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Estimating the Effect of Gang Membership on Nonviolent and Violent Delinquency: A Counterfactual Analysis

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Abstract

This study reconsiders the well-known link between gang membership and criminal involvement. Recently developed analytical techniques enabled the approximation of an experimental design to determine whether gang members, after being matched with similarly situated non-gang members, exhibited greater involvement in nonviolent and violent delinquency. Findings indicated that while gang membership is a function of self-selection, selection effects alone do not account for the greater involvement in delinquency exhibited by gang members. After propensity score matching (PSM) was employed, gang members maintained a greater involvement in both *nonviolent* and *violent* delinquency when measured cross-sectionally, but only *violent* delinquency when measured longitudinally. Additional analyses using inverse probability of treatment weights (IPTW) reaffirmed these conclusions.

Keywords

Add Health; propensity score matching (PSM); inverse probability of treatment weights (IPTW); gang membership

Gang violence continues to plague American communities and is a pointed focal concern for many socioeconomically depressed neighborhoods (Hagedorn, 2005; Lane, 2002). Recent estimates show that an overwhelming majority of the crime committed in urban communities are the result of gang-related activity (Thornberry and Burch, 1997). Gang members are also the primary distributors of most illicit drugs and clearly expand the capacity of drug related organized crime. Estimates gleaned from the National Youth Gang Survey indicated that approximately 43 percent of all drug sales involve gang members (Howell and Gleason, 1999). Moreover, trend statistics from the National Youth Gang Survey show that the prevalence of gang membership has been on the rise since 2001, with nearly 800,000 gang members affiliated with more than 27,000 gangs currently active in the United States (Egley and O'Donnell, 2009).

Contemporary scholars have attempted to garner a better understanding of the effect of gangs on crime through both quantitative and qualitative analysis. A large body of literature

has consistently linked gang membership with a greater involvement in crime and increased levels of drug use (Bjerregaard, 2010; Cohen, 1955; Klein and Maxson, 2006; Shaw and McKay, 1942; Spano, Freilich, and Bolland, 2008). Thornberry and Burch (1997) analyzed data from the Rochester Youth Development Survey and found that gang members accounted for 30 percent of the sample. Although far from representing a majority of the respondents, gang members accounted for a large amount of all crimes committed. Indeed, gang members accounted for more than twice the amount of crimes that would have been expected; they accounted for 65 percent of all criminal acts and 86 percent of serious delinquent acts. Similarly, Bjerregaard (2010) found that gang members had greater odds of using drugs, selling drugs, committing an assault, and carrying a gun.

Some research, however, has shown that the impact of gang membership on delinquency may not be ubiquitous across all types of antisocial behavior. Comparing gang members to non-gang youth with delinquent friends, Battin, Hill, Abbott, Catalano, and Hawkins (1998) reported that gang members did *not* have a significantly greater involvement in nonviolent delinquency, regardless of whether nonviolent offending was measured via self-reports or court records. A similar pattern of findings emerged for substance using behaviors; gang members did *not* report significantly higher rates of alcohol use, binge drinking, marijuana use, or illicit drug use as compared to non-gang youth. Thus, an important consideration is that gang membership may not have a "blanket" effect on all types of delinquency, possibly affecting violent but not property crime or drug using behaviors.

Most scholars researching criminal behavior among gang members have engaged in individual-level analyses (but see Curry and Spergel, 1988 and Hagedorn, 1994). Tita and Ridgeway (2007), alternatively, explored whether gang presence in Pittsburgh communities affected aggregate (i.e., community-level) crime rates. After identifying high gang concentrated areas (i.e., "turf" or "set space"), examination of the effect of gang presence on crime rates revealed that the areas in which gang members congregated were marked by higher crime rates prior to the arrival of the gang. Thus, gangs selected or coincidentally existed in high crime neighborhoods. The number of shots fired and the number of drug crimes committed in the immediate proximity, however, increased after the arrival of the gang. Interestingly—and in line with Battin et al. (1998)—the number of property crimes committed in the neighborhood were unaffected by increased gang presence. In sum, Tita and Ridgeway's analysis indicated that gangs may seek out certain neighborhoods and their presence does not affect property crimes but is associated with an increase in both gun and drug offenses.

Given the consistency with which research has identified a link between gang membership and crime, it is not surprising that some scholars have begun to identify the factors affecting the propensity to join a gang. Research has shown, for example, that prior delinquency, attachment to parents, parental monitoring, self-control, contact with delinquent peer groups, exposure to neighborhood disadvantage, victimization experiences, the presence of neuropsychological deficits, gender, race, and age are all factors related to a youth’s chances of becoming a gang member (e.g., Klein and Maxson, 2006). Prior involvement in delinquency is an obvious correlate of gang membership (Esbensen and Huizinga, 1993). Youth who are enmeshed in delinquent activities are much more likely to join a gang. Familial influences may also be linked with gang membership since exposure to harsh or ineffective parenting is associated with delinquent behavior (Gottfredson and Hirschi, 1990; Loeber and Stouthamer-Loeber, 1986; Sampson and Laub, 1993).

An individual's level of self-control is one of the most consistent predictors of crime and delinquency (Gottfredson and Hirschi, 1990). For this reason, it is likely that one's level of self-control will affect their propensity to join a gang. Peer influence is probably one of the

more obvious factors affecting an individual's decision to join a gang. Youth who associate with gang-affiliated peers are much more likely to join a gang themselves (Decker and Curry, 2000; Esbensen et al., 2001). Factors associated with neighborhood quality have also been theorized to influence gang presence (Shaw and McKay, 1942), thus it is important to consider these effects when modeling gang membership propensity.

Finally, researchers have highlighted the link between more localized experiences such as victimization and the propensity to join a gang. Miller (2001) noted that many female gang members reported sexual and physical abuse prior to joining a gang. Summarizing the extant risks and protective factors of gang involvement, Taylor (2008) pointed out that victimization and the need for safety are important precursors. Peterson, Taylor and Esbensen (2004) corroborated this finding with data from the Gang Resistance Education and Training (GREAT) program. Their analysis indicated that approximately half of all gang members cited protection, respect, and friendship respectively as primary motives for joining. Although prior victimization experiences appear to increase the likelihood of gang membership, some research suggests that members are more likely to experience victimization *after* affiliation (DeLisi, Barnes, Beaver, and Gibson, 2009; Peterson et al., 2004; Spano et al., 2008); perhaps an unsurprising result given that criminal offenders are more likely to be victims of crime than are non-offenders (Lauritsen, Sampson, and Laub, 1991).

Hypothesizing about the "Gang Effect"

Against this backdrop of research findings, scholars have offered three hypotheses which summarize the ways gang membership may be linked to crime and delinquency. As espoused by Thornberry and colleagues (1993), the first hypothesis is the "selection" argument, and states that individuals most likely to be involved with a gang are the same individuals most likely to be involved in crime and delinquency in the first place. This approach is similar to a population heterogeneity explanation of crime (see Gottfredson and Hirschi, 1990; Wilson and Herrnstein, 1985), positing that the gang does not actually influence a person's involvement in crime. Instead, gang membership is seen as just another manifestation of a person's underlying criminal propensity.

Research investigating the composition of gangs and the background characteristics of gang members provide some insight regarding the selection argument. A number of studies have found a statistically significant link between prior delinquency and gang membership (Battin et al., 1998; Esbensen and Huizinga, 1993; Gordon, Lahey, Kawai, Loeber, Stouthamer-Loeber, and Farrington, 2004), with gang members typically exhibiting more delinquent behavior in the years leading up to their gang involvement than non-gang youth.

Attempting to understand the dynamics of gang formation, Johnson et al. (2009) compared a group of online gamers to LA gang members. Analyses showed that group formation processes were similar between the "guilds" of the gamers and the gang members. While the central focus of the two groups differed, formation processes were similar and predictable. On a similar note, there is evidence that the selection of peer groups, including antisocial peer groups, may be explained by genetic factors (Beaver, Wright, and DeLisi, 2008; Cleveland, Harrington, Wiebe, and Rowe, 2005; Iervolino, Pike, Manke, Reiss, Hetherington, and Plomin, 2002), hinting at the possibility that genes may play a role in the selection into gangs. Beaver, DeLisi, Vaughn, and Barnes (2010) recently reported that a variant of the MAOA gene was linked to gang membership and gang-related violence.

The second hypothesis is known as the "facilitation" hypothesis. The facilitation hypothesis states that gang membership *causes* increased involvement in crime and delinquency. According to this perspective, gang-involved youth will increase their criminal activity as a

result of the socio-cultural changes attached to membership. Antecedent differences between individual gang members are believed to be irrelevant. Instead, the behavioral influences of the gang are normative and of principal importance. Supporting evidence can be drawn from Gordon et al. (2004) who estimated fixed effects regression models on panel data in order to control for unobserved heterogeneity. Their models revealed that individuals were more involved in crime and drug use during periods of gang involvement, with these findings consistent across different reporting sources (i.e., self-report, parent report, and teacher report).

The third explanation of the link between gang membership and crime is known as the "enhancement" hypothesis. The enhancement hypothesis is perhaps best understood as a hybrid of selection and facilitation hypotheses. Specifically, this model contends that certain youth may be predisposed to gang affiliation—particularly those socialized in a neighborhood where gangs are prevalent. Once affiliated, the enhancement hypothesis posits that these individuals will quickly elevate their level of criminal involvement. While an individual may self-select into a gang, the gang also affects future behavior. Evidence for this hypothesis can be drawn from Thornberry and colleagues (1993) who analyzed transient and stable gang members. Findings revealed that transient gang members committed delinquent acts at a greater frequency during periods when they were affiliated with the gang as opposed to time periods when they were not affiliated. Stable gang members were more likely to be criminal prior to affiliation, but their offending also increased significantly after joining the gang. Further evidence for the enhancement hypothesis can be gleaned from the observation that certain respondent characteristics such as prior delinquency, low self-control, neighborhood problems, and exposure to neglectful parenting were significantly related to membership in DeLisi et al.'s (2009) analysis. After accounting for these selection effects, the authors observed a statistically significant relationship between gang membership and violent victimization, which did not appear to wane over time (i.e., gang membership predicted contemporaneous and future victimization).

The Current Study

Researchers have wrestled with trying to identify whether the selection, facilitation, or enhancement hypothesis most accurately explains the gangs-crime nexus (Thornberry et al., 1993). Scholars have employed myriad methods ranging from qualitative accounts of socio-cultural processes underlying gang membership to quantitative methods attempting to parse out selection effects so as to isolate the gang-crime relationship. Though the "gold standard" for research is experimental manipulation, for obvious reasons youth cannot be randomly assigned to gang membership status. Instead, researchers are left with the task of trying to approximate experimental designs. One statistical technique that has emerged in recent years that is directly applicable to examining the gang-delinquency association is propensity score matching (PSM; Rosenbaum and Rubin, 1983).

In a short period of time, propensity score matching has become a popular analytical tool within criminology generally. Recent research has utilized PSM in an exploration of the link between marriage and desistance from crime (King et al., 2007), the incapacitative effects of prison on offending (Sweeten and Apel, 2007), the effect of supermax prison confinement on recidivism (Mears and Bales, 2009), and whether gang membership increases victimization experiences (DeLisi et al., 2009; Gibson, Miller, Jennings, Swatt, and Gover, 2009). Only one study, however, has applied counterfactual methods to the analysis of the gang-crime relationship (Haviland, Nagin, and Rosenbaum, 2007). Haviland and colleagues (2007) combined group-based trajectory modeling with propensity score matching to approximate the effect of gang membership on violent crime.

There are many statistical techniques available to gang researchers (Piquero and Weisburd, 2010). Two features of the PSM strategy make it an attractive tool for the current study. First, PSM allows for the simultaneous estimation of factors that predict gang membership and whether gang membership is associated with crime and delinquency. In this way, a researcher can test the selection, facilitation, and enhancement hypotheses simultaneously. Second, PSM is a versatile technique that allows for powerful sensitivity tests. Researchers using PSM can test whether their results are sensitive to "hidden" biases (i.e., spuriousness) using Rosenbaum's (2002) sensitivity test. This feature is particularly important since it is impossible to control for every factor that may influence a youth's choice to join a gang. For these reasons, the current paper applied PSM and a related technique (inverse probability of treatment weighting [IPTW]) to analyze the effect of gang membership on involvement in violent and nonviolent delinquency among a nationally representative sample of youths.

Methods

Data

The current study analyzed data drawn from the National Longitudinal Study of Adolescent Health (Add Health; Udry, 2003). The Add Health data represents a nationally representative sample of American students in grades 7 through 12, collected in three waves beginning in September 1994. The first stage netted information from approximately 90,000 students, who completed voluntary self-report surveys that were administered in school. Students were drawn from 132 schools (schools were selected using stratified random sampling techniques) and were given prior notice of the survey. Parental consent was required for a student to participate in the survey.

A subsample of the original cohort was randomly chosen to be re-interviewed in their home (i.e., the Wave 1 in-home survey). The in-home surveys were confidential and were designed to capture more detailed information than the in-school questionnaires. Respondents were asked, for example, to report on their personal relationships with family and friends, their experiences, and their involvement in various activities including crime and delinquency during the past year. In most cases, the respondent was interviewed in a private setting (almost always within the respondent's home). The in-home surveys were completed using laptop computers where the interviewer read the question aloud and the respondent answered with a verbal response. When sensitive topics were referenced (e.g., sexual experiences), respondents answered questions using audio computer assisted interviewing techniques. Thus, when sensitive topics became the focus, respondents' answers were not given to the interviewer, but were instead coded directly into the computer by the respondent. Each respondent's primary caregiver was also interviewed at Wave 1. Primary caregivers were almost always identified as the respondent's mother. Questions asked to caregivers covered a range of topics—from neighborhood quality to parent-child relationship quality. In all, 20,745 adolescents and 17,700 of their primary caregivers participated in the Wave 1 in-home component (Harris et al., 2003). Respondents ranged between 11 and 21 years of age at Wave 1. Slightly more than half of all respondents were female (n = 10,480).

A second round of in-home interviews were conducted with 14,738 of the Wave 1 respondents approximately one year later (i.e., Wave 2). Not all respondents interviewed at Wave 1 were re-interviewed at Wave 2, due primarily to their graduation from high school. The questionnaire was largely unchanged at Wave 2, with respondents again being asked to report on their personal relationships and involvement in crime and delinquency. The age range for the respondents was between 11 and 23 years at Wave 2.

Approximately five years after the completion of the Wave 2 interviews, 15,197 respondents were contacted and reinterviewed (i.e., Wave 3). While all respondents interviewed at Wave 1 were eligible to be interviewed at Wave 3, most had reached young adulthood and many of the questions appearing in the survey were changed to reflect more age-appropriate topics. For instance, respondents were no longer asked to report on status offenses such as running away from home. Instead, the Wave 3 questionnaires asked respondents to report on criminal behaviors more typical of adult offenders (e.g., deliberately writing bad checks). Respondents ranged between 18 and 27 years of age at Wave 3.

Measures

Outcome Variables

Wave 2 Delinquency—During Wave 2 interviews, respondents were asked 15 questions referencing the frequency with which they were involved in delinquent activities in the past year. For example, respondents were asked how many times in the past twelve months they had deliberately damaged property, stolen a car, taken part in a group fight, and used a weapon in a fight. Responses were coded as 0 (never), 1 (once or twice), 2 (three or four times), or 3 (five or more times). Because these questions do not reflect a homogenous set of behaviors, combining all measures into a single scale may mask important variation unique to specific types of delinquency. Some measures in this scale, for example, tap nonviolent delinquency (e.g., painting graffiti, damaging property, and running away from home), while others capture violence (e.g., taking part in a group fight, hurting someone badly enough that the person required medical attention, and using a weapon to forcibly take something). Principal component analysis indicated that nine variables measuring nonviolent delinquency loaded onto a single component. Thus, to create the nonviolent delinquency scale at Wave 2, responses to these nine variables were summed into a single item ($\alpha = .78$). Six variables tapping violent delinquency also loaded onto a single underlying component and the responses were, therefore, summed into a single violent delinquency variable ($\alpha = .75$). Higher values indicated elevated delinquency for both scales. Table 1 presents the descriptive statistics for the Wave 2 delinquency scales, as well as the other variables/scales used in the analyses.

Wave 3 Delinquency—Recall that the respondents had reached young adulthood at the time of the Wave 3 interviews. As a result, many of the questions regarding involvement in delinquency were no longer relevant. To account for the aging of the respondents, the Add Health researchers altered many of the questions to reflect criminal behaviors that are more common in adulthood. For example, respondents were asked a series of questions about their involvement in fraud activity, such as deliberately writing bad checks and buying or selling stolen property. Similar to the Wave 2 questionnaire, Wave 3 items can be separated into nonviolent and violent criminal behaviors. Items tapping nonviolent delinquency referenced behaviors such as breaking into a house, selling drugs, and buying stolen property. Items tapping violent delinquency referenced behaviors such as carrying a weapon to school or work, using a weapon in a fight, and taking part in a group fight. Principal component analysis indicated that the eight items measuring nonviolent delinquency loaded onto a single component. Thus, the nonviolent delinquency scale was calculated by summing responses to each of the eight items ($\alpha = .68$). Similarly, the four items measuring violent delinquency loaded onto a single component and the violent delinquency scale was created by summing across the four items ($\alpha = .54$). With both scales, higher values indicated more criminal activity.

Treatment Variable

Gang Membership—Prior researchers have uncovered different ways of measuring gang membership (Esbensen and Huizinga, 1993). One method is to offer a definition of gang membership to the respondent and then inquire about gang member status. This process allows for the differentiation between various types of gangs through increasingly restrictive definitions of gang membership (Esbensen and Huizinga, 1993; Esbensen, Winfree, He, and Taylor, 2001). Other scholars have measured gang membership via a single indicator, namely whether or not respondents self-identify as a gang member (Peterson et al., 2004). Typically, researchers taking this approach do not define the parameters within which respondents should consider a group of friends to be a gang. In other words, respondents are asked whether they belong to a gang with no formal definition of a gang being offered. This less restrictive approach yields more conservative estimates of the effect of gang membership on delinquency because some respondents may falsely claim gang involvement.

During the second wave of data collection, the Add Health respondents were asked to self-report whether they had been initiated into a named gang within the past 12 months. Responses to this item were coded dichotomously (0 = the respondent was not initiated into a gang; 1 = the respondent was initiated). Self-reported gang involvement is considered to be a robust measurement strategy (Esbensen et al., 2001) that has been used previously by Add Health researchers (Bell, 2009; DuBois and Silverthorn, 2005). Roughly 5 percent of the Add Health respondents (n = 704) indicated that they had been initiated into a named gang in the past 12 months, an estimate within the expected range for general population samples (Bjerregaard, 2010; Esbensen and Deschenes, 1998; Esbensen and Huizinga, 1993).

Propensity Score Covariates

A host of covariates known to predict gang membership were available at Wave 1. Specifically, information regarding each respondent's involvement in delinquency (Gordon et al., 2004), violent victimization experiences (DeLisi et al., 2009; Gibson et al., 2009), level of attachment to their mother (Esbensen and Deschenes, 1998; Loeber and Stouthamer-Loeber, 1986), level of parental permissiveness (Bell, 2009; Loeber and Stouthamer-Loeber, 1986), level of self-control (Esbensen and Deschenes, 1998; Gottfredson and Hirschi, 1990), contact with drug-using peers (Akers, 1998), exposure to neighborhood disadvantage (Bell, 2009; Decker and Curry, 2000), level of neuropsychological deficits (DeLisi et al., 2009), gender (Bell, 2009; Esbensen and Deschenes, 1998), race (Esbensen and Winfree, 1998; Freng and Esbensen, 2007), and age were all available. Each of these covariates has been linked to probabilities of gang membership and, therefore, are important to consider when modeling gang membership propensity (e.g., Esbensen, Peterson, Taylor, and Freng, 2009; Klein and Maxson, 2006).

Delinquency—Prior involvement in crime and delinquency is associated with an increased likelihood of joining a gang (Battin et al., 1998; Esbensen and Huizinga, 1993; Gordon et al., 2004). To account for these effects, a measure of delinquency at Wave 1 was used as a covariate to predict Wave 2 gang membership. At Wave 1, respondents were asked to indicate the frequency with which they had committed 15 delinquent acts in the past 12 months, ranging from minor delinquency such as stealing something worth less than $50 to more serious delinquency such as selling drugs or stealing a car. The values were coded 0 (never), 1 (once or twice), 2 (three or four times), or 3 (five or more times). Following prior Add Health-based research (Haynie, 2001), answers to each of the 15 items were summed together so that higher values indicated more involvement in delinquency (α = .84).

Violent Victimization—For some youth, gangs represent a form of protection from future victimization experiences (Decker and Curry, 2000; Miller, 1998; Peterson et al., 2004). As

such, an important predictor of gang membership is whether and to what extent the respondent has been previously victimized. During Wave 1 interviews, respondents were asked six questions that referenced experiences of violent victimization within the last 12 months. Respondents were asked, for example, whether they had gotten into a physical fight or whether they had been stabbed. Responses to each question were coded as 0 (never), 1 (once), or 2 (more than once). To create the violent victimization scale, responses to each of the six questions were summed together. Thus, respondents who reported more victimization experiences were assigned higher scores on the violent victimization scale ($\alpha = .70$).

Maternal Disengagement—Exposure to ineffective or harsh parenting is predictive of a child's involvement in delinquency (Gottfredson and Hirschi, 1990; Loeber and Stouthamer-Loeber, 1986; Sampson and Laub, 1993). By extension, neglectful parents may be more likely to raise gang-involved youth. Five questions asked at Wave 1 measured the level of warmth and love expressed by the respondent's mother. The five items were summed together so that higher values indicated more maternal disengagement ($\alpha = .84$).

Maternal Involvement—During Wave 1 interviews, respondents were asked whether they had taken part in ten activities with their mother in the past four weeks. Common activities such as going to a movie, playing a sport, and going to a religious service were referenced. Each of the ten items were coded dichotomously (0 = respondent did not participate in the activity with their mother; 1 = respondent did participate in the activity with their mother). Respondents' answers to the ten questions were summed to create the maternal involvement index with higher values indicating greater maternal involvement ($\alpha = .55$), an index also used previously by Add Health researchers studying gang membership (Bell, 2009).

Maternal Attachment—Prior researchers examining gang involvement, victimization, and delinquent involvement have used two items available at Wave 1 to measure maternal attachment (Bell, 2009; DeLisi et al., 2009; Haynie, 2001; Haynie and Piquero, 2006; Schreck, Fisher, and Miller, 2004). Adolescents were asked to indicate the level of closeness they felt toward their mothers and how much they thought their mothers cared about them. Both items were coded so that higher values indicated a greater bond between the respondent and his/her mother. Responses to these two questions were summed together to create the scale ($\alpha = .64$).

Parental Permissiveness—Researchers have noted that an important risk factor for delinquency and for joining a gang is a lack of parental monitoring (Esbensen and Deschenes, 1998; Decker and Curry, 2000; Gottfredson and Hirschi, 1990; Loeber and Stouthamer-Loeber, 1986). At Wave 1, each respondent was asked seven questions about whether their parent(s) allowed them to make decisions regarding their curfew, their peer group, the clothes they wear, their bed time, their diet, what they watch on television, and how much television they watch. Responses to these seven questions were coded dichotomously (0 = no; 1 = yes) and were summed to create a scale tapping parental permissiveness ($\alpha = .63$). This scale has been used by previous Add Health researchers (Bell, 2009; Felson and Haynie, 2002; Wright, Beaver, DeLisi, and Vaughn, 2008).

Low Self-Control—Many of the traits ascribed to individuals with low self-control are characteristic of gang members (Esbensen and Deschenes, 1998; Gottfredson and Hirschi, 1990). For example, gang members have higher levels of impulsivity than non-gang youth (Esbensen and Deschenes, 1998). Prior research has identified a five-item self-control scale available at Wave 1 (Perrone, Sullivan, Pratt, and Margaryan, 2004; Wright et al., 2008) that measures the adolescent's ability to maintain focus, pay attention in school, and to get along

with others. The scale was created by summing the responses to each of the five questions which were coded so that higher values indicated lower levels of self-control (α = .66).

Drug-using Peers—Exposure to delinquent and drug-using peers is one of the most obvious risk factors for gang membership (Decker and Curry, 2000; Esbensen et al., 2001). During Wave 1 interviews, respondents reported on how many of their three best friends smoked at least one cigarette daily, smoked pot more than once per month, and drank alcohol at least once per month. Summing the responses to these questions generated the Wave 1 drug-using peers scale that was coded so that higher scores reflected more contact with drug-using peers (α = .76). This scale also has been utilized in prior analyses (Bellair, Roscigno, and McNulty, 2003; Mack, Leiber, Featherstone, and Monserud, 2007; Wright et al., 2008).

Neighborhood Disadvantage—Neighborhood structural conditions may be an important factor underlying gang membership (Akers, 1998; Bell, 2009; Curry and Spergel, 1992; Hagedorn, 1994). During Wave 1 interviews, each respondent's parent was asked to report on the condition of their neighborhood. The parent was asked to indicate how much they would like to move away from their current neighborhood, whether drug dealers and users were prevalent in their neighborhood, and whether litter was prevalent. Responses to the three items were coded so that, when summed together, higher values reflected more disadvantage (α = .66). This scale has been used previously (DeLisi et al., 2009).

Neuropsychological Deficits—The presence of neuropsychological deficits has been identified as a key correlate of antisocial behavior (Moffitt, 1990, 1993). During Wave 1 interviews, respondents completed the Peabody Picture Vocabulary Test (PPVT). The PPVT is a standardized instrument measuring verbal skills that has been used previously to measure neuropsychological deficits (Beaver, DeLisi, Vaughn, and Wright, 2010). Scores for the PPVT were reverse-coded so that higher scores indicated more neuropsychological deficits (i.e., less verbal skills).

Demographics—Measures of each respondent's gender, race, and age were included in the analyses. Gender was coded dichotomously (0 = female; 1 = male) as was race (0 = White; 1 = non-White). Age was coded as a continuous variable measured in years.

Plan of Analysis

Two objectives motivate the current analysis. First, the effect of gang membership on contemporaneous measures of nonviolent and violent delinquency (i.e., Wave 2) is investigated. Second, the effect of gang membership on measures of nonviolent and violent delinquency occurring later in life (i.e., Wave 3) is analyzed. To do so, two counterfactual data analytic methods are employed. Counterfactual methods estimate what the outcome for an individual receiving the treatment condition—in our case, gang membership—would have been if they had not received the treatment (Guo and Fraser, 2010). In other words, counterfactual analyses can be used to determine the level of delinquency gang members would have exhibited had they not joined a gang and vice versa.

The first counterfactual analysis to be conducted is known as propensity score matching (PSM). The PSM analysis follows a series of four steps. First, *t*-tests are conducted to determine whether any statistically significant differences exist between gang and non-gang members regarding background characteristics (i.e. the covariates listed above). Second, a logit model utilizing the "treatment" variable (i.e., gang membership) as the outcome variable and the covariates as predictors is estimated. This model will provide estimates of the probability that each respondent joined a gang at Wave 2. Based on these predicted

probabilities, a nearest neighbor matching algorithm then matches gang members with non-gang members based on similar probabilities. The standard caliper of .05 was used. After matching, the sample will approximate that of an experimental design; half of the sample is considered "treated" (i.e., a gang member) and the other half is not (i.e., a non-gang member). At this stage in the analysis, any variation in the involvement in crime and delinquency that is attributable to the covariates has been removed from the observations. Third, after cases are matched, a second set of independent sample *t*-tests between gang members and non-gang members are estimated. In regards to the covariates, all previously highlighted statistically significant differences should be reduced to non-significance and standardized bias statistics should be reduced below an absolute value of 20. The standardized bias statistic represents the mean difference as a percentage of the average standard deviation (Rosenbaum and Rubin, 1985).

The fourth step estimates a post-matching *t*-test between gang members and non-gang members on the outcome variables of interest (i.e., Wave 2 nonviolent delinquency, Wave 2 violent delinquency, Wave 3 nonviolent delinquency, and Wave 3 violent delinquency). Results from these *t*-tests are interpreted as the effect of gang membership on delinquency involvement after selection effects have been removed. In the terms of counterfactual analysis, this final *t*-test indicates the level of delinquency that gang members would have exhibited had they not joined a gang. Separate propensity score analyses were conducted for each of the four outcome variables: Wave 2 nonviolent delinquency, Wave 2 violent delinquency, Wave 3 nonviolent delinquency, and Wave 3 violent delinquency.

The second counterfactual method to be used is referred to as inverse probability of treatment weighting (IPTW). This technique is closely related to the PSM analysis and, therefore, can be used to corroborate the PSM results. To conduct the IPTW analysis, the predicted probabilities gleaned from the logistic regression equation predicting Wave 2 gang membership (i.e., step 2 in the PSM analysis) are saved and utilized as treatment weights in a regression analysis. (As the name implies, the *inverse* of the probability of treatment is used as the regression weight). Rather than matching cases based on similar probabilities of treatment as in the PSM analysis, the IPTWs act as a regression weight for the coefficient representing the effect of the focus variable (see Sampson, Laub, and Wimer, 2006). The regression model thus assumes the formulaic expression of:

$$\widehat{Y}=\widehat{\beta}_0+\widehat{\beta}_{IPTW}(Wave\ 2\ gang\ membership)+\varepsilon$$

In this model, $\hat{Y}$ represents each respondent's predicted value on the delinquency scale, $\hat{\beta}_0$ is the estimated constant, and $\hat{\beta}_{IPTW}$ is the estimated coefficient representing the weighted effect of Wave 2 gang membership on delinquency. IPTWs are useful because they "down-weight" the contribution of those respondents that are most likely to join gangs to the estimation of the regression coefficient. In this way, the analysis can isolate the effect of gang membership on delinquency by allowing those *least* likely to join a gang to contribute more to the final estimate. The logic is that the effect of gang membership for those least likely to join a gang is more likely to reflect causal effects than selection processes.

Before moving to the results, it is important to note that the Add Health data included two gang involvement measures: one at Wave 2 and one at Wave 3. The Wave 2 questionnaire referenced gang membership that had occurred within the past 12 months. During Wave 3 interviews, however, respondents were asked to indicate whether they had *ever* belonged to a gang. The Wave 3 measure, therefore, tapped gang membership that had ever occurred. This difference between the two questions precluded the use of the Wave 3 measure as a treatment variable because it violates the causality axiom of temporal order. The Wave 3

measure can, however, be utilized to more accurately differentiate gang members from non-gang members. Specifically, it is important to remove gang members from the "non-gang sample" if they reported gang membership at Wave 3 but not at Wave 2. Consider the following: a respondent reported that they did not join a gang at Wave 2. Thus, this respondent is included in the non-gang sample. However, imagine that this same respondent reported gang involvement at Wave 3 (i.e., that they had *ever* belonged to a gang). Including this respondent in the non-gang sample may bias the findings toward the null (i.e., no difference in delinquency between gang members and non-gang members).

In the following analyses, only when examining the effects of gang membership on Wave 3 outcomes will the above described removal process be performed. The Wave 3 gang measure cannot be used to remove gang members from the non-gang sample when analyzing Wave 2 delinquency because the Wave 3 gang measure does not allow researchers to determine when the respondent became affiliated with the gang. This is problematic because the removal process may lead to the deletion of a respondent before he/she actually joined the gang.

Results

A series of *t*-tests were conducted on each of the covariates to identify any pre-matching differences. The results from these analyses can be found in the left side of Table 2 under the heading "Unmatched Sample." Before estimating the logistic regression model, several significant differences between gang and non-gang members were identified. For example, respondents who reported gang membership at Wave 2 reported significantly greater involvement in delinquency and more victimization at Wave 1.

Since gang members and non-gang members exhibited significant differences on almost all of the covariates, it was important to "match" gang members to non-gang members who had similar probabilities of joining a gang. Thus, a logistic regression model utilizing Wave 2 gang membership as the outcome and the covariates as independent variables was estimated. The regression coefficients and standard errors gleaned from this model can be found in Table 2. The logistic regression model was used to generate predicted probabilities of gang membership for each respondent in the sample. Based on similar probabilities of gang membership (caliper setting of .05), gang members were matched (one-to-one) with non-gang members and all unmatched respondents were removed from the sample. This process led to a final sample of 478 gang members and 478 non-gang members.

It was important to determine whether the differences between gang members and non-gang members that were highlighted prior to matching were reduced to non-significance after matching. The results from these *t*-tests are presented in the right side of Table 3 under the heading "Matched Sample." As can be seen, all previously highlighted significant differences between gang and non-gang members, with one exception, were reduced to non-significance. The exception was for scores on the parental permissiveness scale; after matching, gang members had slightly higher scores than non-gang members. This difference, however, is not likely to affect the current results for three reasons. First, the difference, although significantly different from zero, was small in magnitude. Second, after matching, the standardized bias statistic for this scale was reduced below 20, evidence that matching was successful. Third, when considering the other three outcomes (i.e., Wave 2 violent delinquency, Wave 3 nonviolent delinquency, and Wave 3 violent delinquency), this difference was reduced to non-significance.

Table 4 presents the results from pre- and post-matching *t*-tests regarding the four outcome variables (i.e., Wave 2 nonviolent delinquency, Wave 2 violent delinquency, Wave 3

nonviolent delinquency, and Wave 3 violent delinquency). Prior to matching, gang members exhibited much greater involvement in both types of delinquency at Wave 2 and at Wave 3. After matching, these differences were reduced. In all but one case, however, the gang members maintained significantly higher scores on the delinquency variables. The one exception was for Wave 3 nonviolent delinquency. As can be seen, the difference between gang members and non-gang members on Wave 3 nonviolent delinquency was *not* significantly different from zero.

Since gang members maintained significantly higher scores on 3 of the 4 delinquency outcomes, it was important to perform sensitivity analyses to determine whether the observed post-matching differences were robust to "hidden" biases (i.e., uncontrolled heterogeneity). Recall that gang and non-gang members were matched on a host of covariates known to predict gang membership. If a variable that affects gang membership *and* delinquency was omitted from the balancing equation, however, the final results may reflect this bias. One way to estimate the level of hidden bias that exists is to perform a sensitivity analysis suggested by Rosenbaum (2002; also see Guo and Fraser, 2010:298–299). This analysis estimates the significance of the effect of gang membership on delinquency at different levels of hidden bias (i.e., Γ). The Γ value represents the degree to which an uncontrolled variable would need to increase the odds of gang membership in order to render the relationship between gang membership and delinquency insignificant. Rosenbaum (2002) explained that a study is sensitive to hidden bias if Γ values close to 1.0 render relationships insignificant. The likelihood that a finding is sensitive to hidden bias can, therefore, be understood as a function of Γ—as Γ values increase beyond 1.0 the results are less sensitive to hidden bias.

The Rosenbaum sensitivity analysis was only performed on the three outcomes that were found to differ significantly between gang and non-gang members. The sensitivity analysis suggested that the relationship between Wave 2 nonviolent delinquency is unlikely to reflect hidden biases ($\Gamma = 2.5$). The Γ value for the Wave 2 violent delinquency scale similarly indicated that an omitted variable is unlikely to substantively alter the findings. Indeed, an omitted variable would need to increase the odds of gang membership by more than 300 percent to reduce the estimated effect of gang membership on Wave 2 violent delinquency to a non-significant value. The Γ value for the violent delinquency scale at Wave 3, however, was only slightly higher than 1.0. This means that the difference between gang members and non-gang members on violent delinquency at Wave 3 may be sensitive to hidden bias. An uncontrolled variable that increases the odds of gang membership by 1.3 could render insignificant the difference between gang and non-gang members' levels of violent delinquency at Wave 3.

Recall that the predicted probabilities generated by the logistic regression analysis can be utilized as IPTWs in a regression analysis. Since the delinquency outcomes were measured as count variables and were overdispersed, negative binomial regression models were estimated (Long, 1997). These negative binomial equations (not presented) revealed gang membership to be a significant predictor of all four types of delinquency after the IPTWs were included. To facilitate interpretation of this analysis, the predicted rates of delinquency based on gang membership status are presented in Figure 1. These predicted rates were gleaned from the negative binomial equations using the IPTWs. Figure 1 reveals that gang members as compared to non-gang members were predicted to have a greater involvement in both nonviolent and violent delinquency at Wave 2 and Wave 3. In line with the previous results, however, gang membership had a much weaker effect on Wave 3 delinquency—both nonviolent and violent delinquency—than was observed for Wave 2 delinquency. Further in line with the previous results was that the effect of gang membership on Wave 3 nonviolent delinquency was equal to about half of the observed effect on Wave 3 violent

delinquency. The primary divergence between the results from the IPTW analysis and the results presented in Table 4 is that the effect of gang membership on nonviolent delinquency at Wave 3 was statistically significant. This difference is likely due to the increased sample size utilized in the IPTW analysis. The matching analysis reduced the sample size to 478 gang members, but the IPTW analysis is a regression-based model that analyzes data from all respondents with non-missing data. The sample sizes for the IPTW analyses are larger than those utilized in the matching analyses. Standard errors are, therefore, much smaller in the IPTW analysis.

Discussion

Prior research has linked gang membership with a range of antisocial behaviors (e.g., Bjerregaard, 2010). Some studies have reported, however, that the "gang effect" may not universally increase a person's level of involvement in all types of criminal activity (Battin et al., 1993; Tita and Ridgeway, 2007). Specifically, research has suggested that gang membership may not influence a person's involvement in nonviolent crime. The current study extends this line of inquiry by examining the link between gang membership and involvement in nonviolent and violent delinquency using two counterfactual analytic techniques. Specifically, PSM and IPTWs were employed to analyze the gang-delinquency relationship both cross-sectionally and longitudinally.

Four findings from the analysis warrant attention. First, scholars have suggested that the gang-crime link may reflect selection, facilitation, or enhancement processes (Thornberry et al., 1993). Employing the PSM technique allowed the current study to simultaneously examine each of these three hypotheses. The findings indicated that respondent background characteristics were predictive of gang involvement (i.e., selection). To be sure, respondents who reported more delinquent involvement, more victimization experiences, and lower levels of self-control at Wave 1 were more likely to report gang membership at Wave 2. These results indicate that identifying risk factors for gang membership should remain a priority for criminologists. At the same time, however, gang membership was linked with greater involvement in delinquency after these selection effects were removed. Recall that the enhancement hypothesis states that certain individuals have a greater propensity of joining a gang, but once in the gang these individuals are likely to increase their involvement in delinquency. The findings from the current study support this reasoning and suggest that identifying youth at risk of joining a gang is a prudent intervention strategy. Although individuals at risk of joining a gang will likely have a history of delinquent behavior, the current study suggests that diverting their path away from gang membership will prevent their delinquent behavior from extending into adulthood. In short, the findings from this study support the notion that certain youth may be predisposed to gang membership. Once in the gang, however, these youth will quickly elevate their involvement in delinquency.

Second, gang membership is predictive of a greater level of involvement in nonviolent and violent delinquency when measured cross-sectionally. Add Health respondents who reported joining a gang during Wave 2 interviews also reported greater involvement in nonviolent and violent delinquency at Wave 2. Third, gang membership was linked with greater involvement in violent delinquency longitudinally. Add Health respondents who reported joining a gang during Wave 2 interviews reported an approximately 60 percent greater involvement in violent delinquency at Wave 3 than non-gang members (mean violent delinquency score after matching for gang members = .55; mean violent delinquency score after matching for non-gang members = .31). It appears that the effect of gang membership on violent crime is not isolated to the time period immediately after gang initiation. Rather,

gang members are more likely to be involved in violent activities up to 5 years after joining the gang.

The fourth finding that emerged from the current analysis is that the effect of gang membership on nonviolent criminal activities may weaken over time. The PSM analysis indicated that gang members reported greater involvement in nonviolent crime at Wave 3 than non-gang members. This difference, however, was not significantly greater than zero. Interestingly, the IPTW analysis indicated that gang members were more likely to be involved in nonviolent crime at Wave 3. As noted, however, the discrepancy in these two findings is likely a function of the differences in sample size across the two analyses. The crucial point to bear in mind, however, is that gang membership may not have long-term effects on a person's involvement in nonviolent crime.

Though a large body of research has identified gangs as a possible catalyst for delinquency (Klein and Maxson, 2006), much less has sought to determine whether the gang effect applies generally to all types of delinquent behavior. For this reason, it is interesting to highlight the possibility that gangs do not have a “blanket” effect on all forms of delinquency. Indeed, the current findings suggest that the gang effect on nonviolent crime is temporary—isolated to the time period immediately following initiation into the gang. This finding seemingly stands in contrast to research that has focused on gang members’ involvement in drug activity (see for example, Bjerregaard, 2010; Levitt and Venkatesh, 2000), property damage (e.g., graffiti), and theft. Perhaps, however, these behaviors can be understood as a rite of passage where newer gang members prove their loyalty to the gang by committing nonviolent criminal acts. We invite future researchers to test this possibility since the Add Health data preclude a direct assessment.

The current study was unable to identify gang members who joined a gang prior to Wave 2. This means that an unknown number of gang members may have erroneously appeared in the non-gang sample. To the extent that this occurred, the estimates of delinquent involvement for non-gang members at Wave 2 will be inflated. Although gang members were removed from the non-gang sample prior to estimating the Wave 3 results, this removal process could not be performed for the Wave 2 analysis. In short, the Wave 2 findings should be considered conservative estimates of the effect of gang membership on nonviolent and violent delinquency.

A similar issue may have led to conservative estimates of the effect of gang membership on Wave 3 delinquent involvement. The current study was unable to identify and analyze transient gang members. Despite the common belief that gang members are in "for life," research has revealed that gang membership is an evanescent state (Decker and Curry, 2000; Esbensen and Huizinga, 1993; Taylor, 2008; Thornberry et al., 1993). These studies have shown that involvement in crime and delinquency is greatest during periods of gang involvement and quickly descends to pre-gang levels upon exiting the gang. Unfortunately, the Add Health data do not allow for the identification of short-term gang members. This limiting factor may have led to conservative estimates of the effect of gang membership on Wave 3 delinquency involvement. Specifically, to the extent that transient gang members are included in the gang member sample, the estimates of gang member's delinquent involvement at Wave 3 will be attenuated. Future research should replicate the current analysis with data that allow for the identification of transient gang members.

It should also be pointed out that gang membership was assessed by asking the respondent to indicate whether they had been “initiated into a named gang.” The possibility remains, however, that some respondents associated with a group of friends that, while not a named gang, might be classified as such by observers and/or researchers. In other words, it is

possible that some respondents would have been classified as gang members by researchers, but responded “no” to the gang question because their peer group was not considered a named gang or because their peer group did not have a formal initiation process (Bouchard and Spindler, in press; Esbensen and Huizinga, 1993; Esbensen et al., 2001). To the extent that this misinterpretation occurred, the mean level of delinquency for the non-gang member sample may have been slightly inflated (Curry, Decker, and Egley, 2002). Given the current debate surrounding the proper measurement of gang membership, we invite future researchers to explore the robustness of the current results across different definitions of gang membership.1 It bears repeating, however, that the measurement strategy employed by the current study has been shown to provide conservative estimates of gang membership (Peterson et al., 2004) and is considered a valid approach to tapping gang membership (Esbensen et al., 2001).

A final point to consider is that information was gleaned from respondents' mothers but not from their fathers. The Add Health researchers chose to interview female heads of households as opposed to male heads of households with the justification being that mothers typically are more informed of their child's activities and well-being. This meant that the current study was unable to include information about paternal influences. Since research has identified a relationship between paternal influences and gang membership, future work should seek data sources that allow for the estimation of these factors.

In summary, the limitations facing the current analysis have likely led to conservative estimates of the effect of gang membership on delinquent involvement. Future researchers should consider these issues to arrive at more accurate estimates. Nonetheless, the current study indicated that gang members reported greater involvement in both nonviolent and violent delinquency during the time in which they also reported gang membership. It also appears that the deleterious effects of gang membership may weaken over time, especially regarding nonviolent delinquent activity. Given the ongoing increase in gang involvement by American youth (Egley and O’Donnell, 2009; Hagedorn, 2005), criminologists should continue to investigate the myriad ways in which gang membership influences a person's involvement in criminal activities. Ostensibly, a greater understanding of the long-term consequences of gang membership will facilitate the creation of more comprehensive prevention and intervention policies.

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[1]The Add Health data do not allow for this type of analysis to be performed.

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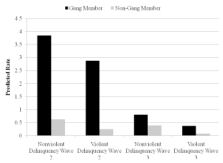

Figure 1. Predicted Rates of Nonviolent and Violent Delinquency Based on Gang Membership Status

Note: Predicted rates were estimated using negative binomial equations with IPTWs for gang membership.

Table 1

Descriptive Statistics for Add Health Variables

	Mean	SD	Min	Max
Outcome Variables				
Wave 2				
Nonviolent Delinquency	1.27	2.68	0	27
Violent Delinquency	.73	1.59	0	14
Wave 3				
Nonviolent Delinquency	.55	1.53	0	24
Violent Delinquency	.18	.69	0	11
Treatment Variable (Wave 2)				
Gang Membership	.05	.21	0	1
Covariates (Wave 1)				
Delinquency	4.31	5.30	0	45
Victimization	1.01	1.69	0	12
Maternal Disengagement	9.06	3.51	5	25
Maternal Attachment	9.37	1.14	2	10
Maternal Involvement	3.93	2.00	0	10
Parental Permissiveness	5.16	1.58	0	7
Neighborhood Problems	4.64	1.57	3	9
Low Self-Control	6.38	3.16	1	20
Drug-using Peers	2.55	2.66	0	9
Neuropsychological Deficits	98.56	15.54	9	141
Gender	.49	.50	0	1
Race	.38	.48	0	1
Age	16.15	1.74	12	21

Table 2

Logistic Regression Model Used to Generate Propensity Scores for Gang Membership

	β	SE
Delinquency	.06*	.01
Victimization	.20*	.03
Maternal Disengagement	.03	.02
Maternal Attachment	.08	.05
Maternal Involvement	−.01	.03
Parental Permissiveness	−.06	.03
Neighborhood Problems	.13*	.03
Low Self-Control	.04*	.02
Drug-using Peers	.13*	.02
Neuropsychological Deficits	−.02*	.00
Gender	.65*	.11
Race	.38*	.11
Age	−.19*	.03

* $p<.05$, two-tailed tests

Table 3

Achieving Balance among Gang and Non-Gang Members: Pre- and Post-Matching *t*-tests Using Nearest-Neighbor Matching

	Unmatched Sample			Matched Sample		
	Gang Member	**Non-Gang Member**	***t* value**	**Gang Member**	**Non-Gang Member**	***t* value**
Wave 1 Covariates						
Delinquency	10.46	4.01	27.34*	10.20	9.90	.54
Victimization	2.83	.85	27.44*	2.77	2.61	.95
Maternal Disengagement	9.48	8.87	3.90*	9.47	9.51	−.18
Maternal Attachment	9.33	9.42	−1.78	9.33	9.32	.19
Maternal Involvement	3.83	4.04	−2.34*	3.83	3.95	−.88
Parental Permissiveness	4.86	5.04	−2.48*	4.87	4.65	2.04*
Neighborhood Problems	5.20	4.58	8.74*	5.19	5.25	−.60
Low Self-Control	8.16	6.24	13.22*	8.11	8.22	−.48
Drug-using Peers	4.10	2.25	15.57*	4.04	3.97	.36
Neuropsychological Deficits	94.73	100.25	−7.95*	94.79	93.72	1.05
Gender	.68	.47	8.95*	.68	.68	−.21
Race	.46	.33	5.88*	.46	.47	−.32
Age	15.54	15.71	−2.25*	15.52	15.48	.45
N		10,782			478	

* $p<.05$, two-tailed tests

Note: Standardized bias statistics are below 20 for all covariates in the "Matched Sample." The "Matched Sample" *t*-tests were gleaned from the Wave 2 nonviolent delinquency analysis.

Table 4

Differences in Delinquency Between Gang and Non-Gang Members Pre- and Post-Matching

	Unmatched Sample			Matched Sample		
	Gang Member	**Non-Gang Member**	***t* value**	**Gang Member**	**Non-Gang Member**	***t* value**
Wave 2						
Nonviolent Delinquency	5.01	1.10	33.12*	4.98	2.36	8.97*
Violent Delinquency	3.73	.57	47.82*	3.72	1.61	11.73*
Wave 3						
Nonviolent Delinquency	1.01	.57	5.10*	1.00	.88	.75
Violent Delinquency	.55	.16	11.16*	.55	.31	3.05*

* $p<.05$, two-tailed tests