J Youth Adolescence (2016) 45:746–762
DOI 10.1007/s10964-016-0417-2

EMPIRICAL RESEARCH

Dual Trajectories of Gang Affiliation and Delinquent Peer Association During Adolescence: An Examination of Long-Term Offending Outcomes

Beidi Dong[1] · **Marvin D. Krohn**[2]

Received: 11 November 2015 / Accepted: 4 January 2016 / Published online: 9 January 2016

Abstract Prior research has demonstrated that both adolescent gang affiliation and perceived delinquent peer association are important predictors of individual offending. A crucial question is whether and how youth gang affiliation contributes to a spectrum of criminal acts above and beyond the influence of associating with delinquent peers. Using 14 waves of data from the Rochester Youth Developmental Study, an ongoing longitudinal panel study aimed at understanding the causes and consequences of delinquency and drug use in an urban sample of adolescents, the current study employs a relatively new modeling technique—dual trajectory analysis—to illustrate the dynamic relationship between these two measures among 666 male youth. The results suggest that the two measures, while overlapping, may constitute distinct concepts that operate in different ways. The most convincing evidence of gang effects, above and beyond the influence of perceived peer delinquency, is for violent behavior and by extension police arrest. Our findings contribute to developmental research and provide information that informs future gang control efforts.

Keywords Gang membership · Perceived peer delinquency · Dual trajectories · Life course · Adolescence

✉ Beidi Dong
bdong@mail.med.upenn.edu

[1] Penn Injury Science Center, Center for Clinical Epidemiology and Biostatistics, University of Pennsylvania, Blockley Hall Room 936, 423 Guardian Drive, Philadelphia, PA 19104, USA

[2] Department of Sociology and Criminology and Law, University of Florida, Turlington Hall Room 3340, Gainesville, FL 32611, USA

Introduction

The disproportionate involvement in serious and violent delinquency by youth gang members is "perhaps the most robust and consistent observation in criminological research" (Thornberry et al. 2003, p. 1). Existing evidence suggests that gangs function as a crime-facilitating context (Melde and Esbensen 2011; Thornberry et al. 1993), and the link between gang membership and offending holds across time, geographic and national boundaries, sex or race/ethnicity division, definitions of gangs and gang membership, and different measurements of offending (Klein and Maxson 2006; Krohn and Thornberry 2008). Prior research has also clearly demonstrated that perceived delinquent peer association is one of the strongest predictors of criminal offending, especially in adolescent years (Agnew 1991; Warr 2002). Since gang affiliation can be considered a form of delinquent peer association, the question arises as to whether the observed relationship between gang membership and crime facilitation is due to something unique to being in a gang or simply a function of having many friends who are delinquent. The elevated level of delinquency, drug use and violence exhibited by youth gang members may be spurious, simply reflecting the fact that youth gangs are only aggregates of deviant friends, albeit at the more extreme end of the continuum.

It is crucial to determine whether and how adolescent gang affiliation contributes to a spectrum of criminal acts above and beyond the influence of associating with delinquent peers. From a policy-making point of view, a lack of understanding of the unique contribution of gang affiliation above and beyond peer delinquency can lead to two types of errors. If no unique contribution exists but current policies emphasize gang suppression, a Type I error (or a "false positive") may lead to profiling, undeserved

sentencing enhancements, and a host of collateral damage (Hallsworth and Young 2008). On the other hand, if gang affiliation indeed leads to higher rates of crime and delinquency above and beyond associating with deviant friends, not acknowledging the distinction leads to a Type II error (or a "false negative"), raising safety issues for both law enforcement and society in general (Kennedy 2009).

Against this background, the current study sets out to disentangle the interrelationship between adolescent gang affiliation and perceived delinquent peer association from a life-course perspective. To the best of our knowledge, prior research has paid little attention to how this interrelationship may differ across individuals and evolve over time. Using Nagin's (2005; Nagin and Tremblay 2001) dual-trajectory modeling technique, we take full advantage of longitudinal panel data and present a dynamic relationship between the two measures during adolescence. Based on that, we move beyond prior research and explore the crime-facilitating effects of gang affiliation above and beyond an individual's adolescent history of peer delinquency on criminal outcomes in adulthood. Importantly, the analyses take into account the developmental patterns of these two variables during adolescence, a critical stage in the life course in which future patterns of criminal offending are grounded.

Peer Delinquency as a Predictor of Gang Membership

Developmental psychologists have argued that peer interaction, especially in the form of age-graded, same-sex peer groups, is an essential element in the transition from childhood to adulthood. Prior to adolescence, individuals are embedded in conventional networks, and they are largely dependent on those networks for resources. During adolescence, peer groups become a temporary replacement of parents and home, providing the setting in which adolescents establish their first identity outside the family. Through observing and interacting with their peers, "adolescents acquire interactional skills and learn the 'rules' about work, dating, sex, interpersonal conflict, and life in general" (Warr 2002, p. 25). In many ways, peers become an independent source of status, self-esteem and even protection. Yet, since age-graded peers are going through the same process of establishing "age-appropriate autonomy" at roughly the same time (Conger 1991, p. 208), adolescent peer groups are partially closed to adult authority while valuing behaviors that demonstrate separation or rebellion from adult authority. One consequence is that the peer culture encourages and reinforces deviant life-styles and experimentation with delinquency and substance use (Thornberry and Krohn 2005).

It is therefore not surprising to observe that perceived delinquent peer association serves as a noted risk factor for gang participation and associated increased levels of deviant behaviors net of other risk factors (Decker et al. 2013; Krohn and Thornberry 2008). Using data from the Seattle Social Development Project, Hill et al. (1999) examined risk factors measured at ages 10–12 as predictors of gang membership between ages 13 and 18. They found that association with deviant peers is one of the most potent risk factors for gang membership. Similarly, using data from the Rochester Youth Development Study, Thornberry et al. (2003) examined risk factors measured before age 14 on the probability of gang affiliation between ages 14 and 17. Unsurprisingly, perceived delinquent peer association is a robust predictor of gang affiliation. Association with delinquent peers, however, is not effective in differentiating within the gang member population (e.g. predicting the duration of gang membership). Klein and Maxson (2006) conducted a synthesis of 20 empirical studies on gang risk factors. They found that the characteristics and dynamics of peer networks receive consistent support in the literature, and concluded that "characteristics of peer networks should receive attention in most gang programs" (Klein and Maxson 2006, p. 148). Several other longitudinal studies have also identified risk factors for gang membership, and association with deviant peers is a significant predictor in each of the studies (e.g. Craig et al. 2002; Gatti et al. 2005; Lahey et al. 1999). Moreover, in one of the most thorough reviews of the gang risk factor literature, Howell (2012, pp. 131–132; Howell and Egley 2005) emphasized the importance of association with delinquent peers in both the "later-childhood" and "early adolescence" stages.

While identifying perceived peer delinquency as a key risk factor for gang participation is meaningful, it is also helpful to make sense of individual motivations for gang joining from a qualitative perspective. Among other attractions (e.g. for protection, for fun or for respect), having friends in the gang is an often cited reason for youth gang participation. For example, Moore's (1978) and Vigil's (1988) early ethnographic studies noted the strong influence of friends on an individual's decision to join a gang. Decker and Van Winkle (1996, p. 65) found that "the prompting of friends and/or relatives" is the second most important reason for gang joining in St. Louis, MO, USA. Becoming a gang member is a natural part of hanging out with friends in the neighborhood:

> I ain't going to say it's going to be my life but it was just something that came up to me where I was staying. I was just with the fellas and it just happened that I became one of them (Decker and Van Winkle 1996, p. 67). This statement represents a typical reason of participation provided by gang youths.

Esbensen et al. (1999, p. 44) also examined reasons for joining a gang using data from the National Evaluation of the Gang Resistance Education and Training (G.R.E.A.T.) program. "Because a friend was in the gang" is one of the most frequently cited reasons for gang joining. Thornberry et al. (2003, p. 78) compiled gang members' responses regarding their motivation for joining a gang in Rochester, NY, USA. More than half of these gang youths specified "friends/family members in the gang" as the primary reason they joined. Moreover, Klein and Maxson (2006, p. 159) summarized the differences between gang and non-gang youths in the reasons they selected for joining their primary peer group in both San Diego and Long Beach, CA, USA. "Friend was a member" is one of the reasons more commonly identified by gang boys.

Gang Membership, Peer Delinquency and Crime

The flip side of the story is that youth gangs may be qualitatively different from non-gang delinquent peer groups. Based on her illuminating work on two Chicano gangs in East Los Angeles, Moore (1991) concluded that "gangs are no longer just at the rowdy end of the continuum of local adolescent groups—they are now really outside that continuum" (p. 132). In a similar vein, Klein (1995) contended that "gangs are something special, something qualitatively different from other groups and from other categories of law breakers" (p. 197). From this perspective, youth gang affiliation should exert a strong proximal criminogenic influence on the attitude and behavior of their members above and beyond the influence of highly delinquent, but non-gang, friends.

Gangs may differ from other law-violating youth groups in their criminogenic effects for several reasons. First, organizational structure combined with some sense of permanence or stability is unique to gangs.[1] Other law-violating youth groups are typically comprised of small aggregates of adolescents that are highly transitory and not well organized (Warr 1996). Although many of these groups are involved in occasional delinquent behavior, they lack a commitment to a criminal orientation. They form temporally over a special issue then are disbanded and never seen again. "These adolescent groups lack the size, formal organization, and permanence of youth gangs, and their delinquency is typically not as frequent, serious, or violent" (Howell 2012, p. 62). On the other hand, Esbensen et al. (2001) found that members of gangs that were somewhat organized (with initiation rites, established leaders, and symbols or colors) self-reported higher rates of delinquency and involvement in more serious delinquent acts than other youths. Decker et al. (2008) also observed crime amplification effects of gang organization.

Second, gang structures may differ, but these differences are "trumped, covered over, by group processes" (Klein and Maxson 2006, p. 194). Youth gangs persist in part because they fulfill certain needs of their members including the desire for status, sense of belonging, perceived protection or respect. Derogation of one of their members affects "collective honor", which demands immediate, aggressive and violent responses (Papachristos 2009, p. 82). As Horowitz (1983) explained, "in seeking to protect and promote their reputation, gangs often engage in prolonged wars" (p. 94). "It is the advancement into a delinquent or criminal or retaliatory mentality that brings the gang into its self-realization" (Klein and Maxson 2006, pp. 205–206). In effect, youth gangs develop group esteem in place of self-esteem, and gang cohesiveness and crime, especially in the form of uncompromised violent confrontation, build upon and reinforce each other (Short and Strodtbeck 1965).

A related point is that any intervention or suppression efforts may unintentionally facilitate gang-related crimes. Prior research has indicated that an "oppositional culture" develops in youth gangs, representing "an institutionalized rejection of the values of adult authority" (Moore and Vigil 1989, p. 31). Each rejection of the gang from conventional social institutions merely reinforces its cohesiveness and its dependence upon itself. Lien (2002) noted that gang members often viewed themselves as the victims of oppression, the unfair targets of racism and inequality, which is consistent with the findings that gang members often expressed less guilt and mobilized more techniques of neutralization for offending than other youth did (Esbensen and Deschenes 1998). Accordingly, the threat of suppression is likely to be discounted by gang members and strong collective social identities motivate members to challenge rather than defer to such threats. This is unlikely to be seen among other law-violating youth groups.

Moreover, unlike most delinquent peer groups, gangs claim physical turf or territory. Identification with a particular territory is another form of symbolism that helps consolidate group solidarity. More importantly, "under the worst slum conditions, territorial claims are inexorably linked with financial, human, and social capital" (Howell 2012, p. 57). This well-defined gathering place or "set space" thus serves as a niche within the greater community

[1] We recognize that there is debate on the level of organization or structure associated with youth gangs. For example, studies in a growing number of cities show that "gangs are generally loosely organized groups that are constantly changing—consolidating, reorganizing, and splintering" (Howell 2012, p. 32). We thus propose this argument as one of the several possible mechanisms through which gangs may uniquely contribute to crime and delinquency; this is not a necessary or sufficient reason.

that allows the gang to survive and even flourish (Tita and Ridgeway 2007, p. 215). As Thornberry et al. (2003) stated, "the staking out and protection of turf is another source of conflict and violence that appears to be absent from non-gang peer groups" (p. 141).

Prior research has provided mixed evidence regarding the unique contribution of gang membership, above and beyond the influence of delinquent friends, to a spectrum of criminal acts. Downes (1966) assessed the necessity of gang organization of peers in promoting delinquency in his study of two boroughs in East London. He suggested that peers provided an important reference group for youth who had favored a delinquent solution to their problems, but that peers' organization into a gang may be unrelated to delinquency. Using data from a national survey of collective youth crime, Miller (1982, p. 4) distinguished between crimes committed by "law-violating youth groups" and "gangs". Although both groups were crime-prone, Miller concluded that "gang members are distinguished from other youths by the high level of their involvement in the most serious forms of violent crime" (p. 140). Morash (1983) made an effort to "demonstrate the relative association of two variables, membership in a stereotypic gang and peers' delinquency, with individuals' seriousness of delinquency" (p. 325). She found that *gang-likeness* was not a sufficient or necessary condition for peers to influence delinquency and was not an important predictor of delinquency even in combination with other variables. The gang-focused theories were no better supported for specific types of delinquency than for delinquency in general.

More recently, Huizinga (1996), Battin et al. (1998), and Thornberry et al. (2003) examined the differential effects of associating with delinquent peers inside versus outside of a gang structure. Using data from the Denver Youth Survey, Huizinga (1996) classified youth aged between 14 and 19 into four groups—those who had low, medium, and high involvement with delinquent friends, and those who were gang members. Compared with non-gang members with highly delinquent peers, gang members exhibited a substantially higher prevalence of serious and total assaults. Similarly, Battin et al. (1998) divided study subjects of the Seattle Social Development Project into three groups: self-reported gang members, non-gang members with delinquent peers, and individuals who were not in a gang and had few or no delinquent friends. They noted that gang membership appeared to facilitate violent and general delinquent acts, but significant differences were not observed for non-violent and minor offenses (including substance use) between gang members and youths with delinquent friends. Thornberry et al. (2003) conducted a more conservative test of the hypothesis by "comparing gang members with an equal number of non-members based on the highest density of delinquent peers in their social network[2]" (p. 146). The results indicated that being a gang member contributed to elevated levels of violent delinquency and drug sale. Yet, gang membership had no greater impact for drug use than associations with delinquent friends.

Additionally, previous studies have included both measures of gang membership and perceived peer delinquency in the same regression model predicting delinquency.[3] For example, Thornberry et al. (2003), Gordon et al. (2004), Melde and Esbensen (2011, 2014) observed that the coefficient for gang membership remained statistically significant when the influence of perceived peer delinquency was held constant, suggesting evidence of gang effects above and beyond associating with delinquent friends. On the other hand, perceived peer delinquency indeed explained a portion of the increase in delinquency associated with gang participation.

The Current Study

Decades of research indicates that perceived peer delinquency is a significant predictor of gang membership, and recent evidence seems to suggest that gang membership contributes to delinquency, especially violent offending, above and beyond the influence of delinquent peers. There are, however, two overarching limitations to the current status of the literature. First, when examining the interrelationship between gang affiliation and perceived peer delinquency, prior research has made inefficient use of longitudinal data. Specifically, they failed to take into account developmental heterogeneity among individuals in gang involvement or association with delinquent friends, thus ignoring the dynamic dimension of the overlap between the two measures. "The customary interpretation of a summary statistic relating two variables, whether it be a correlation coefficient or a multiple regression coefficient, is that its magnitude applies equally to all individuals within the population under study" (Nagin 2005, p. 145). However, a more complicated but more realistic alternative is that for some subpopulations, there may be very little association; while for other subpopulations, the association may be much stronger. Given the enormous cost of conducting longitudinal studies, it is unacceptable to overlook the developmental nature of this issue.

[2] "The matched group of non-members actually reports having a significantly greater number of delinquent peers than do the gang members" (Thornberry et al. 2003, p. 147).

[3] Several studies have included peer delinquency as a covariate when calculating a propensity score of gang participation (e.g. Ariza et al. 2014; Gilman et al. 2014; Pyrooz 2014a).

Second, prior research has not examined the enduring consequences of adolescent gang affiliation on subsequent offending controlling for perceived delinquent peer association in a developmental manner (i.e. beyond one cross-section in time). As we reviewed above, most extant studies have only made cross-sectional comparisons or looked at immediate or short-term outcomes. An increasing number of empirical studies have observed the enduring consequences of gang membership in a variety of life domains years after the period of active gang participation (Dong et al. 2015). Yet, limited evidence exists about the adverse impact of adolescent gang participation, above and beyond association with delinquent friends, on disruptions in adult years. In other words, it is not yet clear if the unique contribution of gang membership to a spectrum of criminal acts observed in a relatively short time period extends to an even longer time span.

To address these limitations, we use Nagin's (2005; Nagin and Tremblay 2001) dual-trajectory modeling technique to explore the dynamic relationship between self-reported gang affiliation and perceived association with delinquent friends during adolescence. "By summarizing the linkages across the trajectory groups for each behavior in the form of an array of probabilities rather than in the form of a single summary statistics, the model provides a statistical basis for communicating not only average tendencies but also deviations from the average tendencies" (Nagin 2005, p. 146). We then rely on the posterior probabilities of group membership to examine the enduring consequences of gang affiliation on a spectrum of criminal outcomes above and beyond peer delinquency. In effect, incorporating developmental trajectories of perceived peer delinquency in the outcome analysis represents a particularly strong form of statistical control for potential confounding effects from associating with delinquent friends. Both prior conceptual work and empirical evidence suggest that if gang membership is related to offending independent of delinquent peer association, it will most likely be for more serious forms of delinquency and, by extension for arrests. Although less serious forms of delinquency such as drug use are hypothesized to be more likely among gang members than non-members, it is less likely that the relationship between gang affiliation and drug use will remain once delinquent peer association is taken into consideration. Hence, we hypothesize that adolescent gang affiliation will be an independent predictor of general delinquency, violence, and being arrested in adulthood above and beyond the influence of delinquent friends. On the other hand, adolescent gang participation will not make a unique contribution to drug use in adulthood.

Methods

Data and Sample

The data for the current study come from the Rochester Youth Development Study (RYDS), an ongoing longitudinal study aimed at understanding the causes and consequences of serious and chronic delinquency. The RYDS began in 1988 with an original sample of 1000 seventh- and eighth-grade students in the public schools of Rochester, NY, USA. Due to the relatively low base rates for serious and chronic delinquency in the general population, the original sample was stratified on two dimensions to provide respondents who were at high risk for serious delinquency. First, males were oversampled given that they are more likely than females to commit serious delinquent acts. Second, individuals from high crime rate neighborhoods were also oversampled based on the assumption that living in such areas of the city represented enhanced risk for delinquency. The sample was predominantly comprised of minorities (68 % African American, 17 % Hispanic, and 15 % White) and males (73 %).

The RYDS has followed the identified subjects from their early teenage years to adulthood, and 14 waves of interviews have been completed across three phases of data collection. In Phase 1, the students (G2) and their primary caretakers (most often biological mothers; G1) were interviewed nine and eight times respectively at 6-month intervals (waves 1–9; ages 14–18). After a 2.5-year gap in data collection, G2 subjects with their primary caregivers (G1) were interviewed at three annual intervals at ages 21–23 (waves 10–12). In Phase 3, two additional interviews of G2 were conducted at G2's ages of 29 and 31 (waves 13 and 14). In addition to G1 and G2 self-report surveys, the RYDS also collected official data (e.g. school-performance data, child maltreatment information and official arrest records) from schools, social services and the police. The attrition rate in the RYDS data has been acceptable. In Phase 3, over 76 % of the original sample had been retained. An examination of the effects of attrition through Phase 3 indicates that attrition does not create significant bias in the key variables used in the analyses.

The current investigation is limited to male subjects because the prevalence of female gang membership was very low after the early adolescent years (Thornberry et al. 2003). Specifically, we use data from Phase 1 to estimate dual trajectories of gang affiliation and delinquent peer association during adolescence. Given the research aim of examining the enduring consequences of adolescent gang affiliation above and beyond peer delinquency, a variety of delinquent outcomes at wave 14 are examined. To control

for offending opportunity, individuals who were incarcerated at wave 14 are excluded from the outcome analysis.[4]

Measures

Gang Affiliation

Operational definitions of gang affiliation vary from more complex measures using gang names, symbols, or some notion of organizational structure to simpler measures relying on self-nomination (Curry 2000; Thornberry et al. 2003). Prior research has indicated that the self-nomination method is a valid indicator of gang membership (Decker et al. 2014; Esbensen et al. 2001). Beginning at wave 2, the RYDS respondents were asked whether he was a member of a "street gang or posse" (the term used by Rochester adolescents at that time) since the date of the last interview. Thornberry et al. (1993) found that, in the RYDS, the single self-reported question results an almost identical list of gang members as measures based on additional selection criteria, such as the size or name of the gang. Thus, at each wave of Phase 1 data collection, we use a binary indicator variable to measure gang affiliation that was constructed using self-reported answers. Approximately 30 % of the RYDS subjects were gang members at some point during adolescence, and very few respondents (fewer than 2 %) reported participation in a gang after wave 9.

Peer Delinquency

The measure for delinquent peer association is based on the subject's report of how many of his friends were involved in seven delinquent acts, such as robbery, assault, vandalism and theft. The response categories ranged from "none of them" (1), "a few of them" (2), "some of them" (3), to "most of them" (4). We averaged the responses, and higher scores indicate greater levels of perceived peer delinquency at each wave. This scale has good reliability (α is above 0.85 for all waves 2–9) and has been used in previous studies using the same data set (e.g. Bernburg et al. 2006).

We recognize that there is controversy over whether a measure of "perceived" delinquent peer association is an indicator of actual peer behavior or a projection of the focal actor's behavior (Meldrum and Boman 2013; Young et al. 2014). Prior research has demonstrated that perceived peer delinquency is a stronger correlate of one's own offending behavior than is peer reported delinquency. Young et al. (2015) have also suggested that perceived and actual peer delinquency may reflect "fundamentally different constructs" (p. 650). Ideally, we would like to have measures of both perceived delinquent peer association and peer reported delinquency in the same model. However, the RYDS did not include a direct (or peer reported) measure of peer delinquency. Since the focus of this study is to explore whether gang affiliation explains delinquent outcomes above and beyond peer delinquency, using the stronger correlate of self-reported delinquency represents a more conservative test of our hypotheses.

Criminal Outcomes in Adulthood

General Delinquency We created a variety score of general delinquency to capture individuals' tendency to commit crimes at wave 14. The general delinquency index includes 26 offenses ranging from minor offenses like vandalism and petty theft to serious offenses like robbery and assault with a deadly weapon. Sweeten (2012) suggested that variety scales are more attractive than dichotomous and frequency scales because "they are less sensitive to high frequency items, much less skewed than frequency scales, and have the highest concurrent validity and equal predictive validity to other scales" (p. 553). For the analysis sample in the outcome analysis, the variety score of general delinquency ranged from 0 to 10, with a mean score of 0.771.

Violence The violent crime index is a subscale of the general crime index, which contains five questions about violent interactions with others such as group fights, robbery, or assault. Again, a variety score was constructed.[5] For the analysis sample, the responses ranged from 0 to 2, with a mean score of 0.068, which is consistent with prior findings that violent acts are relatively rare in adulthood.

Drug use We created a variety score covering 11 entries of illegal drug use. All respondents were asked whether they had used any illegal drugs during the past year, including marijuana, crack cocaine, cocaine other than crack, heroin, LSD, PCP, inhalant, and other nonprescription drugs. For the analysis sample, the responses ranged from 0 to 4, with a mean score of 0.331.

Arrest We created a dichotomous indicator measuring whether a respondent self-reported an arrest at wave 14. While the aforementioned offending variables tap involvement in criminal behavior, this measure examines whether former gang members were also more likely to have contact with the criminal justice system in adulthood above and beyond the influence of adolescent peer

[4] As a robustness check, we also ran analyses when the incarcerated respondents were included. The same substantive findings were observed.

[5] As a robustness check, we also created a frequency score for violence. The same substantive findings were observed.

delinquency. For the analysis sample, about 9 % of the respondents were arrested at wave 14.

Controls

We include several control variables in the outcome analysis. *Age* is included as a continuous variable. We created dummy indicators for *African-American* and *Hispanic* race/ethnicity (reference group is white). *Family poverty* is an indicator of whether a household had an income below the federally defined poverty level for a given family size when the respondents were on average 14.5 years of age (wave 2). *Academic aptitude* is measured by the math percentile score received on the California Achievement Test in 1987 (when G2 subjects were approximately 12 years old). Higher scores on this variable indicate greater academic aptitude. To control for unstructured time spent with peers, *risky time with friends* is measured by three questions regarding how often the respondent and his friends get together where no adults are present, drive around with no special place to go, and get together where someone is using or selling drugs or alcohol (wave 2). Responses were indicated on a five-point scale from "never", "one time per week", "two times per week", "three or four times per week", to "everyday". Items are averaged to provide the mean score, and higher scores indicate greater involvement with deviant friends ($\alpha = 0.82$). *Parental supervision* is measured by a four-item scale at wave 2 regarding how often the primary caregiver knows where the respondent is and with whom and how important that is to the primary caregiver ($\alpha = 0.61$).

Additionally, we include three important individual characteristics in the model. *Self-esteem* is measured by a nine-item scale derived from Rosenberg's (1965) self-esteem scale at wave 2. G2 subjects were asked to what extent they agree or disagree, on a four-point Likert scale, with statements about oneself. Items are averaged to provide the mean score, and higher scores indicate higher self-esteem ($\alpha = 0.79$). *Depression* is measured by a 14-item scale tapping the frequency of depressive symptoms at wave 2 (Radloff 1977). Reponses were indicated on a four-point scale from "never", "seldom", "sometimes" to "often". Items are averaged to provide the mean score, and higher scores indicate greater depressive symptoms ($\alpha = 0.77$). *Aggression* is measured by a trimmed version of the aggression subscale of the Child Behavior Checklist, which was first administered to the primary caregivers (G1) during wave 3. G1 subjects were asked 12 questions about how often (always, sometimes, or never) the adolescent (G2) exhibited behaviors such as being restless and getting into fights. Items are averaged to create a mean score, and higher scores indicate greater level of aggression ($\alpha = 0.85$). Finally, we control for variety scores of *prior general delinquency*, *violence*, *drug use* (wave 2), and a binary indicator of *police contact/arrest* (waves 1–2) in the respective outcome models.

Data Analysis

To illustrate the dynamic relationship between gang affiliation and perceived delinquent peer association during adolescence and examine the enduring consequences of gang membership above and beyond peer delinquency, the analysis for the present study proceeds in three main steps using Stata (Version 14.0; StataCorp 1996–2015). First, distinctive clusters of developmental trajectories are identified for gang affiliation and delinquent peer association, respectively. For each trajectory group, the model defines the shape of the trajectory and estimates the proportion of the sample belonging to each group. Following Nagin's (2005) two-stage model selection process, we first choose the optimal number of groups to include in the model mainly based on the Bayesian Information Criterion (BIC).[6] In the second stage, the model is refined to determine the preferred order of the polynomial specifying the within-individual change for each trajectory given the first-stage decision on number of groups. This statistical procedure provides for each subject (1) the probability of belonging to each trajectory group, and (2) the assigned trajectory group based on the highest probability. When the average posterior probability of assignment (AvePP) is above 0.70 and the odds of correct classification (OCC) are greater than 5.0 for all groups, it indicates adequate model correspondence with the data (Nagin 2005).[7]

Second, a dual trajectory model of gang affiliation and delinquent peer association is estimated. Following Nagin and Tremblay (2001), the final joint model is estimated based on the number and shapes of trajectories found to be optimal in the first step of analysis.[8] Key outputs of a joint model are the conditional and joint probabilities of trajectory membership across two distinct but related behaviors, which are useful in describing the co-occurrence of gang membership and perceived peer delinquency.

In the third step, developmental trajectories of gang membership are linked to criminal outcomes measured at

[6] It is worth mentioning that the model selection process is not a purely statistical practice. "There is no correct model. Statistical models are just approximations" (Nagin 2005, p. 77). Nagin's recommendation is to select a model with no more groups than is necessary to communicate the distinct features of the data.

[7] To guard against local solutions in the estimation of growth mixture models, we estimated trajectory models using multiple sets of starting values (Hipp and Bauer 2006).

[8] Consistent with Nagin and Tremblay (2001), we indeed observed that "trajectories emerging from joint estimation differ little from their univariate counterparts" (p. 26).

wave 14. If statistically significant effects are observed, we then add trajectories of perceived peer delinquency to the model to control for potential confounding effects (Nagin and Tremblay 1999). That is, we examine the effects of gang membership on long-term criminal outcomes above and beyond an individual's adolescent history of peer delinquency. Given the distributions of the outcome variables, negative binomial (for general delinquency) and Poisson regressions (for violence and drug use) were used for count variables, and logistic regression was used for explaining police arrest. To perform these analyses, we relied on the posterior probabilities of group membership based on the best-fitting model. This approach takes into account classification uncertainties when estimating the model outcomes (Raudenbush 2005). The data have been screened for patterns of missingness and the technique of multiple imputation (number of imputations = 20) has been used to deal with missing data in the present study (Allison 2002).[9]

Results

Trajectories of Gang Membership and Peer Delinquency

For gang affiliation during adolescence, we select a 3-group model, which is defined by one group following a zero-order trajectory and two groups following a quadratic trajectory (Fig. 1a).[10] This solution has the best BIC score and acceptable values of minimum AvePP (0.839) and OCC (6.236). Not surprisingly, the majority of the respondents (74.9 %) demonstrate very low probabilities of being part of a youth gang during their adolescent years. The "early adolescence" group (14.6 %) begins with relatively high probabilities of gang affiliation that drop off after age 14. The "late adolescence" group (10.5 %), on the other hand, has low probabilities at early adolescence. These probabilities rise to a peak around age 17 and decline gradually after that. It is worth noting that Lacourse et al. (2003) identified almost identical trajectories of male gang membership using a comparable sample.

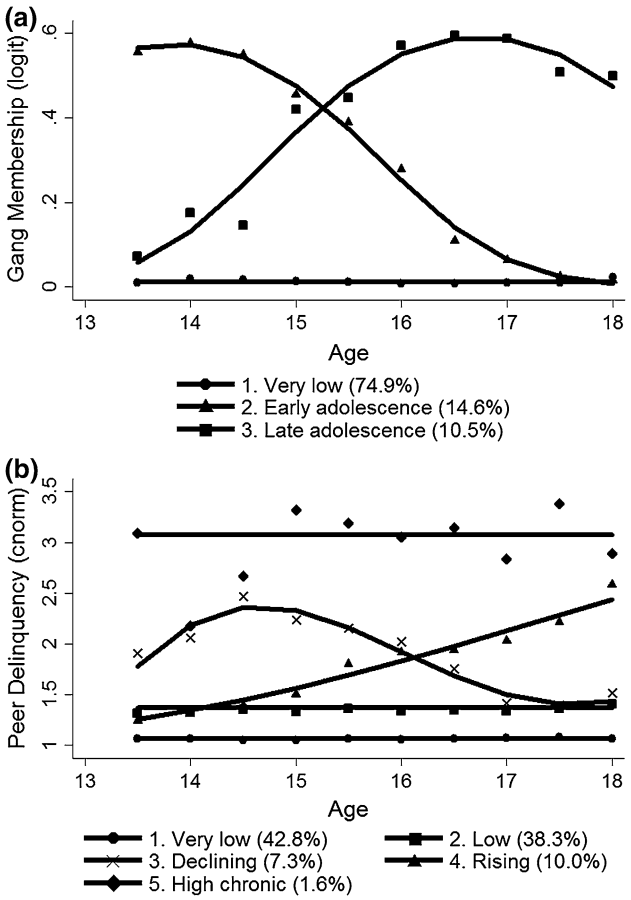

Fig. 1 **a** Trajectories of gang affiliation during adolescence. **b** Trajectories of delinquent peer association during adolescence

Based on BIC scores and acceptable values of minimum AvePP (0.827) and OCC (7.978), a 5-group model (Fig. 1b) is selected as the best fitting model for perceived delinquent peer association during adolescence. Specifically, the model is defined by three groups following a zero-order trajectory (the "very low", "low" and "high chronic" groups), one group following a linear trajectory (the "rising" group) and another group following a cubic trajectory (the "declining" group). To some extent, the observed patterns of delinquent peer association are consistent with Warr's (1993) "sticky friends" argument that exposure to delinquent peers remains stable during adolescence, although other studies have found evidence against the stability of peer delinquency (Kreager et al. 2011). Again, the majority of the respondents (81.1 %) follow either the "very low" or "low" trajectory of peer delinquency, and a very small proportion (1.6 %) of the respondents demonstrate consistently high delinquent peer association. Moreover, the "declining" and "rising" trajectories of peer delinquency exhibit significant within-individual variations.

[9] We excluded G2 subjects from the outcome analysis if they have missing information regarding the outcome variables, although criminal outcomes at wave 14 were included in the imputation model. We found no statistically significant differences between the analysis sample ($N = 502$) and those not included in the analysis with respect to membership of gang affiliation and delinquent peer association trajectories, race/ethnicity, academic aptitude, risky time with friends, parental supervision, aggression, self-esteem and prior delinquent acts. However, those not included in the analysis sample were slightly older, experienced lower levels of depression and higher levels of family poverty.

[10] Following the suggestion of Helgeson et al. (2004), higher order terms are removed from the model if they fall short of statistical significance.

The Interrelationship Between Gang Membership and Perceived Peer Delinquency

To uncover the dynamic relationship between gang affiliation and delinquent peer association during adolescence, Table 1 reports the conditional and joint probabilities of trajectory membership across the two measures. Specifically, Table 1(a) shows the probability of membership in each of the three gang membership trajectories, conditional on membership in each peer delinquency trajectory (each column sums to 1). As expected, individuals following the two low risk trajectories of peer delinquency are most likely to follow the "very low" trajectory of gang affiliation. For individuals in the "declining" trajectory of peer delinquency, over 80 % of them follow the similarly shaped "early adolescence" trajectory of gang membership. On the other hand, for individuals in the "rising" trajectory, only half of them follow the similarly shaped "late adolescence" trajectory of gang membership and 30 % of them stay away from a youth gang during adolescence. Unexpectedly, nearly 20 % of them follow the "early adolescence" trajectory of gang membership. It is also clear that individuals with consistently high levels of peer delinquency are unlikely to escape from gang participation during adolescence.

Table 1(b) presents the reverse set of conditional probabilities: the probability of membership in each of the five peer delinquency trajectories, conditional on membership in each gang affiliation trajectory (each row sums to 1). Consistent with the results from Table 1(a), about 95 % of individuals in the "very low" trajectory of gang membership exhibit a "very low" or "low" level of peer delinquency. For individuals in the "early adolescence" trajectory of gang membership, they are most likely to have a "low" (41.2 %) or "declining" level (40.6) of peer delinquency, whereas about 13 % of them follow the unexpected "rising" trajectory of peer delinquency. In addition, for individuals in the "late adolescence" trajectory of gang membership, fewer than half of them (47.5 %) follow the similarly shaped "rising" trajectory of peer delinquency.

Table 1(c) shows the joint probability of membership in a specific trajectory of gang membership and a specific trajectory of peer delinquency (the 15 joint probabilities sum to 1). Not surprisingly, the modal group is composed of individuals belonging to the "very low" trajectories of both gang membership and delinquent peer association (41.2 %), followed by 30.2 % belonging to the "very low" trajectory of gang membership and the "low" trajectory of peer delinquency. It is also noteworthy that few individuals follow a high-risk trajectory for one measure and a low-risk trajectory for the other.

However represented, the results suggest an interrelationship between the developmental trajectories of gang affiliation and delinquent peer association during adolescence. Yet, the co-occurrence is far from perfect (the bivariate correlations are between 0.217 and 0.403 across waves 2–9). Compared with simply correlating the two measures, the dual trajectory model indicates that the magnitude of an average association does not apply homogeneously to everyone. We observe more uncertainties for individuals in between than for individuals at the extremes. The dual trajectory model thus provides a far richer, yet still comprehensible, summary of the relationships in the data.

Criminal Outcomes in Adulthood

Since the juxtaposition of longitudinal patterns of gang affiliation and perceived peer delinquency suggests both similarities and distinctions between the two measures, we now move to examine the enduring consequences of gang participation above and beyond an individual's adolescent history of delinquent peer association. Table 2 reports descriptive statistics for the variables used in the outcome analysis.

Consistent with earlier research, adolescent gang affiliation indeed predicts criminal offending in adulthood. As Table 3 shows, when compared to individuals in the "very low" trajectory, individuals in the "late adolescence" trajectory are likely to commit higher levels of general delinquency, violence as well as drug use. Individuals in both trajectories of active gang involvement also exhibit a higher probability of being arrested in adulthood. Since significant effects are observed for gang membership trajectories, we then add trajectories of delinquent peer association to the outcome models.[11] As Thornberry et al. (2003) stated, "if the coefficient for gang membership is not significant when the impact of associations with delinquent peers is held constant, it would suggest that what appears to be a gang effect is simply a peer effect" (p. 160).

Table 4 shows mixed support for the unique contribution of gang membership to criminal outcomes above and beyond perceived peer delinquency. Associating with delinquent friends seems sufficient for predicting the less serious forms of misbehavior—general delinquency and drug use. When developmental trajectories of peer delinquency are included in the model, gang membership trajectories are no longer significant predictors of subsequent general delinquency and drug use. Compared with individuals in the "very low" trajectory of delinquent peer association, being in a relatively low or a rising trajectory

[11] It is worth pointing out that multicollinearity is not a concern in the outcome analysis. The VIF scores are below 2.35 for all included variables.

Table 1 The interrelationship between gang affiliation and delinquent peer association during adolescence ($N = 666$)

Gang membership group	Peer delinquency group				
	Very low	Low	Declining	Rising	High chronic
(a) Probability of gang membership group k conditional on peer delinquency group j (π_{klj})					
Very low	0.964	0.787	0.034	0.306	0.099
Early adolescence	0.013	0.157	0.808	0.192	0.120
Late adolescence	0.023	0.056	0.158	0.502	0.781
(b) Probability of peer delinquency group j conditional on gang membership group k (π_{jlk})					
Very low	0.551	0.403	0.003	0.041	0.002
Early adolescence	0.038	0.412	0.406	0.131	0.013
Late adolescence	0.094	0.203	0.110	0.475	0.118
(c) Joint probability of peer delinquency group j and gang membership group k (π_{jk})					
Very low	0.412	0.302	0.003	0.031	0.002
Early adolescence	0.006	0.060	0.059	0.019	0.002
Late adolescence	0.010	0.021	0.012	0.050	0.012

Table 2 Descriptive statistics ($N = 502$)

Variables	Mean (proportion)	SD	Min	Max	Wave
General delinquency	0.771	1.294	0.000	10.000	14
Violence	0.068	0.267	0.000	2.000	14
Drug use	0.331	0.564	0.000	4.000	14
Arrest	0.090	0.286	0.000	1.000	14
GM1	0.762	0.380	0.000	0.999	2–9
GM2	0.138	0.277	0.000	0.999	2–9
GM3	0.099	0.256	0.000	1.000	2–9
PD1	0.426	0.433	0.000	0.999	2–9
PD2	0.384	0.384	0.000	0.997	2–9
PD3	0.073	0.221	0.000	1.000	2–9
PD4	0.098	0.240	0.000	1.000	2–9
PD5	0.019	0.133	0.000	1.000	2–9
Age	13.910	0.784	11.400	15.500	1
African American	0.622	0.485	0.000	1.000	1
Hispanic	0.179	0.384	0.000	1.000	1
Family poverty	0.261	0.440	0.000	1.000	2
Self esteem	3.079	0.411	1.778	4.000	2
Depression	2.107	0.440	1.000	3.571	2
Risky time with friends	2.016	0.619	1.000	4.111	2
Parental supervision	3.596	0.410	1.500	4.000	2
Prior general delinquency	1.869	3.028	0.000	19.000	2
Prior violence	0.601	0.947	0.000	4.000	2
Prior drug use	0.141	0.418	0.000	3.000	2
Prior police contact/arrest	0.123	0.329	0.000	1.000	1–2
Aggression	0.459	0.351	0.000	1.833	3
Academic aptitude	59.068	26.010	1.000	99.000	–

GM gang membership trajectory group, *PD* peer delinquency trajectory group

of delinquent peer association significantly predicts general delinquency in adulthood. Similarly, being in a relatively low, a declining or a rising trajectory of delinquent peer association significantly predicts drug use in adulthood. On the other hand, consistent with our hypothesis, developmental trajectories of gang membership remain statistically significant when peer delinquency trajectories are included in the models predicting violence and being arrested or

Table 3 Regression of general delinquency, violence, drug use and arrest on gang affiliation trajectory groups ($N = 502$)

Variables	General delinquency		Violence		Drug use		Arrest	
	IRR (SE)	*p* value	IRR (SE)	*p* value	IRR (SE)	*p* value	OR (SE)	*p* value
GM2	1.215 (0.363)	0.515	1.967 (1.152)	0.248	1.303 (0.326)	0.290	4.364 (2.127)	0.003*
GM3	1.910 (0.545)	0.024*	3.100 (1.706)	0.041*	1.717 (0.472)	0.049*	4.556 (2.360)	0.003*
Age	0.879 (0.094)	0.226	0.825 (0.201)	0.432	0.891 (0.106)	0.332	0.827 (0.193)	0.414
African American	1.330 (0.271)	0.163	1.906 (1.080)	0.255	0.983 (0.198)	0.932	1.417 (0.705)	0.484
Hispanic	1.259 (0.333)	0.384	1.068 (0.850)	0.934	0.783 (0.222)	0.388	1.275 (0.783)	0.693
Family poverty	0.858 (0.174)	0.452	0.887 (0.428)	0.804	1.071 (0.203)	0.718	0.864 (0.343)	0.713
Self esteem	0.823 (0.186)	0.389	0.954 (0.496)	0.928	0.649 (0.139)	0.044*	0.767 (0.361)	0.574
Depression	0.823 (0.161)	0.319	0.639 (0.296)	0.333	0.943 (0.181)	0.761	0.750 (0.317)	0.496
Risky time with friends	0.964 (0.130)	0.788	1.781 (0.496)	0.038*	0.896 (0.141)	0.484	1.044 (0.302)	0.880
Parental supervision	0.888 (0.167)	0.528	1.305 (0.621)	0.576	1.069 (0.197)	0.720	0.971 (0.390)	0.941
Aggression	1.569 (0.332)	0.033*	1.852 (0.861)	0.185	1.044 (0.230)	0.845	0.954 (0.461)	0.923
Academic aptitude	1.007 (0.003)	0.030*	1.013 (0.008)	0.129	1.001 (0.003)	0.712	0.998 (0.007)	0.791
Prior general delinquency	1.059 (0.033)	0.064	–	–	–	–	–	–
Prior violence	–	–	1.339 (0.252)	0.121	–	–	–	–
Prior drug use	–	–	–	–	1.482 (0.274)	0.033*	–	–
Prior police contact/arrest	–	–	–	–	–	–	1.276 (0.576)	0.589

GM gang membership trajectory group

* $p < 0.05$

not.[12] In effect, the magnitude of the relationships between gang membership trajectories and violence/being arrested is not trivial as indicated by associated incidence rate ratios (IRR) and odds ratios (OR).

Discussion

Gang members report that among the reasons for joining a youth gang are to feel part of the group, to be in a family of supportive friends, to be assured that someone have their backs in case trouble ensues. These testimonies to the functions of gang membership suggest that gang members consider at least some of their fellow members to be friends; friends who by definition are expected to engage in delinquent activities. Both the variables of gang membership and perceived delinquent peer association have been shown to facilitate delinquent behavior. The questions that we set out to answer in this study were: (1) how the two distinct but related measures evolve over the adolescent years and differ across individuals, and (2) whether the relationship between affiliating with a youth gang and subsequent offending is simply a manifestation of having many friends who engage in delinquency or does gang membership facilitate delinquent behavior above and beyond the impact of having delinquent associations? Although recent studies suggest an affirmative answer to the second question, those studies have not examined this issue in a way that recognizes the developmental heterogeneity among individuals in gang membership or association with delinquent friends during adolescence.

Our first step in taking into account the developmental heterogeneity of gang membership and association with delinquent friends was to use Nagin's dual trajectory modeling technique to explore the dynamic relationship between these two variables during adolescence, a crucial period in the life course when individuals accumulate human and social capital that greatly influences later life chances. In so doing, we examined the conditional probabilities of being in one of the three observed gang membership trajectories based on being in one of the five observed delinquent peer association trajectories and vice versa. As the first study to investigate the developmental co-morbidity of these two distinct but related measures, our current efforts revealed some interesting and thought-provoking findings.

The analysis based on being in a delinquent peer association trajectory revealed some anticipated findings. Individuals who were in the two low risk trajectories of delinquent peer association are unlikely to have been in a youth gang throughout their teenage years. On the other hand, the small percentage of individuals with consistently

[12] In these two models, the posterior probabilities defining peer delinquency group membership do not have a jointly significant relationship with violence or arrest (Nagin and Tremblay 1999).

Table 4 Regression of general delinquency, violence, drug use and arrest on gang affiliation and delinquent peer association trajectory groups ($N = 502$)

Variables	General delinquency		Violence		Drug use		Arrest	
	IRR (SE)	p value	IRR (SE)	p value	IRR (SE)	p value	OR (SE)	p value
GM2	1.351 (0.488)	0.404	3.990 (2.685)	0.040*	0.790 (0.255)	0.466	2.853 (1.869)	0.110
GM3	1.399 (0.543)	0.387	2.193 (1.869)	0.357	1.217 (0.421)	0.571	4.965 (3.627)	0.028*
PD2	1.991 (0.425)	0.001*	1.143 (0.677)	0.822	2.060 (0.464)	0.001*	1.974 (1.044)	0.199
PD3	0.585 (0.304)	0.302	0.133 (0.160)	0.094	2.702 (1.225)	0.028*	2.360 (2.059)	0.325
PD4	2.344 (0.893)	0.025*	1.658 (1.451)	0.563	2.047 (0.724)	0.043*	1.067 (0.896)	0.939
PD5	0.965 (0.608)	0.955	0.964 (1.155)	0.976	2.032 (0.982)	0.142	0.812 (1.027)	0.869
Age	0.871 (0.091)	0.188	0.960 (0.247)	0.873	0.863 (0.099)	0.197	0.800 (0.184)	0.332
African American	1.234 (0.248)	0.296	1.722 (0.980)	0.339	0.955 (0.189)	0.815	1.441 (0.726)	0.468
Hispanic	1.232 (0.319)	0.422	1.008 (0.803)	0.992	0.755 (0.212)	0.318	1.234 (0.767)	0.735
Family poverty	0.924 (0.188)	0.697	0.919 (0.447)	0.862	1.101 (0.206)	0.607	0.911 (0.353)	0.811
Self esteem	0.807 (0.180)	0.336	0.870 (0.449)	0.788	0.657 (0.146)	0.059	0.787 (0.376)	0.615
Depression	0.854 (0.165)	0.414	0.659 (0.303)	0.364	0.918 (0.182)	0.666	0.750 (0.322)	0.504
Risky time with friends	0.980 (0.130)	0.881	1.892 (0.542)	0.026*	0.888 (0.136)	0.440	1.032 (0.295)	0.912
Parental supervision	0.951 (0.175)	0.784	1.415 (0.675)	0.468	1.150 (0.218)	0.460	1.069 (0.436)	0.870
Aggression	1.570 (0.328)	0.031*	1.921 (0.885)	0.156	0.970 (0.213)	0.890	0.971 (0.464)	0.951
Academic aptitude	1.007 (0.003)	0.046*	1.014 (0.008)	0.101	1.000 (0.003)	0.989	0.999 (0.007)	0.625
Prior general delinquency	1.080 (0.035)	0.016*	–	–	–	–	–	–
Prior violence	–	–	1.451 (0.281)	0.054	–	–	–	–
Prior drug use	–	–	–	–	1.437 (0.262)	0.047*	–	–
Prior police contact/arrest	–	–	–	–	–	–	1.288 (0.582)	0.575

GM gang membership trajectory group, *PD* indicates peer delinquency trajectory group

* $p < 0.05$

high levels of peer delinquency are likely to be members of a youth gang sometime during their adolescence. The more interesting results involve those in the declining and rising trajectories of peer delinquency. For individuals in the declining trajectory of peer delinquency, most of them fell into the early adolescence trajectory of gang affiliation. However, in spite of reducing their delinquent peer association, 15.8 % fell in the late adolescence group for gang membership, a trajectory that represents people who are escalating their gang affiliation during mid to late adolescence. Does this co-occurrence of being in a declining trajectory of delinquent peer association yet an increasing trajectory of gang membership represent a coalescence of deviant friends? It seems counterintuitive that the overall perception of delinquent friends would diminish for late adolescence gang joiners, but it may reflect the desire to keep their delinquent activities within a smaller clique once they join a youth gang. Decker and Van Winkle (1996), for instance, observed that "gang life has an obsessively deadly attraction for our subjects, one which constricts and diminishes their life to the friendship group of the gang" (p. 187). It may also be partially due to the more serious nature of gang-related offending and the consequent need to keep knowledge of it within a small group. Alternatively, it could mean that the recruitment to a youth gang is done only by a few special (and delinquent) friends in spite of having many other friends desisting from delinquency. Discovering which of these possibilities is operating (and perhaps both are) in future research is key to our understanding of the operation of youth gangs.

The conditional probability of gang membership for those in the rising trajectory of peer delinquency demonstrates two important aspects of the dynamic relationship between these variables. First, the mere fact of having a relatively high and increasing percentage of delinquent friends does not necessarily mean that there will be gang involvement. This is consistent with the moderate correlation between these variables when viewed in a cross-sectional manner. Additionally, in spite of being in the rising trajectory of delinquent peer association, approximately 20 % are in the early adolescence trajectory of gang affiliation. This means that they were likely to be a gang member early in adolescence and are decreasing their membership status as the perception of peer delinquency

increases. Again this underscores the relative independence of these two measures.

When delinquent peer association is viewed as a conditional probability of gang affiliation, similar conclusions are reached. Those in the "very low" gang trajectory are most likely to report "very low" or "low" level of perceived peer delinquency. Those who are in the early adolescence trajectory of gang membership are likely to be decreasing their level of peer delinquency for the most part. However, about 13 % are rising in their level of delinquent peer association despite a decreasing probability of participating in a youth gang. It is likely that they are still attracted to delinquent friends and activities but have been dissuaded either by the violence/danger associated with a youth gang or the increased probability of having trouble with law enforcement from continuing to participate in gang related activities (Decker and Lauritsen 2002). The existence of this pattern is also consistent with the prior observations that although the level of crime by former gang members is somewhat reduced after they have left the gang, it remains higher than the level for those youth who have never been in a gang (Thornberry et al. 2003). Finally, not everyone in the group that is rising (late adolescence) in the probability of gang affiliation increases their delinquent peer association. Again this pattern reinforces the conclusion that the two measures are distinct and do not necessarily rise together over this developmental period. In a joint view, the majority of the subjects (71.4 %) fit into a relatively low-risk profile.

Our next step was to enter the posterior probabilities of group membership into regression equations to predict offending in adulthood. Although several studies have reported the enduring consequences of adolescent gang affiliation years after the period of active participation, we are particularly interested in whether the adverse impact of adolescent gang involvement persists once we control for perceived peer delinquency in a developmentally comprehensive way. This represents a major step forward from previous studies that only take into account delinquent peer association at one cross-section in time.

Consistent with our hypothesis, being a member of a youth gang increases the risk of continued violence and subjects former members to an increased probability of being arrested above and beyond delinquent peer association. It is interesting to notice that when developmental trajectories of delinquent peer association are taken into account, belonging to the "late adolescence" trajectory of gang affiliation is no longer a significant predictor of violence, whereas being in the "early adolescence" trajectory now significantly predicts violent offending. One possible explanation is that developmental trajectories of delinquent peer association introduce confounding or mediation effects for late gang joiners but suppression effects for early gang joiners (MacKinnon et al. 2000). Early gang joiners exhibit an enhanced level of violence in adulthood because perceived peer delinquency accounts for the outcome-irrelevant predictive variance in the "early adolescence" gang membership trajectory, which increases the predictive validity of the focal predictor (i.e. the "early adolescence" trajectory).[13] It is also important to notice that developmental trajectories of gang membership were significantly related to the more serious measures of offending in a non-trivial manner, underscoring the importance of the decision to join a youth gang and the continuing adversity that ensues from that decision.

On the other hand, being in either gang trajectory did not predict the less serious forms of misbehavior— general delinquency and drug use, above and beyond perceived peer delinquency. In other words, associating with delinquent friends seems sufficient for predicting subsequent general delinquency and drug use. In effect, even being in a relatively low peer delinquent trajectory predicted these two outcomes suggesting that some peer delinquent associations are all that are needed to set the stage for continued problematic behavior. It is also noteworthy that the declining peer delinquency trajectory was not related to general delinquency but was related to drug use. This may suggest that once peer delinquency leads to involvement in drug use, such use continues even if individuals decrease their associations with deviant others. Finally, it was surprising that the high chronic group did not predict any of the four outcomes. However, <2 % of our sample fell into this trajectory and this, coupled with the greater overlap in membership in this group with the gang membership trajectories, may account for the findings.

Our findings have important implications for the understanding of youth gangs and policies that may be based on that understanding. Results from both the dual-trajectory analysis and the prediction of offending outcomes suggest that adolescent gang affiliation and perceived delinquent peer association, while overlapping, may constitute distinct concepts that operate in different ways.[14] Being in a gang indeed facilitates the type of behavior we most often associate with gang activity—violent behavior, and by extension police arrest. It is not just a matter of associating with deviant friends during adolescence; we suspect that the organizational structure, group processes,

[13] We observed that for the "early adolescence" trajectory of gang affiliation, its incidence rate ratio (IRR) increased from 1.967 in Table 3 (not significant) to 3.990 in Table 4 (significant), whereas for the "late adolescence" trajectory, its IRR decreased from 3.100 in Table 3 (significant) to 2.193 (not significant).

[14] It is worth pointing out that we did not perform a formal test of discriminant validity in the current study. See Young et al. (2015) for a detailed discussion on how to use measurement models to examine discriminant validity of related constructs.

culture, and norms of the gang make it distinctive at least in terms of the most serious forms of offending. This finding suggests that other outcomes may also be differentially predicted by adolescent gang affiliation and delinquent peer association. It might be that having highly delinquent peer associations can be overcome in terms of leading to negative life chances, whereas having been a member of a youth gang makes it less likely that a successful transition to adulthood will be made. Prior research has demonstrated that gang membership does adversely affect educational, familial and work related outcomes (Dong et al. 2015). Yet, similar analyses using delinquent peer associations rather than gang membership have, to our knowledge, not been reported.

Given that the more problematic behaviors and outcomes occur to youth gang members, efforts and resources should be more directed toward them than those who simply hang out with deviant friends. The results provide preliminary support for policies and practices that specifically target violent offending associated with youth gang members. Yet, we need to be careful not to "widen the net" to deliver enhanced sentences and so to gang members only on the basis of their non-violent offenses or drug use. Although addressing the youth gang problem is formidably difficult,[15] it is not impossible with carefully designed and implemented control programs and policies (Howell 2012; Klein and Maxson 2006). Informed by our findings, we suggest several elements that may be taken into account when dealing with the youth gang problem. First, we consider adolescence a critical time to address the gang problem. Using a nationally representative sample, Pyrooz (2014b) demonstrated that the modal age of onset of gang participation is 13 and the modal age of gang membership is 15. Waiting beyond this window to deal with the youth gang problem may well be too late. In fact, gang reduction efforts are unlikely to be successful once gang members reach adulthood. Older members tend to identify more with the gang and obtain a "master status" of being a gang member (Decker and Curry 2000). Thus, "delayed interventions will have to deal with not only gang membership but also a host of interlocking deficits generated, at least in part, by gang membership" (Thornberry et al. 2003, p. 199). Second, effective gang programs and policies are those that take into the peculiarities of *gang group norms and processes*. For many non-gang youths, hanging out with the wrong crowd during adolescence may simply be a by-product of establishing "age-appropriate autonomy", whereas, for youth gang members, it means honor, respect, protection, and even survival (Anderson 1999). Unfortunately, many well-intentioned but ineffective programs barely include any "calculus of the gang members' perceptions, values, and entrapment in the social psychology of group process" (Klein 1995, p. 160). Given the confrontational nature of youth gangs, we suggest that gang reduction efforts must recognize the social marginality experienced by gang-prone youths in multiple life domains, and give higher priority to efforts at prevention and treatment than suppression or deterrence. Additionally, the findings also evidenced the heterogeneity of both gang membership and delinquent peer association. As with other gang researchers, we call for a move beyond the dichotomy of "gang member" versus "non-gang member" and recognize the existence of developmental differences in youth gang affiliation (Pyrooz 2013). As Hennigan et al. (2014) suggested, an understanding of developmental heterogeneity among gang youths will aid in the shift from relatively inefficient primary prevention (i.e. activity programs open to all) to secondary prevention (i.e. focusing highly structured interventions on youths identified as the ones most likely to join a gang).

The current study is not without limitations. We consider these limitations areas where future research may expand our knowledge. First, the findings of this study were derived from a high-risk, predominantly African American sample in Rochester, NY, USA, a new or "emergent" gang city. Unlike traditional gang cities in which street gangs have existed for many decades, gangs emerged in Rochester in the mid-1980s (Thornberry et al. 2003). Prior research suggests that gang composition, culture, activities and residents' reactions to gangs differ in emergent versus traditional gang cities (Howell 2012). It is not clear to what extent the findings reported in this study are influenced by context and whether they are replicable in other cities, especially traditional gang cities such as Los Angeles or Chicago. Second, the present findings are limited to males only. Although previous studies have identified similarities in risk factors and delinquency facilitating effects between male and female gang members, important differences still exist (Miller 2001; Moore 1991). With appropriate data, future research should validate our conclusions with a female sample. Third, it is necessary to recognize that developmental trajectories of self-reported gang affiliation are not necessarily reflecting changing levels of gang commitment. Pyrooz et al. (2013) introduced a new concept, gang embeddedness, to capture individual immersion in a gang, "reflecting varying degrees of involvement, identification, and status among gang members" (p. 243). Self-identification as a gang member is a manifestation of the latent trait of gang embeddedness. A future member may increase his/her level of embeddedness in a gang prior to joining; likewise, a

[15] At the present time, only a handful of gang programs have acceptable scientific evidence of effectiveness in preventing or reducing gang activity; the effect sizes of these programs are small (Howell 2012; Klein and Maxson 2006).

former member is likely to have residual or non-zero levels of gang embeddedness after leaving. Future research may build on the construct of embeddedness by exploring the social network characteristics of the gang (Krohn 1986).

Moreover, we have acknowledged the difficulty with being limited to the use of a measure of perceived delinquent peer association rather than a measure of peer reported delinquency. Given that the perceptual measure of peer delinquency is more highly related to delinquent behavior than the peer reported measure, our finding that developmental trajectories of gang membership predict self-reported violence and arrest even when controlling for trajectories of perceived peer delinquency is particularly important. Since we have also controlled for unstructured time spent with peers, it is unlikely that our measure of gang affiliation only picks up peer influence that was inadequately operationalized through a perceptual or indirect measure.

What does the use of perceived delinquent peer association mean for our findings regarding the significant impact of that measure on general delinquency and drug use? Our discussions of these findings have assumed that there is some non-trivial relationship between peer behavior and perceptions of the same. However, as Young et al. (2014) have shown, it is possible that the observed relationship is simply a reflection of the projection that occurs among those involved in general delinquency and drug using behavior. It would be interesting to see what would happen if developmental trajectories of peer reported behavior could be estimated and the analysis we have reported in this study be replicated. Unfortunately, the RYDS did not include a direct measure of peer reported behavior. Our hypothesis would be that trajectories of peer reported delinquency might be a less important predictor of general delinquency and drug use and gang membership trajectories would be slightly more important.

Conclusion

Previous studies have shown that both adolescent gang affiliation and perceive peer delinquency are important predictors of individual offending. However, how these two measures evolve during adolescence and differ across individuals is largely unclear. Using a new modeling technique that takes full advantage of longitudinal data, the current study illustrates the dynamic relationship between these two measures. Our results suggest that the two measures, while overlapping, may constitute distinct concepts that operate in different ways. Being in a youth gang indeed facilitates the type of behavior we most often associate with gang activity—violent behavior and by extension police arrest, above and beyond simply hanging out with deviant friends. We suspect that associating with peers during adolescence means something different for socially marginalized gang youths than for non-gang delinquent youths. The organizational structure, group processes, culture and norms, and claimed turf associated with youth gangs reveal that those individuals are probably experiencing adolescence in a way that many of us cannot envision. Future research should continue to investigate gang youths' lives, recognizing their distinctive group mentality as well as heterogeneity among them. In this way, we might best help them in the future.

Acknowledgments Support for the Rochester Youth Development Study has been provided by the Office of Juvenile Justice and Delinquency Prevention (86-JN-CX-0007), the National Institute on Drug Abuse (R01DA005512, R01DA020195), the National Science Foundation (SBR-9123299), and the National Institute of Mental Health (R01MH63386). Work on this project was also aided by grants to the Center for Social and Demographic Analysis at the University at Albany from NICHD (P30HD32041) and NSF (SBR-9512290). Points of view or opinions in this document are those of the authors and do not necessarily represent the official position or policies of the funding agencies.

Authors Contributions B. D. conceived of the study, performed the statistical analyses, and drafted the manuscript. M. K. aided in interpretation of the results and revised the manuscript. Both authors read and approved the final manuscript.

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

References

Agnew, R. (1991). The interactive effects of peer variables on delinquency. *Criminology, 29*, 45–72.

Allison, P. D. (2002). *Missing data: Quantitative applications in the social sciences*. Thousand Oaks, CA: Sage.

Anderson, E. (1999). *Code of the street: Decency, violence, and the moral life of the inner city*. New York, NY: Norton.

Ariza, J., Cebulla, A., Aldridge, J., Shute, J., & Ross, A. (2014). Proximal adolescent outcomes of gang membership in England and Wales. *Journal of Research in Crime and Delinquency, 51*, 168–199.

Battin, S. R., Hill, K. G., Abbott, R. D., Catalano, R. F., & Hawkins, J. D. (1998). The contribution of gang membership to delinquency beyond delinquent friends. *Criminology, 36*, 93–115.

Bernburg, J. G., Krohn, M. D., & Rivera, C. J. (2006). Official labeling, criminal embeddedness, and subsequent delinquency: A longitudinal test of labeling theory. *Journal of Research in Crime and Delinquency, 43*, 67–88.

Conger, R. D. (1991). *Adolescence and youth: Psychological development in a changing world* (4th ed.). New York, NY: HarperCollins Publishers.

Craig, W. M., Vitaro, F., Gagnon, L., & Tremblay, R. E. (2002). The road to gang membership: Characteristics of male gang and nongang members from ages 10 to 14. *Social Development, 11*, 53–68.

Curry, G. D. (2000). Self-reported gang involvement and officially recorded delinquency. *Criminology, 38*, 1253–1274.

Decker, S. H., & Curry, G. D. (2000). Addressing key features of gang membership: Measuring the involvement of young members. *Journal of Criminal Justice, 28*, 473–482.

Decker, S. H., Katz, C. M., & Webb, V. J. (2008). Understanding the black box of gang organization: Implications for involvement in violent crime, drug sales, and violent victimization. *Crime and Delinquency, 54*, 153–172.

Decker, S. H., & Lauritsen, J. (2002). Leaving the gang. In C. R. Huff (Ed.), *Gangs in American* (3rd ed., pp. 51–70). Thousand Oaks, CA: Sage.

Decker, S. H., Melde, C., & Pyrooz, D. C. (2013). What do we know about gangs and gang members and where do we go from here? *Justice Quarterly, 30*, 369–402.

Decker, S. H., Pyrooz, D. C., Sweeten, G., & Moule, R. K. (2014). Validating self-nomination in gang research: Assessing differences in gang embeddedness across non-, current, and former gang members. *Journal of Quantitative Criminology, 30*, 577–598.

Decker, S. H., & Van Winkle, B. (1996). *Life in the gang: Family, friends and violence*. Cambridge, England: Cambridge University Press.

Dong, B., Gibson, C. L., & Krohn, D. M. (2015). Gang membership in a developmental and life-course perspective. In S. H. Decker & D. C. Pyrooz (Eds.), *The handbook of gangs* (pp. 78–97). London: Wiley.

Downes, D. M. (1966). *The delinquent solution*. London: Routledge and Kegan Paul.

Esbensen, F. A., & Deschenes, E. P. (1998). A multisite examination of youth gang membership: Does gender matter? *Criminology, 36*, 799–827.

Esbensen, F. A., Deschenes, E. P., & Winfree, L. T. (1999). Differences between gang girls and gang boys: Results from a multisite survey. *Youth and Society, 31*, 27–53.

Esbensen, F. A., Winfree, L. T., He, N., & Taylor, T. J. (2001). Youth gangs and definitional issues: When is a gang a gang, and why does it matter? *Crime and Delinquency, 47*, 105–130.

Gatti, U., Tremblay, R. E., Vitaro, F., & McDuff, P. (2005). Youth gangs, delinquency and drug use: A test of the selection, facilitation, and enhancement hypotheses. *Journal of Child Psychology and Psychiatry, 46*, 1178–1190.

Gilman, A. B., Hill, K. G., & Hawkins, J. D. (2014). Long-term consequences of adolescent gang membership for adult functioning. *American Journal of Public Health, 104*, 938–945.

Gordon, R. A., Lahey, B. B., Kawai, E., Loeber, R., Stouthamer-Loeber, M., & Farrington, D. (2004). Antisocial behavior and youth gang membership: Selection and socialization. *Criminology, 42*, 55–87.

Hallsworth, S., & Young, T. (2008). Gang talk and gang talkers: A critique. *Crime, Media, Culture, 4*, 175–195.

Helgeson, V. S., Snyder, P., & Seltman, H. (2004). Psychological and physical adjustment to breast cancer over 4 years: Identifying distinct trajectories of change. *Health Psychology, 23*, 3–15.

Hennigan, K. M., Maxson, C. L., Sloane, D. C., Kolnick, K. A., & Vindel, F. (2014). Identifying high-risk youth for secondary gang prevention. *Journal of Crime and Justice, 37*, 104–128.

Hill, K. G., Howell, J. C., Hawkins, J. D., & Battin-Pearson, S. R. (1999). Childhood risk factors for adolescent gang membership: Results from the Seattle Social Development Project. *Journal of Research in Crime and Delinquency, 36*, 300–322.

Hipp, J. R., & Bauer, D. J. (2006). Local solutions in the estimation of growth mixture models. *Psychological Methods, 11*, 36–53.

Horowitz, R. (1983). *Honor and the American dream: Culture and identity in a Chicano community*. New Brunswick, NJ: Rutgers University Press.

Howell, J. C. (2012). *Gangs in America's communities*. Thousand Oaks, CA: Sage.

Howell, J. C., & Egley, A. (2005). Moving risk factors into developmental theories of gang membership. *Youth Violence and Juvenile Justice, 3*, 334–354.

Huizinga, D. (1996). *The influence of delinquent peers, gangs, and co-offending on violence*. Washington, DC: Official of Juvenile Justice and Delinquency Prevention.

Kennedy, D. M. (2009). Gangs and public policy: Constructing and deconstructing gang databases. *Criminology and Public Policy, 8*, 711–716.

Klein, M. W. (1995). *The American street gang: Its nature, prevalence, and control*. New York, NY: Oxford University Press.

Klein, M. W., & Maxson, C. L. (2006). *Street gang patterns and policies*. New York, NY: Oxford University Press.

Kreager, D., Rulison, K., & Moody, J. (2011). Delinquency and the structure of adolescent peer groups. *Criminology, 49*, 95–127.

Krohn, M. D. (1986). The web of conformity: A network approach to the explanation of delinquent behavior. *Social Problems, 33*, 581–593.

Krohn, M. D., & Thornberry, T. P. (2008). Longitudinal perspectives on adolescent street gangs. In A. Liberman (Ed.), *The long view of crime: A synthesis of longitudinal research* (pp. 128–160). New York, NY: Springer.

Lacourse, E., Nagin, D., Tremblay, R. E., Vitaro, F., & Claes, M. (2003). Developmental trajectories of boys' delinquent group membership and facilitation of violent behaviors during adolescence. *Development and Psychopathology, 15*, 183–197.

Lahey, B., Gordon, R., Loeber, R., Stouthamer-Loeber, M., & Farrington, D. (1999). Boys who join gangs: A prospective study of predictors of first gang entry. *Journal of Abnormal Child Psychology, 27*, 261–276.

Lien, I. (2002). *The pain of crime and gang mentality*. Oslo: The Norwegian Institute of Urban and Regional Research.

MacKinnon, D. P., Krull, J. L., & Lockwood, C. M. (2000). Equivalence of the mediation, confounding and suppression effect. *Prevention Science, 1*, 173–181.

Melde, C., & Esbensen, F. A. (2011). Gang membership as a turning point in the life course. *Criminology, 49*, 513–552.

Melde, C., & Esbensen, F. A. (2014). The relative impact of gang status transitions: Identifying the mechanisms of change in delinquency. *Journal of Research in Crime and Delinquency, 51*, 349–376.

Meldrum, R. C., & Boman, J. H. (2013). Similarities and differences between perceptions of peer delinquency, peer self-reported delinquency, and respondent delinquency: An analysis of friendship dyads. *Journal of Criminal Justice, 41*, 395–406.

Miller, W. B. (1982). *Crime by youth gangs and groups in the United States*. Washington, DC: Office of Juvenile Justice and Delinquency Prevention.

Miller, J. (2001). *One of the guys: Girls, gangs and gender*. New York, NY: Oxford University Press.

Moore, J. W. (1978). *Homeboys: Gangs, drugs and prison in the barrios of Los Angeles*. Philadelphia, PA: Temple University Press.

Moore, J. W. (1991). *Going down to the barrio: Homeboys and homegirls in change*. Philadelphia, PA: Temple University Press.

Moore, J. W., & Vigil, J. D. (1989). Chicano gangs: Group norms and individual factors related to adult criminality. *Aztlan: A Journal of Chicano Studies, 18*, 31–42.

Morash, M. (1983). Gangs, groups and delinquency. *The British Journal of Criminology, 23*, 309–335.

Nagin, D. (2005). *Group-based modeling of development*. Cambridge, MA: Harvard University Press.

Nagin, D., & Tremblay, R. E. (1999). Trajectories of boys' physical aggression, opposition, and hyperactivity on the path to physically violent and nonviolent juvenile delinquency. *Child Development, 70*, 1181–1196.

Nagin, D., & Tremblay, R. E. (2001). Analyzing developmental trajectories of distinct but related behaviors: A group-based method. *Psychological Methods, 6*, 18–34.

Papachristos, A. V. (2009). Murder by structure: Dominance relations and the social structure of gang homicide. *American Journal of Sociology, 115*, 74–128.

Pyrooz, D. C. (2013). Gangs, criminal offending, and an inconvenient truth. *Criminology and Public Policy, 12*, 427–436.

Pyrooz, D. C. (2014a). From colors and guns to caps and gowns? The effects of gang membership on educational attainment. *Journal of Research in Crime and Delinquency, 51*, 56–87.

Pyrooz, D. C. (2014b). "From your first cigarette to your last dyin' day": The patterning of gang membership in the life-course. *Journal of Quantitative Criminology, 30*, 349–372.

Pyrooz, D. C., Sweeten, G., & Piquero, A. R. (2013). Continuity and change in gang membership and gang embeddedness. *Journal of Research in Crime and Delinquency, 50*, 239–271.

Radloff, L. S. (1977). The CES-D Scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement, 1*, 385–401.

Raudenbush, S. W. (2005). How do we study what happen next? *The Annals of the American Academy of Political and Social Science, 602*, 131–144.

Rosenberg, M. (1965). *Society and the adolescent self-image*. Princeton, NJ: Princeton University Press.

Short, J. F., & Strodtbeck, F. L. (1965). *Group process and gang delinquency*. Chicago, IL: The University of Chicago Press.

Sweeten, G. (2012). Scaling criminal offending. *Journal of Quantitative Criminology, 28*, 533–557.

Thornberry, T. P., & Krohn, M. D. (2005). Applying interactional theory to the explanation of continuity and change in antisocial behavior. In D. P. Farrington (Ed.), *Integrated developmental and life-course theories of offending* (pp. 183–210). New Brunswick, NJ: Transaction Publishing.

Thornberry, T. P., Krohn, M. D., Lizotte, A. J., & Chard-Wierschem, D. (1993). The role of juvenile gangs in facilitating delinquent behavior. *Journal of Research in Crime and Delinquency, 30*, 55–87.

Thornberry, T. P., Krohn, M. D., Lizotte, A. J., Smith, C. A., & Tobin, K. (2003). *Gangs and delinquency in developmental perspective*. New York, NY: Cambridge University Press.

Tita, G. E., & Ridgeway, G. (2007). The impact of gang formation on local patterns of crime. *Journal of Research in Crime and Delinquency, 42*, 275–308.

Vigil, J. D. (1988). *Barrio gangs: Street life and identity in Southern California*. Austin, TX: University of Texas Press.

Warr, M. (1993). Age, peers, and delinquency. *Criminology, 31*, 17–40.

Warr, M. (1996). Organization and instigation in delinquent groups. *Criminology, 34*, 11–37.

Warr, M. (2002). *Companions in crime: The social aspects of criminal conduct*. New York, NY: Cambridge University Press.

Young, J. T. N., Rebellon, C. J., Barnes, J. C., & Weerman, F. M. (2014). Unpacking the black box of peer similarity in deviance: Understanding the mechanisms linking personal behavior, peer behavior, and perceptions. *Criminology, 52*, 60–86.

Young, J. T. N., Rebellon, C. J., Barnes, J. C., & Weerman, F. M. (2015). What do alternative measures of peer behavior tell us? Examining the discriminant validity of multiple methods of measuring peer deviance and the implications for etiological models. *Justice Quarterly, 32*, 626–652.

Beidi Dong is currently a postdoctoral fellow at the Penn Injury Science Center of the University of Pennsylvania. He received his Ph.D. in Criminology, Law and Society from the University of Florida. His primary research interests include developmental and life-course criminology, neighborhood and crime, and youth gangs and violence prevention.

Marvin D. Krohn is a professor in the Department of Sociology and Criminology and Law at the University of Florida. He is primarily interested in developmental approaches to the explanation of delinquency, drug use, and crime. He is a co-principal investigator of the Rochester Youth Development Study (RYDS), a three generational longitudinal panel study targeting those at high risk for serious crime and delinquency.