to crime (Logan and Stults 1999; Logan et al. 2004). For instance, evidence suggests an independent effect of race on exposure to violent crime regardless of socioeconomic status, in that Blacks live in communities with higher rates of violent crime when compared with their White counterparts (Chauhan et al. 2009; Logan and Stults 1999). Similarly, research suggests that youth who live in socially disadvantaged contexts report higher rates of delinquent behaviors, exposure to violence, and neighborhood problems (Elliott et al. 1996a; Piquero et al. 2006; Tobler et al. 2009b).

Findings also suggested that alcohol use was an important risk factor in the trajectories of physical aggression among urban adolescents. Past year alcohol users were two times more likely to be in the "Escalators" and "Chronic Aggressive" trajectory groups. Specifically, after adjusting for baseline physical aggression, delinquent peers, lack of supervised time, several demographic variables, smoking and marijuana use, past year alcohol users at age 11 were 2.1 times more likely to increase their level of physical aggression over time (ages 12–14), and 1.9 times more likely to remain in the "Chronic Aggressive" trajectory group. Unexpectedly, smoking and marijuana use were not associated with any trajectories of physical aggression among adolescents. This is an important finding because it highlights the role of alcohol, rather than other substances, in the development and progression of physical aggression behaviors among adolescents. Moreover, our study does not provide evidence supporting the hypothesis that alcohol use is masking the predictive power of marijuana use. Therefore, when examining the relationship between substance use, aggression, and delinquency during adolescence, it is important to examine the independent effect of alcohol, rather than examine it as a composite of substance use on the development of physical aggression, violence and delinquency over time. Future studies should examine marijuana use as an indirect effect of the relationship between alcohol use and trajectories of behaviors over time.

Gender differences were also observed in the trajectories of physical aggression over time. Consistent with prior applications of group-based trajectory models (Broidy et al. 2003; D'Unger et al. 2002; Odgers et al. 2009; Piquero et al. 2005), males were at higher risk to belong to the "Escalators" and "Chronic Aggressive" trajectories. Specifically, being male significantly increased an individual's likelihood for being assigned to an increasing or chronic trajectory group rather than to a non-aggressive trajectory group. Furthermore, these results are also consistent with a recent study by Jennings and colleagues who found that males and females had similar trajectories of delinquency, yet the frequency of escalating and chronic delinquency was greater among the males (Jennings et al. 2009).

In addition to reporting gender differences in the trajectories of physical aggression among adolescents, our study suggested that adolescents who were born in the United States were more likely to increase physical aggression over time (e.g. be assigned to the "Escalators" trajectory). The concept of "US-born" can serve as a proxy for the complex process of acculturation. For instance, previous research among Hispanic adolescents has provided strong evidence that US-born youth are at higher risk for substance use, delinquency, and other behavioral problems (Delva et al. 2005; Duarte et al. 2008; Maldonado-Molina et al. 2007, 2009; Prado et al. 2009; Vega and Gil 2005). Although the current study did not examine acculturation as a developmental process, after accounting for race/ethnic differences in the rates of physical aggression, youth who were born in the US were at increased risk for engaging in physical aggression over time, a finding consistent with other studies and that highlight the role of acculturation during adolescence.

The role of delinquent peers is another important factor discriminating between trajectories of physical aggression. For instance, delinquent peers were associated with a higher risk for increasing physical aggression (i.e. Escalators) and consistently high levels of physical aggression. These findings are also consistent with Jennings et al. (2009) who examined the role of peer delinquency and found that delinquent peers significantly distinguished the moderate and high-rate trajectory groups from the non-delinquents for both males and females (Jennings et al. 2009). In addition, our results regarding the delinquent peer effect are also similar with a number of other recent studies that have indicated that associating with delinquent peers is particularly salient for increasing the likelihood of involvement in crime and delinquency (Akers and Jennings 2009). Moreover, after controlling for several demographics and risk factors (guided by Jessor's behavioral-problem theory), alcohol use at baseline was associated with trajectories of physical aggression over time. This is an important

finding that provides support for previous studies showing alcohol use as a risk factor for physical aggression among youth (Lipsey et al. 1997; NIAAA 2000; Roizen 1993).

In contrast to the risk factors associated with physical aggression, adolescents living in a natural parent household (e.g. mother and father together) were less likely to belong to any of the physical aggression trajectories; therefore, youth living with mother and father together were at a lower risk for being assigned to an Escalators, Desistors, or Chronic Aggressive trajectory. Although Osgood et al. (1996) have suggested that unstructured socializing increases an individual's likelihood for delinquency, our results suggested that unsupervised time was not significantly associated with trajectories of aggressive behaviors; however, it is possible that unsupervised time and natural parent household are accounting for similar behaviors (and therefore they are not independent). It is also possible that there may be an interaction effect between delinquent peers and unstructured socializing. For example, perhaps just merely spending greater amounts of time in the absence of adult supervision is not a risk factor per se; rather, the risk is only observed when a youth is spending a significant portion of their unsupervised time in the presence of delinquent peers.

Strengths and Limitations

The findings from this study should be considered in light of a few limitations. Although, this study examined the effect of alcohol and substance use at age 11, in addition to various risk factors at multiple levels (e.g. demographic variables, peer and family, and other individual factors), we did not examine how changes in trajectories of alcohol and substance use were associated with changes in physical aggression over time. Future research should examine how trajectories of alcohol in early adolescence are associated with trajectories of physical aggression from adolescence to adulthood. Second, it is important to acknowledge that the majority of the factors included in the current study were coded as a risk factor (associated with increased probability of negative outcomes), except natural parent household. Thus, future research should make an effort to incorporate more protective factors when available. Third, considering that our trajectory analysis relied on single-item measures and self-report data, future studies should include data from multiple sources and examine reports of physical aggression behaviors among early and middle adolescence (ages 12–14) using official data. For example, only one measure of lifetime cigarette use was included, which did not discriminate between experimenters and regular smokers. Similarly, the lack of supervised time item did not measure the extent to which a parent knows the whereabouts of their adolescent. Future studies should include data from multiple sources, including parent, teacher, and direct observer reports. Also, future studies should examine whether or not the findings can be replicated using official sources of data (e.g., arrest, conviction, incarceration records). Fourth, our study included data from minority adolescents, primarily Black and Hispanic youth, living in Chicago, IL, an urban high-risk context. We found that, after controlling for various risk factors at multiple levels, Black youth were at increased risk for "Chronic Aggressive" group. Future research should examine the etiology of physical aggression during early adolescence to increase our understanding of the contextual factors (e.g. exposure to violence, neighborhood disorganization) by which Black youth were at increased risk for physical aggression when compared to other adolescents from similar urban contexts. Finally, the current study does not examine the dynamic nature of changes in substance use and aggression between ages 11–14; modeling the dynamic nature of aggression and substance use as distinct (but related processes) related to adolescent development is outside the scope of the current project. Future research should examine the reciprocal effects between substance use and aggression (dynamic nature of two behaviors occurring at the same time and not focus on the evaluation of the temporal order of the effects).

Our study has several strengths. First, in the current study, we focus specifically on examining the temporal order of the effects of risk/protective factors at age 11 to changes over time in aggression (ages 12–14). Second, the current study supports previous research insofar as the number of trajectories and their respective interpretations, while also providing new information on how the prevalence in these trajectories of physical aggression differs across groups among at-risk urban youth. The current study provided a rationale for the investigation of differences in the prevalence of physical aggression behaviors as youth included in the current study where living in Chicago, a context with higher than the national average of violence and exposure to crime. Third, our study included longitudinal data from a large, ethnically diverse at-risk sample of urban youth in a disadvantaged area. For instance, a recent review of 46 empirical studies examining trajectories of antisocial and delinquent behaviors, seven studies included longitudinal data from low-income urban adolescents (primarily African American and Hispanic) (Fontaine et al. 2009). Fourth, our study examined the effects of individual, familial, and peer influences on trajectories of physical aggression over time and permitted the evaluation of temporal effects in the developmental process of physical aggression over time. For instance, the current study design permitted the evaluation of behaviors at age 11 on trajectories of physical aggression between ages 12–14. In sum, our study permitted the investigation of risk and protective factors associated with trajectories of physical aggression among minority adolescents, primarily Hispanic and African American youth.

In conclusion, the current study examined trajectories of physical aggression among urban, primarily African American and Hispanic, youth. Four trajectories were identified: Non-aggressive, Desistors, Escalators, and Chronic Aggressive. Findings suggest that alcohol use at age 11 was related to increased risk to belong to the “Escalators” and “Chronic Aggressive” trajectories (ages 12–14). Gender and ethnic differences were also observed in the trajectories of physical aggression. Findings highlight the need for prevention research to reduce physical aggression among urban adolescents and to examine the etiology of the trajectories of physical aggression among urban youth across the life-course.

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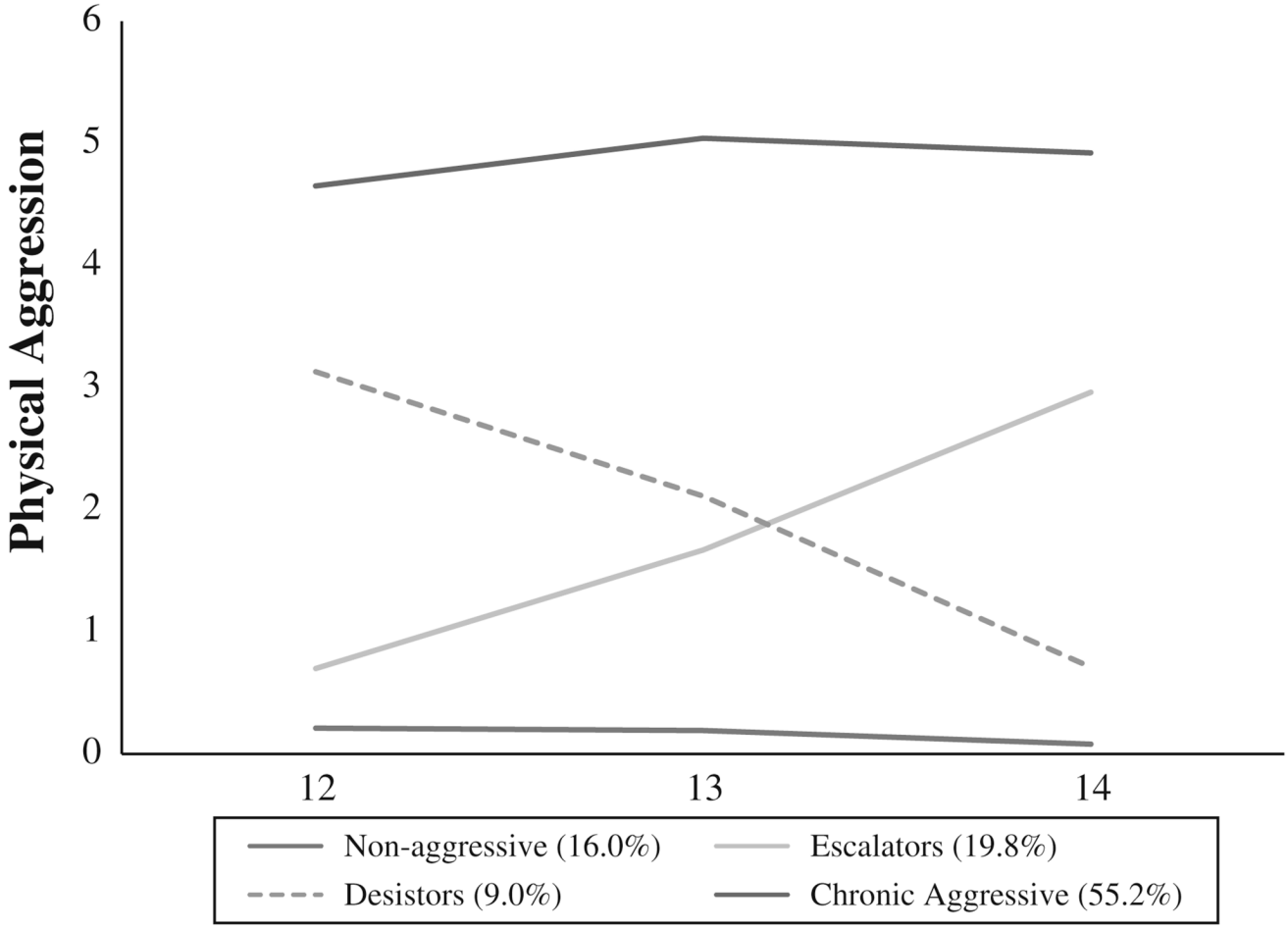

Fig. 1.
Trajectories of past month physical aggression among urban youth, ages 12–14, PNC study, Chicago, IL, 2002–2005

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Table 1

Sample descriptives (n = 3,038) of demographics and covariates at the beginning of 6th grade (age 11) and physical aggression behaviors over time

Variables	Mean	SD	Proportion	Minimum	Maximum
Demographics/covariates					
Age	11.84	0.57	–	10.34	14.34
Male	–	–	0.51	0.00	1.00
Black	–	–	0.38	0.00	1.00
Hispanic	–	–	0.33	0.00	1.00
US born	–	–	0.85	0.00	1.00
Low socioeconomic status	–	–	0.80	0.00	1.00
Natural parent household	–	–	0.56	0.00	1.00
Delinquent peers[a]	0.50	0.87	–	0.00	4.00
Unsupervised time[b]	1.71	1.44	–	0.00	4.00
Prior police contact	–	–	0.09	0.00	1.00
Alcohol and substance use					
Past year alcohol use	–	–	0.16	0.00	1.00
Ever smoking	–	–	0.10	0.00	1.00
Past year marijuana use	–	–	0.06	0.00	1.00
Physical aggression behaviors					
Baseline[c]	2.62	2.36	–	0.00	8.00
6th grade (Age 12)[c]	3.05	2.49	–	0.00	8.00
7th grade (Age 13)[c]	3.27	2.44	–	0.00	8.00
8th grade (Age 14)[c]	3.27	2.49	–	0.00	8.00

[a]Range: 0–4; a higher score on this scale indicates a higher number of delinquent friends

[b] Range: 0–4; a higher score on this scale indicates a higher number of hours without adult supervision

[c] Range: 0–8; a higher score on this scale indicates higher physical aggression

Table 2

Baseline covariates associated with trajectory group membership: analysis-of-variance results (n = 2136)

Variables	G1	G2	G3	G4	*F*-test	*p*-value
Past year alcohol use	.11	.16	.19	.16	2.82	.037
Ever smoking	.09	.12	.09	.10	.51	.676
Past year marijuana use	.05	.07	.05	.05	.53	.665
Natural parent household	0.70	0.59	0.61	0.50	16.63	<.001
Low socioeconomic status	0.82	0.80	0.78	0.80	.67	.571
Hispanic	0.44	0.39	0.41	0.27	26.54	<.001
US born	0.78	0.87	0.80	0.87	7.78	<.001
Male	0.41	0.50	0.52	0.53	6.75	<.001
Delinquent peers[a]	0.16	0.48	0.26	0.68	46.07	<.001
Unsupervised time[b]	1.33	1.57	1.63	1.86	12.53	<.001
Black	0.18	0.28	0.28	0.49	71.83	<.001
Age	11.73	11.75	11.79	11.90	10.23	<.001
Prior police contact	0.02	0.07	0.03	0.13	22.84	<.001
Physical aggression (baseline)[c]	0.74	2.36	1.33	3.59	234.77	<.001
Physical aggression (6th grade)[c]	0.21	3.13	0.70	4.65	1215.34	<.001
Physical aggression (7th grade)[c]	0.19	2.11	1.67	5.04	1123.97	<.001
Physical aggression (8th grade)[c]	0.08	0.71	2.96	4.92	1037.60	<.001

G1 non-aggressive, G2 desistors, G3 escalators, G4 chronic aggressive

[a] Range: 0–4; a higher score on this scale indicates a higher number of delinquent friends

[b] Range: 0–4; a higher score on this scale indicates a higher number of hours without adult supervision

[c] Range: 0–8; a higher score on this scale indicates higher physical aggression

Table 3

Distinguishing trajectory group membership by LCA group probabilities and baseline covariates: multinomial logistic regression results (n = 2136)

	b	robust se	exp b (OR)
Past year alcohol users			
G2	0.10	0.43	1.10
G3	0.76	0.25	2.14**
G4	0.63	0.24	1.88**
Past year marijuana users			
G2	0.92	0.69	2.52
G3	0.78	0.53	2.18
G4	0.56	0.54	1.75
Ever smokers			
G2	−0.15	0.36	0.86
G3	−0.48	0.34	0.62
G4	−0.30	0.33	0.74
Natural parent household			
G2	−0.49	0.19	0.61***
G3	−0.44	0.17	0.65**
G4	−0.40	0.17	0.67**
Low socioeconomic status			
G2	−0.27	0.32	0.77
G3	−0.25	0.29	0.78
G4	−0.19	0.21	0.83
Hispanic			
G2	−0.08	0.33	0.93
G3	0.14	0.20	1.15
G4	−0.05	0.30	0.95
US born			
G2	0.52	0.25	1.68*
G3	−0.02	0.21	0.98
G4	0.23	0.22	1.26
Male			
G2	0.19	0.26	1.22
G3	0.42	0.19	1.52*
G4	0.42	0.19	1.53*
Delinquent peers			
G2	0.64	0.20	1.90***
G3	0.32	0.23	1.38
G4	0.55	0.20	1.73**
Unsupervised time			

	b	robust se	exp b (OR)
G2	0.03	0.10	1.03
G3	0.13	0.08	1.14
G4	0.13	0.09	1.14
Black			
G2	0.02	0.36	1.02
G3	0.59	0.33	1.81
G4	0.93	0.36	2.52**
Age			
G2	−0.11	0.04	0.89**
G3	0.00	0.05	1.00
G4	−0.06	0.05	0.94
Prior police contact			
G2	−0.74	0.48	0.48
G3	−0.85	0.61	0.43
G4	−0.60	0.45	0.55
Physical aggression (baseline)			
G2	0.52	0.06	1.69***
G3	0.24	0.06	1.27***
G4	0.75	0.06	2.11***
Model diagnostics			
Log likelihood = −1518.05			
Craig and Uhler's R^2 = 0.29			

G1 non-aggressive, G2 desistors, G3 escalators, G4 chronic aggressive

* $p < .05$;

** $p < .01$;

*** $p < .001$