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Dangerous Places: Gang Members and Neighborhood Levels of Gun Assault

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Despite attention to the role of gangs in urban gun violence, much remains to be learned about the spatial distribution and consequences of residential gang membership. This study uses data from St. Louis to examine the effects of resident gang membership on rates of gun assault. We also consider whether gun violence is conditioned by the level of gang membership in surrounding communities. As anticipated, communities with the highest number of gang

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members also have the highest rates of gun assault. However, much of the impact of gang membership on gun assaults extends outside of the boundaries of gang neighborhoods, especially those neighborhoods with few or no gang members. The number of gang members in surrounding neighborhoods has no discernible effect on gun assaults in communities with higher rates of gang membership. Finally, controlling for the spatial proximity of residential gang membership helps to account for some of the association between neighborhood disadvantage and gun assaults.

Keywords gangs; guns; neighborhoods; violence

A broad body of research has examined the theoretical and empirical linkages between neighborhood characteristics, social processes, and aggregate crime patterns (Anderson, 1999; Bursik & Grasmick, 1993; Sampson & Groves, 1989). Less attention has been paid to gangs in the resurgence of research on neighborhoods and violence (Decker, Melde, & Pyrooz, 2013). Further, much of the neighborhoods research focuses on gangs as dependent variables, seeking to explain the emergence of gangs (Tita, Cohen, & Engberg, 2005) or spatial distribution of gang homicide (Rosenfeld, Bray, & Egley, 1999). The dearth of research in this area is surprising given that a rich body of fieldwork identifies the importance of gangs in neighborhood social organization and urban violence (e.g. Decker & van Winkle, 1996; Harding, 2010; Thrasher, 1927; Venkatesh, 1997). A small body of quantitative studies has demonstrated that gang activity clusters within disadvantaged neighborhoods, but it is unclear how residential gang membership contributes to violence within and around neighborhood borders net of the structural conditions of communities.

The present study examines the effect of residential gang membership on differential neighborhood gun assault rates and contributes to the extant literature on neighborhood violence and gangs in several important ways. First, we consider the spatial interdependence in residential gang membership and the location and concentration of gun assaults. Prior work has focused on gang territory as an independent, homogeneous measure rather than measuring the number of individuals that belong to gangs (Tita & Ridgeway, 2007), the density of which may vary dramatically across neighborhoods regardless of the number of gangs that are active in a neighborhood. In addition, research has traditionally focused on more refined units-of-analysis such as street corners or gang territory, and has been centered on the consequences of gang activity for more global measures of crime within communities (e.g. Kennedy, Braga, & Piehl, 1997; Robinson et al., 2009; Taniguchi, Ratcliffe, & Taylor, 2011). This latter body of work has not paid enough attention to the impact of gang membership on nonlethal gun violence.

Second, we document the consequences of residential gang membership for violence with a unique focus on gun assault. Eight percent of all violent crime involves a firearm and nonfatal firearm injuries outnumber firearm fatalities three to one (Planty & Truman, 2013). The consequences of gun violence are far reaching, including burdensome medical costs (Cook, Lawrence, Ludwig, & Miller, 1999) and increased fear of crime (Galster, Tatian, Santiago, & Smith, 1999).

We build on this research by considering how community-level variation in residents' involvement with gangs contributes to neighborhood levels of gun violence within and beyond community borders. To that end, the present study lays out theoretical mechanisms linking gangs and community crime rates, specifically cultural heterogeneity, group process, and routine activity theories. Drawing on diverse data sources, we assess how residential and spatial concentrations of gang members contribute to neighborhood rates of gun assault in St. Louis.

Community Structure and the Presence and Proliferation of Gangs

During the late 1970s and 1980s, many neighborhoods underwent significant structural changes—rising levels of poverty, single-parent households, and unemployment—which undermined neighborhood organization and social control (Anderson, 1999; Sampson & Groves, 1989; Wilson, 1987). The consequences of neighborhood decline are numerous, including the emergence of gangs. To explain the proliferation and maintenance of gangs in disadvantaged communities, two general perspectives—structural control and adaptation—have been put forth (Decker et al., 2013). Structural control perspectives hold that gangs emerge as a result of ineffective neighborhood social control. Such a view is consistent with social disorganization theory and Thrasher's (1927) observation that gangs arose in the Chicago slums. Neighborhoods with high residential turnover and racial/ethnic heterogeneity have greater social distance between neighbors. As a consequence, these neighborhoods have limited capacity for the regulation of resident behaviors and are unable to stop gang activity (Bursik & Grasmick, 1993; Kornhauser, 1978). Because gangs are naturally occurring social groups that integrate through conflict, the absence of community control permits seemingly trivial conflicts to escalate beyond the tipping point that propels such groups into gangs (Thrasher, 1927).

Structural adaptation perspectives hold that gangs emerge in response to the economic and social landscape of neighborhoods. Gangs provide economic and status enhancements in environments where conventional opportunities are limited. Classic adaptation perspectives emphasize structural barriers, differential opportunity structures, and discrepancies in means to achieve economic goals (Cloward & Ohlin, 1960; Cohen, 1955). Contemporary perspectives emphasize the acquisition of social status in post-industrial, hyper-segregated America, where guns and violence are pervasive (Anderson, 1999; Fagan & Wilkinson, 1998). Such an understanding of gangs embraces cultural heterogeneity, recognizing that gang values may not reflect those of the larger community.

There is only limited evidence to adjudicate between control and adaptation perspectives, although many of the cities that witnessed the emergence of gang activity in the 1980s and 1990s also underwent structural changes consistent with Wilson's (1987) underclass theory. Evidence also suggests that once gangs emerge in disadvantaged communities, they are unlikely to disappear or dissolve, with many instead adapting to changing circumstances (Ayling, 2011). What is important, then, is to determine how gangs contribute to violence above and beyond the structural conditions of neighborhoods.

The Contribution of Gangs to Neighborhood Violence

Structural control and adaptation perspectives have been used to explain high rates of gang membership and violence. The structural control perspective suggests gangs are only a proxy for social disorganization, and thus have no independent or causal impact on crime rates (Kornhauser, 1978). The social disorganization model does not fully account for the variability in levels of community violence, as neighborhoods may have similar structural traits, only to have different crime rates (Kubrin & Weitzer, 2003; Sampson, Raudenbush, & Earls, 1997). Veysey and Messner (1999, p. 171) argued that advances in neighborhood research would be found in the socializing rather than controlling aspects of communities (see also Anderson, 1999; Bursik & Grasmick, 1993).

Gangs are one such socializing aspect, but their influence on neighborhoods extends beyond the mere socialization of adolescents. Gangs become a broader part of the social fabric of communities, exerting unique influences on community behavior (Venkatesh, 1997). These influences extend beyond cultural processes and the socialization of neighborhood adolescents into crime (Sampson & Groves, 1989). Thus, we situate the salience of gangs for differential rates of neighborhood violence within the context of group processes (Short & Strodtbeck, 1965) and routine activity (Cohen & Felson, 1979) perspectives.

The higher the prevalence of gang members in a neighborhood, the more residents are exposed to the group processes generated by gangs (Klein & Maxson, 2006; Short & Strodtbeck, 1965). Gang membership enhances offending among delinquent youth, and facilitates criminality by non-delinquent youth, over and above the association with delinquent peers and other known correlates (Battin et al., 1998). Klein and Maxson (2006) attributed these differences to the group processes of gangs. Violence crystallizes cliques and playgroups into gangs and acts to maintain group cohesion (Klein & Crawford, 1967; Thrasher, 1927). Cohesion promotes group membership and participation in crime, particularly retaliatory violence that can extend beyond the original participants and across neighborhood boundaries (Decker, 1996; Papachristos, 2009; Short & Strodtbeck, 1965).

Much of this violence involves firearms, as gun ownership is a strong correlate of gang membership among youth. Gang members often engage in an urban arms race as they seek to obtain more firepower than their rivals

(Blumstein, 1995; Watkins, Huebner, & Decker, 2008), and this is reflected in the high levels of violent death rates found among gang-involved populations in field research (Decker & van Winkle, 1996) and official data (Decker & Pyrooz, 2010a). In St. Louis, gang youth are six times more likely to get shot at than non-gang youth (Curry, Decker, & Egley, 2002). The salience of firearms to gangs is indicative of the "predominant myth system" of violence under which gangs operate (Klein, 1971, p. 85), and is one component of cultural properties associated with neighborhood violence (Berg, Stewart, Schreck, & Simons, 2012). Moreover, group processes and mythic systems of violence coalesce with increased opportunities for violence.

Routine activity theory suggests that crime will be higher in areas where motivated offenders, suitable targets, and an absence of capable guardians converge in time and space (Cohen & Felson, 1979). The presence of certain facilitators, such as firearms, also contributes to crime (Clarke, 1995). Gang members spend significantly more time engaged in unstructured socializing in public settings than their non-gang peers during active periods of membership (Hughes & Short, 2014; Sweeten, Pyrooz, & Piquero, 2013). This unstructured socializing typically takes place in public spaces and brings members into frequent contact with others, increasing the chances for conflict (Decker & van Winkle, 1996). Further, such opportunity structures heighten spatially concentrated conflict, quickly escalating intergroup violence (Decker & Pyrooz, 2010a; Papachristos, 2009).

The consequences associated with neighborhood gang membership (e.g. group processes and opportunity structures) are especially meaningful because they may fundamentally alter the sociocultural context of the neighborhood. Whole neighborhoods are carved up by gang turf or territory (Decker & van Winkle, 1996; Papachristos, Hureau, & Braga, 2013). As membership becomes more common, it is easier for members to disseminate street values and ameliorate some of the negative perceptions of gangs and gang behaviors, at least among youth (Anderson, 1999; Shaw & McKay, 1942; Venkatesh, 1997). Further, non-gang residents may be less willing to cooperate with law enforcement because gang members are intimately tied to other community residents through familial and social networks. In such instances, gang members reinforce legal cynicism (Kirk & Papachristos, 2011; Venkatesh, 1997) and strengthen the desire of residents to arm themselves for protection (Black, 1983). Because the values espoused and disseminated by gangs reward violence with status within the gang, neighborhoods with strong street cultures are sites of higher levels of retaliatory violence (Berg et al., 2012).

What we have described above—group process, routine activities, and neighborhood culture—combines to elevate rates of community gun violence. Areas characterized by spatial concentrations of gang members will have exposure to more situations conducive to gun violence. The socializing components of gangs elevate violence in general and gun violence in particular. Based on these perspectives, the prevalence of gang members in a community would be expected to exert direct, independent effects on community rates of gun violence, and as we argue below, rates of gun violence in surrounding neighborhoods as well.

Neighborhood Proximity to Gang Members and Violence

Community processes reflect conditions and events beyond their borders. Violence spills across neighborhood boundaries because of the mobility of gang members, the role of contagion in violence, and—in statistical terms—spatial dependence. Spatial dependence is the influence of nearby geographic units that produce similar social processes and outcomes. Crime is spatially dependent, as neighborhoods adjacent to high-crime areas also tend to have higher rates of violence (Morenoff, Sampson, & Raudenbush, 2001).

Given the territorial aspects of gangs, the residential concentration of gang members should be reflected in geographic patterns of violent crime. Offenders commit crime in close proximity to their homes (Cohen & Felson, 1979). Exposure to the risk of violence is greater for neighborhoods sharing or bordering the physical and social space of offenders. As gang members navigate public space, they take great care not to accidentally cross into rival gang territory; to do so is to risk exposure to serious violence (Pyrooz, 2012). Further, interpersonal crimes like assault can generate sequences of retaliatory violence beyond a single neighborhood and the initial participants (Cohen & Tita, 1999; Decker, 1996; Morenoff et al., 2001). Gangs and their members have a well-documented history of engaging in retaliatory violence (Decker, 1996), with gang violence frequently spilling into surrounding territories and neighborhoods (Brantingham et al., 2012; Robinson et al., 2009; Tita & Ridgeway, 2007). Papachristos's (2009) examination of the structure of gang networks in Chicago illustrated that proximity between gangs strongly predicted sequences of retaliatory violence (see also Papachristos et al., 2013). Huddleson and colleagues (2012) identified a criminal sphere of influence illustrating that gang crime is not confined to gang territory although it decays considerably moving outside of gang territory.

We continue this line of research by considering how residential gang membership contributes to violence in local and surrounding communities. Rates of gun assault should increase with the prevalence of gang members in communities, but should be moderated by a neighborhood's proximity to other neighborhoods with concentrations of gang members. Our focus on gun assault is particularly appropriate for the study of neighborhoods, gangs, and violence. Unlike fatal violence, gun assaults leave behind individuals who are likely motivated to avenge their victimization. Disputes between gangs and retaliatory conflict involving guns are most likely to unfold in and around the communities where gang members reside, consistent with the group process, routine activities, and neighborhood culture theoretical frameworks.

Data and Methods

Data

We use census tract data from St. Louis to assess the impact of residential gang membership on levels of gun assault.[1] Data from the 2000 US Census were used to measure neighborhood structural conditions. Police data were used to measure residential gang membership, illegal gun seizures, and gun assaults. Drug-related deaths were obtained from the Office of the St. Louis Medical Examiner. Details on the measures used can be found in Table 1.

Dependent Variable

The dependent variable, *gun assault incidents*, is the average tract-level count of aggravated assaults with a firearm recorded between 2002 and 2004. Approximately, 40% of all assaults documented during this time period involved a firearm. The mean estimate of all gun assault incidents during this period (N = 1,540) was selected to reduce the instability and potential bias associated with yearly fluctuations in neighborhood gun violence.[2]

Explanatory Variables

Concentration of gang member residents reflects the rate of gang membership in each tract (per 1,000 residents) over a four-year period, 1998—2002. A rate was used to adjust for unequal potential for gang members due to population differences across tracts. Member addresses were geocoded using ArcMap and aggregated to the tract level. Residential information was available for 96% (n = 1,727) of the 1,800 gang members in the database; individuals without addresses were removed from the database. Addresses are updated when new data arise; these addresses represent the most recent address between 1998 and 2002.

Data were drawn from a gang database maintained by the St. Louis PD and Missouri Department of Corrections. A gang is defined as a group of three or more persons, identified by a common name, symbol, or sign, which engages in a pattern of criminal activity. A person qualifies for identification as gang

1. The city of St. Louis includes 113 census tracts, 110 of which contain adequate residential populations (>250 people) to ensure reliable community characteristic measures (Kubrin & Weitzer, 2003). As census boundaries may not be the best representation of neighborhood perimeters, we replicated our analyses using the 79 neighborhood boundaries defined by the City of St. Louis. Results were not substantively different and are available upon request.

2. Information on the motive behind the assault was unavailable; thus, the measure captures assaults beyond gang violence (e.g. domestic disputes). Nonetheless, this remains consistent with our theoretical rationale that higher rates of residential gang membership should maintain an independent contribution to gun violence in communities.

Table 1 Variables, descriptions, and descriptive statistics for analyses of gun assaults in St. Louis neighborhoods, 2002–2004 (N = 110)

Variable name	Description	Sum	Mean	SD	Min	Max
Gun assault incidents	Avg. annual gun assault count between 2002 and 2004	1,541	14.01	12.89	0	61.67
Drug related deaths per 1,000 (Ln)	Number of decedents from 2000 to 2002 who had drug or alcohol toxicity reported as primary or secondary cause of death	846	1.21	.44	.28	2.66
Residential stability	Standardized index of the following Census 2000 indicators	–	.00	1.00	−2.56	2.11
	Percentage of residents living in same house for 5 years		51.57	11.43	20.75	70.29
	Percentage of households owner occupied		39.10	19.47	.68	87.96
At-risk population	Percentage of the male population between ages 15 and 34	–	13.76	5.00	3.69	40.84
Temporal lag of violent crime rate	Avg. annual violent crime rate (1995–1997)	–	31.72	25.35	2.03	198.23
Concentrated disadvantage	Standardized index of the following Census 2000 indicators	–	0	1.00	−1.69	2.28
	Percent households vacant		17.61	9.26	2.54	38.94
	Percent households female-headed with dependents		23.63	13.13	0	68.05
	Unemployment rate		13.39	9.67	1.32	58.05
	Percent living below poverty		26.48	13.73	2.74	65.21
	Percent households receiving public assistance		17.61	10.42	2.35	49.43
	Percent Black population		56.34	37.43	.84	100
Concentration of gun seizures	Number of guns confiscated by police/neighborhood pop. (per 1,000 residents)	3,751	11.54	7.62	.32	34.38
Concentration of gang-member residents	Number of gang members and affiliates residing in NH that came to the attention of police between 1998 and 2002 (per 1,000 residents)	851	2.14	1.93	0	8.10

(*Continued*)

Table 1 (*Continued*)

Variable name	Description	Sum	Mean	SD	Min	Max
Proximity to gang-involved residents	Avg. rate of gang-involved residents from 1998 to 2002 in adjacent tracts (per 1,000)	—	2.24	1.40	0	5.14
Average # of gun assaults in surrounding tracts	Avg. annual gun assault count (2002—2004) in adjacent NHs	—	14.47	9.85	.21	59.05
Total population	Number of residents in tract	348,067	3,164.24	1,495.65	785	9,154

Note. The sum listed next to gun assault incidents, the rate of gang membership, crime gun seizures, logged drug-related deaths, and violent crime represents raw total numbers from 1995 to 1997. The corresponding descriptive statistics for these items pertain to the per capita (per 1,000) number of gang membership, crime guns seized, violent crimes, and natural log of drug related deaths across St. Louis neighborhoods.

member when three of the following criteria apply: admits to membership; has gang tattoos or wears clothing specific to a gang; arrested for participation in criminal acts with known gang member or gang-related crimes; close association with known gang members; observed displaying gang hand signs or writing gang graffiti; subject appears in photographs or other media in affiliation with a gang; identifying jail/prison correspondence; participating in gang-related activities when contacted by police officers. An individual is removed from the database after five years without further criminal justice system contact.[3]

The gang database is similar to other law enforcement systems (see Katz, 2003). Curry (2000) found strong overlap in self-reported and official gang membership among youth. Further, Decker and Pyrooz (2010b) found that police gang data has high external and internal validity, and are particularly reliable for cities like St. Louis with specialized gang units. We carefully reviewed the St. Louis tracking system documentation protocol. Criminal justice officials are not allowed to directly impute data into the database. Instead, they must show that a person merits inclusion, formally request they be considered, and a supervisor at the Regional Justice Information Service must approve the entry pending supporting evidence of a rationale for entry. This second-level evidentiary review can be done in many ways. In total, 22% of the current cases were the result of an individual admitting involvement in a particular street gang. Just over half (55%) of those in the database were "known for" or arrested for illegal guns, and the remaining had histories of gunshot wounds, assault, homicide, drug sales, or weapons possession violations. The measure provides a reliable estimate of variation in resident gang membership and is consistent with data sources used in prior research (Katz & Schnebly, 2011).

A *spatial lag of gang membership* was also created using a contiguity-based spatial weights matrix where a given tract's neighbor is defined as any tract it shares a common boundary line or point with. This spatial-lagged indicator of gang member density provides an estimate of the average gang membership rate in the tracts that adjoin each focal neighborhood.

Community-level data were drawn from the 2000 Census. *Concentrated disadvantage* includes percentage of residents living in poverty; unemployment rate; percent receiving public assistance; percent female-headed households with dependent children; percent black; and the percent of vacant households

3. This represents the number of newly documented gang members coming to police attention and verified between 1998 and 2002. A four-year measure was used to provide an estimate of community differences in residential gang affiliation that was not sensitive to short-term police crackdowns. This estimate captures a stable yet temporally proximate estimate of gang membership levels. This is consistent with the purging practices of law enforcement gang databases (e.g. CalGang, REJIS), and with research finding the vast majority of individuals exit gangs within four years (Pyrooz, Sweeten, & Piquero, 2013, p. 261). Police recorded 1,720 gang members between 1993 (the first-year police began documenting the addresses of known gang members) and 2002. Supplemental analyses were conducted with a measure of gang membership that included neighborhood counts of gang members documented from 1993 to 2002. Results were similar to those shown here and are available upon request.

(eigenvalue 4.6, all loadings >.78). We account for neighborhood age structure, specifically *young males* aged 15–34. *Residential stability* is a two-item factor score of the percentage of owner-occupied households and the percent of residents residing in the same home for the past five years.

The *gun seizure* measure represents the total number of crime guns recovered by police in each tract per 1,000 residents for the years 2000–2002 (guns seized by police through a warrant, pedestrian or traffic stop, or other means where the citizen did not have the legal right to possess).[4] The St. Louis PD provided address data for each illegal gun seized; data were geocoded to the tract level. We aggregated three years of crime gun recoveries so that the measure was not sensitive to any year-specific gun recovery crackdowns that may have occurred.

The *drug-related death* measure is derived from data obtained from the Office of the St. Louis Medical Examiner.[5] The measure reflects the number of decedents, during the years 2000–2002, who had drug or alcohol toxicity reported as a primary or secondary cause of death. Decedent addresses were geocoded to the tract level. A rate measure was constructed and then log-transformed to account for the small sample sizes and positive skew.

Analytic Technique

Because our outcome is a count variable, a Poisson model is appropriate. We use a negative binomial model, effectively an extension of the Poisson, that relaxes the assumption that the dependent variable's mean and variance are equivalent (Long, 1997). The significance of the dispersion parameter in each model indicates that the negative binomial model is appropriate for the data. We include the log of the population as an exposure variable, which permits us to model the incidence of gun assault as a per capita rate (Osgood, 2000).

Initial inspections of the data confirmed the presence of significant spatial clustering (Moran's $I = .679$) of gun assaults. The diagnostic procedures for detecting residual spatial autocorrelation, and the tests of the appropriateness of a spatial error versus spatial lag approach to address it, are only available for OLS regression models. We first estimated several OLS regression models in

4. Gun seizures may be entangled to the policing patterns and crime levels in a community, and it is difficult to disentangle this relationship. Research conducted in St. Louis by Burruss and Decker (2002) suggests that most guns (50%) seized by the police happen in the course of routine patrols. Only 39 percent come from calls for service, and the remainder came from warrants (11%); thus, most of the guns are seized during traditional policing operations. St. Louis was a part of the Project Safe Neighborhoods program implemented in October, 2002 (see Decker et al., 2007). Although gun assaults did decline in the intervention areas after the intervention, the decline was greater in non-intervention communities—owed largely due larger trends in crime decline.

5. The drug-related death measure was included as a proxy for drug markets as part of a larger goal to capture geographic variability in conditions that may provoke or facilitate armed conflict. We also estimated a model that replaced the rate of drug-positive deaths with the drug arrest rate. The results indicate that the drug arrest rate is not a significant predictor of gun assault nor does its inclusion alter the effects of gang membership on gun assault.

GeoDa using both raw and log-transformed gun assault rates. Lagrange multiplier diagnostics indicated significant residual spatial autocorrelation consistent with a spatial lag process (Anselin, 1988). The spatial lag specification includes a control for the weighted average number of gun assaults in adjacent tracts, operating under the assumption that the rate of gun assault within a focal tract is partially dependent upon the number of gun assaults in neighboring tracts. To construct a spatial lag of gun assaults, we created a spatial weights matrix expressed as a first-order contiguity-based matrix using queen criteria. This criteria provides an $n \times n$ row-standardized, binary matrix (W), where each tract's contiguous neighbor equals 1 and non-neighbors (including the focal tract itself) equal zero (Anselin, 2002). We use a first-order contiguity-based weight matrix where only tracts sharing common borders (lines) or vertices (corners) are deemed neighbors. This provides a conservative estimate of the clustering of gun assaults and is consistent with the LISA cluster scores observed in GeoDa.

Spatial lag models were estimated in Stata using the Anselin alternative two-stage least squares estimator (Anselin, 1988; Land & Deane, 1992). Anselin (1988) and Land and Deane (1992) advocate for the use of an instrumental variables technique to correct for endogeneity introduced by including a spatial lag of the outcome (*Wy*) as a control in spatial models.[6] We use Anselin's (1988) 2SLS method, which requires replacing the control for the weighted average count of gun assaults in adjacent tracts (the standard spatially lagged dependent variable) with an expected level of gun assault in adjacent tracts, the level of which is conditioned upon a set of fully exogenous variables (Anselin, 2004). We then fit a model of gun assaults in a first-stage regression using our exogenous variables as instruments (Land & Deane, 1992). Fitted values were saved and exported into GeoDa and transformed by multiplying the fitted values by the first-order contiguity-based weight matrix. The spatial lag of the average predicted gun assault count was then exported back into Stata and included in the final regression models as a control for potential gun assault spillover from adjacent areas. This process yields the final structural model:

$$\mathbf{y} = \boldsymbol{\rho}\mathbf{y}^{*} + \mathbf{y}\boldsymbol{\beta} + \boldsymbol{\varepsilon}$$

Here $\boldsymbol{\rho}$ is the spatial effects parameter, $\mathbf{y^*}$ is the spatially lagged variable calculated using the expected gun assault count in surrounding tracts multiplied by the weight matrix (*W*), **X** is a matrix of exogenous explanatory variables, $\boldsymbol{\beta}$ is the vector of corresponding regression coefficients, and ε is a vector of randomly and normally distributed error terms. The parameter $\boldsymbol{\rho}$ can be interpreted as the effect of a one-unit change in the average number of gun assaults in adjacent tracts on the expected mean count of gun assault in focal

6. The outcome and its spatial lag are determined simultaneously, *Wy** is endogenous to Y (Land & Deane, 1992, p. 228). Endogeneity concerns also arise because the *Wy** is a function of the lagged values of the *predictors* in the equation. The lagged gun assault count is then correlated with the error term resulting in biased, inconsistent regression coefficients.

tract *i*. We also use the Huber-White Sandwich estimator to obtain robust standard errors (Hardin, 2002).

One challenge in cross-sectional studies is the potential for endogeneity bias arising from simultaneity. Gang membership tends to be higher in and around neighborhoods with higher gun assault rates. The relationship may be recursive —levels of membership are a response to, rather than an influence on, gun assault (Sobel & Osoba, 2009). The strongest determinants of community variation in gang membership involve residential instability and economic disadvantage, rather than violent crime rates (Katz & Schnebly, 2011; Pyrooz, Fox, & Decker, 2010; Tita et al., 2005). We nonetheless control for these characteristics to better isolate the effects of gang membership on gun assaults, since short-term fluctuations in gun assault may motivate local residents to join or leave gangs. Gang membership and gun assaults are not measured simultaneously, but *any* degree of endogeneity could yield biased parameter estimates. Instrumental variables regression, via a generalized method of moments (GMM) estimator robust to heteroskedasticity, is one way to diagnose and address the possibility that gang membership is an endogenous regressor (Baum, Schaffer, & Stillman, 2007; Kovandzic, Schaffer, & Kleck, 2011). The model treats membership as endogenous to gun assault. We assess the effect of gang membership using a variable that we hypothesized is not directly related to gun assault, is correlated with neighborhood variation in gang membership, and is not correlated with the error term: the proportion of the population consisting of young males ages 15—34.

The effect of gang membership remained significant after treating it as endogenous to gun assault. A Hansen *J*-test of over-identifying restrictions was not significant, suggesting that the instruments are sufficiently independent of the error term and are valid. Results from a GMM distance test, which tests the null hypothesis that gang membership can be properly treated as exogenous, were null ($\chi^2 = 1.517$, $p < .218$). This suggests that gang membership can be treated as exogenous. In this context, instrumental variables regression would result in a loss of efficiency and would not yield more consistent standard errors than a standard regression model (Baum et al., 2007, p. 20).

We also attempt to isolate the effects of gang membership on gun assault by controlling for prior levels of violent crime. A temporal lag of neighborhood violent crime from 1995 to 1997, the years preceding the gang membership measure, is used to isolate this effect. Lagged crime measures provide less-biased estimates stemming from simultaneity or reverse causal ordering (e.g. Slocum, Rengifo, Choi, & Herrmann, 2013).[7]

7. We explored the utility of controlling for various temporally lagged measures of violent crime. The correlation between gun assault levels from 2002 to 2004 and gun assault levels from 1995 to 1997 exceeds .90, an unacceptable level of multicollinearity. We instead use a measure of prior levels of overall violent crime (which includes all forms of gun violence). The inclusion of this measure alleviated problems associated with multicollinearity and provides a more comprehensive measure of the types of victimizations that may prompt or reduce residents' gang membership.

We describe the spatial distribution of gun assault and gang membership, correlations among the variables, and estimate baseline models of gun assault. Our second model assesses the relationship between gang member prevalence and neighborhood rates of gun assault. Finally, models are estimated to test whether rates of gun assault are influenced by spatial proximity to gang members, and if this effect is moderated by membership within the neighborhood.

Results

Neighborhood Variation in Gun Assault and Gang Membership

Table 1 shows descriptive statistics. Neighborhoods averaged 14 gun assaults annually between 2002 and 2004. A small group of tracts account for many of these incidents. Twenty neighborhoods recorded gun assault levels that fell between 1 standard deviation above the city average and the maximum of 61 incidents. These neighborhoods make up only 18% of our sample, yet account for nearly half ($n = 716$) of all gun assaults in the city. Figure 1 shows that many neighborhoods with high levels of gun assault are in close proximity to each other, clustering in the northern sector of the city. Police documented the residential location of 851 gang members between 1998 and 2002. Neighborhoods average roughly two gang members per 1,000 residents, and see a similar rate of gang membership in surrounding areas (2.24).

Table 2 presents bivariate correlations among the study variables. There is a significant correlation between neighborhood rates of gang membership and gun assault ($r = .635^*$). Figure 1 illustrates this geographic overlap between the two. Many neighborhoods that experience high rates of gun assault and gang membership cluster together and are isolated from communities in the southwestern region of the city, where gang membership and gun assault are rare. Bivariate correlations also indicate that disadvantaged neighborhoods are disproportionately exposed to communities with relatively high concentrations of gang members ($r = .732^*$).

Figure 2 shows the association between proximity to high vs. low gang membership communities and gun assault rates. Neighborhoods with higher levels of gang membership (denoted by the two bars grouped together on the right hand side of the chart) have a gun assault rate double (6.7 incidents) that of low membership neighborhoods (3.4 incidents) (results not shown). High membership neighborhoods surrounded by a higher concentration of gang members experience the highest rate of gun assault in the city (8.55 gun assaults per 1,000 residents); double the rate (4.82) of high-gang neighborhoods surrounded by low-gang neighborhoods. The chart also shows that any benefits associated with low rates of resident gang membership are diminished for low membership areas located near high membership areas. The mean gun assault rate for these neighborhoods is four times higher (5.44) than the rate of gun assault (1.35) for low membership neighborhoods near similar neighborhoods.

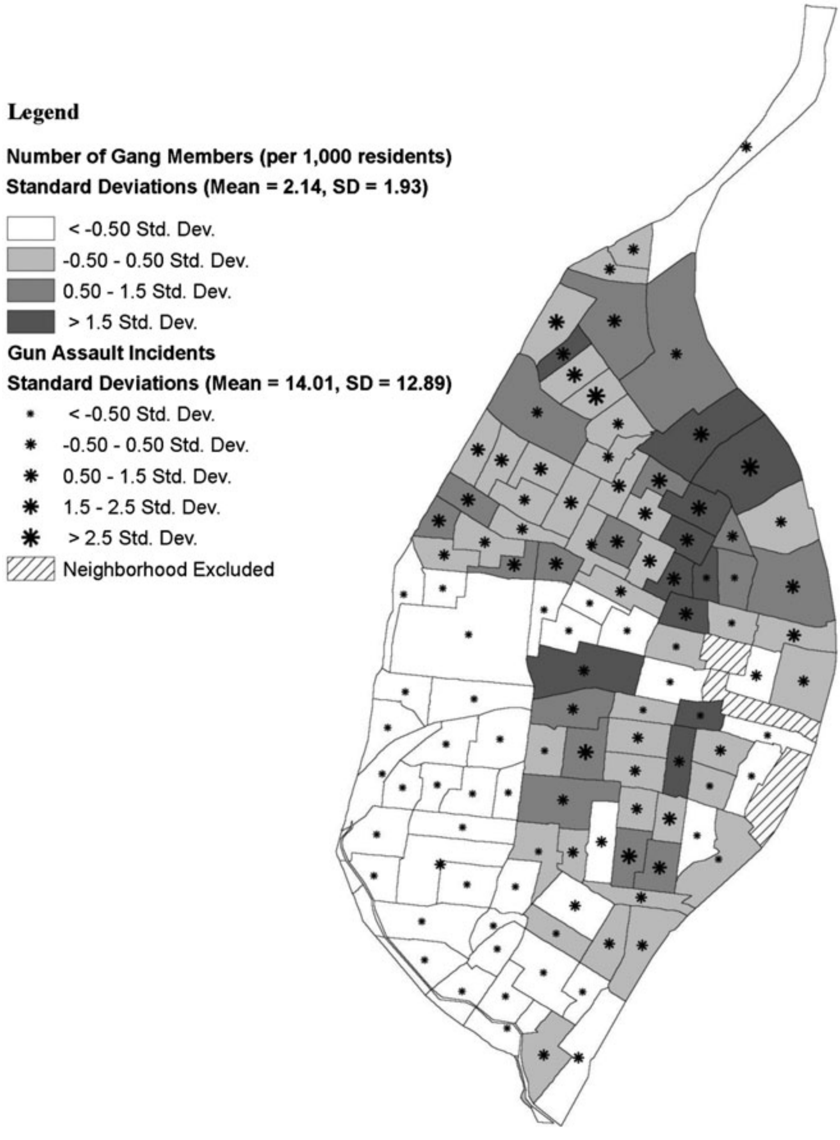

Figure 1 The geographic distribution of gang memship and gun assault incidents in St. Louis (N = 110).

Multivariate Results

Results from regression analyses are presented in Table 3. In Model 1, structural factors explain much of the variation in gun assaults. Concentrated disadvantage is positively associated with rates of gun assault, and the magnitude of the effect is large. A standard deviation increase in disadvantage is associated with a 93% increase ($[e^{(.658 \times 1.0)} - 1] \times 100$) in the per capita gun assault rate. Drug deaths and gun seizures were unrelated to gun assault rates.

Table 2 Bivariate correlation matrix

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1)	Gun assault incidents	—	.704**	.645*	.613*	.646*	.690*	.448*	.029	.179*	−.319*	.595*	.353*
(2)	Concentration of gang member residents		—	.625*	.706*	.654*	.639*	.392*	−.112	−.079	−.251*	.591*	.434*
(3)	Proximity to gang-involved residents			—	.718*	.652*	.829*	.543*	−.227*	−.134	−.174	.807*	.500*
(4)	Concentrated disadvantage				—	.709*	.739*	.592*	−.423*	−.280*	−.222*	.554*	.603*
(5)	Concentration of gun seizures (per 1,000 population)					—	.733*	.669*	−.096	−.214*	−.332*	.623*	.693*
(6)	Drug Arrest Rate						—	.583*	−.127	−.147	−.241	.794*	.536*
(7)	Drug-related deaths (ln) (per 1,000)							—	−.261*	−.305*	−.098	.468*	.673*
(8)	Residential stability								—	.003	−.322*	−.068	−.322*
(9)	Population size									—	.031	−.076	−.380*
(10)	At risk population										—	−.210*	−.114
(11)	Spatial lag of gun assault (2002—2004)											—	.398*
(12)	Temporal lag of violent crime rate (1994—1996)												—

*$p < .05$.

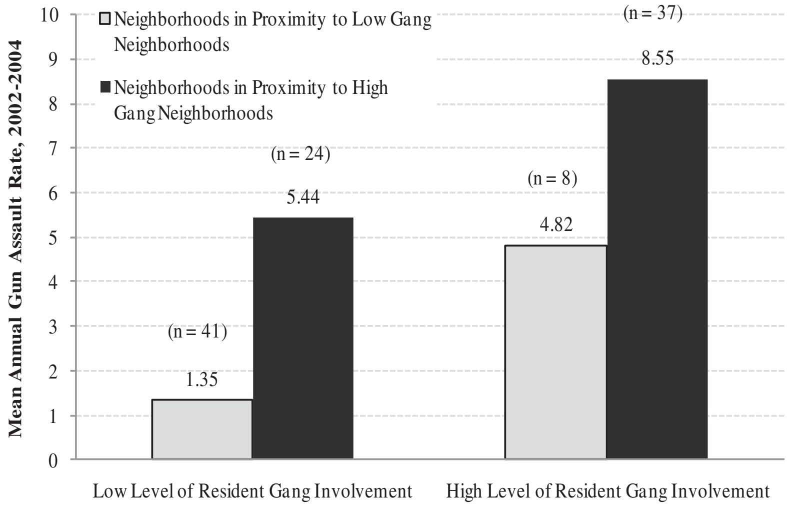

Figure 2 Average gun assault rate by level and spatial proximity to gang-involved residents.

Neighborhood gang membership is introduced in Model 2. Neighborhoods where gang members are concentrated experience higher rates of gun assault. A one-unit increase in gang membership is associated with a 7% increase in the expected gun assault rate ($[e^{(.068)} - 1] \times 100$). This effect appears small at first, but the magnitude of the relationship becomes more evident when considering that a one-standard deviation change in the proportion of residents belonging to a gang (an addition of 1.93 gang members per 1,000 residents) is associated with a 14% increase in the gun assault rate ($[e^{(.068 \times 1.93)} - 1] \times 100$).[8]

Given the concentration of gang membership in certain neighborhoods, we examined how neighborhoods with above-average levels of gang membership fared with respect to gun assault. Neighborhoods with membership rates two standard deviations above the mean (i.e. 6 + gang members per 1,000 residents) experience a 30% increase in the gun assault rate. Seven neighborhoods exhibit such levels of gang membership. Subsequent models that included a squared term of gang membership suggest that the relationship is not linear. The results show that at extremely high levels of gang membership, the rate of expected increase in the gun assault rate begins to level off. A closer examination of the data suggests that this nonlinear relationship may be driven by several neighborhoods with "average" levels of gang membership that are in proximity to neighborhoods with above-average levels of gang membership.

8. We explored if the concentration of gun seizures influenced gun assault indirectly by moderating the influence of gang member prevalence on gun assault (results not shown); the relationship was not significant.

Table 3 Negative binomial regressions of gun assault incidents in St. Louis neighborhoods (N = 110)

	(1)	(2)	(3)	(4)
Controls				
Drug-related deaths per 1,000 (Ln)	.04	.05	.06	.14
	(.14)	(.13)	(.13)	(.12)
Residential stability	.28*	.27*	.25*	.26*
	(.06)	(.06)	(.06)	(.05)
Percent population male between ages 15 and 34	−.00	−.00	−.00	−.01
	(.01)	(.01)	(.01)	(.01)
Temporal lag of violent crime rate	.01*	.01*	.01*	.01*
	(.00)	(.00)	(.00)	(.00)
Average number of gun assault incidents in surrounding neighborhoods (*r*)	.02*	.02*	.01	.00
	(.01)	(.01)	(.01)	(.01)
Concentrated disadvantage	.66*	.58*	.53*	.40*
	(.07)	(.08)	(.08)	(.08)
Concentration of gun seizures (per 1,000 residents)	.02	.01	.01	.01
	(.01)	(.01)	(.01)	(.01)
Explanatory variables				
Concentration of gang member residents (per 1,000)		.07*	.06*	.14*
		(.03)	(.03)	(.03)
Average resident gang membership in surrounding neighborhoods			.11*	.15*
			(.05)	(.05)
Neighborhood gang membership × gang Membership in surrounding neighborhoods				−.07*
				(.02)
Constant	−6.38*	−6.45*	−6.59*	−6.07*
	(.21)	(.20)	(.22)	(.19)
Model diagnostics and fit				
Dispersion (alpha)	.09*	.07*	.07*	.05*
Full log likelihood	−315.07*	−312.34*	−310.34*	−300.76*
AIC	648.14	644.69	642.68	625.52
Mean VIF	2.45	2.58	2.95	2.96

Notes. N = 110; *p < .05 (two-tailed); unstandardized coefficients reported with standard errors in parentheses.

Spatial Proximity to Gang Members

Table 3 also assesses whether gun assault rates are significantly higher in neighborhoods exposed to higher concentrations of gang members from surrounding communities. In Model 3, we introduce a spatial lag of gang membership that captures the average number of gang members (per 1,000 residents) in surrounding neighborhoods. The spatial lag has a positive and significant association with local gun assault rates net of other variables in the model. The parameter estimate (*b* = .108) indicates that a one-unit change in the number of gang members in surrounding neighborhoods is associated with an 11% increase in the gun assault rate.

We also explored the possibility that rates of neighborhood gang membership moderate the impact of gang membership in surrounding neighborhoods. Model 4 in Table 3 displays a model that includes a two-way interaction between these characteristics. Both main effects and the interaction term are significant (*b* = −.071, suggesting that gang membership *within* a focal tract moderates the extent to which membership in surrounding areas impacts the focal tract's gun assault rate. The negative coefficient suggests that proximity to high-gang membership tracts has the greatest impact on neighborhoods with very few (or no) gang members.

Figure 3 illustrates this effect: it plots the predicted number of gun assaults associated with varying levels of gang membership in surrounding tracts for low, average, and high gang membership communities. Gun assault rates in high membership neighborhoods are essentially unaffected by the number of gang members residing in surrounding areas. The impact of being surrounded by larger numbers of gang members is stronger when the number of gang members in a focal neighborhood is low. As the spatial lag nears its maximum value (i.e. more than 4 members), the predicted number of gun assaults for medium and low membership tracts exceeds the expected gun assault rate of high membership neighborhoods. This is not to suggest that it is beneficial to have high internal rates of gang membership. The expected gun assault rate is much

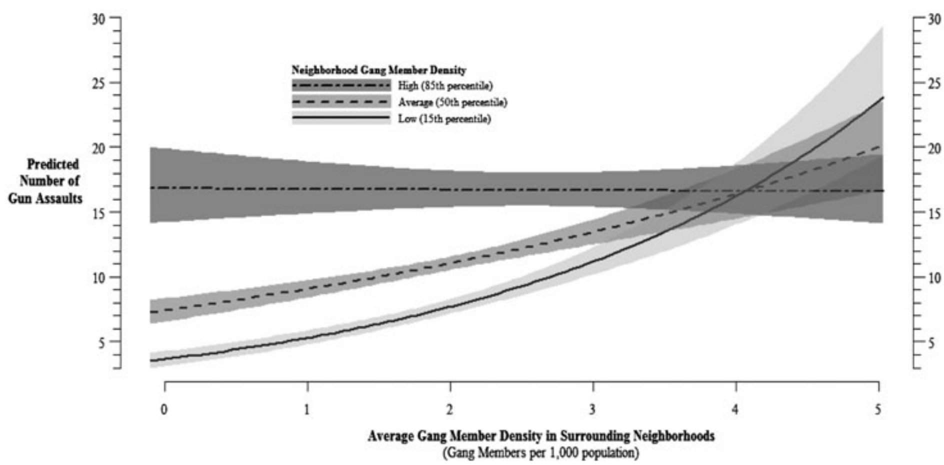

Figure 3 The moderating effect of neighborhood gang membership on the relationship between gun assault and the number of gang members in surrounding neighborhoods.

higher in high membership neighborhoods regardless of how many gang members reside in surrounding areas. Rather, it suggests the protective benefits of low internal rates of gang membership vanish as the number of gang members in surrounding tracts increases.

In sum, the results suggest that neighborhood levels of gang membership exert important influences on a community's rate of gun assault as well as levels of gun assault in nearby areas. It is worth noting that while residents' gang membership does not fully mediate the effects of neighborhood disadvantage on gun assault; however, the influence of neighborhood gang membership and proximity to gang members accounts for much of the disadvantage—gun assault relationship. Introducing both measures, along with their interaction in Model 4, yielded a 39-% reduction in the coefficient for disadvantage reported in Model 1 ($100 \times (.658 - .401)/.658$).[9]

Discussion

A large fraction of gun violence is driven by processes and events occurring within a small group of neighborhoods (Morenoff et al., 2001). As a consequence, much is to be learned about gun violence by studying those neighborhoods. This study examined the spatial distribution of gun assaults across neighborhoods in St. Louis. Drawing from group process, routine activity, and neighborhood culture theories, our aim was to determine not only if residential gang membership influenced patterns of gun assault within neighborhoods, but also in surrounding neighborhoods. Based on our results, we can draw several conclusions that merit further consideration.

First, the residential concentration of gang members has consequences for rates of gun assaults in neighborhoods. Our results indicate that St. Louis neighborhoods with high rates of gang membership have increased levels of gun assaults, net of neighborhood structural conditions, which is consistent

9. We estimated models to explore the robustness of the link between neighborhood gang membership and gun assault (results not shown). First, we regressed the rates of other crimes (non-gun assault, robbery with no gun, and robbery with a gun) on the gang measures. If gang membership reflects the presence of a deviant population generally, we would anticipate significant effects of neighborhood gang membership on a variety of violent crimes. Analyses revealed no significant association between neighborhood gang membership and other violent crimes. Finally, we explored the possibility that the effect of proximity to gang members is spurious because of propinquity to disadvantaged neighborhoods (Mears & Bhati, 2006). We included a spatial lag of concentrated disadvantage in two additional models: one with and one without a spatial lag of gang membership. Results indicate that disadvantage in surrounding neighborhoods is not a significant predictor of gun assault rates, and its inclusion does not alter the spatial lag effect of gang membership. We were unable to control for the spatial lag of gun assault in the latter model as it yielded unacceptable levels of multicollinearity and produced unstable coefficient estimates. Because the spatial lag of gun assault is not significant in any models containing the spatial lag of gang membership, we estimated the effects of proximity to gang members (controlling for the spatial lag of disadvantage) without the inclusion of the spatial lag for gun assault.

with the theoretical model we advanced. Further, these findings are consistent with ethnographic and survey research that reveals that guns and gangs are closely intertwined. Indeed, members rely on guns in their daily routines (e.g. Decker & van Winkle, 1996; Watkins et al., 2008). In addition to carrying guns, gang members are also more likely to engage in violence and experience violent victimization—especially gun violence—than youth who avoid gangs. In this sense, because offenders tend to commit crimes closer to home (Felson, 2006), areas where gang membership is commonplace become focal points of gun violence and conflicts.

As we elaborated on above, our theoretical model contends that while the patterning of gang membership throughout the city of St. Louis may be endogenous to the structural makeup of the city, it also makes an independent contribution to community violence. In the absence of confounding (e.g. collective efficacy) and mediating (e.g. status, prosocial opportunities) measures, it is impossible for us to shed light on the empirical status of structural control and adaptation perspectives. Nonetheless, by focusing on the implications of residential concentrations of gang members for rates of neighborhood gun assault in St. Louis, this study makes a unique contribution to the sparse literature on gangs as independent variables that has, to date, examined the relationship between the gang spaces and neighborhood violence in Camden, Los Angeles, and Pittsburgh (e.g. Robinson et al., 2009; Taniguchi et al., 2011; Tita & Ridgeway, 2007).

Second, we extend this literature by illustrating that neighborhoods with high levels of gang membership create a geographically broad landscape of gun violence. This risk extends beyond any single neighborhood's boundaries to impact nearby areas with few or no gang members. As anticipated, neighborhoods with the highest gang member concentration had the highest levels of gun assault. Low and average gang membership neighborhoods surrounded by neighborhoods with a higher concentration of gang members experience elevated rates of gun assault, and the effects are nearly twice the size experienced by high-gang neighborhoods surrounded by low gang member neighborhoods. To the extent that neighborhoods are not islands unto themselves, the consequences of gang member prevalence cascade across the landscape (Mears & Bhati, 2006). The concentration of gang members even in a few proximate communities makes for a particularly explosive situation with respect to gun violence as they increase the likelihood of potential contact with rival gang members (Papachristos et al., 2013). These results might help explain why certain neighborhoods function as outliers for gun violence despite structural and cultural features suggesting otherwise. Similarly, Zeoli and colleagues (2014) document how gangs served as an infectious agent in Newark helping spread clusters of homicide geographically and over time. Gangs, independent of crack markets, appeared to play a large part in the recursive nature of violence. The contagion model, overall, provides further evidence to suggest that gang violence can influence violence in neighboring communities.

Third, the results of this study have important policy implications for reducing violence in and around communities with gang activity. Our findings suggest the utility of narrowly targeted interventions, like 'pulling levers' strategies, in areas where gang members are most prevalent (Kennedy, Piehl, & Braga, 1996). The results of the research also add to the burgeoning literature which suggests that focused deterrence models which concentrate on high-risk individuals in dangerous areas may also benefit neighboring, and outside of the immediate focus of these interventions, low-risk communities (see Bowers, Johnson, Guerette, Summers, & Poynton, 2011 for a review). Yet, communities proximate to high gang member areas may also need specialized assistance. In these bordering areas, "total community" solutions (e.g. Spergel, 1995) might be fruitful. These approaches work to supplement a community's ability to engage in informal social control. This approach might consider the use of micro-level analysis for better addressing issues associated with street gangs. Using data from Pittsburgh, Tita and Ridgeway (2007) explored how gang territories are associated with crime rates. Using geographic territories rather than official neighborhood designations, they documented the most at-risk areas. This work could be used to refine interventions and identify stable communities at risk to be caught in gang rivalries. These combined approaches help to better address gangs and street violence not being constrained by borders or boundaries.

The present study is not without limitations. First, as we mentioned above, we are unable to model mechanisms through which rates and spatial distribution of gang membership influence gun violence. The current work centers on an analysis of gang member prevalence, not individual gangs; the spatial neighborhood analysis may not reflect social networks of these entities. We cannot determine with certainty the level of overlap in gang territory and neighborhood location or the exact number of distinct gangs within each geographic unit. Neighborhoods with higher levels of gang members may also have more gangs, thus increasing the likelihood for retaliatory violence. Conversely, neighborhoods that are reined by one gang may have lower rates of gun violence, as some have held that gangs may shelter residents from external conflicts (see Sobel & Osoba, 2009). This occurrence is less likely given that single-gang communities are rare (Klein, 1995). Future research should better capture the extent to which specific gang rivalries and violence spill over to surrounding communities, consistent with Papachristos and colleagues (2013) who use conflict incidents between gangs as units of analysis and Huddleson and colleagues (2012) who document the geographic distance of gang crime beyond gang boundaries, also known as the sphere of influence.

Second, our measure of gun violence does not include specific data on motive; therefore, it is difficult to ascertain the amount of violence that is directly gang-related. Research suggests that a large proportion of crime is driven by a small number of high-risk offenders (Kennedy et al., 1996). The violence denoted in the current study may reflect a small number of St. Louis residents, and it is unclear how many of the offenses here involve gang members. However, Rosenfeld and colleagues (1999) found that approximately one-third of all homicides in St. Louis were gang-related. A similar pattern may translate to gun violence, suggesting that a large portion of the gun assaults studied here involve gang-related motives. Our theoretical framework also anticipates the impact of gang member prevalence on non-gang crime. In specific, the existing literature highlights how the public nature of gang violence and the risks that members bring to the community broaden the negative consequences of gangs and widen the net of potential victims to include non-members (Pattillo, 1998; Harding, 2010). Gangs may stake claims at public areas where rival members and hostile non-members may frequent or come into contact and such violence can destabilize broader efforts to maintain social control in neighborhoods (Fagan, 1996). Communities with more gangs are often characterized by neighborhood cultural values that tolerate violence (Anderson, 1999; Harding, 2010). These risks are magnified by the fact that the social networks of gang members include family members, many of whom are also neighborhood residents (Pattillo, 1998). Future research could work to better elucidate the long-term changes in community culture and control associated with the presence and prevalence of gangs and their members.

In conclusion, communities with concentrations of gangs, guns, and social and economic disadvantages are dangerous places. Our findings confirm that neighborhoods with high levels of gang membership have elevated rates of gun violence net of neighborhood disadvantage. Perhaps, more importantly, the consequences of residential gang member concentrations transcend neighborhood boundaries and radiate into adjacent neighborhoods. Recognizing that broader ecological forces impact local neighborhoods has crucial implications for understanding the structural sources of crime, and suggests that we focus our policy efforts to combat gun violence more broadly since residents of one community cannot be expected to control surrounding neighborhoods. While we were unable to identify the precise mechanisms by which rates of gang membership influence gun assaults, we believe this is a necessary first step in developing a more comprehensive understanding of neighborhood social problems. Related approaches should be a high priority for future research.

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