Parent, Peer, and Neighborhood Risk Factors Accounting for Spatial Clustering of Adolescent Aggressive Behavior

by Teresa T. Hsu

B.A. in Psychology, May 2004, Northwestern University
M.Phil in Clinical Psychology, May 2008, The George Washington University

A Dissertation submitted to

The Faculty of
The Columbian College of Arts and Sciences
of The George Washington University
in partial fulfillment of the requirements
for the degree of Doctor of Philosophy

August 31, 2011

Dissertation directed by

Sharon F. Lambert
Associate Professor of Clinical/Community Psychology

The Columbian College of Arts and Sciences of The George Washington University certifies that Teresa T. Hsu has passed the Final Examination for the degree of Doctor of Philosophy as of March 30, 2011. This is the final and approved form of the dissertation.

Teresa T. Hsu

Parent, Peer, and Neighborhood Risk Factors Accounting for Spatial Clustering of Adolescent Aggressive Behavior

Dissertation Research Committee:

Sharon F. Lambert, Associate Professor of Clinical/Community Psychology, Dissertation Director

George W. Howe, Professor of Clinical Psychology, Committee Member

Michelle Stock, Assistant Professor of Applied Social Psychology, Committee Member

© Copyright 2011 by Teresa T. Hsu
All rights reserved

Acknowledgments

The author wishes to acknowledge her family and Gregory Walklet for their encouragement and considerable patience during this dissertation process. She would further like to thank her dissertation committee members, George Howe and Michelle Stock, for their valuable feedback, as well as Ryan Engstrom and David Wong for their advice on spatial analytic techniques. Lastly, and most importantly, she thanks her advisor, Sharon F. Lambert; this dissertation would not have been possible without her guidance and support.

Abstract of Dissertation

Parent, Peer, and Neighborhood Risk Factors Accounting for Spatial Clustering of Adolescent Aggressive Behavior

The existing aggression literature highlights the importance of risk factors from multiple domains, including the parent, peer, and more recently, the neighborhood domains. However, this literature generally has not extended the study of neighborhood effects on adolescent aggression to include geographic location. Of the existing research examining neighborhood effects on youth aggression, neighborhood is typically measured using aggregate data of bounded areas, although aggressive behavior may vary according to geographic locations within pre-defined boundaries. Reliance only on aggregate data may lead to errors such as the ecological fallacy (i.e., the assumption that individuals have the same average characteristics of the larger group) or the overestimation or underestimation of model parameters (Diez-Roux, 2007). Thus, using analyses that link geographic information to individual data, or spatial analyses, may be particularly valuable given these problems. The present study used both spatial and non-spatial analyses to examine whether observations of high adolescent aggression and its risk factors geographically cluster, or occur in geographic proximity to other observations, as well as whether geographic clusters of adolescent aggression overlap or coincide with clusters of risk factors. Nearest Neighbor Analyses and multi-level analyses were conducted with a community, epidemiologically-defined sample of adolescents in 8th grade residing in Baltimore City. Results of spatial analyses revealed that aggression and its risk factors of low parental monitoring, high deviant peer affiliation, high community violence exposure, and high perceived neighborhood violence geographically clustered, and that these clusters overlapped to some extent. However, results of non-spatial analyses did not indicate clustering at the census

tract level. Clinical implications of study results and future directions for using both types of analyses are discussed.

Table of Contents

Acknowledgments iv

Abstract of Dissertation v

List of Figures viii

List of Tables ix

Chapter 1: Introduction and Literature Review 1

Chapter 2: Methods 24

Chapter 3: Results 40

Chapter 4: Discussion 47

References 63

List of Figures

Figure 1…….105

Figure 2…….106

Figure 3…….107

Figure 4…….108

Figure 5…….109

Figure 6…….110

Figure 7…….111

Figure 8…….112

Figure 9…….113

Figure 10……..…….114

Figure 11……..…….115

Figure 12……..…….116

Figure 13……..…….117

Figure 14……..…….118

Figure 15……..…….119

List of Tables

Table 1……..93

Table 2……..94

Table 3……..95

Table 4……..96

Table 5……..97

Table 6……..98

Table 7……..99

Table 8…….100

Table 9…….101

Table 10……...…..….....102

Chapter 1: Introduction

The serious physical and mental health consequences of youth aggressive behavior have led researchers to examine risk factors for aggression in order to inform the development of interventions to prevent and reduce aggressive behavior (e.g., Burke, Loeber, & Birmaher, 2004; Deater-Deckard, Dodge, Bates, & Pettit, 1998; Farrington & Loeber, 2000; Patterson, DeBaryshe, & Ramsey, 1989; Tremblay, Nagin, Séguin, Zoccolillo, Zelazo, Boivin, et al., 2004). While considerable research has focused on risk factors in the parent and peer contexts (e.g., Dishion & McMahon, 1998; Espalage, Holt, & Henkel, 2003), the neighborhood has received comparatively less attention, particularly in intervention research (Leventhal & Brooks-Gunn, 2000; Mason, Cauce, Gonzales, Hiraga, & Grove, 1994). Moreover, the existing neighborhood research primarily has examined aggregate information about administratively-defined areas, such as census tracts (Diez-Roux, 2004). This type of analysis provides only limited information about how location may affect aggressive behavior (Chaix, Merlo, Subramanian, Lynch & Chauvin, 2005) because each area is assigned a value that represents the average level of a particular construct (e.g., crime) without attention to potentially varying levels of the construct within the area. In addition, these administratively-defined units may not represent residents' own perception of their neighborhoods (Coulton, Korbin, Chan, & Su, 2001). Another limitation of the existing research on risk for aggression is that the majority of research has examined domains of risk independently (Evans, 2006), rather than in combination as suggested by transactional ecological models of the development of aggressive behavior. To address these limitations in the existing literature, the present study will examine whether

aggression and parent, peer, and neighborhood risk factors cluster in geographical space, and, if so, which risk factor clusters contribute to the clustering of aggressive behavior.

Significance of Aggression

Adolescent aggression, which can range from minor defiance with authority figures to violent criminal behavior, is recognized as a significant public health concern because of its strong associations with concurrent and later problems in the interpersonal, academic, and physical and mental health domains. Adolescent aggression and youth violence have been linked with conduct disorder (Miller-Johnson, Coie, Maumary-Gremaud, Bierman, & Bierman 2002; Vitaro, Gendreau, Tremblay, & Oligny, 1998), witnessing and victimization by violence (Diehl, 2004; Fitzpatrick, 1997; Salzinger, Feldman, Stockhammer, & Hood, 2002), and the onset and maintenance of substance abuse (O'Donnell, Hawkins, & Abbott, 1995; Weinberg, Rahdert, Colliver, Glantz, 1998). These problems often lead to increases in aggressive behavior (e.g., Salzinger et al., 2002). Youth violence also has been associated with depression (Knox, King, Hanna, Logan, & Ghaziuddin, 2000; Mason, Kosterman, Hawkins, Herrenkohl, Lengua, & Mccauley, 2004), academic problems (for a review, see Hinshaw, 1992; Loveland, Lounsbury, Welsh, & Buboltz, 2007), school dropout (Farmer, Estell, Leung, Trott, Bishop, & Cairns, 2003; French & Conrad, 2003), and difficulties in relationships (Chang, 2003; Loeber & Hay, 1997; Patterson et al., 1989; Woodward & Fergusson, 1999). Co-occurrence of these aforementioned problems with aggression not only affects adolescents' own mental and physical health, but also can have serious implications for society.

Adolescent aggression can extend to adulthood, and adults' aggressive behavior has been linked with negative outcomes including perpetration of child maltreatment (Rogosch,

Cicchetti, & Aber, 1995; Tremblay et al., 2004), occupational difficulties (Bloomquist & Schnell, 2002; Virtanen, Kivimäkia, Elovainiob, Vahterac, Kokko, & Pulkkinen, 2005), long-term unemployment (Kokko & Pulkkinen, 2000; Kokko, Pulkkinen, & Puustinen, 2000), and criminal activity (Nagin & Tremblay, 1999; Stattin & Magnusson, 1989; U.S. Public Health Service, 2001). These outcomes impact not only the individual, but also their families, children, and community. For example, families may suffer economically and emotionally, and communities may become more dangerous as a consequence of adolescents' and adults' aggressive behaviors (e.g., Tremblay et al., 2004). Adolescent aggression also may be a catalyst for financial and public health costs to society given the associations between aggressive behavior and delinquency (e.g., costs of vandalism) and criminal behaviors (Stattin & Magnusson, 1989; Tremblay et al., 2004).

The prevalence of youth aggression and violence is high and appears to be increasing (Center for Disease Control [CDC], 2008; Ellickson, Saner, & McGuigan, 1997; U.S. Public Health Services, 2001; Youth Risk Behavior Survey [YRBS], 2007). For example, the number of violent acts committed by high school seniors increased by almost 50 percent over the past two decades (U.S. Public Health Services, 2001). A 2006 CDC report found that over one-third of high school students reported engaging in physical fights over the past 12 months, and 4 percent reported needing medical treatment by a doctor or a nurse following these physical fights. In the same year, emergency units treated over 720,000 young people aged 10 to 24 for violence-induced injuries (CDC, 2008). Data from the YRBS also revealed that 18% of high school students had carried a weapon such as a gun or a knife to school within the past 30 days (YRBS, 2007). The U.S. Surgeon General called for intervention efforts against youth violence in 2001, promoting the need

for research examining the etiology of aggression to inform strategies and programs for preventing youth aggression (U.S. Public Health Service, 2001). To inform these preventive interventions, it is important to understand the development of aggression in adolescents and to examine risk factors that may account for the development of aggression.

Models of Aggression

Ecological models examine the individual's environmental context when studying development, and stress the importance of interactions between the individual and his/her environment, which may change over time and according to place (Bronfenbrenner, 1979; Caspi & Roberts, 2001; Jessor & Jessor, 1977). These models can be used to describe how factors external to youth may impact their behaviors, including aggression. Several models incorporating different environmental influences on child development exist (e.g., Bronfenbrenner, 1979; Crick & Dodge, 1994; Fontaine, 2006; Mason et al., 1994; van Bertalanffy, 1968). Many are consistent with Bronfenbrenner's ecological theory, an extension of systems theory (van Bertalanffy, 1968), which incorporates factors from various environments to understand the child's developmental outcomes such as aggression.

Bronfenbrenner's ecological theory is best illustrated by a number of overlapping concentric circles, with the child at the center and different environmental systems, or domains, in which the child participates represented by circles surrounding the child or individual. According to Bronfenbrenner's model, domains closest to the individual have the most direct impact on his/her development. Each domain is composed of structures, organizations, or people with which the individual has a relationship and which impact the

individual's development. The domain closest to the individual is the microsystem, the immediate environment in which the individual participates, and includes relationships with parents and peers. The mesosystem, exosystem, and macrosystem are the systems surrounding the microsystem. The mesosystem is comprised of connections between microsystems, such as interactions between the individual's family and school, while the exosystem includes external environments, such as the neighborhood. The macrosystem is the broader cultural context. Risk factors in the microsystem and the exosystem, and specifically risks in the family, peer, and neighborhood contexts, have received the most attention in aggression research (e.g., Crick & Dodge, 1994; Mason et al., 2004; Patterson et al., 1989; Sampson, Morenoff, & Gannon-Rowley, 2002).

Several ecological models specific to the development of aggression have been developed. According to social information processing theory (SIP) theory, youth who are repeatedly exposed to threatening environments may encode neutral or ambiguous cues from the environment as threatening, become hypervigilant, and attribute hostile intent to others' behavior. Consequently, youth may react aggressively because they perceive others as dangerous, even in ambiguous situations. According to Fontaine (2006), who applied principles from systems theory to SIP theory in order to understand youth aggression, five hierarchical social-cognitive processes (long-term memory, working memory, on-line schematic processing, on-line conceptual processing, and perception) act independently and interdependently to affect youths' social cognition and aggression. Put simply, an individual's memory and perception affect his/her response to the environment, including aggressive responses. This social cognition system provides a theoretical framework with which to understand how environments such as the neighborhood context may lead to

cognitions that increase youth aggression (Fontaine, 2006). Consistent with Bronfenbrenner's model, Fontaine (2006) suggests that microsystem and exosystem influences affect youth's cognitions and thereby aggressive behavior.

Mason and colleagues (1994) proposed an ecological model specific to African American adolescents' externalizing behaviors, including aggression, using concepts from Bronfenbrenner's (1980) ecological model. They suggested that because adolescents are influenced both by factors in the microsystem and the exosystem, both types of environments should be included when examining the development of adolescent externalizing behavior. Therefore, their proposed model includes factors related to family relationships (microsystem), as well as parents' social connections and community factors (exosystem). Empirical tests of Mason et al.'s model revealed that the exosystem variables of parental work environment and parental social support had an indirect effect on adolescent externalizing behavior via the microsystem factors of parental warmth, parental use of restrictive control, and family conflict (Mason et al., 1994). In addition, Mason et al. (1994) found a direct effect of perceptions of the neighborhood context (exosystem) on aggressive behavior. Their model highlights the importance of including factors with direct (parental warmth, parental control, and family conflict) and indirect (parental work environment, parental social support, and the neighborhood) contact with adolescents to understand the development of externalizing behaviors. Similarly, Salzinger and colleagues (2002) integrated the literatures in child maltreatment, domestic violence, and exposure to community violence to create a developmental-ecological model specific to youth exposure to violence, which has consistently been linked with adolescent aggression. They proposed that five domains of

risk, community, family, relationships with parents and caregivers, peers, and individual characteristics, affect adolescent exposure to violence (Salzinger et al., 2002).

The aforementioned models each emphasize the impact of multiple domains on adolescent involvement in violence, including aggression. Each model includes an emphasis on peer and parent environments as well as the neighborhood environment as important influences on adolescent aggression. Given these models' emphases on the importance of the peer, parent, and neighborhood domains for studying adolescent aggression, the current study also will include risk factors from each of these domains in examining adolescent aggression.

Existing Research on Risk Factors for Adolescent Aggression

Consistent with ecological models, a number of risk factors from the parent, peer, and neighborhood domains have been identified as influential in the development of aggression in adolescence. Only the factors most consistently associated with aggression will be discussed in detail here and will be included in the present study. For the parenting domain, parental monitoring has been linked with adolescent aggression (e.g., Ary, Duncan, Duncan & Hops, 1999; Chang, Dodge, Schwartz, & McBridge-Chang, 2003; Dishion & McMahon, 1998; Gorman-Smith & Loeber, 2005; Patterson et al., 1989); parental involvement has been less consistently and weakly if at all associated with aggression but more strongly with academic outcomes (Colder, Mott, Levy & Flay, 2000; Ibanez, Kuperminc, Jurkovic, & Perilla, 2004; Moore, Guzman, Hair, Lippman, & Garrett, 2004; Patrikakou, 2004; Patterson, Reid, & Dishion, 1992; Shelton, Frick, & Wooton, 1996). In the peer domain, deviant peer affiliation has been repeatedly associated with youth aggression (Brendgan, Vitaro, & Bukowski, 2000; Dishion et al., 1991; Espelage et

al., 2003; Patterson et al., 1989). In the neighborhood domain, perceived neighborhood safety and community violence exposure have been identified as predictors of youth aggressive behavior (Aneshensel & Sucoff, 1996; Diehl, 2004; Griffin, Scheier, Botvin, Diaz, & Miller, 1999; Hadley-Ives, Stiffman, Elze, Johnson, & Dore, 2000; Hill & Madhere, 1996; Luthar & Goldstein, 2004; Overstreet, 2000; Purugganan, Stein, Silver, & Benenson, 2003; Salzinger et al., 2002).

Parenting. The current literature highlights parental monitoring as critical in the development of adolescent aggression (e.g., Ary et al., 1999; Chang et al., 2003; Dishion & McMahon, 1998; Gorman-Smith & Loeber, 2005; Patterson et al., 1989). In fact, Patterson et al.'s (1989) developmental model on antisocial behavior highlights parental monitoring, a parent's knowledge of his/her child's location (DiClemente, Wingood, Crosby, Sionean, Cobb, Harrington et al., 2001; Dishion & McMahon, 1998), as an important predictor of youth aggressive behavior. In fact, parental monitoring has been identified as one of the most important parenting behaviors influencing aggression (Barnes & Farrell, 1992; Capaldi & Patterson, 1996; Carlo, Raffaelli, Laible, Meyer, 1999; Dishion & McMahon, 1998; Jessor 1987, Patterson et al., 1989; Richards, Miller, O'Donnell, Wasserman, & Colder, 2004; Wall & Barth, 2005), and it has been suggested that parental monitoring may be more predictive of delinquency and health risk behaviors than other parenting behaviors (Dishion & McMahon, 1998; Patterson & Stouthamer-Leober, 1984; Steinberg, Fletcher, & Darling, 1994). For example, one study found approximately 2.5 times as much variance in delinquency scores accounted for by parental monitoring as compared with parental discipline, problem-solving, or reinforcement patterns within the family (Patterson & Stouthamer-Loeber, 1984). Youth

who are monitored less display higher rates of delinquent aggressive behavior compared with youth who are more highly monitored (Dishion & McMahon, 1998; Pettit, Bates, Dodge, & Meece, 1999). Low parental monitoring often contributes to deviant peer affiliation, which provides another setting in which aggressive behavior may be reinforced (Bandura & Walter, 1963; Jacobson & Crockett, 2000); however, it should be noted that some research also has identified the reverse association between deviant peer affiliation and parental monitoring (i.e., deviant peers may less likely be willing to disclose their whereabouts to parents; Keijsers, Branie, VanderValk, & Meeus, 2010; Kerr & Stattin, 2000).

Peers. Both social learning theory (Bandura & Walter, 1963) and Patterson et al.'s (1989) model of antisocial behavior highlight deviant peer affiliation as a significant risk factor for adolescent aggressive behavior. According to social learning theory, adolescents' observations of deviant peers' behavior and the reinforcement that these peers receive for aggressive behavior can lead to the initiation and maintenance of their own aggressive behavior (Bandura & Walters, 1963). Similarly, according to Patterson and colleagues' (1989) model, youth who are rejected by mainstream peers may drift into a deviant peer group in which aggressive behavior is modeled and reinforced. Consistent with these theories, several studies have demonstrated a significant positive association between deviant peer affiliation and aggression (e.g., Brendgan et al., 2000; Burke et al., 2004; Dishion et al., 1991; Espelage et al., 2003). Deviant peers can influence youth by encouraging them to engage in delinquent behaviors or by changing their positive or neutral attitude to one that is negative (e.g., Laird, Jordan, Dodge, Pettit, & Bates, 2001). For example, deviant peer groups often promote the expectation of engaging in deviant

behavior such as aggression (Dishion, Andrews, & Crosby, 1995; Dishion, Capaldi, Spracklen, & Li, 1995; Dishion & Owen, 2002). Research also suggests that deviant peers can encourage youth to have aggressive or violent beliefs and as a result, adolescents who affiliate with deviant peers may be more likely to engage in delinquent or aggressive activities than adolescents without these beliefs and peer influences (Gerrard, Gibbons, Benthin, & Hessling, 1996; Nash & Bowen, 1999).

Neighborhood. Consistent with ecological theories (e.g., Bronfenbrenner, 1979, Mason et al., 1994), the neighborhood context can influence adolescent aggression through its structural characteristics, such as the number of physical structures (e.g., municipal services and retail stores [bars, liquor stores, grocery stores, etc.]), as well as the availability, accessibility, and quality of its resources, such as housing and community centers (for a review, see Evans, 2006; Shaw & McKay, 1969). These characteristics have been found to affect adolescent mental health independent of neighborhood socio-economic status (SES; Evans, 2006). A neighborhood's social characteristics, such as community social organization (e.g., presence of adult role models or the relationship between residents and policemen), also are important in the development of aggression (Jencks & Mayer, 1990; Leventhal & Brooks-Gunn, 2000; Sampson et al., 2002). The presence or absence of neighborhood resources and social structures indicate its level of organization, which may facilitate or deter youth aggression (Evans, 2006; Jencks & Mayer, 1990; Sampson et al., 2002; Shaw & McKay, 1969). Neighborhood disorganization may include limited or poor quality resources or services such as lack of community centers or inefficient police patrol, or the disintegration of these types of organizations (Shaw & McKay, 1969). Characteristics of disorganized neighborhoods, such as low

income, high unemployment, and drug activity, can contribute to increased exposure to community violence and perception of neighborhood violence, two aspects of the neighborhood context which have been identified as important predictors of adolescent aggressive behavior (Leventhal & Brooks-Gunn, 2000; Sampson et al., 2002).

Exposure to community violence may affect youth aggression through contagion or social learning processes (Bandura, 1977; Jencks & Mayer, 1990). Contagion models emphasize deviant peer and negative adult role models in the neighborhood as influences in the development of aggression (Jencks & Mayer, 1990). These models propose that the absence of positive adult role models and the presence of negative adults and peers contribute to adolescents' observation and imitation of negative behaviors, including aggression. Consistent with social learning theory, these behaviors may be reinforced, such as in neighborhoods where aggressive behaviors are associated with status, respect, and/or money (Anderson, 1999; Bandura, Ross, & Ross, 1961), which encourages the continuation of these behaviors. In addition, community violence may affect adolescents' cognitions; specifically, adolescents may perceive aggression more positively following exposure to community violence and thereby exhibit more aggression, particularly if the exposure leads youth to believe that aggression is an effective way to handle conflicts (Brookmeyer, Henrich, & Schwab-Stone, 2005; Guerra, Huesmann, & Spindler, 2003).

Youth's exposure to community violence either as a victim or as a witness has important implications for adolescent aggression. Youth who are exposed to violence are at increased risk for aggression, delinquency, and difficulty with relationships (e.g., Diehl, 2004; Luthar & Goldstein, 2004; Overstreet, 2000; Purugganan et al., 2003; Salzinger et al., 2002). Exposure to community violence also predicts risk-taking behaviors and deviant

peer affiliation (Fitzpatrick, Piko, Wright, & LaGory, 2005; Foney & Cunnigham, 2002; Gorman-Smith & Tolan, 1998; Rankin & Quane, 2002). The strong positive association between community violence exposure and aggressive behaviors suggests that adolescents consistently exposed to violence may continue the cycle of neighborhood violence by behaving aggressively themselves (Spano, Rivera, & Bolland, 2006).

Similar to community violence exposure, perception of neighborhood violence has been linked with youth aggression (Aneshensel & Sucoff, 1996; Griffin et al., 1999; Hadley-Ives et al., 2000; Hill & Madhere, 1996). Associations between perceived neighborhood violence and aggression are consistent with Problem Behavior Theory (PBT; Jessor & Jessor, 1977) which highlights the importance of the perceived environment in the development of adolescent problem behaviors, including aggression (Griffin et al., 1999). As described above, the amount of violence in a neighborhood can influence individuals' perceptions of their environment and their aggressive behaviors. Specifically, youth who are exposed to violence may believe that their neighborhood is dangerous, that any ambiguous social cues should be perceived as hostile in order to protect themselves, and that aggression is an appropriate way to address conflicts or achieve goals (Colder et al., 2000; Dodge, 1993). Individuals who perceive their environments as hostile may hold positive beliefs about aggression because aggression is considered a way to keep themselves safe (Colder et al., 2000). For instance, Colder and colleagues (2000) found that positive beliefs about aggression mediated the relationship between perceived neighborhood danger and high levels of aggression.

Perceptions of the neighborhood environment are increasingly recognized as a reliable and valid measure of the neighborhood (Bass & Lambert, 2004; Colder et al.,

2000; Hill & Madhere, 1996; Howard, Kaljee, & Jackson, 2002). In fact, research has suggested that the perceived environment may be just as, if not more, influential than measures of the actual environment in determining adolescents' behaviors, likely because adolescents may experience the same neighborhood differently depending on their own perceptions of the neighborhood environment (e.g., Elze, Johnson, & Dore, 2000; Griffin et al., 1999; Hadley-Ives et al., 2000; Kupersmidt, Griesler, DeRosier, Patterson, & Davis., 1995). Furthermore, police reports or census crime data may describe neighborhood violence according to arbitrary boundaries that may not reflect residents' beliefs about the boundaries of their neighborhoods or the amount of violence experienced in their neighborhoods (Coulton et al., 2001). Perception of neighborhood risk and violence have been found to predict negative emotional and behavioral adjustment including aggression, depression, anxiety, inability to form social relationships, and difficulties with trust, emotion regulation, and moral development (e.g., Aneshensel & Sucoff, 1996; Covington & Taylor, 1991; Kuther, 1999; LaGrange & Ferraro, 1989; Ortega & Myles, 1987; Overstreet, 2000).

Summary of risk factor research

The available literature on adolescent aggression highlights parental monitoring, deviant peer affiliation, community violence exposure, and perception of neighborhood violence as important predictors of adolescent aggression. However, this literature is limited because of the few empirical studies integrating information from the parent, peer, and neighborhood contexts to understand adolescent aggression. In addition, the existing literature examining neighborhood effects on aggression is limited due to the lack of

attention to how geographic location may influence adolescent aggression. This study will address each of these limitations.

Integration of Neighborhood Context with Peer and Parent Domains

Ecological theories suggest that the neighborhood context should be incorporated with the peer and parent domains for a comprehensive understanding of the development of aggression (Jencks & Mayer, 1990; Leventhal & Brooks-Gunn, 2000; Sampson et al., 2002; Shinn & Toohey, 2003). In terms of interactions between neighborhood and parent influence that may have implications for aggression, parents in middle income communities may be more likely to allow their children to play at the homes of peers and to allow other children into their homes; consequently, these youth are likely supervised and monitored more by parents, resulting in lower levels of aggression (Kupersmidt et al., 1995). Parents also may be more willing to share responsibility for supervision and monitoring of adolescents in middle- or high-SES communities than in low-SES communities, and adolescents may receive more monitoring as a result (Chilcoat, Breslau, & Anthony, 1996; Kupersmidt et al., 1995). In contrast, other studies suggest that parental monitoring is higher in low-SES communities where parents may be concerned about their youths' exposure to community violence, limit their child's outside social activities, and increase the amount of monitoring (Baldwin, Baldwin, & Cole, 1990; Spencer et al., 1996). This increased monitoring suggests decreased exposure to the neighborhood (Baldwin et al., 1990) and therefore less opportunity for exposure to community violence. Although the evidence is mixed, these studies highlight some ways that the interaction of family and neighborhood factors can influence parenting behavior and thus adolescent aggression.

Neighborhood characteristics also may have implications for adolescents' peer relationships, and the combination of neighborhood and peer risks may be important for understanding aggressive behavior. For example, Haynie and colleagues (2006) found that the opportunity for deviant peer affiliation was greater when neighborhoods lacked the resources and organization to increase social control, which protects against deviant peer groups (Haynie, Silver, & Teasdale, 2006). Studies indicate that because disorganized neighborhoods allow for more deviant peer activity, risk for exposure to community violence and opportunity for adolescents to become involved with deviant peers may increase, and therefore, adolescent aggression may be higher (Sampson et al., 2002). Additionally, Jencks and Mayer (1990) assert that reinforcement from deviant peers moderates the association between violence in the neighborhood and youth violence involvement, suggesting that higher deviant peer affiliation exacerbates the association between neighborhood violence and youth aggression. In neighborhoods with low social cohesion, often a characteristic of low SES neighborhoods (Sampson et al., 2002), the presence of deviant peers and their acceptance of and respect for problem behaviors such as getting in trouble with the police, joining gangs, and using substances may contribute to adolescents believing these behaviors as acceptable and acting aggressively (Menard & Elliott, 1994).

Because the interaction of neighborhood risks with peer and parent risk factors has important implications for adolescent aggressive behavior, future research should endeavor to integrate information from these domains for a comprehensive understanding of risk for aggression. Of particular interest for this research is the degree to which parent and peer risk factors may account for the geographic concentrations of aggressive behavior, as

suggested by literature documenting higher aggressive behavior in some types of neighborhoods, which in turn suggests geographic concentrations of aggressive behavior. These geographic concentrations of aggression may be best examined by studying location, an extension of the neighborhood effects literature.

Location

Existing literature regarding neighborhood effects on youth aggression measures neighborhood using aggregate data, and therefore provides limited information about location. Specifically, this research provides information about average levels of a risk factor or outcome in particular pre-defined areas (e.g., census tracts). However, aggressive behavior may vary according to geographic locations within an administratively defined unit such as a census tract, or across pre-determined boundaries. Currently, there appear to be no studies in the extant psychology literature that consider the geographic location of problem behaviors such as aggression. However, the criminology and public health literatures have incorporated the geographic location of aggression, violence, crime, and disease to understand the development of these problems and risk factors for these problems (Britt, Carlin, Toomey, & Wagenaar, 2005; Chaix et al., 2005; Van Patten & Delhauer, 2007).

Aggression may cluster in geographic space (i.e., occur in close proximity) just as criminal acts often cluster in certain locations due to shared risk characteristics (e.g., Bowers, Johnson & Pease, 2004; Grubesic & Murray, 2001; Ratcliffe & McCullagh, 1999; Speer, Semenza, Kurosaki, & Anton-Culver, 2002). Criminologists have identified crime "hot spots", or areas of high crime, using geographically-based analytic techniques (Bowers et al., 2004; Grubesic & Murray, 2001; Ratcliffe & McCullagh, 1999; Sherman &

Weisburd, 1995). They have analyzed the geographic location of crimes to better understand patterns of crime, including how location shapes the types and levels of criminal behavior in an area (Anselin, Cohen, Cook, Gorr, & Tita, 2000). Existing criminology research suggests that targeting these crime "hot spots" in interventions can decrease risk for crime by up to 13 percent (Sherman & Weisburd, 1995). By using similar methods, psychologists could locate areas of high adolescent aggression. The present study will identify areas with a high incidence or clustering of aggression and examine what risk factors account for clusters of aggressive behavior.

As noted above, research on neighborhood risk factors for aggression often uses data that has been collected from individuals and then grouped together. Specifically, this data is often collected from participants in different geographic areas within a neighborhood and aggregated to yield a neighborhood-level measure; the neighborhood-level data typically is analyzed without consideration of where aggressive behavior occurs (Diez-Roux, 2007). This is important to consider because such aggregate data suggests that all individuals within a neighborhood have the same level of the variable of interest (e.g., aggressive behavior, SES). This error is known as the ecological fallacy, the assumption that individuals have the same characteristics of the larger group or unit (Robinson, 1950). In order to avoid problems associated an ecological fallacy, researchers can use point data, geographic points representing individual-level data or specific incidences of an event (e.g., crime, disease outbreak; Connell, Diehr, & Hart, 1987).

There are a number of advantages of using point data instead of grouped data from an area. First, data analyzed using aggregate data yields different results depending on the

unit of analysis (e.g., census tract versus block group; Krieger, 1992). Second, census tracts, which are commonly used to represent a neighborhood, are government-defined boundaries and may not reflect residents' definitions of their neighborhood (Coulton et al., 2001; Tatalovich, Wilson, Milam, Jerrett, & McConnell, 2006). Thus, results from analyses of census data for a particular neighborhood may not be reflective of the neighborhood it intends to describe. Third, although assessments of a variable that occur close together are not independent and may share characteristics that account for their proximity, many analyses of grouped data assume independence of observations (Diez-Roux, 2000; Klein, Dansereau, & Hall, 1994). A model that incorrectly assumes independence runs the risk of overestimating or underestimating model parameters (Diez-Roux, 2007). Using spatial analyses to analyze point data is particularly valuable in addressing these problems.

The Present Study

Using an ecological framework, this study integrates information from the parent, peer, and neighborhood contexts with geographic location to better understand the associations between adolescent aggression and its risk factors. The present study has three aims. The first aim is to examine the degree to which aggressive behaviors cluster geographically in a sample of predominantly low-income, African-American adolescents. The second aim is to determine whether low parental monitoring, high deviant peer affiliation, high community violence exposure, and high perceived neighborhood violence spatially cluster. The third aim is to examine the coincidence of these risk factors and aggression by determining whether or not these geographic clusters overlap. Based on previous literature that suggests spatial clustering due to parent, peer, and neighborhood characteristics (e.g., Sampson, Morenoff, & Earls, 1999), it is hypothesized that aggressive behaviors will

cluster in geographic space, as will low parental monitoring, high deviant peer affiliation, high community violence exposure, and high perceived neighborhood violence. Moreover, because of the strong associations with these risk factors and aggression (e.g., Aneshensel & Sucoff, 1996; Brendgan et al. 2000; Chang et al., 2003; Dishion & McMahon, 1998; Espelage et al., 2003; Gorman-Smith & Loeber, 2005; Patterson et al., 1989, Hadley-Ives et al., 2000; Leventhal & Brooks-Gunn, 2000; Sampson et al., 2002), it is expected that each of these risk factors will contribute to the clustering of aggression, specifically that geographic clusters of risk factors will coincide with clusters of aggression (i.e., overlap).

The proposed research adds to the existing literature in several ways. Prior research has relied on aggregate data by using administrative reports of risk factors (e.g., census measures of SES or police reports of crime in an area) in areas with boundaries that may not be meaningful to residents and obscuring information about specific locations. Instead, this research does not rely on predetermined boundaries to understand the effects of location on adolescent behavior. By using point data instead of aggregated data to study aggression, this research will be less subject to the ecological fallacy and possible under- or overestimation of model coefficients that may occur when using aggregated data. The proposed study will use data from a community epidemiologically-defined sample of adolescents in contrast to much of the aggression literature, which has used high-risk samples (e.g., Dishion et al., 1995; Gorman-Smith & Loeber, 2005). Using a community sample rather than a high-risk sample will provide information applicable to populations that might otherwise be overlooked in prevention efforts. Finally, because the results of this study can be disseminated through maps and thereby easily understood, this study will increase the accessibility of information regarding aggression and its risk

factors. Thus, this research will provide information relevant to researchers, residents, and policy makers, all of whom will benefit from a better understanding of the etiology of adolescent aggression.

Spatial Analysis

Spatial analysis is the analysis of geographically-referenced data. This analytic technique involves the linking of geographic information to individual-level data. Spatial analyses can be used to determine whether data clusters by geographic location, such as when observations geographically proximal to one another are more similar than observations that are farther apart, and to create visual representations (e.g., maps) of the geographic relationship between variables. Similar to longitudinal data analysis in which observations that occur close in time are assumed to be more similar than observations assessed at wider time intervals, an underlying assumption of spatial analysis is that observations closer together in geographic space are more similar than those further apart (Schabenberger & Gotway, 2005). Such spatial dependency often suggests that two observations close in geographic space share characteristics which account for their dependency on each other. Thus, spatial dependency violates an assumption that individual observations are independent. Failure to account for non-independence of observations may result in overestimating or underestimating model parameters (Klein et al., 1994). Although multilevel and spatial analyses both can account for spatial dependence (non-independence) between variables, spatial analyses yield more information about the effect of location than multilevel analyses which only describe the average level of a variable within a particular area or unit (Klein et al., 1994). Specifically, multilevel analyses assume that all individuals within a predetermined area

share some characteristic (Klein et al., 1994) without the actual knowledge of where within those areas the individuals live (Chaix et al., 2005). Thus, multilevel analyses assume that observations are similar within areas and different across areas without knowing exactly how individuals within these areas might differ or whether individuals' locations within these areas matter (Chaix et al., 2005; Klein et al., 1994). This distinction in type of information gathered from these two analyses is particularly relevant for this study, which emphasizes the need to account for spatial patterns in understanding the associations between aggression and its risk factors.

Few studies have used spatial analytic methods in psychological research (Chaix et al., 2005; Diez-Roux, 2000). However, spatial analytic techniques are applicable to psychology in several ways, including documenting the spatial distribution of problem behaviors or risk factors (e.g., Chen, Harris, Folkoff, Drudge, & Jackson, 1999; Mason et al., 2004). For example, Chaix and colleagues (2005) examined the spatial distribution of substance-related disorders and the degree to which these were dependent on neighborhood deprivation. They found that areas with even single residences of severe deprivation within the neighborhood were more likely to have substance-related disorders than areas that were not deprived (Chaix et al., 2005). Similarly, Mason and colleagues (2004) examined the geographic distribution of risk factors in adolescents' social environments by creating profiles of personal risk (e.g., location of individuals who use substances and are depressed), social risk (e.g., distance to social network members who use drugs), and environmental risk (e.g., neighborhood poverty and the number of crimes within a 1 km radius) to understand adolescents' mental health (Mason et al., 2004). Spatial analytic methods also can be used to present information relevant to policy

makers and residents such as mapping areas in which many individuals are affected by the same risk factor and creating maps that indicate "hot spots" with high prevalences of problem behavior. These techniques yield information that is useful to neighborhood residents and to policymakers.

Spatial analyses require statistical technology systems that allow users to link geographic location information to other data (e.g., individual-level data such as level of aggression), and to integrate information about spatial location (e.g., geographic coordinates) into traditional statistical methods. One such system is ArcGIS, which integrates computer hardware, software, and data to capture, display, and analyze geographically-based information (ArcGIS, 2009). In this study, ArcGIS will be used to examine the amount of spatial variation in aggression and to determine whether spatial patterns exist in the data (i.e., clustering). ArcGIS is a spatial tool that can be used in conjunction with mapping programs such as ArcView to visually display data (e.g., with maps). ArcGIS also can be used for determining spatial autocorrelation or spatial clustering, creating maps to demonstrate the presence or absence of clustering, and conducting spatial regression.

Power. Power analysis involves estimating the sample size necessary to find statistically significant effects using a particular statistical test (Cohen, 1992). Estimating power requires determining the sample size to obtain a small, medium, or large effect (Cohen, 1992; Cohen, Cohen, West, & Aiken, 2003). While there are well-established methods for determining sample size for non-spatial data (e.g., Cohen et al., 2003), methods for estimating power for spatial analyses are less available. There are similarities between the underlying hypotheses guiding multilevel and spatial analyses (e.g., both

multilevel and spatial analyses assume that observations within a cluster or unit are similar, and that observations across clusters or further apart are dissimilar). However, it is not possible to use multilevel methods of estimating power for spatial data because the grouping unit and the number of individuals per group must be specified in a power analysis for multilevel data; in spatial analyses, the grouping unit is not specified a priori. Therefore, the total number of individuals per unit is not known. Estimating adequate power in spatial data is further complicated by the fact that for non-spatial analyses, power is calculated for null and alternative hypotheses; with spatial data, the alternative hypothesis is less clear. For example, with spatial data, because the exact geographic areas, or units of analysis, are not defined a priori, there are an infinite number of alternative hypotheses. Research that has estimated power for spatial analyses has used simulated data rather than real data (e.g., Kuldorff, Tango, & Park, 2003; Ozonoff, Webster, Vieira, Weinberg, Ozonoff & Aschengrau, 2005). However, these methods are so complicated that they often are not used (Kuldorff et al., 2003; Waller & Gotway, 2004).

Chapter 2: Methods

Participants

The data for the current study are drawn from a community, epidemiologically-defined sample of urban and predominantly African-American youth (N = 678) who were part of a longitudinal study evaluating two preventive interventions focusing on early learning and behavior. A randomized block design was used; teachers and children from three 1st grade classrooms in each of nine elementary schools (27 classrooms total) were randomly assigned to one of two intervention conditions or to a control condition. The interventions were provided in the 1st grade only. The initial sample was approximately 53% male and 86.8% African-American. Approximately two-thirds (63.4%) of participants were eligible for free or reduced lunch, a proxy for low socioeconomic status. Additional information regarding the measures and methods used to collect first grade data can be found in Ialongo, Werthamer, et al. (1999).

This study used data from the Grade 8 follow-up assessment. In 8th grade, study variables were collected for 91.4% of the original 678 participants (N = 638). Chi-square tests revealed no significant differences in race (χ^2= 2.94, $p > .05$) or gender (χ^2 = .01, $p >$ .05) between individuals who did and did not participate in 8th grade (N = 638 and N = 40, respectively). Location information such as addresses is necessary to conduct spatial analysis. Address information was obtained for 97.6% (N = 623) of the 638 Grade 8 participants. At the 8th grade follow-up, participants were located primarily in Baltimore City and its nearby counties (see Table 1). Given the large number of participants in Baltimore City as compared to areas outside of the city where there were few participants, only participants with addresses in Baltimore City were used in analyses. Participants in

Baltimore City comprised 64.5% of the 623 participants, resulting in a final N of 402 for this study.

All addresses for the 402 participants in the study sample were successfully geocoded, and the x, y coordinates were linked to a geographic map. T-tests revealed no significant differences between those who lived in Baltimore City in 8th grade (N = 402) and those who did not live in Baltimore City in 8th grade (N = approximately 221; exact N differs depending on the variable due to some missing variable data) in regards to 8th grade aggression (t = -0.39, p > .05), parental monitoring (t = -0.22, p < .05), deviant peer affiliation (t = 0.80, p > .05), or number of times an individual was exposed to community violence (t = -0.60, p > .05). There was a significant difference in perceived neighborhood violence between those who did and did not reside in Baltimore City (t = -6.56, p < .01), with those who lived in Baltimore City reporting higher perceptions of neighborhood violence than those living outside of Baltimore City. Chi-square tests revealed significant differences in race (χ^2 = 40.08, p < .01) between the participants in Baltimore City and those not in Baltimore City, with a larger percentage of Caucasians residing outside of Baltimore City. No significant differences in gender (χ^2 = 0.00, p > .05) or lunch status (χ^2 = 4.80, p > .05) were found between participants who did and did not reside in Baltimore City in Grade 8. Participants lived in 98 census tracts in Baltimore City. Approximately 27% of the sample resided in six census tracts (Table 2). The final study sample was 53.5% male and 93.0% African-American, and 71.4% qualified for free or reduced lunch. Participants ranged in age from 13-15 years of age with a mean of 13.77 years (standard deviation = .40).

Procedure

Parental written informed consent and youth verbal assent were collected each year. In Grade 8, data were obtained from teachers and adolescents during face-to-face interviews. Interviews with teachers and youth were conducted in a private location at the youth's school. Youth provided self-reports of their parental monitoring, deviant peer affiliation, community violence exposure, and perceived neighborhood violence. Teachers reported on youths' aggressive behavior.

Measures

Deviant Peer Affiliation: Adolescents' involvement with delinquent peers was measured with the Exposure to Deviant Peers (Capaldi & Patterson, 1989) scale. This scale, composed of 6 items, assesses the number of friends who have engaged in delinquent activities. Questions such as *"During the last year, how many of your friends have hit or threatened someone without any real reason?"* are rated on a 5-point Likert scale (1= None, 5= All of them). Higher scores indicate more exposure to deviant peers. Cronbach's alpha for this subscale was .84 in grade 8.

Parental Monitoring: The Structured Interview of Parent Management Skills and Practices-Youth Version (SIPMSP, Capaldi & Patterson, 1982) was used to measure parental monitoring. Created by Patterson and colleagues (1982) to examine the caregiver disciplinary practices targeted in their family-oriented intervention program, the SIPMSP assesses parental monitoring, discipline, reinforcement, rejection, and problem solving. The youth version of the SIPMSP includes items rated on a 6-point Likert scale (1= All of the time, 6= Never). In this study, the 6-item parental monitoring subscale was used, with higher scores indicating lower levels of parental monitoring. This subscale includes items

such as "*How often would your parents or a sitter know if you came home an hour late on weekends?*" Cronbach's alpha for this subscale was .69 for grade 8.

Perceived Neighborhood Violence: Six items from the Neighborhood Environment Scale (NES, Elliott, Huizinga, & Ageton, 1985) were used to measure perceived neighborhood violence. The NES assesses neighborhood disorganization by measuring participants' perception of racism, violent crime, and drug use and availability within the neighborhood. Respondents rate items on a 4-point Likert scale (1=Not at all, 4=Very true). Of the 7 items focusing on neighborhood safety and violence, one item, "*Most adults in my neighborhood respect the law,*" was conceptually ambiguous and could refer to laws ranging from disobeying traffic signals to committing violent crime. Therefore, this item was not included in the analyses. A confirmatory factor analysis was conducted to examine whether the remaining 6 neighborhood safety and violence items loaded on a single neighborhood violence factor. Results demonstrated adequate loadings (>*.42*) of these items onto the neighborhood violence factor. These questions included items such as "*I feel safe when I walk around my neighborhood by myself during the day*". Cronbach's alpha for these 6 items was .74 in 8th grade.

Community Violence Exposure: The Children's Report of Violence Exposure (CREV; Cooley, Turner, & Beidel, 1995) was used to measure exposure to community violence. The CREV, developed for children and adolescents 9 to 15 years old, is a self-report assessment that measures the frequency of four types of violence exposure (Cooley et al., 1995). In the present research, only reports of violence directly witnessed and violence experienced through victimization were used. For these items, participants were asked to recall whether or not they had been beaten up, robbed or mugged, shot or stabbed,

witnessed someone experiencing one or more of those events, or witnessed someone getting killed during the past year. These 7 items were summed to create a total score of how often in the past year an individual witnessed or was victimized by community violence, with higher scores indicating more frequent exposure to community violence.

Aggressive Behavior: Aggression was measured using the Authority Acceptance subscale of the Teacher Report of Classroom Behavior Checklist (TRCBC; Werthamer-Larsson et al., 1991), an adaptation of the Teacher Observation of Classroom Adaptation-Revised (TOCA-R; Werthamer-Larsson et al., 1991). Due to the economic constraints of interviewing hundreds of teachers in more than 130 schools since the majority of middle school students have different teachers for every subject, the checklist format of the TRCBC was used. Only the English or Mathematics teacher completed the checklist. The 7-item Authority Acceptance subscale of the TRCBC assesses overt maladaptive child and adolescent aggressive behaviors. Teachers rated children on items such as "*coerced classmates with physical violence*" on a scale ranging from 1 (Almost Never) to 6 (Almost Always). The coefficient alpha for Grade 8 for this subscale was .86.

Analytic Plan. Spatial analyses were used to examine the study aims. Spatial autocorrelation statistics describe the degree to which observations that are geographically proximal are similar (i.e., spatially dependent). Several spatial analytic techniques and methods are available to examine spatial autocorrelation. These are summarized in Table 3. The statistics reviewed in Table 3 are measures of global (i.e., larger area) clustering (i.e., Ripley's K, Average Nearest Neighbor Analysis, Getis-Ord General G, and Moran's I), as well as measures of local (i.e., smaller area) clustering (i.e., the Getis-Ord Gi* and Local Moran's I). Multilevel analysis is also included in Table 3. Although not truly spatial

analysis because there is no spatial component (i.e., spatial data such as x, y coordinates), multilevel analyses can provide information about the clustering of aggression and its risk factors, specifically whether there is an effect of tract (or other bounded unit) on aggressive behavior; the results of multilevel analyses can supplement the results of spatial analyses.

Ripley's K. Ripley's K, a point pattern statistic often used to generate information about global clustering, compares the actual distribution of points to a normal Poisson distribution (Bailey & Gattrell, 1995). This statistic requires a participant sample of greater than 30 cases (Bailey & Gattrell, 1995) and a data sample that includes all possible observations in the area (in the present study, "area" refers to Baltimore City). Although the current data set meets the sample size requirement, the sample does not include complete data on the underlying population, i.e., all possible events (observations) in Baltimore City (Bailey & Gattrell, 1995). Ripley's K measures the actual proximity of similar attributes, data describing a specific aspect of an observation (e.g., aggression), and compares the observed distribution of similar attributes to an estimated distribution of points with similar attributes. In this data set, the estimated distribution of points cannot be generated because not all possible events are available.

Nearest Neighbor Analysis (NNA). Average Nearest Neighbor Analysis (NNA) is used to determine global point patterns (ESRI, 2010a). It differs from Ripley's K because it compares the actual distance between points (e.g., x, y coordinates) to an estimated distance between points (the average distance between points in a hypothetical random distribution of points), as opposed to comparing the actual proximity of similar attributes to an estimated random distribution of similar attributes (e.g., aggression; Dixon, 2002)[1]. In

[1] The Nearest Neighbor ratio is given as:

the present study, participants' location data (i.e., geographic residence) are linked with attribute data (e.g., aggression, parental monitoring); thus, examining the distance between x, y coordinates could indicate the degree of spatial clustering for a particular attribute.

Getis-Ord General G. The Getis-Ord General G is a measure of global clustering that describes the type of cluster (i.e., a cluster of high values versus a cluster of low values) in an area (ESRI, 2010b). The General G is frequently used to assess spatial clustering in a locale where clustering is known to exist (ESRI, 2008). However, like the Ripley's K, the General G requires complete data for the underlying population, and General G analyses require using all observations in a particular area (i.e., Baltimore City; Bailey & Gattrell, 1995). Thus, this spatial analytic method is not appropriate to use with the current data set.

Moran's I. Similar to the Getis-Ord General G, the Moran's I is a global clustering statistic. It provides evidence of clustering, but does not indicate the type of clustering (i.e., cannot specify whether clusters are of high or low values; ESRI, 2008). The Moran's I involves determining whether attributes with similar values are closer together than might be expected in a random distribution (ESRI, 2010d). In addition, this spatial analytic technique requires information about the variables for the underlying population (i.e.,

---

$$ANN = \frac{\bar{D}_O}{\bar{D}_E}$$

where D_o is the observed mean distance between each observation and its nearest neighbor

$$\bar{D}_O = \frac{\sum_{i=1}^{n} d_i}{n}$$

(d_i is the distance between observation *i* and its nearest neighbor; *n* is the total number of observations)

and D_E is the expected mean distance for the observations given a random pattern of observations

$$\bar{D}_E = \frac{0.5}{\sqrt{n/A}}$$

(*A* is the total study area; ESRI, 2011a)

aggression and its risk factors; Bailey & Gattrell, 1995). In this dataset, the estimated distribution of points cannot be generated, however, because the current data does not contain all possible observations in Baltimore City.

*Getis-Ord Gi**. The Getis-Ord Gi* spatial statistic indicates local clustering and is the local counterpart to the Getis-Ord General G, a global statistic. Similar to its global counterpart, the Gi* statistic requires data on all possible observations within a designated area (Bailey & Gattrell, 1995). Without data on all possible observations, the Gi* yields biased estimates. Because the current dataset does not contain all possible observations on aggression and its risk factors in Baltimore City, the Gi* statistic cannot be used for this study.

Local Moran's I. The Local Moran's I is a measure of local clustering and is the local counterpart to the Moran's I. As with the Moran's I, the Local Moran's I statistic requires an estimate of attributes of the underlying population; all possible events in an area are necessary for such an estimate (Bailey & Gattrell, 1995). Because not all possible events in the area are available for this study's dataset, it is not possible to compare the actual point data pattern present and an estimated point pattern distribution.

Other Methods. As summarized in Table 3 and described above, many of the spatial analytic techniques for examining clustering are not ideal for this study due to characteristics of this study's data set; specifically, the data do not conform to some of the underlying assumptions of the available statistical techniques for assessing spatial clustering. However, if the aforementioned data limitation was addressed (i.e., not all data are available), some of the spatial analytic methods described above might be appropriate for the current dataset. One method to address the unavailability of all possible data in all

locations (a sampling bias) would be to only analyze data from the census tracts with participant data (i.e., remove tracts without participant data) in global spatial clustering analyses. While this strategy addresses the problems with sampling bias, information about all of the underlying population (i.e., aggression and risk factor data on all possible participants) is still necessary to compare the current data with a random distribution of observations; therefore, this method is not appropriate.

A second method to address the problem of unavailability of all possible events (observations) in Baltimore City would be to use the dataset in its present form. If the sample is representative of the underlying population, the data can be used as is (D. Wong, personal communication, September 16, 2010). For example, if demographics such as race, gender, and socio-economic status are similar for this data set as they are for all of Baltimore City, the data may be appropriate. However, this sample is more representative of African-American communities than a general sample of all of Baltimore City, which is more ethnically diverse, has a higher juvenile arrest rate, and a higher birth to teens rate (see Table 6); therefore, the data cannot be used in its present form.

Methods Used in the Current Study. While no spatial statistical method was ideal for these data, NNA was the most appropriate because this statistic does not depend entirely on the availability of data on all events in an area (D. Wong, personal communication, September 16, 2010). Specifically, data in this project are linked with individuals' spatial information; thus, it is possible to examine the proximity of user-specified observations. NNA is a widely used, standard tool in fields such as criminology and public health, and it is considered a reliable global measure of spatial clustering (e.g., Canter, 1997; Chainey, Reid, & Stuart, 2004; Craglia, Haining, & Wiles, 2000; Grubesic &

Mack, 2008; Moore & Carpenter, 1999). Moreover, NNA is appropriate for this study because it involves comparing data clusters of different variables associated with the same individuals' location data (ESRI, 2009). NNA also is more appropriate for point pattern analyses (e.g., analyses of x, y coordinates) such as used in this study than for analyses of line and polygon patterns (e.g., bounded areas such as census tracts). Thus, NNA is a good fit for these data.

The present study used x, y coordinates and address information to conduct spatial analyses. In order to obscure the individual address locations and thereby protect the identities of study participants, study points (x, y coordinates) were adjusted. Specifically, points were offset by a random short distance from the exact location. The objective of this spatial adjustment was to preserve the confidentiality of locations while still capturing the characteristics of the spatial point pattern. Spatial adjustment, and specifically randomly moving data points, is frequently performed on spatial data in order to ensure the privacy of data collected (e.g., Leitner & Curtis, 2006; Pickle, Szczur, Lewis, & Stinchcomb, 2006).

Multilevel analyses also were conducted and compared to the results of the NNA. Although multilevel analyses do not specify where clustering occurs within an area as do spatial analyses, multilevel analyses describe the clustering of data within larger areas and can account for the hierarchical nature of nested data (e.g., Vanfossen, Brown, Kellam, Sokoloff, & Doering, 2010). For the present study, the geographic units that encompassed the individual observations were considered a clustering variable. The census tract was chosen as the clustering variable because it has clear boundaries and participants are encompassed in one area (a single census tract) only. To determine how the clustering of participants within tracts affects the data, the variability between tracts was compared with

the total variability (between tracts and within tracts). If the variability between census tracts was close to or equal to the total variability, this suggested an effect of tract on the data.

Analyses to Address Study Aims

Study Aims 1 and 2: To examine the spatial clustering of aggression and its risk factors – spatial analyses. The NNA was used to assess the degree to which aggression (Aim 1) and risk factors for aggression (i.e., parental monitoring, deviant peer affiliation, community violence exposure, perceived neighborhood violence; Aim 2) cluster in geographic space. This analysis entails determining whether or not points (observations or events) are geographically proximal versus randomly dispersed. These analyses only examine the proximity of points without attention to whether or not the points are similar. Dichotomizing variables as "high" or "low" would provide information about whether individuals with particular levels on the variables are in close proximity (e.g., whether individuals with "high" aggression are in close proximity to each other). Therefore, high aggression and high risk factors (i.e., low parental monitoring, high deviant peer affiliation, high community violence exposure, and high perceived neighborhood violence) were examined, with "high" defined as values of the variable above the mean, and "low" defined as values of the variable below the mean.[2]

The NNA statistic provides an overall degree of spatial clustering, or spatial autocorrelation, of an attribute in a specified area (referred to as the minimum enclosing rectangle; in the present study, this area is Baltimore City). A significant NNA statistic indicates that the null hypothesis, that observations are randomly distributed, can be

[2] The mean level of aggression was 1.751, whereas the median level of aggression was 1.50. Because the mean was above the median and the study examines "high" aggression, the sample was dichotomized according to the higher statistic.

rejected (ESRI, 2009). If the null hypothesis is rejected, observations are not randomly distributed, which suggests spatial clustering.

NNA yields a *z*-score that indicates the degree of spatial autocorrelation in an area (ESRI, 2010a). The *z*-score and associated p-value are determined by the nearest neighbor index, a ratio of the observed distance (actual distance) between two observations divided by the expected distance (average distance between two neighboring observations in a hypothesized random distribution; ESRI, 2010a). If this index is smaller than 1, the spatial pattern suggests clustering. If the index is larger than 1, the spatial pattern suggests spatial dispersion, or no clustering (ESRI, 2010a). Statistics are calculated based on either a Euclidean or Manhattan distance. A Euclidean distance refers to the straight distance between two observations ("as the crow flies"), and a Manhattan distance indicates distance by street block (ESRI, 2009).

Study Aims 1 and 2: To examine the clustering of aggression and its risk factors - non-spatial analytic methods. Multilevel analyses were conducted to supplement the results of the NNA, and results of the two types of analyses were compared. To determine whether aggression and its risk factors cluster, the intracluster correlation coefficient (ICC) was calculated. The ICC is the ratio of the variability between clusters to the total variability (i.e., within and between clusters; Petrie & Sabine, 2005); the ICC for this study was calculated by taking the ratio of between census tract variability in a particular variable to the total variability (between and within census tracts) of that variable. The ICC is 1 when there is no variation within census tracts and all variation is captured by the variance between census tracts (i.e., the between cluster variance is the same as the total variance). Thus, clustering exists if the variability in aggression or a

risk factor between census tracts is a significant portion of the variability between and within census tracts. The closer the ICC is to 1, the more variance in aggression (or in a risk factor) occurs at the between level (i.e., tract level) than the within levels (i.e., within tracts). In contrast, the ICC is 0 or close to 0 when there is no variability between clusters, suggesting spatial dispersion (i.e., no spatial clustering).

In addition to the ICC, the design effect was calculated. The design effect, which reflects how much the standard error would need to be adjusted due to the impact of clustering on individuals in the data, is influenced by the size of the ICC as well as the average sample cluster size (MPlus, 1999). A design effect greater than or equal to 2 suggests that clustering exists, whereas a design effect less than 2 indicates a lack of clustering and that the shared environment (e.g., census tract) does not impact the individuals within that environment (Muthén & Satorra, 1995).

Study Aim 3: To examine the overlap of clusters of aggression and clusters of risk factor(s) - spatial analytic methods. To address the third aim, regression analyses and visual density maps were used to examine the coincidence of spatially dependent aggression and its risk factor(s). It should be noted that regression analyses are not a direct test of whether the clusters of risk factors overlap with aggression clusters. However, if a risk factor that clusters accounts for some of the variance in aggression, and aggression clusters geographically, that risk factor cluster might overlap with aggression.

A necessary condition for testing Aim 3 (the overlap of aggression and risk factor clusters) is that aggression and at least one risk factor cluster in geographic space. As noted above, a significant *z*-score for the NNA indicates that high levels of aggression

(and/or risk factors) cluster in geographic space (i.e., there is spatial autocorrelation). Significant spatial autocorrelation (e.g., spatial clustering) violates the OLS regression assumption of independence in the data, and results from non-spatial regression analyses would be biased. Thus, if aggression and at least one risk factor clustered in Aims 1 and 2, geographically weighted (i.e., spatial) regression (GWR) would be used to test Aim 3. This method adjusts for such dependence in order to avoid under- or overestimation of model parameters (Diez-Roux, 2007). GWR is a relatively recent approach to modeling spatial processes (Charlton & Fotheringham, 2009). GWR involves permitting the coefficient β to vary across the study area. Specifically, this spatial regression model is an OLS model that assigns greater weight to observations depending on their proximity to a designated location u. Thus, generally, a multiple linear regression is written as:

$$y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \ldots \beta_m x_{mi} + \varepsilon_i$$

where $i = 1 \ldots n$. In GWR, however, the equation includes location u such that:

$$y_i(u) = \beta_{0i}(u) + \beta_1(u) x_{1i} + \beta_2(u) x_{2i} + \ldots \beta_m(u) x_{mi}$$

(Charlton & Fotheringham, 2009). Given that the sample points are not regularly spaced throughout this study's area, an adaptive bandwidth will be specified to allow the same number of sample points for each estimation. The adaptive bandwidth is calculated by sorting the distances of observations from the specified location u and including only the closest values that would results in an optimal p-value. In ArcGIS, once the kernel, or weighting scheme, is set to an adaptive setting, the program is able to implement this process (Charlton & Fotheringham, 2009). The kernel used in ArcGIS is defined as:

$$w_i(u)=(1-d_i(u)/h)^2)^2$$

where $w_i(u)$ is the geographical weight for observation i, d is distance, and h is the bandwidth (Charlton & Fotheringham, 2009). ArcGIS defaults were employed given the lack of consensus regarding standardization when using spatial analytic techniques (R. Engstrom, personal communication, March 30, 2011). Bivariate and multivariate regression analyses would be conducted. First, only one risk factor would be used in each regression equation. After conducting these bivariate spatial regressions, a multivariate regression with all significant risk factors would be performed to determine if each risk factor still contributes to aggression after adjusting for the other risk factors in the regression model. Only risk factors that were spatially dependent (per results of NNA) would be used in the spatial regression analyses.

A visual density map was used to supplement the spatial regression analyses. Density maps frequently are used to show the range of a particular observation in a pre-defined unit. In the present study, density maps displayed the frequency of particular risk factors within areas of high aggression. These areas of high aggression were indicated by circles with arbitrary radii of 500 meters and centers determined by the location of concentrated high aggression observations. It should be noted that increasing the size of the radii does not typically change the density value; although more points are encompassed in the area, the area is also greater (ESRI, 2010c). If aggression did not cluster and none of the risk factors clustered, it would not be possible to test Aim 3 using spatial analytic techniques. Likewise, if aggression clustered but none of the risk factors clustered, or if risk factors clustered, but not aggression, it would not be possible to test Aim 3 using spatial analytic techniques. In either of these instances, logistic and OLS regression analyses would be conducted (as described below) to provide related

information, specifically the nature of the associations between risk factors and adolescent aggression. Results from these analyses would indicate what proportion of variance in aggression is accounted for by the risk factors, which would suggest overlap in the variables, although not overlap according to location.

Study Aim 3: To examine the overlap of clusters of aggression and risk factor(s) - non-spatial analytic methods. If the non-spatial analyses (the ICC and design effect) for Aims 1 and 2 indicate that multilevel analyses are appropriate for the study (i.e., clustering of aggression and/or risk factor(s) in tracts), multilevel regression analyses would be used to address the third aim. Aggression would be regressed on each risk factor with a significant ICC first in separate bivariate models; next, aggression would be regressed on all risk factors with a significant ICC in a multivariate model. In addition, models that do not adjust for census tract will be compared to models that do adjust for census tract. Significant differences in models that do and do not account for census tract suggest clustering by census tract. Small or lack of differences in models that do and do not account for clustering may indicate that clustering does not need to be accounted for in analyses (Kreft & de Leeuw, 1998). Alternatively, small differences may suggest that clustering does not occur at the tract level, but rather at a different areal unit. As mentioned above, if clustering did not exist, non-spatial regression analyses would be most appropriate.

Chapter 3: Results

Sample Characteristics

Participants were located in 98 different census tracts in Baltimore City. The average number of individuals per census tract was 2.22, with 27% of the sample residing in six tracts. Table 6 provides 2000 Census (the year corresponding to the 8th grade data collection used in this study) information about the census tracts in which the participants reside. The total population per census tract was 1341-7747 (M = 3772.93, SD = 1343.81), with the total population of 10-17 year olds per tract ranging from 181-1943 (M = 1031.49, SD = 377.36). In terms of data regarding teens, births to teens ranged from 0 to 18 (M = 5.42, SD = 3.95), drug-related juvenile arrests ranged from 0 to 62 (M = 16.31, SD =15.24), juvenile arrests for violent crimes (ages 10-17) ranged from 0 to 24 (M = 4.58, SD =4.21), and juvenile arrests for serious non-violent crimes (ages 10-17) ranged from 0 to 41 (M = 9.42, SD =7.32. In terms of adult crime, murder and non-negligent homicide ranged from 0-6 (M = 1.33, SD =1.48), adult violent offenses ranged from 7-199 (M = 83.04, SD =46.91), and adult serious non-violent offenses ranged from 79-476 (M = 217.35, SD =88.55) in the tracts in which participants resided. Table 6 also illustrates information on these variables for all of Baltimore City (Baltimore Neighborhood Indicators Alliance, 2008; Federal Bureau of Investigation to the National Archive of Criminal Justice Data, 2000; U.S. Census Bureau, 2000).

Descriptive Statistics

Means and standard deviations for study variables are presented in Table 4, with bivariate associations between study variables shown in Table 5. Males reported more deviant peer affiliation and community violence exposure than females (t = 3.86, $p < .01$; t

= 3.33, $p < .01$, respectively). Of the 402 participants in 8th grade, 34.6% reported experiencing community violence exposure at least once, either as a witness or as a victim. Males were more likely than females to experience any exposure to community violence ($\chi^2 = 3.95, p < .05$).

Study Aim 1: To examine the spatial clustering of aggression

NNA were conducted to examine the geographic clustering of high aggression. As described above, nearest neighbor ratios that are smaller than 1 suggest clustering of the attribute, whereas ratios larger than 1 indicate spatial dispersion (no clustering) in the attribute examined. To test this aim using non-spatial analyses, the ICC and design effect were computed for the dichotomous aggression variable. An ICC closer to one and a design effect greater than or equal to two suggests clustering of the attribute by census tract, whereas an ICC closer to zero and a design effect less than two suggests spatial dispersion. The ICC and design effect results for the dichotomous aggression variable are compared with the NNA results.

The NNA was significant for aggression (see Table 7), with an expected mean distance of 668.47 meters between points (i.e., x, y coordinates) of high aggression and an actual mean distance of 479.89 meters between points of high aggression, resulting in a nearest neighbor ratio of .72 ($z = -6.13, p < .01$). The significant *z*-score suggests a rejection of the null hypothesis that observations are randomly distributed (ESRI, 2010f). Specifically, the nearest neighbor ratio indicates that the attribute of high aggression geographically clusters more than would be expected in a random distribution of observations. Figure 1 illustrates the spatial clustering of high aggression. In contrast, in the non-spatial analysis, the between-census tract variance accounted for only a small

proportion of the total variance in aggression, suggesting little variability between clusters. The ICC for high aggression was .02, with a design effect of 1.02. These values suggest that aggression does not cluster according to census tract.

Study Aim 2: To examine the spatial clustering of risk factors for aggression

NNA were conducted to examine whether low parental monitoring, high deviant peer affiliation, high community violence exposure, and high perceived neighborhood violence were clustered in geographic space (see Table 7). For each risk factor, a map was created to illustrate possible spatial clustering (Figures 2-5). The ICC and design effect also were calculated to determine whether these variables clustered according to census tract. The ICC and design effect results for the dichotomous risk factors were compared with the NNA results.

For low parental monitoring, the expected mean distance was 597.39 meters, while the observed mean distance was 394.97 meters, resulting in a nearest neighbor ratio of .66 (z = -8.28, p < .01). This ratio suggests that observations of low parental monitoring occurred more closely in geographic space than would have been expected in a random distribution of observations. Thus, the null hypothesis that there is a random distribution of observations of low parental monitoring can be rejected. In contrast, in the non-spatial analysis, the between-census tract variance did not account for any of the total variance; the ICC and design effect for parental monitoring were .00 and 1.00, respectively, suggesting that parental monitoring does not cluster by census tract. Specifically, 0.00% of the total variance in parental monitoring occurs by census tract, and 100% of the total variance occurs within tracts; thus, there was no variability between census tracts.

The NNA for high deviant peer affiliation indicated geographic clustering. For high deviant peer affiliation, the expected mean distance was 699.84 meters and the observed mean distance was 456.43 meters, resulting in a nearest neighbor ratio of .65 (z = -7.35, $p < .01$). This ratio suggests that observations of high deviant peer affiliation occurred more closely in geographic space than would have been expected in a random distribution of observations. Thus, the null hypothesis that there is a random distribution of observations of deviant peer affiliation can be rejected. In contrast, the between-census tract variance was small in the non-spatial analysis; specifically, the ICC for high deviant peer affiliation was .11 and the design effect was 1.13, suggesting that high deviant peer affiliation does not significantly cluster by census tract (between tract variance *S.E.* = .07; $p > .05$).

Results of the NNA for high community violence exposure revealed that the expected mean distance between observations was 588.68 meters, and the observed mean distance was 375.57 meters. The nearest neighbor ratio was .64 (z = -9.21, $p < .01$), indicating that observations of high community violence exposure occurred more closely in geographic space than would have been expected in a random distribution of observations. Therefore, the null hypothesis can be rejected, suggesting that high community violence exposure clusters in geographic space. In contrast, the ICC for high community violence exposure was .05 and the design effect was 1.05; this suggests that only approximately 5% of the variance in high community violence exposure occurs at the census tract level, indicating lack of spatial clustering by tract (between tract variance *S.E.* = .26; $p > .05$).

NNA was used to examine high perceived neighborhood violence, and results of this analysis indicated that the expected mean distance (627.10 meters) was significantly larger than the observed mean distance (397.26 meters), resulting in a nearest neighbor ratio of .63 (z = -8.73, p < .01). This result indicates that reports of perceived neighborhood violence occurred more closely in geographic space than expected in a random distribution of observations. Thus, the null hypothesis, a random distribution of observations, can be rejected; high perceived neighborhood violence clusters spatially. In contrast, in the non-spatial analysis, the between-tract variance did not account for any of the total variance. The ICC for high perceived neighborhood violence was .00, and the design effect was 1.00, indicating that there was no variability between census tracts. Specifically, 0.00% of the variance in high perceived neighborhood violence occurs by census tracts, suggesting that high perceived neighborhood violence does not cluster according to census tract and that 100% of the variance occurs within tracts or according to non-census tract boundaries.

Study Aim 3: To examine the overlap of aggression and risk factor clusters

In Aims 1 and 2, NNA revealed that aggression and all of the risk factors (low parental monitoring, high deviant peer affiliation, high community violence exposure, and high perceived neighborhood violence) clustered in geographic space. Therefore, spatial regression analyses were conducted with all risk factors. First, aggression was regressed on each risk factor in separate models. Next, aggression was regressed on all of the risk factors in the same model. Density maps were conducted in order to supplement results of the spatial regression analyses.

Spatial regression analysis revealed that each risk factor contributed to the overall clustering in Baltimore City both at a bivariate and multivariate level (Table 9). Overall, there was significant spatial regression for the entire city, suggesting that each risk factor accounted for some of the variance in aggression. As shown in Table 9, in bivariate associations, parental monitoring contributed approximately 25% to the variance in aggression; deviant peer affiliation contributed approximately 14% to the variance in aggression; community violence exposure contributed about 25% of the variance in aggression; and perceived neighborhood violence contributed about 24% of the variance in aggression. When all risk factors were included in a multivariate model, the risk factors contributed approximately 32% to the variance in aggression. However, this significance should be interpreted with caution, because this statistic may include both areas in which spatial regression was significant and areas in which the association between risk factor(s) and aggression was not significant. Specifically, this statistic encompasses the entire area of Baltimore City, and does not specify where within the city the association between aggression and its risk factors may be significant.

Density maps supplement the information obtained from the spatial regression analyses and illustrate the overlap between aggression and each risk factor (see Figures 6 - 9). While these maps do not indicate the significance of the overlap between aggression and each risk factor, the areas colored darkest red demonstrate areas where high rates of aggression and high (or low) rates of the risk factors (i.e., low parental monitoring, high deviant peer affiliation, high community violence exposure, high perceived neighborhood violence) exist. The blue areas suggest locations of either a high prevalence of high aggression or a risk factor, whereas areas closer to red in color suggest overlap of

aggression and a risk factor. The darkest red-colored areas in Figure 10 indicate the overlapping of clusters of aggression and all risk factors together in the same map. It should be noted however, that this interpretation is speculation based on visual inspection because statistical significance cannot be determined from these maps.

Results of the ICC and design effect calculations used to examine Aims 1 and 2 revealed that neither aggression nor any of the risk factors had significant between-tract variance as compared to the total variability (between and within tract variability). These results suggest that aggression and its risk factors did not significantly cluster according to census tract. Thus, bivariate and multivariate regression analyses were conducted to examine the association between the risk factors and aggression. Because the variables were dichotomized for the spatial analyses, and it was of interest to conduct parallel non-spatial analyses, the dichotomous variables were used in the regression analyses. Thus, non-spatial logistic OLS regression analyses were performed to examine the association between the risk factors and high aggression. For bivariate analyses, aggression was regressed on each risk factor in separate regression models. In the multivariate analysis, aggression was regressed on all risk factors together in the same regression model. In the bivariate analyses, only low parental monitoring and high community violence exposure were significantly associated with aggression (see Table 10). In addition, results of the multivariate analyses demonstrated that only low parental monitoring and high community violence exposure were significantly associated with adolescent aggression after adjusting for the other risk factors in logistic regression analyses (see Table 10).[3]

[3] The bivariate analyses also were conducted with the continuous aggression and risk factor variables, and all risk factors (i.e., parental monitoring, deviant peer affiliation, community violence exposure, and perceived neighborhood violence) were significantly positively associated with aggression. Results of the multivariate analyses revealed that only

Chapter 4: Discussion

Understanding whether individuals with high levels of aggression are located in close geographic proximity enhances our understanding of the etiology of aggression, specifically whether the occurrence of aggression is strongly associated with its environment. Moreover, understanding whether geographic clusters of aggression and its risk factors coincide provides valuable information for improving prevention and intervention programs targeting aggressive adolescents. The present study examined these issues using spatial analytic methods, supplemented by information from non-spatial analyses. Spatial analyses revealed that aggression and risk factors for aggression (i.e., low parental monitoring, high deviant peer affiliation, high community violence exposure, and high perceived neighborhood violence) cluster geographically, and that clusters of aggression coincide with these risk factors in geographic space. These findings support the proposition that individuals living in geographical proximity may share common experiences due to their proximity (e.g., Kreft & de Leeuw, 1998). These results also are consistent with Sampson and colleagues' (2002) analysis of neighborhood research from which they concluded that social problems such as crime and adolescent delinquency frequently occur together at the neighborhood level. Similarly, as discussed in the neighborhood effects literature, families may select their neighborhoods according to shared characteristics, also suggesting similarity amongst individuals living in close proximity; for example, family socioeconomic status largely influences neighborhood choice and/or families may choose to live near similar others (Duncan, Connell, & Klebanov, 1997; Leventhal & Brooks-Gunn, 2000; Tienda, 1991). In contrast to results of

---

community violence exposure was significantly associated with adolescent aggression after adjusting for the other risk factors in the OLS regression analyses.

the spatial analyses, there was no evidence of significant clustering at the census tract level.

Geographic clustering of aggression and risks for aggression

As hypothesized, results of spatial analyses revealed that adolescent aggression clustered in geographic space. This finding is consistent with literature documenting that aggression and violence often occur in the same areas due to a shared environment (i.e., Bowers, et al., 2004; Grubesic & Murray, 2001; Ratcliffe & McCullagh, 1999). For example, criminologists have identified crime "hot spots", or specific areas with a high concentration of crime (Bowers et al., 2004; Grubesic & Murray, 2001; Ratcliffe & McCullagh, 1999; Sherman & Weisburd, 1995). Similarly, individuals residing in environments with similar characteristics (e.g., neighborhood crime, SES) may share behaviors that are adaptive for their particular environment. For example, in some contexts, aggression is an adaptive response to the environment. Relatedly, social information processing theories suggest that the perception of constant threat in the environment (e.g., due to crime and/or neighborhood violence) may lead individuals to interpret ambiguous stimuli as hostile, and respond aggressively as a result (Colder et al., 2000; Dodge, 1993). Thus, spatial clustering of adolescent aggression may suggest that these participants reside in like environments and may be exposed to similar risk factors for aggression.

Consistent with expectations, spatial analyses revealed significant geographic clustering for low parental monitoring, high deviant peer affiliation, high community violence exposure, and high perceived neighborhood violence. Geographic clustering of low parental monitoring suggests that geographically proximal neighbors monitored their children in similar ways. Similarly, prior research using non-spatial methods suggests that parental monitoring may vary by neighborhood. For example, Beyer and colleagues'

(2003) found that parental monitoring was significantly correlated with neighborhood characteristics such that high neighborhood disadvantage was associated with less parental monitoring, suggesting that parental monitoring can vary by neighborhood. In addition, Rankin and Quane (2002) found that in a sample of poor and mixed-income neighborhoods of African-American youth in Chicago, parental monitoring was higher in neighborhoods with greater collective efficacy, also suggesting clustering of parental monitoring by neighborhood type. Similarly, Kupersmidt and colleagues (1995) found a protective effect of middle- and high-SES communities on aggression. They suggested that in these neighborhoods, adults might share the responsibility for supervision and monitoring of adolescents, resulting in lower levels of aggression in the neighborhood. These studies suggest that parents living in similar neighborhood types might monitor their children in similar ways, although it should be noted that neighborhood type is not a direct proxy for location.

Geographic clustering of deviant peer affiliation mirrors research suggesting that deviant peer affiliation frequently varies by neighborhood due to differences in neighborhood social organization (e.g., Brody et al., 2001; Haynie et al., 2006; Sampson et al., 2002). Neighborhood social disorganization is characterized by lack of neighborhood social controls, such as police and neighborhood adults (often parents), that monitor the behavior of neighbors' children and therefore can prevent or decrease delinquent activity as well as deter violence and crime (Sampson et al., 2003). Menard and Elliott (1994) suggested that in neighborhoods with high disorganization, the presence of delinquent youth, along with community residents' reluctance to intervene and thereby implicit acceptance of delinquent behaviors (e.g., engaging in gang-related behavior, using illegal

substances), contributes to adolescents believing these behaviors are acceptable and acting aggressively. This link between neighborhood disorganization and high deviant peer affiliation suggests that the prevalence of deviant peer affiliation is highly dependent on the geographic location or area.

Spatial clustering of exposure to community violence is consistent with neighborhood research indicating that adolescents living in similar types of neighborhoods, particularly neighborhoods characterized by high poverty and low neighborhood social organization, may be exposed to similar levels of community violence (Sheidow, Gorman-Smith, Tolan, & Henry, 2001). Researchers also have identified specific areas with high rates of crime, or "hot spots", suggesting that crime and violence tend to concentrate in particular areas (Bowers et al., 2004; Grubesic & Murray, 2001; Ratcliffe & McCullagh, 1999; Sherman & Weisburd, 1995). The geographic clustering of perceptions of neighborhood violence may have occurred for a similar reason. It is possible that individuals in the same neighborhoods or areas might perceive their environments in a similar manner due to similar exposures to the environment (Sampson, Raudenbush, & Earls, 1997). In addition, individuals who have been exposed to violence in their neighborhoods as a witness, as a victim, or via hearsay may view their environments as similarly violent (Sampson et al., 1997).

As anticipated, spatial regression analyses and the density maps revealed that concentrations of aggression were more prominent in areas with higher levels of risk factors (i.e., low parental monitoring, high deviant peer affiliation, high community violence exposure, high perceived neighborhood violence). These results supplement the existing neighborhood literature by suggesting that location, a feature of the neighborhood

environment, has effects on aggression because of geographic variations in risk factors; neighborhood research similarly discusses differential distribution of risk factors across neighborhoods (Sampson et al., 1997). Examination of the density maps (specifically, the overlap of clusters of aggression and risk factors) suggest that risk factor clusters contribute to the presence of aggression. However, this conclusion is speculative because the data are cross-sectional. In addition, without all data on aggression and its risk factors in the underlying population (i.e., in Baltimore City), it is not feasible to determine whether these overlaps are statistically significant. Interestingly, clusters of aggression also sometimes occurred in areas without risk factor clusters (see Figure 10), suggesting that additional risk factors not examined here (e.g., neighborhood crime, prevalence of drug or alcohol use; Herrenkohl, McMorris, Catalano, Abbott, Hemphill, & Toumbourou, 2007) may be important for understanding the geographic clustering of aggression. For example, clusters ("hot spots") of neighborhood crime, which can be violent, likely correlate with high rates of aggression (Bowers et al., 2004; Grubesic & Murray, 2001; Ratcliffe & McCullagh, 1999; Sherman & Weisburd, 1995).

While spatial analyses suggested that aggression and risk factors for aggression occurred in geographically proximal areas, non-spatial analytic methods indicated that neither aggression nor the risk factors for aggression clustered. One explanation for this result is that these study data do not cluster according to the clustering variable used in this study (i.e., census tract). Individuals' experiences do not necessary fall within census tract boundaries (Coulton et al., 2001; Halliday-Boykins & Graham, 2001), and the data may actually cluster according to another clustering boundary, such as a neighborhood or census block, or they may cluster across boundaries, as suggested per visual inspection of the

clusters found in this study (Figures 11-15). For instance, as depicted in Figure 11, there appear to be 14 full clusters (circles) with 13 clusters that crossed census tract borders. These findings complement research suggesting that the census tract is an arbitrary boundary and may not necessarily reflect resident-defined communities or may be too large or small an area to match individual experiences (Coulton et al., 2001; Halliday-Boykins & Graham, 2001). In addition, different units of aggregation can yield different results (e.g., census tracts versus block group; Krieger, 1992). Government defined aggregate data, such as obtained through the census or local government, also do not necessarily assess neighborhood disorganization or collective efficacy, which are associated with higher violence or aggression (Furstenberg & Hughes, 1997; Sampson et al., 1999; Sampson et al., 2003). Thus, the information provided by non-spatial analyses is specific to the aggregating unit.

Implications for Research and Intervention

The present study highlights the importance of examining geographic location to understand adolescent aggression and risk factors for aggression, and suggests that applying spatial analytic methods may reveal information not captured by multilevel analyses of a priori defined spatial units. Specifically, with non-spatial analyses, it might not be possible to identify geographic clustering of variables of interest using a priori boundaries. For example, it may be difficult for researcher to know which boundaries would appropriately capture the spatial clustering of aggression or its risk factors. Thus, researchers should consider more than one unit of analysis (e.g., census tract and a locally-defined unit) because the unit appropriate for one variable may not necessarily be appropriate for another variable. In addition to identifying spatial patterns not captured by

analyses of aggregate data, spatial analysis can supplement non-spatial methods even when non-spatial methods reveal area-level effects. Specifically, knowing that there is significance between-unit variance on a particular variable does not indicate where in the unit the variable is high (or low); for multilevel analyses that reveal significant area effects, spatial analyses can add precision by identifying the locations where clusters of behavior exist within the area.

In addition to research implications, there are also clinical implications for this study. Given findings from spatial analyses indicating specific areas of high aggression and/or risk factor(s), it may be useful to implement interventions at targeted locations. For example, interventions aimed at decreasing adolescent aggression can focus on providing more anger-management group interventions in schools and clinics located in areas characterized by high levels of aggression. This study's findings suggesting a geographic association between individuals' aggression and peer, parent, and neighborhood factors highlights the importance of intervening at different levels in Bronfenbrenner's (1979) ecological model. Thus, the study's results are consistent with a multisystemic approach, which views the child as enclosed within different systems of influence and focuses on communities, families, and peer relationships (Henggeler, 1999). Integrating location data (e.g., gathered from spatial analyses) can enhance MST interventions by providing information about risks and resources in an area that might affect whether or not an intervention is successful or intervention effects are maintained. For example, combining this information with results revealing spatial clustering of low parental monitoring and deviant peer affiliation might suggest implementing parent interventions (e.g., parenting skills classes or encouraging group or shared parenting) in specific neighborhoods that can

increase parental monitoring and establish strong peer and adult role models to decrease deviant peer affiliation (Anderson, 1999; Holland 1991; Stewart-Brown, Patterson, Mockford, Barlow, Klimes, & Pyper, 2004; Utting, 2003). More specifically, same-aged or older peers who have successfully resisted associating with deviant peers and met their goals, or adults who are invested in influencing adolescents in a positive way (Utting, 2003) can establish a strong network of support in which they can offer alternatives to turning to deviant peers and teach adolescents skills and strategies for problem-solving. Targeting such efforts in areas of low parental monitoring and high deviant peer affiliation can prevent and reduce adolescent aggression.

This study's findings highlight the importance of neighborhood-level interventions. Neighborhood-level interventions might include increasing formal and informal social controls such as neighborhood watch and/or police patrols that can monitor adolescent (and other individuals') activities to increase neighborhood organization and thereby decrease neighborhood violence (perceived and experienced) and adolescent aggression. Such interventions also can include school-sponsored, supervised functions at various neighborhood locations such as community centers, restaurants, and parks, or neighborhood resident meetings. These types of interventions increase neighborhood cohesion, which affects adolescents on a neighborhood-wide level due to the increased involvement of adults in the neighborhood (Henggeler, Cunningham, Pickrel, Schoenwald, & Brondino, 1996). Increasing the involvement and willingness of adults in the neighborhood to intervene can increase collective efficacy, which has been shown to reduce aggression (Sampson et al., 1997).

Strengths and Limitations

The present study extends prior research in several ways. Whereas much of the neighborhood literature has used aggregate data to examine effects of neighborhood poverty or other structural characteristics on child and adolescent maladjustment, (Diez-Roux, 2004), this study includes specific locations of individuals rather than average effects in a bounded area to understand adolescent aggression. The benefit of such an approach is that specific clusters of aggression can be identified; without specific information about location, it is not clear where within a bounded area cluster(s) might occur. Relatedly, because spatial analytic methods may be employed without defining boundaries a priori, one can identify clusters of a particular behavior or phenomenon that may not cluster at a pre-defined aggregate level. The use of a community sample is another strength because these results are more readily generalizable to urban adolescents living in cities or major metropolitan areas than a study using only a high-risk sample. As such, results can reveal areas of high aggression that might otherwise not be identified if the focus were on only high-risk individuals.

From a layperson's perspective, research on adolescent maladjustment may be perceived as inaccessible by neighborhood residents and/or policy makers (e.g., Zigler, 1998), whether due to the use of field-specific or intricate statistical language, or because of the availability of the literature to only those in the psychology field. Maps may facilitate discussions between researchers and laypeople as maps do not require field-specific jargon and can be distributed with information that is concise and easy to grasp. Once researchers and laypeople have engaged in these discussions, specific interventions may be developed to address particular problems. For example, in the criminology field, interventions such as increased police patrols in areas high crime based on maps detailing

"hot spots" (identified through spatial analytic methods) have led to decreased crime in those areas (Braga, 2001; Sherman & Weisburd, 1995).

The aforementioned study strengths should be evaluated in the context of the following limitations. Of particular concern for the spatial analyses was that the dataset did not include all possible observations of each variable in Baltimore City (e.g., level of aggression for every adolescent residing in the city). Thus, the NNA was employed based on the assumption that other analyses were inappropriate, and spatial analyses that would have been appropriate to conduct had data on all such observations been available could not be used. Furthermore, results of the current study must be interpreted with caution due to these data limitations. Although NNA and spatial regression still provided information useful to this study, the results did not reveal where clustering occurred in the study area. Relatedly, the NNA is a global statistic and therefore comprised of smaller areas, some of which may have spatial clustering and some of which may not. Had this study's focus been examination of spatial clustering in smaller areas such as census blocks or neighborhoods, additional spatial analyses could have been conducted in order to determine more specific areas of clustering, providing even more detailed information about where clustering occurred. Additionally, because the number of participants in each census tract differed (and in the present study, some tracts did not have participants), it was not possible to use spatial analytic methods that required comparing the observed data with the expected data, because data on all possible observations were not available. Some tracts did not have participants because only information from those participants who consented to the study in 1st grade and the 8th grade follow up could be used. The sampling strategy in 1st grade did not yield a sample randomly selected from all Baltimore tracts, but instead a sampling of

youth enrolled in the nine schools participating in the parent study. While this sample was representative of 1st grade students in Baltimore, the sample was not evenly dispersed over Baltimore city, resulting in a sampling bias (in terms of geographic analyses). Lastly, ArcGIS program defaults were used, and if other restrictions were set during analyses, results may have differed.

In terms of measurement, adolescent self-reports were used to assess deviant peer affiliation, community violence exposure, and perception of neighborhood violence. Ideally, multiple informants would have been used to assess these constructs. However, regarding adolescent self-reports, it should be noted that because youths' freedoms increase during the adolescent years, parents and teachers may not know the amount of deviant peer affiliation or community violence exposure adolescents experience (e.g., Ceballo, Dahl, Aretakis, & Ramirez, 2001; Pettit, Bates, Dodge & Meece, 1999). Thus, adolescents' self reports about their deviant peer affiliation, exposure to community violence, and perception of neighborhood violence may be more valid assessments of these constructs than reports from other sources. While teacher-rated aggression is commonly used in studies of aggression given the frequency with which teachers are able to observe children and adolescents in a variety of settings and interactions (e.g., Connors, 1969; Greca, 1981; Uren & Stagnitti, 2009), some research indicates that teacher ratings may be biased across ethnicities, gender, and urbanization (e.g., Hughes & Cavell, 1999; Weissberg, Cowen, Lotyczewski, Boike, Orara, Stalonas, et al, 1987; Zwirs, Burger, Schulpen, Vermulst, HiraSing, & Buitelaar, 2010). Moreover, the aggression measure focused on overt (physical) aggression only; examination of other types of aggression such as covert (e.g., teasing) aggression might yield different results. For example, cyber-

bullying and other telecommunications also may not cluster geographically because a definitive location cannot be specified for some of the actions that occur via media.

Dichotomizing the continuous aggression and risk factor variables is an additional measurement issue. While dichotomizing was deemed necessary in order to use the nearest neighbor analyses, it should be noted that when continuous data are dichotomized, information may be lost (e.g., Streiner, 2004). Another measurement concern is that only one aspect of parenting, parental monitoring, was assessed; however, parental monitoring has been suggested to be the parental behavior most predictive of aggression (Dishion & McMahon, 1998; Patterson & Stouthamer-Leober, 1984; Steinberg et al., 1994). The parental monitoring scale also may have been interpreted differently based on the adolescent; the questions employed the term "parent" and some adolescents may have construed this to include other caregivers such as grandparents, whereas others may have only thought of a parent when answering these items.

Because cross-sectional data were used, causality could not be examined in this study. Longitudinal data would have allowed inferences about causality in the relationship between risk factors and adolescent aggression. However, the feasibility of obtaining the necessary data for this type of analysis is significantly more difficult for psychology researchers than for researchers in the criminology and public health fields. For example, crime data over a particular time span is often available from police reports and recorded 911 calls; similarly, public health data such as the prevalence of cancer over several years is available through hospital or clinic records. These data can be readily obtained because they are more likely publicly reported each time they occur. For psychological research, it is necessary to identify individuals who not only have a particular set of characteristics at

different points in time, but also are willing to share that information. Furthermore, in order to obtain an unbiased sample of a study area, specific location information is needed for all study participants. However, such data are sensitive and create concerns about confidentiality. Thus, the feasibility of collecting longitudinal from all individuals in a particular region is far more difficult (and sometimes impossible) in psychological research.

Future Research

This study suggests several directions for future ecological research focusing on location and adolescent aggression, including measurement issues, using longitudinal data, and examining gender differences. To further examine the prevalence and location of aggression and other risks and problem behaviors, future research should attempt to obtain samples that are definitively representative of the underlying population of study in order to employ spatial analytic techniques aside from NNA. Other spatial analytic methods can illustrate even more specific information about the geographic area by: providing statistics similar to the NNA but for each individual area defined by the researcher (e.g., census tract or block, community area); detecting outliers; and exploring the existence of "cold spots", areas in which low values of a particular variable might geographically cluster. Results from such analyses can be used to inform interventions and prevention programs for particular areas as described above. For example, examining "cold spots" might inform researchers about area-specific protective factors (e.g., low crime, prosocial peer affiliation and behaviors; Jessor, Van den Bos, Vanderryn, Costa, & Turbin, 1995; Sampson et al., 2002) or suggest areas where there are lower levels of risk factors for aggression. Furthermore, the differences between spatial and non-spatial analyses in this study revealed

that the census tract boundary did not adequately capture this study data's spatial clustering. These differences suggest that the utility of census tracts (or other administrative data) for understanding whether variables of interest cluster may vary depending on the variable of interest or characteristics of the study data. Thus, future research should use multiple units of analyses and/or supplement non-spatial analyses with spatial analytic techniques in order to adequately assess clustering in an area.

In terms of measurement, rather than a mean split to examine problematic levels of aggression and risk factors for aggression, it may be informative to use more extreme thresholds in spatial analyses examining clustering. Specifically, aggression and/or its risk factors might have different spatial patterns at more extreme levels; similarly, more extreme thresholds on these variables might reveal clustering at different spatial units (e.g., the census tract). Relatedly, considering other risk variables may be beneficial in understanding the etiology of aggression. For instance, neighborhood crime can strongly impact neighborhood social cohesion or fear of violence and therefore also aggression (e.g., Markowitz, 2003; Sampson et al., 2002).

Longitudinal data on aggression and its risk factors will be important to examine which risk factors predict the presence of aggression in particular areas. Because aggression and the risk factors examined in this study are dynamic, identifying whether the spatial dependence of aggression changes over time or with development (e.g., adolescents spend more time outside of the home and thus have a higher potential for exposure to community violence and subsequent aggression compared with children) will be important for the design of interventions and for a better understanding of how aggression develops. For example, longitudinal analyses can provide information regarding how geographic

clusters of aggression might change concurrent with changes in age and environment (e.g., due to changes in the presence or concentration of risk factors).

Future research should examine whether spatial patterns of aggression, or the coincidence of aggression and its risk factors according to location, vary by individual-level characteristics and/or gender. In particular, individual-level variables such as impulsivity, hyperactivity, and emotion regulation could affect clustering of adolescent aggression. For instance, because aggression has been linked to hyperactive and impulsive behaviors (e.g., Burke et al., 2004; Hinshaw, Lahey, & Hart, 1993; Kerr, Tremblay, Pagani-Kurtz, & Vitaro, 1997), individuals displaying such characteristics might also geographically cluster in the same areas. Spatial patterns might also be similar for individuals who lack effective coping strategies and thus ineffectively regulate emotions as evidenced by maladaptive behaviors (e.g., internalizing symptoms).

Finally, prior research highlights gender differences in rates of aggression as well as which risk factors contribute to males' and females' aggression (Gorman-Smith & Loeber, 2005; Gorman-Smith & Tolan, 1998; Newman & Newman, 2001), suggesting that spatial patterns might vary. For instance, the association between parental monitoring and aggression may be significantly stronger for females than for males (Gorman-Smith & Loeber, 2005); therefore, the clusters of low parental monitoring might coincide with the clustering of aggression for females but not for males. Moreover, some studies have found that the association between deviant peer affiliation and aggression is stronger for males than for females (Gorman-Smith & Loeber, 2005), suggesting that spatial clusters for these variables might more frequently coincide for males than for females. Distinguishing these types of differences may be helpful for tailoring preventive interventions specific to gender,

such as offering parenting skills classes for parents of adolescent girls or encouraging an increased presence of adult role models in the neighborhood to decrease male deviant peer affiliation.

References

Alvy, K. T.; Fuentes, E. G.; Harrison, D. S.; & Rosen, L. D. (1980). The culturally-adapted parent training project: Original grant proposal and first progress report. Studio City, CA: Center for the Improvement of Child Caring.

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

Aneshensel, C. S., & Sucoff, C. A. (1996). The neighborhood context of adolescent mental health. *Journal of Health and Social Behavior*, *37*(4), 293-310.

Anselin, L. (1988). *Spatial Econometrics: Methods and Models*. Dordrecht: Kluwer Academic Publishers.

Anselin, L., Cohen, J., Cook, D., Gorr, W., & Tita, G. (2000). Spatial analysis of crime. *Criminal Justice, 4*, 212-62.

ArcGIS (Version 9.3.1) [Computer software]. Redlands, CA: ESRI.

Ary, D.V., Duncan, T.E., Duncan, S.C., & Hops, H. (1999). Adolescent problem behavior: The influence of parents and peers. *Behaviour Research and Therapy, 37*(3), 217-230.

Bailey, T.C. & Gatrell, A.C. (1995). *Interactive Spatial Data Analysis*. Michigan: Longman Scientific & Technical, The University of Michigan.

Baldry, A.C. & Farrington, D.P. (2000). Bullies and delinquents: personal characteristics and parental styles. *Journal of Community & Applied Social Psychology, 10*(1), 17-31.

Baldwin, A., Baldwin, C., & Cole, R. (1990). Stress resistant families and stress-resistant children. In J.E. Rolf, A.S. Masten, D. Cicchetti, K.H. Nuechterlein, & S.

Weintraub (Eds.), *Risk and Protective Factors in the Development of Psychopathology* (pp. 257-280). New York: Cambridge University Press.

Baltimore Neighborhood Indicators Alliance. (2008). *Crime and Safety*. Retrieved December 23, 2010, from http://bniajfi.org/vs/vital_signs/3

Baltimore Neighborhood Indicators Alliance. (2008). *Children and Family Health*. Retrieved December 23, 2010, from http://bniajfi.org/vs/vital_signs/2

Bandura, A. (1977). *Social Learning Theory*. New York: General Learning Press.

Bandura, A., Ross, D., Ross, S. A. (1961). Transmission of aggression through imitation of aggressive models. *Journal of Abnormal and Social Psychology, 63*, 575-582.

Bandura, A. & Walters, R.H. (1963). *Social learning and personality development*. New York: Holt, Rinehart, & Winston.

Barnes, G. M., & Farrell, M. P. parental support and control as predictors of adolescent drinking, delinquency, and related problem behaviors. *Journal of Marriage and the Family, 54*(4), 763-776.

Bass, J.K., & Lambert, S.F. (2004). Urban adolescents' perceptions of their neighborhoods: An Examination of spatial dependence. *Journal of Community Psychology, 32*(3), 277-293.

Baumrind, D. (1967). Child care practices anteceding three patterns of preschool behavior. *Genetic Psychology Monographs, 75(1)*, 43-88.

Beyers, J. M., Bates, J. E., Pettit, G. S., & Dodge, K. A. (2003). Neighborhood structure, parenting processes, and the development of youths' externalizing behaviors: A multilevel analysis. *Journal American Journal of Community Psychology, 31*(1-2), 35-53.

Bloomquist, M. L. & Schnell, S. V. (2002). *Helping Children with Aggression and Conduct Problems: Best Practices for Intervention.* New York, New York: Guilford Press.

Bowers, K.J., Johnson, S.D., & Pease, K. (2004). Prospective hot-spotting: The future of crime mapping? *The British Journal of Criminology, 44,* 641-658.

Braga, A. A. (2001). The effects of hot spots policing on crime. *The Annals of the American Academy of Political and Social Science, 578*(1), 104-125.

Brendgen, M., Vitaro, F., & Bukowski, W. M. (2000). Deviant friends and early adolescents' emotional and behavioral adjustment. *Journal of Research on Adolescence, 10*(2), 173-189.

Britt, H.R., Carlin, B.P., Toomey, T.L., & Wagenaar, A.C. (2005). Neighborhood Level Spatial Analysis of the Relationship Between Alcohol Outlet Density and Criminal Violence. *Environmental and Ecological Statistics, 12*(4), 411-426.

Brookmeyer, K.A., Henrich, C., & Schwab-Stone, M. (2005). Adolescents who witness community violence: Can parent support and prosocial cognitions protect them from committing violence? *Child Development, 76*(4), 917-929.

Bronfenbrenner, U. (1979). Ecology of childhood. *School Psychology Review, 9*(4), 294-297.

Brown, B., Clasen, D.R., & Eicher, S.A. (1986). Perceptions of peer pressure, peer conformity dispositions, and self-reported behavior among adolescents. *Developmental Psychology, 22*(4), 521-530.

Buka, S.L., Stichick, T.L., Birdthistle, I., & Earls, F.J. (2001). Youth exposure to violence: Prevalence, risks, and consequences. *American Journal of Orthopsychiatry, 71*(3), 298-310.

Burke, J.D., Loeber, R., & Birmaher, B. (2004). Oppositional Defiant Disorder and Conduct Disorder: A review of the past 10 years, Part II. *Journal of the American Academy of Child and Adolescent Psychiatry, 41*(11), 1275-1293.

Canter, P.R. (1997). Geographic information systems and crime analysis in Baltimore County, Maryland. In D. Weisburd and J.T. McEwen (Eds.), *Crime Mapping and Crime Prevention* (157-190). Monsey, NY: Criminal Justice Press.

Capaldi, D. M., & Patterson, G. R. (1996). Can violent offenders be distinguished from frequent offenders: Prediction from childhood to adolescence. *Journal of Research in Crime and Delinquency, 33*(2), 206-231.

Carlo, G., Raffaelli, M., Laible, D. J., & Meyer, K. A. (1999). Why are girls less physically aggressive than boys? Personality and parenting mediators of physical aggression. *Sex Roles: A Journal of Research, 40*(9/10), 711-730.

Caspi, A. & Roberts, B.W. (2001). Personality development across the life course: The argument for change and continuity. *Psychological Inquiry, 12*(2), 49-66.

Casas, J.F., Weigel, S.M., Crick, N.R., Ostrov, J.M., Woods, K.E., Yeh, E.A.J., et al. (2006). Early parenting and children's relational and physical aggression in the preschool and home contexts. *Journal of Applied Developmental Psychology*, 27(3), 209-227.

Ceballo, R., Dahl, T.A., Aretakis, M.T., & Ramirez, C. (2001). Inner-city children's exposure to community violence: How much do parents know? Journal of Marriage and Family, 63(4), 927-940.

Centers for Disease Control and Prevention (CDC). (2008). Web-based Injury Statistics Query and Reporting System (WISQARS). Retrieved November 23, 2008, from, www.cdc.gov/ncipc/wisqars/default.htm.

Centers for Disease Control and Prevention: Preventing youth violence (2006). Retrieved April 19, 2008, from, http://www.cdc.gov/ncipc/pubres/research_agenda/09_youthviolence.htm

Chainey, S. and Reid, S. and Stuart, N. (2004) When is a hotspot a hotspot? A procedure for creating statistically robust hotspot maps of crime. In D. Kidner, G. Higgs and S. White (Eds.), *Innovations in GIS 9: Socio-economic Applications of Geographic Information Science* (21-36). London: Taylor and Francis.

Chaix, B., Merlo, J., Subramanian, S.V., Lynch, J., & Chauvin, P. (2001). Comparison of a spatial perspective with the multilevel analytical approach in neighborhood Studies: The Case of Mental and Behavioral Disorders due to psychoactive substance use in Malmö, Sweden, 2001. *American Journal of Epidemiology, 162*(2), 171-182.

Chang, L. (2003). Variable effects of children's aggression, social withdrawal, and prosocial leadership as functions of teacher beliefs and behaviors. *Child Development*, *74*(2), 535-548.

Chang, L., Dodge, K.A., Schwartz, D., McBridge-Chang, C. (2003). Harsh parenting in relation to child emotion regulation and aggression. *Journal of Family Psychology, 17*(4), 598-606.

Charlton, M. & Fotheringham, A.S. (2009). Geographically weighted regression [White paper]. Retrieved from http://ncg.nuim.ie/ncg/GWR/GWR_WhitePaper.pdf

Chen, X., Dong, Q., & Zhou, H. (1997). Authoritative and authoritarian parenting practices and social and school performance in Chinese children. *International Journal of Behavioral Development, 21*(4), 855-873.

Chen, M., Harris, D., Folkoff, M., Drudge, R., & Jackson, C. (1999). Developing a collaborative GIS in social services. *Geographic Information Systems, 9*, 44-47.

Chilcoat, H.D., Breslau, N., & Anthony, J. (1996). Potential barriers to parent monitoring: Social disadvantage, marital status, and maternal psychiatric disorder. *Journal of the American Academy of Child & Adolescent Psychiatry, 35*(12), 1673-1682.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences (2nd ed.)*. New Jersey: Lawrence Earlbaum Associates.

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112*(1), 155-159.

Cohen, J., Cohen, P., West, S.G., & Aiken, L.S. (2003). *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences (3rd ed.)*. New Jersey: Lawrence Earlbaum Associates.

Colder, C.R., Mott, J., Levy, S., & Flay, B. (2000). The Relation of Perceived Neighborhood Danger to Childhood Aggression: A Test of Mediating Mechanisms. *Journal American Journal of Community Psychology, 28*(1), 83-103.

Collins, W.A., Maccoby, E.E., Steinberg, L., Hetherington, E.M., & Borstein, M.H. (2000). Contemporary research on parenting: The case for nature and nurture. *American Psychologist, 55,* 218-232.

Connors, C.K. (1969). A Teacher Rating Scale for Use in Drug Studies with Children. *American Journal of Psychiatry, 126*, 884-888.

Connell, F.A., Diehr, P., & Hart, L.G. (1987). The use of large data bases in health car estudies. *Annual Review of Public Health, 8*, 51-74.

Coulton, C. J., Korbin, J., Chan, T., & Su, M. (2001). Mapping residents' perceptions of neighborhood boundaries: A methodological note. American Journal of Community Psychology, 29(2), 371-383.

Covington, J. & Taylor, R.B. (1991). Fear of crime in urban residential neighborhoods: Implications of between- and within-neighborhood sources for current models. *The Sociological Quarterly, 32*, 231-249.

Craglia, M., Haining, R., & Wiles, P. (2000). A comparative evaluation of approaches to urban crime pattern analysis. Urban studies, 37(4), 711-729.

Crick, N.R., & Dodge, K.A. (1994). A review and reformulation of social information-processing mechanisms in children's social adjustment. *Psychological Bulletin, 115*(1), 74-101.

Crick, N.R., & Dodge, K.A. (1996). Social information-processing mechanisms in reactive and proactive aggression. *Child Development*, *67*(3), 993-1002.

Deater-Deckard, K., Dodge, K.A., Bates, J.E., & Pettit, G.S. (1998). Multiple risk factors in the development of externalizing behavior problems: Group and individual differences. *Development and Psychopathology, 10*(3), 469-493.

DiClemente, R.J., Wingood, G.M., Crosby, R., Sionean, C., Cobb, B.K., Harrington, K., et al. (2001). Parental monitoring: Association with adolescents' risk behaviors. Pediatrics, 107*(6), 1363-1368.*

Diehl, R.L. (2004). Violence exposure and externalizing symptoms in inner-city youth as mediated by fear of crime and perceived risk of victimization. Unpublished doctoral dissertation, Virginia Commonwealth University.

Diez-Roux, A.V. (2000). Multilevel analysis in public health research. *Annual Review of Public Health, 21*, 171-192.

Diez-Roux, A.V. (2004). Estimating neighborhood health effects: The challenges of causal inference in a complex world. *Social Science and Medicine, 58*, 1953-1960.

Diez-Roux, A.V. (2007). Neighborhoods and health: Where are we and were do we go from here? *Revue d'Epidemiologie et de Sante Publique, 55*(1), 13-21.

Dishion, T. J., Andrews, D. W., & Crosby, L. (1995). Antisocial boys and their friends in adolescence: Relationship characteristics, quality, and interactional processes. *Child Development, 66*, 139-151.

Dishion, T. J., Capaldi, D., Spracklen, K. M., & Li, F. (1995). Peer ecology of male adolescent drug use. *Development and Psychopathology, 7,* 803-824.

Dishion, T. J., & Owen, L. D. (2002). A longitudinal analysis of friendships and substance use: Bidirectional influence from adolescence to adulthood. *Developmental Psychology, 38*, 480-491.

Dishion, T. J., & McMahon, R. J. (1998). Parental monitoring and the prevention of child and adolescent problem behavior: A conceptual and empirical formulation. *Clinical Child and Family Psychology Review, 1*(1), 61-75.

Dishion, T., Patterson, G., Stoolmiller, M., & Skinner, M. (1991). Family, school, and behavioral antecedents to early adolescent involvement with antisocial peers. *Developmental Psychology, 27*(1), 172-180.

Dixon, P.M. (2002). Ripley's K function. In A.H. El-Shaarawi and W.W. Piegorsch (Ed.), Encyclopedia of Environmetrics (Vol. 3, 1796-1803). Chichester, England: John Wiley & Sons, Ltd.

Dodge, K.A. (1993). Social-cognitive mechanisms in the development of conduct disorder and depression. *Annual Review of Psychology, 44*, 559-584.

Duncan, G.J., Connell, J.P., & Klebanov, P.K. (1997). Conceptual and methodological issues in estimating causal effects of neighborhood and family conditions on individual development. In J. Brooks-Gunn, G.J. Duncan, and J.L. Aber (Eds.), *Neighborhood Poverty: Vol. 1. Contexts and Consequences for Children* (219-250). New York: Russell Sage Foundation.

Ellickson, P., Saner, J., & Mcguigan, K. (1997). Profiles of violent youth: Substance use and other concurrent problems. *American Journal of Public Health, 87*, 985-991.

Espelage, D. L., Holt, M. K., & Henkel, R. R. (2003). Examination of peer-group contextual effects on aggression during early adolescence. *Child Development, 74*(1), 205-220.

ESRI (2008, December 16). Moran's I vs Getis-Ord General G [Msg 3]. Message posted to http://forums.esri.com/Thread.asp?c=93&f=983&t=270745

ESRI (2009). Average Nearest Neighbor (spatial statistics). Retrieved September 23, 2010, from

http://webhelp.esri.com/arcgiSDEsktop/9.3/index.cfm?TopicName=average_neares t_neighbor_(spatial_statistics)

ESRI (2010a). How Average Nearest Neighbor distance (spatial statistics) works. Retrieved October 20, 2010, from http://resources.esri.com/help/9.3/argisengine/java/GP_ToolRef/spatial_statistics_to ols/how_average_nearest_neighbor_distance_spatial_statistics_works.htm

ESRI (2010b). How high/low clustering: Getis-Ord General G (spatial statistics) works. Retrieved October 20, 2010, from http://edndoc.esri.com/arcobjects/9.2/net/shared/geoprocessing/spatial_statistics_to ols/how_high_low_clustering_colon_getis_ord_general_g_spatial_statistics_works. htm

ESRI (2010c). How point density works. Retrieved November 3, 2010, from http://webhelp.esri.com/arcgiSDEsktop/9.3/index.cfm?TopicName=How%20Point %20Density%20works

ESRI (2010d). How spatial autocorrelation: Moran's I (spatial statistics) works. Retrieved October 20, 2010, from http://edndoc.esri.com/arcobjects/9.2/net/shared/geoprocessing/spatial_statistics_to ols/how_spatial_autocorrelation_colon_moran_s_i_spatial_statistics_works.htm

ESRI (2010e, December 16). Mapping geographically weighted regression, p values [Msg 2]. Message posted to http://forums.arcgis.com/threads/19614-Mapping-Geographically-weighted-regression-p-values

ESRI (2010f). What is a Z score? Retrieved November 1, 2010, from http://edndoc.esri.com/arcobjects/9.2/NET/shared/geoprocessing/spatial_statistics_toolbox/what_is_a_z_score_qst_.htm

Evans, G.W. (2006). Child development and the physical environment. *Annual Review of Psychology, 57,* 423-451.

Farmer, T. W., Estell, D. B., Leung, M., Trott, H., Bishop, J., & Cairns, B. D. (2003). Individual characteristics, early adolescent peer affiliations, and school dropout: An examination of aggressive and popular group types. *Journal of School Psychology, 41*(3), 217-232.

Farrington, D.P. (1998). Predictors, causes, and correlates of male youth violence. *Crime and Justice, 24*, 421-475.

Farrington, D.P. & Loeber, R. (2000). Epidemiology of juvenile violence. *Child & Adolescent Psychiatric Clinics of North America, 9*(4), 733-748.

Federal Bureau of Investigation to the National Archive of Criminal Justice Data. (2000). *Crimes reported in Baltimore City, Maryland: Crimes 2000.* Retrieved January 20, 2011, from http://www.fedstats.gov/mapstats/crime/county/24510.html

Felson, R.B. (1996). Mass media effects on violent behavior. Annual Reviews in Sociology, 22, 103-128.

Fitzpatrick, K.M., (1997). Aggression and environmental risk among low-income African-American youth. *Journal of Adolescent Health, 21*(3), 172-178.

Fitzpatrick, K.M., Piko, B.F., Wright, D.R., & LaGory, M. (2005). Depressive symptomatology, exposure to violence, and the role of social capital among African American adolescents. *American Journal of Orthopsychiatry 75*(2), 262-274.

Foney, D., & Cunningham, M. (2002). Why do good kids do bad things? Considering multiple contexts in the study of antisocial fighting behaviors in African American urban youth. *Journal of Negro Education, 71*, 143-157.

Fontaine, R.G. (2006). Applying systems principles to models of social information processing and aggressive behavior in youth. *Aggression and Violent Behavior, 11*, 64-76.

French, D.C., & Conrad, J. (2003). School dropout as predicted by peer rejection and antisocial behavior. *Journal of Research on Adolescence, 11*(3), 225-244.

Furstenberg, F.F. & Hughes, M.E. (1997). The influence of neighborhoods on children's development: A theoretical perspective and research agenda. In J. Brooks-Gunn, G.J. Duncan, & J.L. Aber (Eds.), *Neighborhood Poverty: Vol. 2. Policy Implications in Studying Neighborhood* (23-47). New York: Russell Sage Foundation.

Garcia, M.M., Shaw, D.S., Winslow, E.B., & Yaggi, K.E. (2000). Destructive sibling conflict and the development of conduct problems in young boys. *Developmental Psychology, 36*(1), 44-53.

Gardner, M. & Steinberg, L. (2005). Peer influence on risk taking, risk preference, and risky decision making in adolescence and adulthood: An experimental study. *Developmental Psychology, 41*(4), 625-635.

Gerrard, M., Gibbon, F., Benthin, A., Hessling, R. (1996). A longitudinal study of the reciprocal nature of risk behaviors and cognitions in adolescence: What you do shapes what you think, and vice versa. *Health Psychology, 15*, 344-354.

Gorman-Smith, D., & Loeber, R. (2005). Are developmental pathways in disruptive behaviors the same for girls and boys? *Journal of Child and Family Studies, 14*(1), 15-27.

Gorman-Smith, D., & Tolan, P. (1998). The role of exposure to community violence and developmental problems among inner-city youth. *Development and Psychopathology, 10*, 101–116.

Greca, A.M. (1981). Peer acceptance: The correspondence between children's sociometric scores and teachers' ratings of peer interactions. *Journal of Abnormal Child Psychology, 9*(2), 167-178.

Griffin, K., Scheier, L., Botvin, G., Diaz, T., & Miller, N. (1999). Interpersonal aggression in urban minority youth: Mediators of perceived neighborhood, peer, and parental influences. *Journal of Community Psychology, 27*(3), 281-298.

Gritz, E. (1984). Cigarette smoking by adolescent females: Implications for health and behaviour. *Women and Health, 9*(2-3), 103-115.

Grubesic, T.H. & Mack, E.A. (2008). Spatio-Temporal Interaction of Urban Crime. *Journal of Quantitative Criminology, 24*(3): 285-306.

Grubesic, T. & Murray, A.T. (2001). *Detecting hot spots using cluster analysis and GIS*. Presentation at the National Institute of Justice's Fifth Annual International Crime Mapping Research Conference, Dallas, December 2001. Retrieved April 15, 2009, from, http://www.ojp.usdoj.gov/nij/maps/Conferences/01conf/Papers.html.

Guerra, N.G., Huesmann, R., & Spindler, A. (2003). Community violence exposure, social cognition, and aggression among urban elementary school children. *Child Development, 74*(5), 1561-1576.

Hadley-Ives, E., Stiffman, A.R., Elze, D., Johnson, S.D., & Dore, P. (2000). Measuring neighborhood and social environments: Perceptual and aggregate approaches. *Journal of Human Behavior in the Social Environment, 3*, 1-28.

Halpem, R. (1990). Poverty and early childhood parenting: toward a framewokr for intervention. *American Journal of Orthopsychiatry, 60*(1), 6-18.

Haynie, D. L., Silver, E., Teasdale, B. (2006). neighborhood characteristics, peer networks, and adolescent violence. *Journal of Quantitative Criminology, 22*(2), 147-169

Henggeler, S.W. (1999). Multisystemic Therapy: An overview of clinical procedures, outcomes, and policy implications. *Child Psychology & Psychiatry Review, 4*(1), 2-10.

Herrenkohl, T., Hawkins, D., Abbott, R.D., & Guo, J. (2002) Correspondences between youth report and census measures of neighborhood context. *Journal of Community Psychology, 30*, 225-233.

Herrenkhol, T.I., McMorris, B.J., Catalano, R.F., Abbott, R. D., Hemphill, S. A., & Toumbourou, J. W. (2007). Risk Factors for Violence and Relational Aggression in Adolescence. Journal of Interpersonal Violence, 22(4), 386-405.

Hill, H.M., & Madhere, S. (1996). Exposure to community violence and African American children: A multidimensional model of risks and resources. *Journal of Community Psychology, 24*, 26-43.

Hinshaw, S.P. (1992). Externalizing behavior problems and academic underachievement in childhood and adolescence: causal relationships and underlying mechanisms. *Psychological Bulletin, 111*(1), 127-155.

Hinshaw, S.P., Lahey, B.B., & Hart, E.L. (1993). Issues in taxonomy and comorbidity in the development of conduct disorder. *Development and Psychopathology, 5*, 31-49.

Howard, D.E., Kaljee, L., & Jackson, L. (2002). Urban African American adolescents' perception of community violence. *American Journal of Health Behavior, 26*(1), 56-67.

Hughes, J.N. & Cavell, T.A. (1999). Influence of the teacher-student relationship on childhood conduct problems: a prospective study. American Journal of Community Psychology, 15(4), 387-401.

Ibanez, G.E., Kuperminc, G.P., Jurkovic, G. & Perilla, J. (2004). Cultural attributes and adaptations linked to achievement motivation among Latino adolescents. *Journal of Youth and Adolescence, 33*(6), 559-568.

Jacobson, K.C., & Crockett, L. J. (2000). Parental monitoring and adolescent adjustment: An ecological perspective. *Journal of Research on Adolescence, 10*(1), 65-97.

Jencks, C. & Mayer, S.E. (1990). The social consequences of growing up in a poor neighborhood. In L.E. Lynn, Jr., & Mcgeary, M.G.H. (Eds.), *Inner-City Poverty In the United States* (pp. 111-196). Washington, D.C.: National Academy Press.

Jessor, R., & Jessor, S. L. (1977). Problem behavior and psychosocial development: A longitudinal study of youth. New York: Academic Press.

Jessor, R., Van den Bos, J., Verderryn, J., Costa, F.M., & Turbin, M.S. (1995). Protective factors in adolescent problem behavior: Moderator effects and developmental change. *Developmental Psychology, 31*(6), 923-933.

Kandel, D.B. (1990). Parenting styles, drug use, and children's adjustment in families of young adults. *Journal of Marriage and the Family*, *52*(1), 183-196.

Keijsers, L., Branje, S.J., VanderValk, I.E., & Meeus, W. Reciprocal effects between parental solicitation, parental control, adolescent disclosure, and adolescent delinquency. *Journal of Research on Adolescence, 20*(1), 88-113.

Kerr, M., & Stattin, H. (2000). What parents know, how they know it, and several forms of adolescent adjustment: Further support for a reinterpretation of monitoring. *Developmental Psychology, 36,* 366-380.

Kerr, M., Tremblay,R.E., Pagani-Kurtz, L., & Vitaro, F. (1997). Boys' behavioral inhibition and the risk of later delinquency. *Archives of General Psychiatry, 54*(9), 809-816.

Kilgore, K., Snyder, J., & Lentz, C. (2000). The contribution of parental discipline, parental monitoring, and school risk to early-onset conduct problems in African- American boys and girls. *Developmental Psychology, 36*(6), 835-845.

Klein, K.J., Dansereau, F., & Hall, R.J. (1994). Levels issues in theory development, data collection, and analysis. *The Academy of Management Review, 19*(2), 195-229.

Knox, M., King, C., Hanna, G.L., Logan, D., & Ghazuiddin, N. (2000). Aggressive Behavior in Clinically Depressed Adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry, 39*(5), 611-618.

Kokko, K. & Pulkkinen, L. (2000). Aggression in childhood and long-term unemployment in adulthood: A cycle of maladaptation and some protective factors. *Developmental Psychology, 36*(4), 463-472.

Kokko, K., Pulkkinen, L., & Puustinen, M. (2000). Selection into long-term unemployment and its psychological consequences. *International Journal of Behavioral Development, 24*(3), 310-320.

Kotchick, B.A., & Forehand, R. (2002). Putting parenting in perspective: A discussion of the contextual factors that shape parenting practices. *Journal of Child and Family Studies, 11*(3), 255-269.

Kou, Y., Lu, C.T., & Chen, D. (2006). Spatial weighted outlier detection. Retrieved May 1, 2009, at http://www.siam.org/proceedings/datamining/2006/dm06_072kouy.pdf

Kramer, W. (2005). Finite sample power of Cliff-Ord-type tests for spatial disturbance correlation in linear regression. *Journal of Statistical Planning & Inference, 128*, 489-496.

Kreft, I. & de Leeuw, J. (1998). Introducing multilevel modeling. Thousand Oakes, CA: Sage Publications.

Krieger, N. (1992). Overcoming the absence of socioeconomic data in medical records: validation and application of a census-based methodology. *American Journal of Public Health*, *82*(5), 703-710.

Kulldorf, M., Tango, T., & Park, P.J. (2003). Power comparisons for disease clustering tests. *Computational Statistics & Data Analysis, 42*, 665-684.

Kupersmidt, J.B., Griesler, P.C., DeRosier, M.E., Patterson, C.J., & Davis, P.W. Childhood aggression and peer relations in the context of family and neighborhood factors. *Child Development, 66*, 360-375.

Kuther, T.L. (1999). A developmental-contextual perspective on youth covictimization by community violence. *Adolescence, 34*, 699-714.

LaGrange, R.L., & Ferraro, K.F. (1989). Assessing age and gender differences in perceived risk and fear of crime. *Criminology, 27*(4), 697-719.

Laird, R.D., Jordan, K.Y., Dodge, K.A., Pettit, G.S., & Bates, J.E. (2001). Peer rejection in childhood, involvement with antisocial peers in early adolescence, and the development of externalizing behavior problems. *Development and Psychopathology, 13*, 337-354.

Leitner, M. & Curtis, A. (2006). A first step towards a framework for presenting the location of confidential point data on maps - results of an empirical perceptual study. *International Journal of Geographical Information Science, 20*(7), 813-822.

Leventhal, T., & Brooks-Gunn, J. (2000). The neighborhoods they live in: the effects of neighborhood residence on child and adolescent outcomes. *Psychological Bulletin, 126*(2), 309-337.

Lewis, C.E., & Lewis, M.A. (1984). Peer pressure and risk-taking behaviors in children. *American Journal of Public Health, 74*(6), 580-584.

Loeber, R., & Hay, D. (1997). Key issues in the development of aggression and violence from childhood to early adulthood. *Annual Review of Psychology, 48*, 371-410.

Longley, P.A., Goodchild, M.F., Maguire, D.J., & Rhind, D.W. (2005). Geographic Information Systems and Science, Second Edition. New York, NY: John Wiley and Sons.

Loveland, J.M., Lounsbury, J.W., Welsh, D., & Buboltz, W.C. (2007). The validity of physical aggression in predicting adolescent academic performance. *British Journal of Educational Psychology, 77*(1), 167-176.

Luther, S. S. & Goldstein, A. (2004). Children's exposure to community violence: Implications for understanding risk and resilience. *Journal of Clinical Child and Adolescent Psychology, 33,* 499-505.

Markowitz, F.E. (2003). Socioeconomic disadvantage and violence: Recent research on culture and neighborhood control as explanatory mechanisms. *Aggression and Violent Behavior, 8*(2), 145-154.

Mason, C.A., Cauce, A.M., Gonzales, N., Hiraga, Y., & Grove, K. (1994). An ecological model of externalizing behaviors in African-American adolescents: No family is an island. *Journal of Research on Adolescence, 4*(4), 639-655.

Mason, W.A., Kosterman, R., Hawkins, J.D., Herrenkohl, T.I., Lengua, L.J., & Mccauley, E. (2004). Predicting depression, social phobia, and violence in early adulthood from childhood behavior problems. *Journal of the American Academy of Child & Adolescent Psychiatry, 43*(3), 307-315.

McHale, S. M., Crouter, A. C. & Tucker, C. J. (1999). Family context and gender role socialization in middle childhood: Comparing girls to boys and sisters to brothers. *Child Development 70*(4), 990-1004.

Menard, S., Elliott, D. S. (1994). Delinquent bonding, moral beliefs, and illegal behavior: A three-wave panel model. *Journal Justice Quarterly, 11*(2), 173-188.

Miller-Johnson, S., Coie, J.D., Maumary-Gremaud, A., & Bierman, K. (2002). Peer Rejection and Aggression and Early Starter Models of Conduct Disorder. *Journal of Abnormal Child Psychology, 30*(3), 217-230.

Mitchell, A. (2005). The ESRI Guide to GIS Analysis: Spatial Measurements and Statistics. Redlands, CA: ESRI Press.

Moore, D.A. & Carpenter, T.E. (1999). Spatial analytic methods and geographic information systems: Use in health research and epidemiology. *Epidemiologic Reviews, 21*(2), 143-161.

Moore, K.A., Guzman, L., Hair, E., Lippman, L., & Garrett, S. (2004). Parent-Teen Relationships and Interactions: Far More Positive Than Not. Research Brief, Retrieved April 25, 2009, at http://www.childtrends.org/files/parent_teenRB.pdf

MPlus (1999, October 29). Intraclass correlations [Msg 2]. Message posted to http://www.statmodel.com/discussion/messages/12/18.html

Muller, R.T., Hunter, J.E., & Stollak, G. (1995). The intergenerational transmission of corporal punishment: A comparison of social learning and temperament models. *Child Abuse & Neglect, 19*(11), 1323-1335.

Musher-Eizenman, D. R., & Kulick, A. D. (2003). An alcohol expectancy-challenge prevention program for at-risk college women. *Psychology of Addictive Behaviors, 17*, 163-166.

Nagin, D., & Tremblay, R.E. (1999). Trajectories of boys' physical aggression, opposition, and hyperactivity on the path to physically violent and nonviolent juvenile delinquency. *Child Development, 70*(5), 1181-1196.

Nash, J.K., & Bowen, G.L. (1999). Perceived crime and informal social control in the neighborhood as a context for adolescent behavior: A risk and resilience perspective. *Social Work Research, 23*(3), 171-186.

Newman, B.M., & Newman, P.R. (2001). Group Identity and Alienation: Giving the We Its Due. *Journal of Youth and Adolescence, 30*(5), 515-538.

O'Donnell, J., Hawkins, J.D., & Abbott, R.D. (1995). Predicting serious delinquency and substance use among aggressive boys. *Journal of Consulting and Clinical Psychology, 63*(4), 529-537.

Olalekan, U. (2008). Environmental factors, neighbourhood deprivation, and under-five mortality in Nigeria: An exploratory spatial data analysis. *The Internet Journal of Pediatrics and Neonatology, 9*(1). Retrieved April 30, 2009, from http://www.ispub.com/journal/the_internet_journal_of_pediatrics_and_neonatology/volume_9_number_2_9/article/environmental_factors_neighbourhood_deprivation_and_under_five_mortality_in_nigeria_an_exploratory_spatial_data_analysis.html

Ortega, S. L. & Myles, J.L. (1987). Race and gender effects on fear of crime: An interactive
model with age. *Criminology, 25*, 133-152.

Overstreet, S. (2000). Exposure to community violence: Defining the problem and understanding the consequences. *Journal of Child and Family Studies, 9*, 7-25.

Ozonoff, A., Bonetti, M., Forsberg, L., & Pagano, M. (2005). Power comparisons for an improved disease clustering test. *Computational Statistics & Data Analysis, 48*(4), 679-684.

Ozonoff, A., Webster, T., Vieira, V., Weinberg, J., Ozonoff, D., & Aschengrau, A. (2005). Cluster detection methods applied to the Upper Cape Cod cancer data. *Environmental Health: A Global Access Science Source, 4*(19). doi:10.1186/1476-069X-4-19

Pagani, L.S., Tremblay, R.E., Nagin, D., Zoccolillo, M., Vitaro, F., & McDuff, P. (2004). Risk factor models for adolescent verbal and physical aggression toward mothers. *International Journal of Behavioral Development, 28*(6), 528-537.

Park, N. (2004). Character strengths and positive youth development. *Annals of the American Academy of Political and Social Science, 591*(1), 40-54.

Patrikakou, E. (2004). Adolescence: Are parents relevant to students' high school achievement and post-secondary attainment? Harvard Family Research Project Research Digest. Retrieved April 25, 2009, at http://wwww.gse.harvard.edu/hfrp/projects/fine/resources/digest/adolescence.html

Patterson G.R., DeBaryshe B.D., & Ramsey E. (1989). A developmental perspective on antisocial behavior. *American Psychologist, 44*(2), 329-335.

Patterson, G.R., Capaldi, D., & Bank, L. (1991). An early starter model for predicting delinquency. In Debra J. Pepler and Kenneth H. Rubin (Eds.), *The Development and Treatment of Childhood Aggression.* (pp. 139-168). Hillsdale, N.J.: Lawrence Erlbaum Associates, Inc.

Patterson, G.R., Reid, J.B., & Dishion, T.J. (1992). *A social learning approach: Volume 4, Antisocial boys*. Eugene, OR: Castalia.

Patterson, G. & Stouthamer-Loeber, M. (1984). The correlation of family management practices and delinquency. *Child Development, 55*, 1299-1307.

Patterson, G.R., & Yoerger. K. (1993). Developmental models for delinquent behavior. In S. Hodgins (ed.), *Mental Disorder and Crime* (pp. 140-172). Newbury Park: Sage.

Pettit, G. S., Bates, J. E., Dodge, K. A., Meece, D. W. (1999). The impact of after-school peer contact on early adolescent externalizing problems is moderated by parental monitoring, perceived neighborhood safety, and prior adjustment. *Child Development 70*(3), 768–778.

Pickle, L.W., Szczur, M., Lewis, D.R., & Stinchcomb, D.G. (2006). The crossroads of GIS and health information: A workshop on developing a research agenda to improve cancer control. *International Journal of Health Geographics, 5*(51). Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1665447/

Poulin, F. & Boivin, M. (2000). The role of proactive and reactive aggression in the formation and development of boys' friendships. *Developmental Psychology, 36*(2), 233-240.

Purugganan, O.H., Stein, R., Silver, E.J., Benenson, B.S. (2003). Exposure to violence and psychosocial adjustment among urban school-aged children. *Developmental and Behavioral Pediatrics, 24*(6), 424-430.

Querido, J.G., Warner, T.D., & Eyberg, S.M. (2002). Parenting styles and child behavior in African American families of preschool children. *Journal of Clinical Child Psychology, 31*(2), 272-277.

Rankin, B.H. & Quane, J.M. (2002). Social contexts and urban adolescent outcomes: The interrelated effects of neighborhood, families, and peers on African-American youth. *Social Problems, 49*(1), 79-100.

Rappaport, N., & Thomas, C. (2004). Recent Research Findings on Aggressive and Violent Behavior in Youth: Implications for Clinical Assessment and Intervention. *Journal of Adolescent Health, 35*, 260-277.

Ratcliffe, J.H. & McCullagh, M.J. (1999). Hotbeds of crime and the search for spatial accuracy.

Journal of Geographical Systems, 1(4), 385-398.

Richards, M. H., Miller, B. V., O'Donnell, P. C., Wasserman, M. S., & Colder, C. (2004). Parental monitoring mediates the effects of age and sex on problem behaviors among African American urban young adolescents. *Journal of Youth and Adolescence, 33*(3), 221-233.

Robinson, W.S. (1950). Ecological correlations and the behavior of individuals. *American Sociological Review, 15,* 351-357.

Roosa, M.W., Deng, S., Ryu, E., Burrell, G.L., Tein, J.Y., Jones, S. et al. (2005). Family and children characteristics linking neighborhood context and child externalizing behavior. *Journal of Marriage and Family, 67*(2), 515-529.

Rothbaum, F., & Weisz, J.R. (1994). Parental caregiving and child externalizing behavior in nonclinical samples: A meta-analysis. *Psychological Bulletin, 116*(1), 55-74.

Rogosch, F. A., Cicchetti, D., & Aber, J. L. (1995). The role of child maltreatment in early deviations in cognitive and affective processing abilities and later peer relationship problems. *Development and Psychopathology, 7*(4), 591-609.

Petrie, A. & Sabine, C. (2005). Medical statistics at a glance (2nd ed.). Oxford, England: Blackwell Publishing Ltd.

Salzinger, S., Feldman, R.S., Stockhammer, T., & Hood, J. (2002). An ecological framework for understanding risk for exposure to community violence and the effects of exposure on children and adolescents. *Aggression and Violent Behavior, 7*, 423-451.

Sampson, R.J., Morenoff, J.D., & Earls, F. (1999). Beyond social capital: Spatial dynamics of collective efficacy for children. *American Sociological Review, 64*(5), 633-660.

Sampson, R. J., Morenoff, J., & Gannon-Rowley, T. (2002). Assessing neighborhood effects: Social processes and new directions in research. *Annual Review of Sociology, 28*, 443-478.

Sampson, R.J., Raudenbush, S.W., & Earls, F. (1997). Neighborhoods and violence crime: A multilevel study of collective efficacy. *Science, 277*, 918-924.

Schabenberger, O., & Gotway, C.A. (2006). Statistical methods for spatial data analysis. Florida: CRC Press.

Shaw, C. R. & McKay, H. D. (1969). *Juvenile Delinquency and Urban Areas.* Chicago, IL: The University of Chicago Press.

Shelton K.K, Frick P.J., Wootton J. The assessment of parenting practices in families of elementary school-aged children. *Journal of Child Clinical Psychology*, *25*, 317–329.

Sheidow, A.J., Gorman-Smith, D., Tolan, P.H., & Henry, D.B. (2001). Family and community characteristics: Risk factors for violence exposure in inner-city youth. *Journal of Community Psychology, 29*(3), 345-360.

Sheidow, A.J., Gorman-Smith, D., Tolan, P.H., & Henry, D.B. (2001). Family and community characteristics: Risk factors for violence exposure in inner-city youth. *Journal of Community Psychology, 29*(3), 345-360.

Sherman, L., & Weisburd, D. (1995). General deterrent effects of police patrol in crime" hot spots": A randomized, controlled trial. *Justice Quarterly, 12*(4), 625-648.

Shinn, M. & Toohey, S. M. (2003). Community contexts of human welfare. *Annual Review of Psychology, 54*, 427-459.

Simons, R.L, Wu, C.I., Conger, R.D., & Lorenz, F.O. (1994). Two routes to delinquency: Differences between early and late starters in the impact of parenting and deviant peers. *Criminology, 32*(2), 247-276.

Song, L., Singer, M., & Anglin, T.M. (1998). Violence exposure and emotional trauma as contributors to adolescents' violent behaviors. *Archives of Pediatrics & Adolescent Medicine, 152*, 531-536.

Spano, R., Rivera, C., Bolland, J. (2006). The impact of timing of exposure to violence on violent behavior in a high poverty sample of inner city African American youth. *Journal of Youth and Adolescence, 35*(5), 681-692.

Speer, S.A., Semenza, J.C., Kurosaki, T., Anton-Culver, H.M. (2002). A combination of geographic information system and case-control studies. *Journal of Environmental Health, 64*(7), 9-15.

Spencer, M.B., Dupree, D., Swanson, D., & Cunningham, M. (1996). Parental monitoring and adolescents' sense of responsibility for their own learning: An examination of sex differences. *Journal of Negro Education, 65*, 30-43.

Spera, C. (2005). A Review of the Relationship Among Parenting Practices, Parenting Styles, and Adolescent School Achievement. *Educational Psychology Review, 17*(2), 125-146.

Springer, C., & Padget, D.K. (2000). Gender differences in young adolescents' exposure to violence and rates of PTSD symptomatology. *American Journal of Orthopsychiatry, 70*(3), 370-379.

Stattin, H. & Magnusson, D. (1989). The role of early aggressive behavior in the frequency, seriousness and types of later crime. *Journal of Consulting and Clinical Psychology, 57*, 710-718.

Steinberg, L., Fletcher, A., & Darling, N. (1994). Parental monitoring and peer influences on adolescent substance use. *Pediatrics*, *93*, 1060-1064.

Stewart-Brown, S., Patterson, J., Mockford, C., Barlow, J., Klimes, I., & Pyper, C. (2004). Community child health, public health, and epidemiology: Impact of a general practice based group parenting programme: quantitative and qualitative results from a controlled trial at 12 months. *Archives of Disease on Childhood, 89*, 519-525.

Swan, A.V., Creeser, R., & Murray, M. (1990). When and why children first start to smoke. *International Journal of Epidemiology, 19*, 323-330.

Tatalovich, Z., Wilson, J.P., Milam, J.E., Jerrett, M., & McConnell, R. (2006). Competing definitions of contextual environments. *International Journal of Health Geographics, 5,* 55.

Tienda, M. (1991). Poor people and places: Deciphering neighborhood effects on poverty outcomes. In J. Huber (Ed), *Macro-micro Linkages in Sociology* (244-262). Newberry, CA: Sage.

Tremblay, R.E., Nagin, D.S., Séguin, J.R., Zoccolillo, M., Zelazo, P.D., Boivin, M., et al. (2004). Physical aggression during early childhood: Trajectories and predictors. *Pediatrics, 114*(1), e43-e50.

U. S. Census Bureau. (2000). *Total population: Population Estimates.* Retrieved January 20, 2011, from http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=PEP_2008_T01&prodType=table

U.S. Public Health Service. (2001). *Youth Violence: A Report of the Surgeon General January 2001*. Retrieved November 22, 2006, from http://www.surgeongeneral.gov/library/youthviolence/youvioreport.htm.

Uren, N. & Stagnitti, K. (2009). Pretend play, social competence and involvement in children aged 5–7 years: The concurrent validity of the Child-Initiated Pretend Play Assessment. *Australian Occupational Therapy Journal, 56*(1), 33-40.

Uthman, O.A. (2008). A multilevel analysis of the effect of household wealth inequality on under-five child under-nutrition: Evidence from the 2003 Nigeria Demographic and Health Survey . *The Internet Journal of Nutrition and Wellness, 6*(2). Retrieved February 10, 2009, from http://www.ispub.com/ostia/index.php?xmlPrinter=true&xmlFilePath=journals/ijnw/vol6n2/survey.xml

Utting, D. (2003). Prevention through family and parenting programmes. In D.P. Farrington & J. Coid (Eds.), *Early Prevention of Adult Antisocial Behaviour* (243-263). Cambridge, United Kingdom: Cambridge University Press.

Vanfossen, B., Brown, C.H., Kellam, S., Sokoloff, N., & Doering, S. (2010). Neighborhood context and the development of aggression in boys and girls. *Journal of Community Psychology, 38*(3), 329-349.

Van Patten, I.T., & Delhauer, P.Q. (2007). Sexual homicide: a spatial analysis of 25 years of deaths in Los Angeles. *Journal of Forensic Science, 52*(5), 1129-1141.

Virtanen, M., Kivimäki, M., Elovainio, M., Vahtera, J., Kokko, K., & Pulkkinen, L. (2005). Mental health and hostility as predictors of temporary employment: Evidence from two prospective studies. *Social Sciences and Medicine, 61*(10), 2084-2095.

Vitaro, F., Gendreau, P.L., Tremblay, R., & Oligny, P. (1998). Reactive and proactive aggression differentially predict later conduct problems. *Journal of Child Psychology & Psychiatry, 39*(3), 377-385.

von Bertalanffy, L. (1968). General system theory. New York: George Braziller.

Wall, A. E., & Barth, R. P. (2005). Aggressive and delinquent behavior of maltreated adolescents: Risk factors and gender differences. Stress, Trauma, and Crisis: An International Journal, 8, 1-24.

Waller, L. A. & Gotway, C. A. (2004). *Applied Spatial Statistics for Public Health Data*. New Jersey: John Wiley & Sons, Incorporated.

Weinberg, N.Z., Rahdert, E., Colliver, J.D., & Glantz, M.D. (1998). Adolescent Substance Abuse: A Review of the Past 10 Years. *Journal of the American Academy of Child & Adolescent Psychiatry, 37*(3), 252-261.

Weiss, B., Dodge, K.A., Bates, J.E., & Pettit, G.S. (1992). Some consequences of early harsh discipline: Child aggression and a maladaptive social information processing style. *Child Development*, *63*(6), 1321-1335.

Weissberg, R.P., Cowen, E.L., Lotyczewski, B.S., Boike, M.F., Orara, N.A., Stalonas, P. et al. (1987). Teacher ratings of children's problem and competence behaviors: Normative and parametric characteristics. *American Journal of Community Psychology, 15*(4), 387-401.

Wilson, W.C., Rosenthal, B.S., & Battle, W.S. (2007). Effects of gender, ethnicity and educational status on exposure to community violence and psychological distress in adolescence. *Journal of Aggression, Maltreatment & Trauma, 15*(1), 93-111.

Woodward, L.J., & Fergusson, D.M. (1999). Childhood peer relationship problems and psychosocial adjustment in late adolescence. *Journal of Abnormal Child Psychology, 27*(1), 87-104.

Youth Risk Behavior Survey. (2007). Retrieved April 3, 2009, from, http://www.cdc.gov/HealthyYouth/yrbs/pdf/yrbs07_us_overview.pdf

Zigler, E. (1998). A place of value for applied and policy studies. *Child Development, 69*(2), 532-542.

Zwirs, B., Burger, H., Schulpen, T., Vermulst, A.A., HiraSing, R.A., & Buitelaar, J. (2010). Teacher ratings of children's behavior problems and functional impairment across gender and ethnicity: Construct equivalence of the Strengths and Difficulties Questionnaire. *Journal of Cross-Cultural Psychology, July 10, 2010.* doi: 10.1177/0022022110362752

Table 1

Locations of Study Participants with Address Information

	County				
State	*Anne Arundel*	*Baltimore*	*Baltimore City*	*Other*	*Total N*
Maryland	28	149	402	15	594
Other States*	0	0	0	29	29
Total N	28	149	402	44	623

*Other states include: Delaware (1), Florida (2), Georgia (4), Michigan (1), New Jersey (1), New York (2), North Carolina (3), Ohio (2), Pennsylvania (1), South Carolina (2), Virginia (8), and West Virginia (2).

Table 2

Number of Participants per Census Tract (N=402)

Number of Participants (N) in Tract	*Number of Tracts with N Participants*	*Total N (Cumulative)*
21	1	21
20	1	41
19	1	60
18	1	78
16	1	94
15	1	109
13	1	122
12	2	146
10	2	166
9	1	175
8	1	183
7	6	225
6	3	243
5	5	268
4	9	304
3	9	331
2	18	367
1	35	402

Table 3

Statistics and Methods for Assessing Clustering

Statistic/Method	*Typical Application*	*Assumptions*	*Limitations*
Ripley's K	Determine overall clustering in a pre-defined area	Events or observations are interdependent (i.e., geographically proximal events/observations are similar); sample must have more than 30 observations per area/unit	• Not all of underlying population is included in analyses, but all of the underlying population is necessary since the attributes (data describing a specific aspect of a point) of a particular area as a whole are examined. • Cannot assume that points are different from a random pattern that might be generated from the underlying population.
Nearest-neighbor methods	Determine whether similar points are proximal (per Euclidean or Manhattan distance measurements) in an area that includes all points (the minimum enclosing rectangle)	Events or observations are interdependent; attributes (data describing a specific aspect of a point) are linked to individual location data	• Cannot claim that these analyses are an infallible way to test for clustering in this sample due to the non-random geographic sampling in this data.
Multilevel analyses	Determine overall clustering in a pre-defined area	Events or observations are interdependent; areas are to be defined a priori	• Cannot identify where clustering occurs. • Data must be aggregated to pre-defined levels.
Getis-Ord *Gi**	Determine where clustering of specified observations occur	Events or observations are interdependent	• Not all of underlying population is included in analyses, but all of the underlying population is necessary since the attributes (data describing a specific aspect of a point) of a particular area as a whole are examined. • Cannot assume that points are different from a random pattern that might be generated from the underlying population.

Table 3 (Continued)

Statistic/Method	*Typical Application*	*Assumptions*	*Limitations*
Local Moran's *I*	Determine where clustering of specified observations occur	Events or observations are interdependent	• Not all of underlying population is included in analyses, but all of the underlying population is necessary since the attributes (data describing a specific aspect of a point) of a particular area as a whole are examined. • Cannot assume that points are different from a random pattern that might be generated from the underlying population.
(Method) Remove areas (e.g., census tracts without participants)	Data is available for all events in some areas but not others	Events or observations are interdependent	• Not all of underlying population is included in analyses, but all of the underlying population is necessary since the attributes (data that describes a specific aspect of a point) of a particular area as a whole are examined. • Cannot assume that points are different from a random pattern that might be generated from the underlying population.
(Method) Use sample data as is (i.e., include areas without participants)	Sampled data is fully representative of underlying sample	Events or observations are interdependent	• Sample not representative of underlying population

Note. As cited in: Bailey & Gattrell (1995), Longley, Goodchild, Maguire, & Rhind (2005), Mitchell, (2005), and Wong (personal communication, September 16, 2010).

Table 4

Means and Standard Deviations of Study Variables for Total Sample and by Gender

Variable	*M*	*SD*	*Range*
Aggression	1.77	0.74	1-4.20
Parental Monitoring[a]	2.07	0.68	1-4.43
Deviant Peer Affiliation	1.55	0.64	1-4.67
Community Violence Exposure	1.31	1.62	0-11
Perceived Neighborhood Violence	1.84	0.66	1-3.80

Note. All variables were assessed in the spring of 8th grade (during the latter half of the academic year). Parental monitoring was assessed using the The Structured Interview of Parent Management Skills and Practices-Youth Version (SIPMSP, Capaldi & Patterson, 1989). Perceived neighborhood violence was assessed with items from the Neighborhood Environment Scale (NES, Elliott, Huizinga, & Ageton, 1985). Deviant peer affiliation was measured using the Exposure to Deviant Peers (Capaldi & Patterson, 1989). Community violence exposure was determined using the Children's Report of Violence Exposure (CREV; Cooley, Turner, & Beidel, 1995). Aggression was assessed using the Teacher Report of Classroom Behavior Checklist (TRCBC; Werthamer-Larsson et al., 1991).

[a] Higher scores suggest lower parenting monitoring.

Table 5

Correlations among Study Variables

Variable	1	2	3	4	5
1. Aggression	--	-.16*	.44**	.02	.15**
2. Parental Monitoring†		--	.40**	.25**	.28**
3. Deviant Peer Affiliation			--	.32**	.13**
4. Community Violence Exposure				--	.31**
5. Perceived Neighborhood Violence					--

Note. All variables were assessed in the spring of 8th grade (during the latter half of the academic year). Parental monitoring was assessed using the The Structured Interview of Parent Management Skills and Practices-Youth Version (SIPMSP; Capaldi & Patterson, 1989). Perceived neighborhood violence was assessed with items from the Neighborhood Environment Scale (NES; Elliott, Huizinga, & Ageton, 1985). Deviant peer affiliation was measured using the Exposure to Deviant Peers (Capaldi & Patterson, 1989). Community violence exposure was assessed using the Children's Report of Violence Exposure (CREV; Cooley, Turner, & Beidel, 1995). Aggression was assessed using the Teacher Report of Classroom Behavior Checklist (TRCBC; Werthamer-Larsson et al., 1991).

† Higher numbers on the parental monitoring scale indicate lower levels of parental monitoring.

*$p < .05$.

**$p < .01$.

Table 6

Means and Standard Deviations for 2000 Census Tract Variables for Study Participants

Variable	*Sample*	*Baltimore City* [a]
Total Population	358,428	651,154
Total Population ages 10-17	44,107	72,691
Birth to teens	11.68[b]	83.3[b]
Drug-related juvenile arrests	35.12[b]	39.26[b]
Juveniles arrests violent crimes, ages 10-17	9.86[b]	10.66[b]
Murder & non-negligent homicides	2.86[b]	0.40[b]
Adult violent offenses	178.86[b]	26.19[b]

[a]Baltimore City data was obtained from the Baltimore Neighborhood Indicators Alliance (2008), the U.S. Census (2000), and the Federal Bureau of Investigation to the National Archive of Criminal Justice Data, University of Michigan (2000).

[b] Mean rate per 1,000.

Table 7

Results of the Nearest Neighbor Analysis (NNA)

Variable	*Observed Mean Distance*	*Expected Mean Distance*	*Nearest Neighbor Ratio*	*z-score*
Aggression	479.89	668.47	.72	-6.13**
Parental Monitoring	394.97	597.39	.66	-8.28**
Deviant Peer Affiliation	456.43	699.84	.65	-7.35**
Community Violence Exposure	375.57	588.68	.64	-9.21**
Perceived Neighborhood Violence	397.26	627.10	.63	-8.73**

Note. Nearest Neighbor Ratios less than 1 denote clustering; ratios more than 1 suggest dispersion. All distances are displayed in meters.

** $p < .01$.

Table 8

ICC and Design Effect for Aggression and Risk Factor Variables

	Dichotomous Variables			*Continuous Variables*		
Variable	*Average Cluster Size*	*ICC*	*Design Effect*	*Average Cluster Size*	*ICC*	*Design Effect*
High Aggression	2.06	.02	1.02	3.42	.01	1.02
Low Parental Monitoring	2.43	.00	1.00	3.49	.00	1.00
High Deviant Peer Affiliation	2.21	.11	1.13	3.49	.00	1.00
High Community Violence Exposure	1.93	.05	1.05	3.49	.01	1.02
High Perceived Neighborhood Violence	2.07	.00	1.00	3.49	.17	1.42

Table 9

Results of Spatial Regression on Adolescent Aggression, Bivariate and Multivariate

Independent Variable	R^{2*}	*Adjusted* R^{2*}
Bivariate		
Parental Monitoring	.26	.25
Deviant Peer Affiliation	.15	.14
Community Violence Exposure	.26	.25
Perceived Neighborhood Violence	.25	.24
Multivariate	.35	.32

*The statistical significance for these values is not presented because *p*-values are not calculated when using GWR. The p-values would be heavily biased because they do not account for the weighting scheme (values closer to the specified location *u* are given more weight than values farther to the specified location; ESRI, 2010e). However, it can be assumed that some contribution exists because these R^2 values are greater than 0.

Table 10

Results of Logistic Regression on Adolescent Aggression, Bivariate and Multivariate (Dichotomous Variables)

	Bivariate			***Multivariate***		
Independent Variable	*Estimate*	*S.E.*	*p-value*	*Estimate*	*S.E.*	*p-value*
Low Parental Monitoring	-.74	.23	.00	-.61	.25	.01
High Deviant Peer Affiliation	.43	.23	.07	.03	.26	.92
High Community Violence Exposure	.80	.24	.00	.66	.27	.01
High Perceived Neighborhood Violence	.36	.23	.12	.07	.25	.79

Figure Captions

Figure 1. Map of geographic clusters of high adolescent aggression.

Figure 2: Map of geographic clusters of low parental monitoring.

Figure 3. Map of geographic clusters of high deviant peer affiliation.

Figure 4. Map of geographic clusters of high community violence exposure.

Figure 5. Map of geographic clusters of high perceived neighborhood.

Figure 6. Overlapping spatial clusters of high aggression and low parental monitoring.

Figure 7. Overlapping spatial clusters of high aggression and high deviant peer affiliation.

Figure 8. Overlapping spatial clusters of high aggression and high community violence exposure.

Figure 9. Overlapping spatial clusters of high aggression and high perceived neighborhood.

Figure 10. Overlapping spatial clusters of high aggression and all risk factors.

Figure 11. High aggression clusters (9x magnification).

Figure 12. Low parental monitoring clusters (9x magnification).

Figure 13. High deviant peer affiliation clusters (9x magnification).

Figure 11. High community violence exposure clusters (9x magnification).

Figure 11. High perceived neighborhood violence clusters (9x magnification).

Figure 1. Map of geographic clusters of high adolescent aggression.

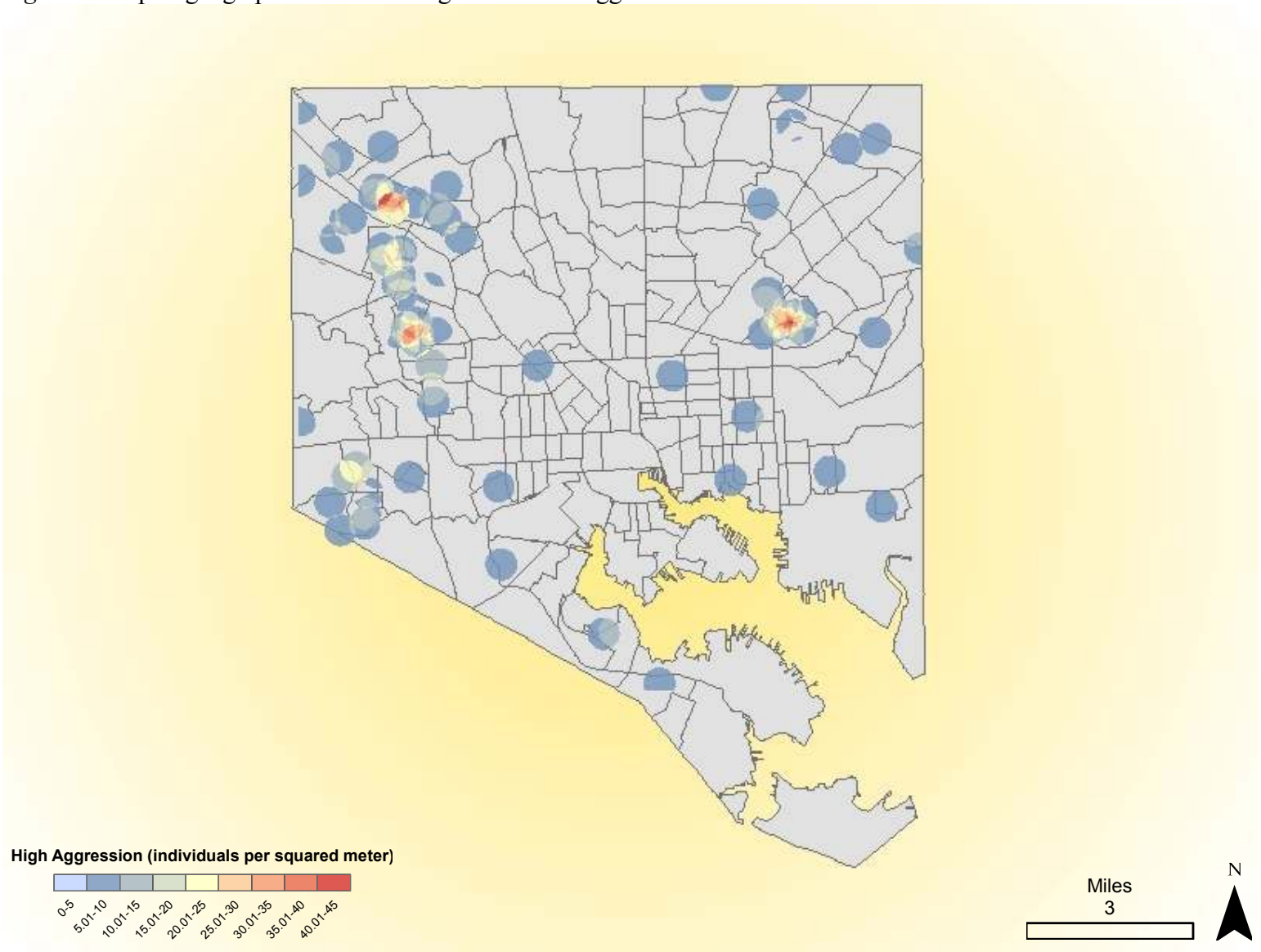

Figure 2: Map of geographic clusters of low parental monitoring.

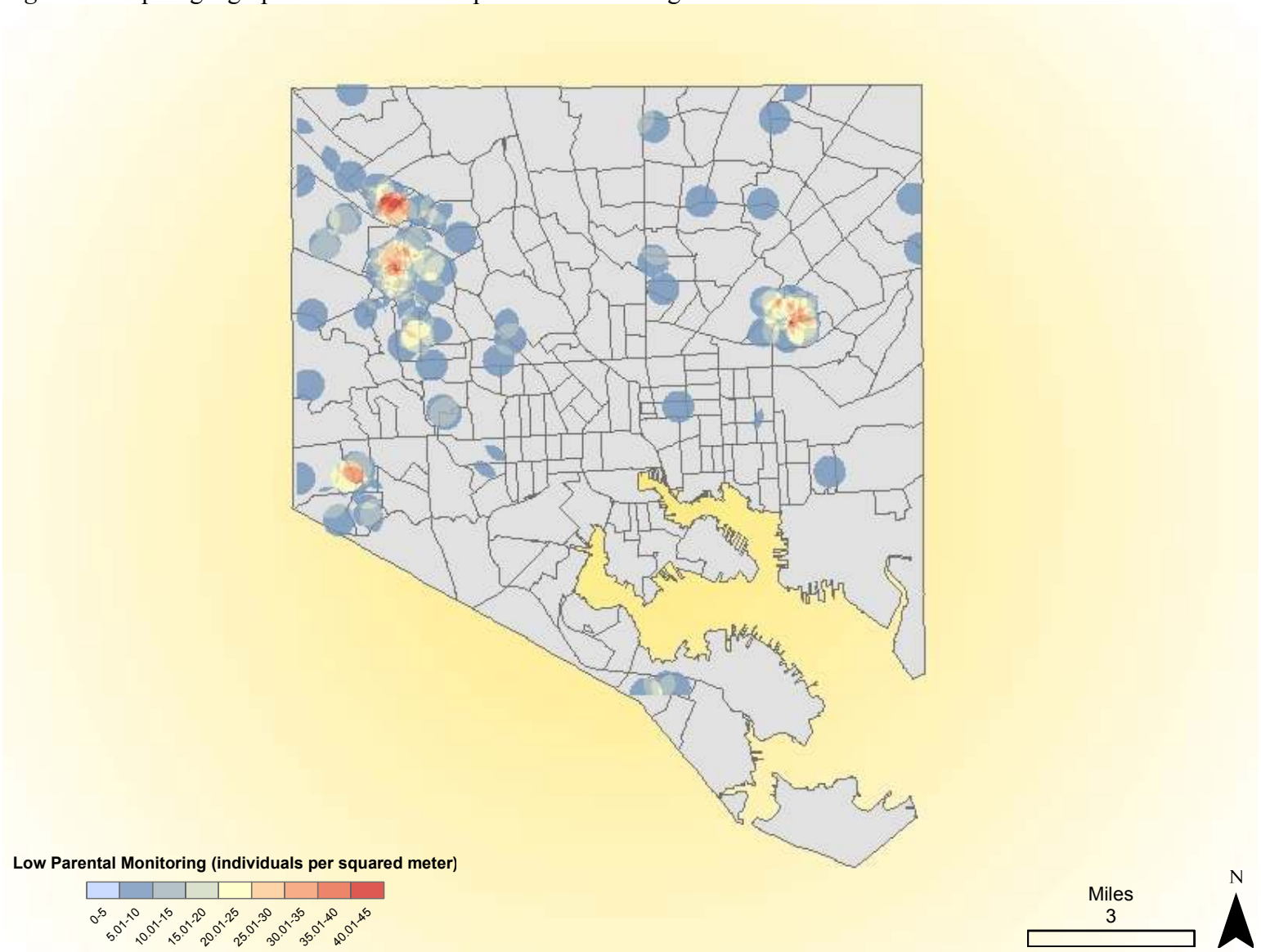

Figure 3. Map of geographic clusters of high deviant peer affiliation.

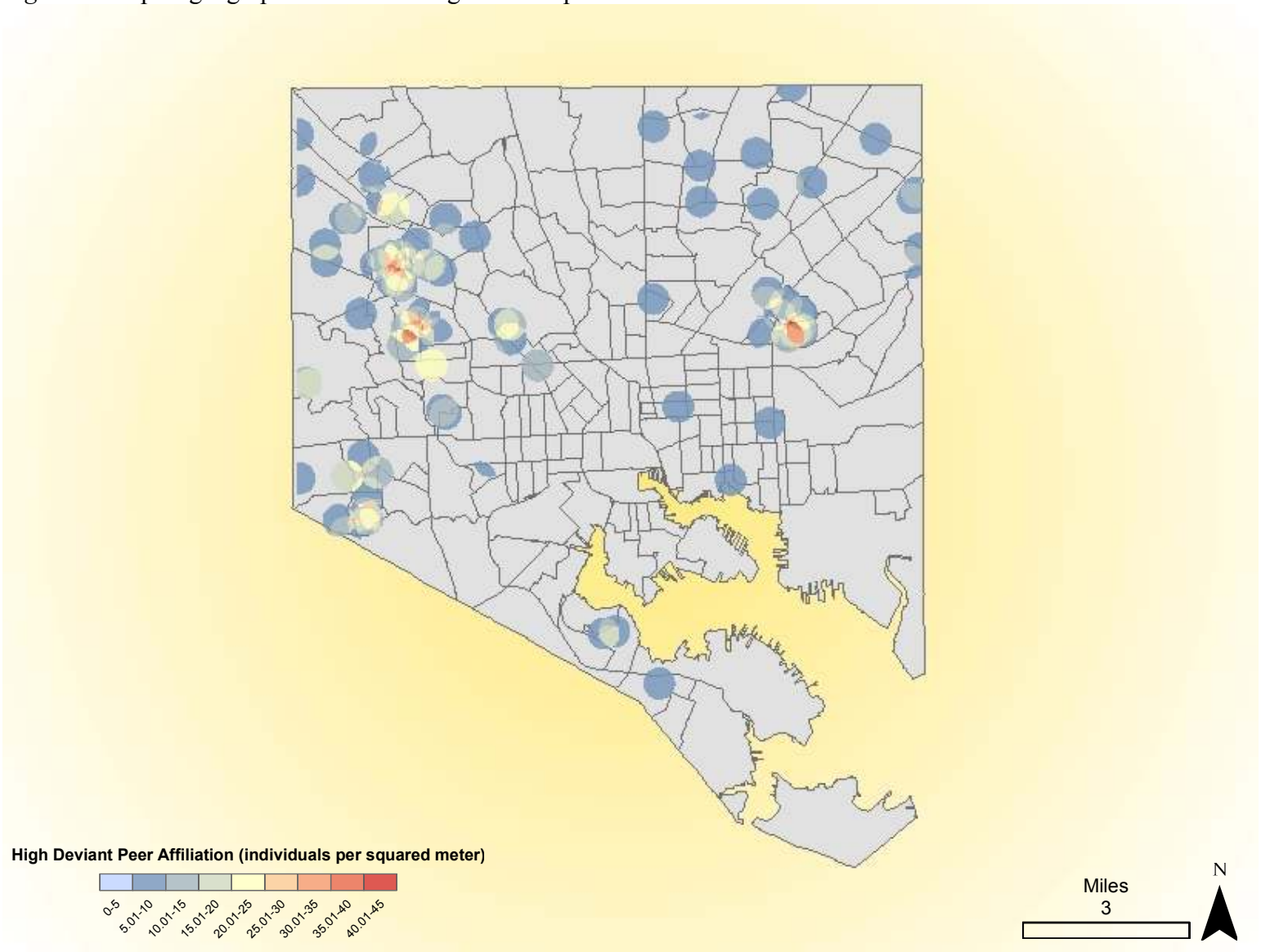

Figure 4. Map of geographic clusters of high community violence exposure.

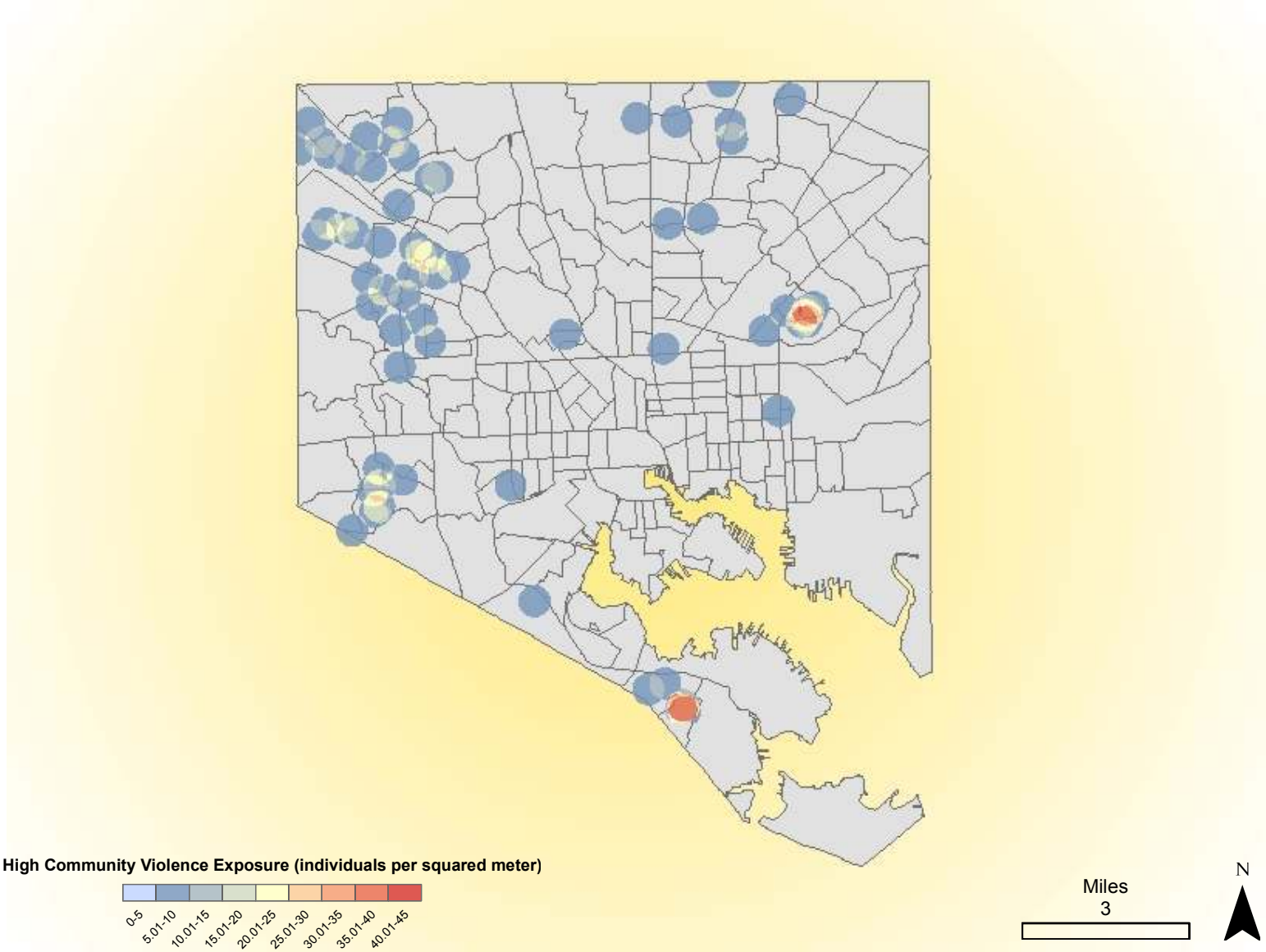

Figure 5. Map of geographic clusters of high perceived neighborhood violence.

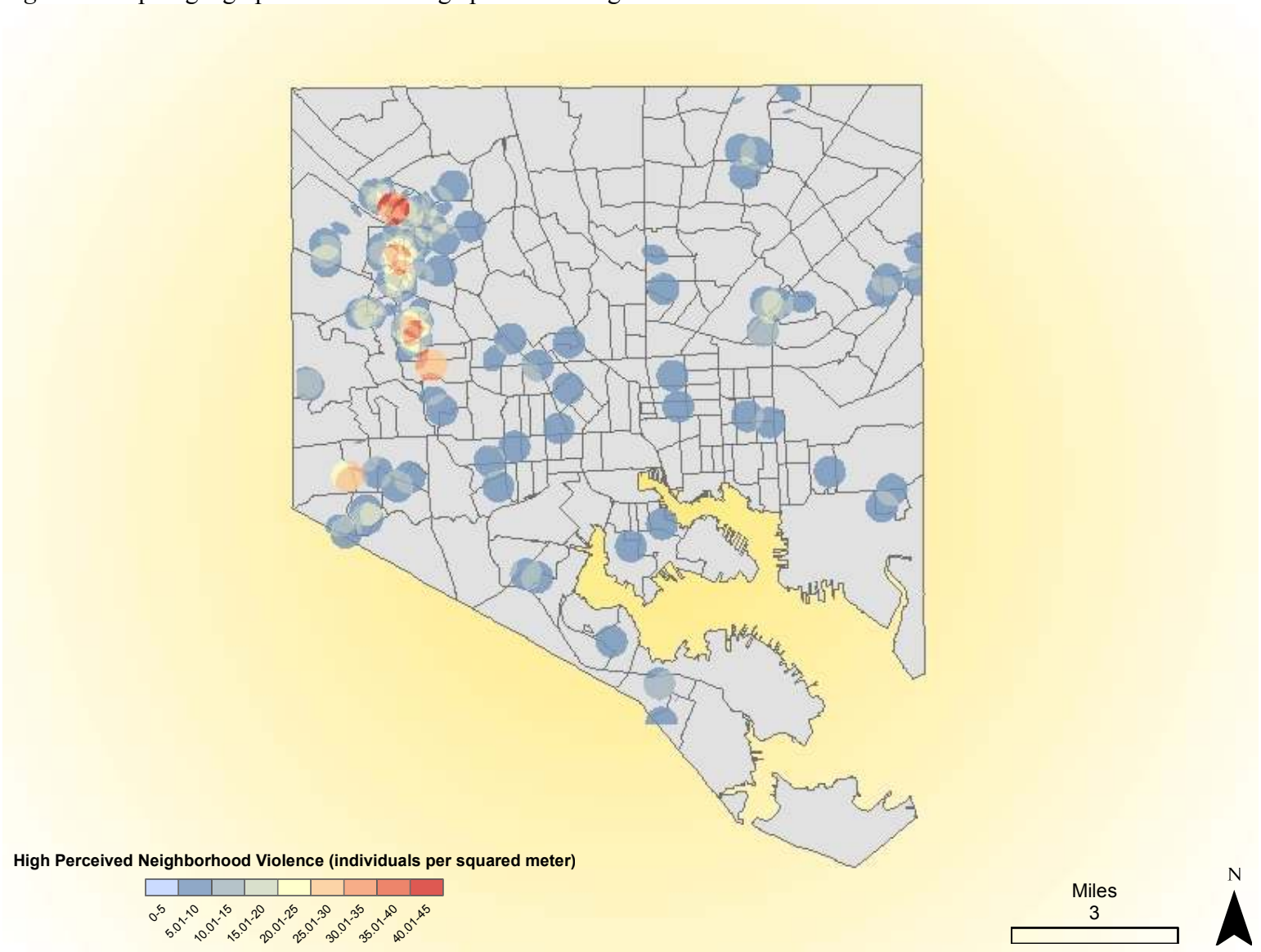

Figure 6. Overlapping spatial clusters of high aggression and low parental monitoring.

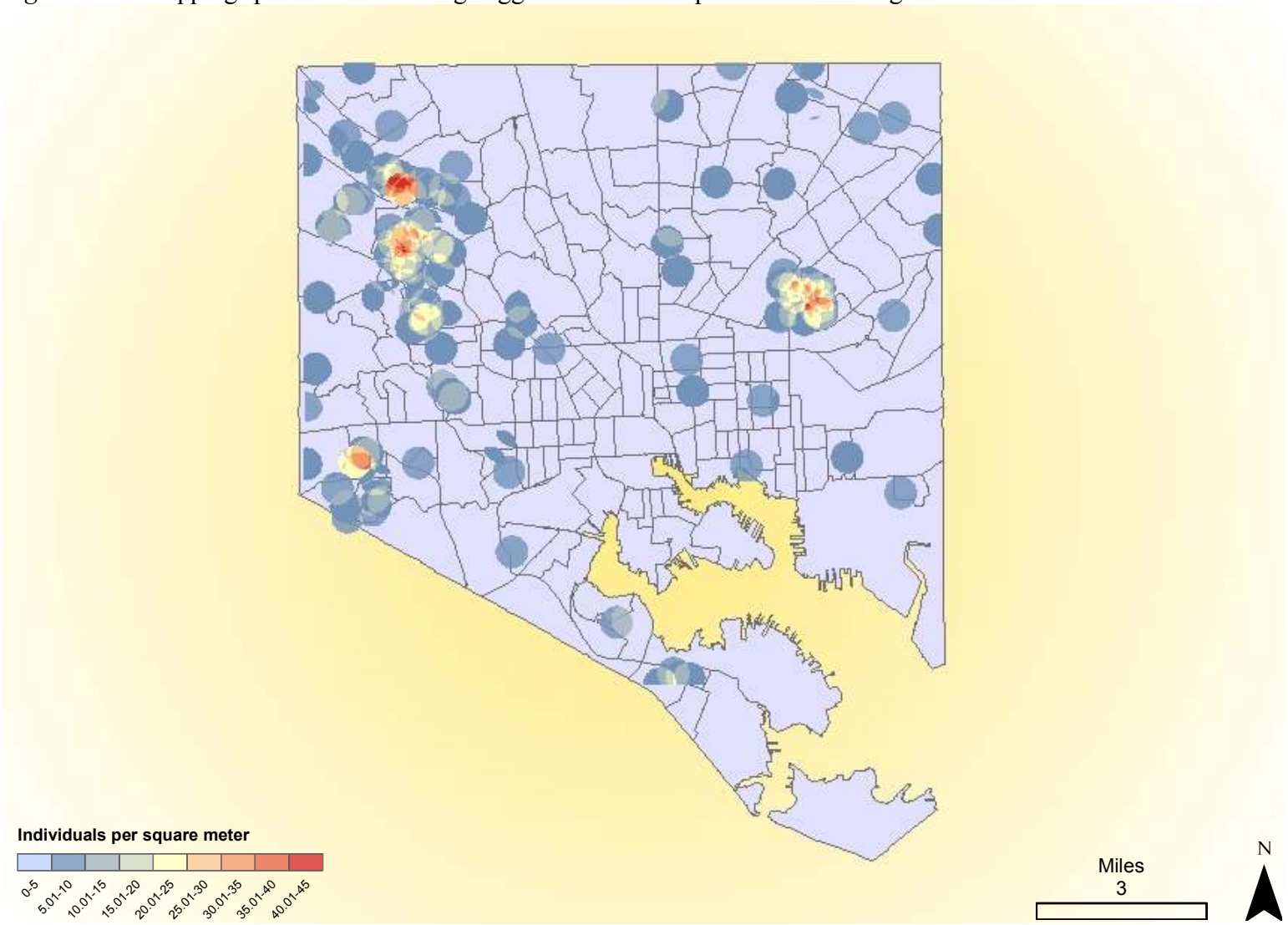

Figure 7. Overlapping spatial clusters of high aggression and high deviant peer affiliation.

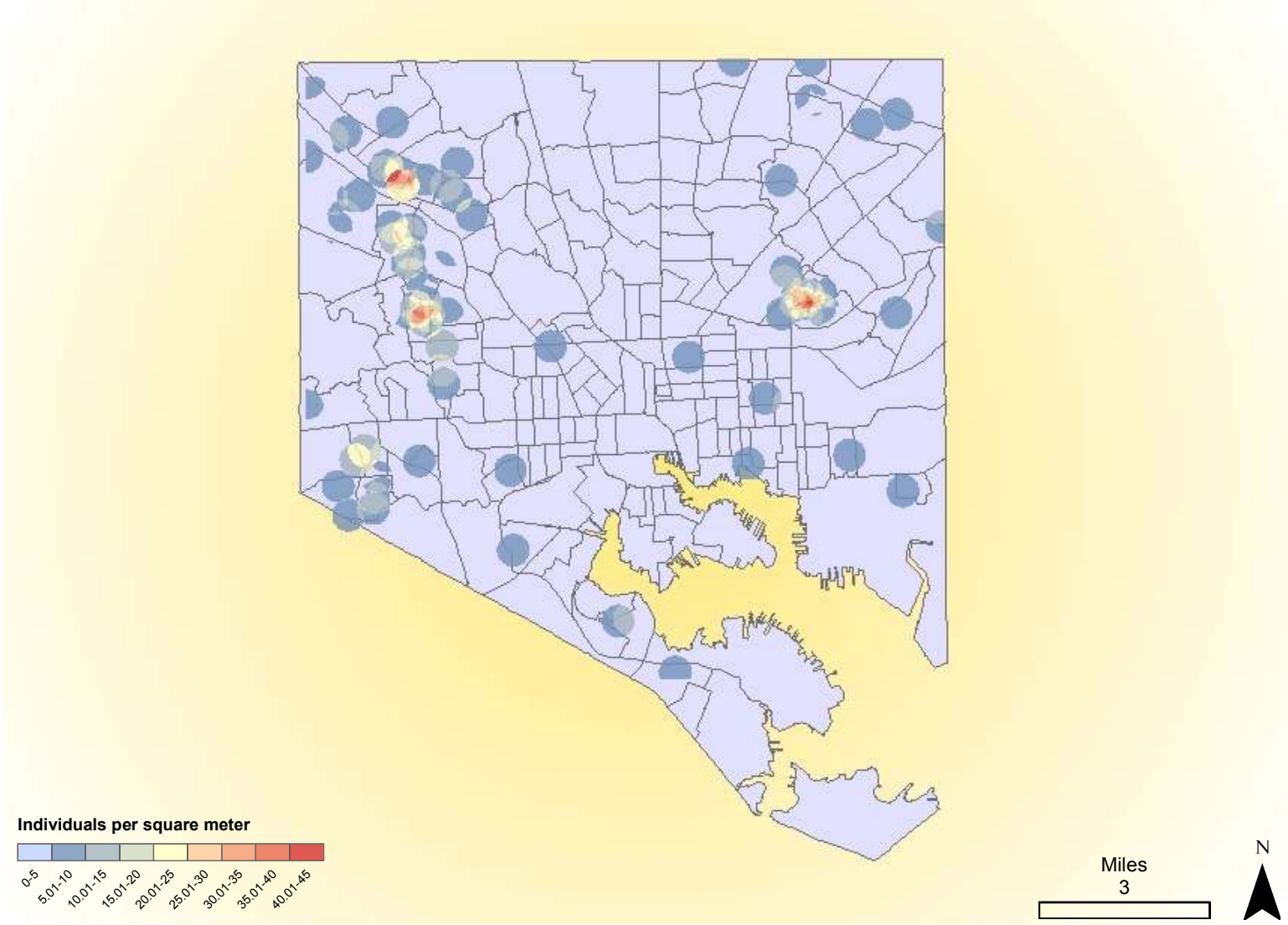

Figure 8. Overlapping spatial clusters of high aggression and high community violence exposure.

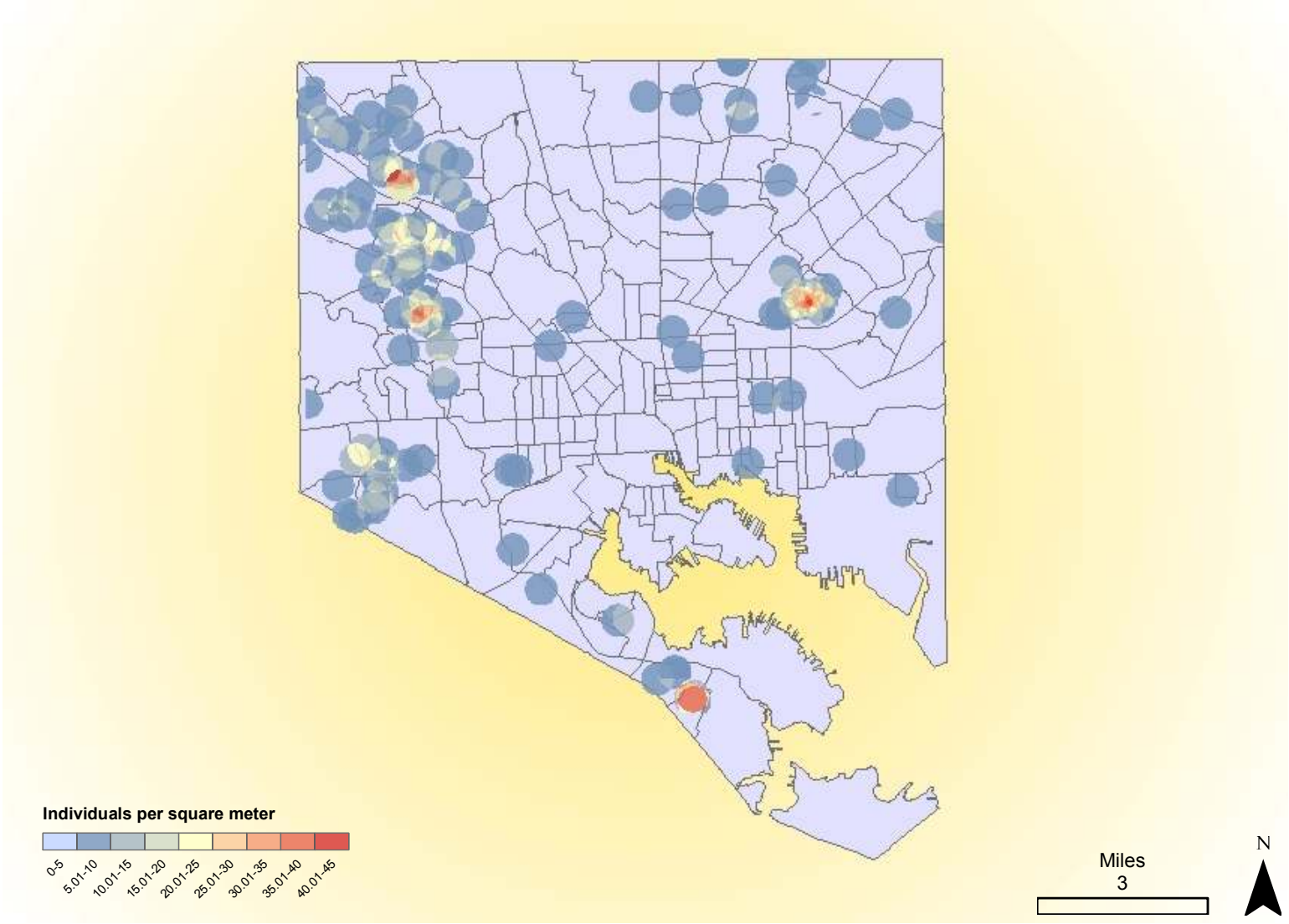

Figure 9. Overlapping spatial clusters of high aggression and high perceived neighborhood.

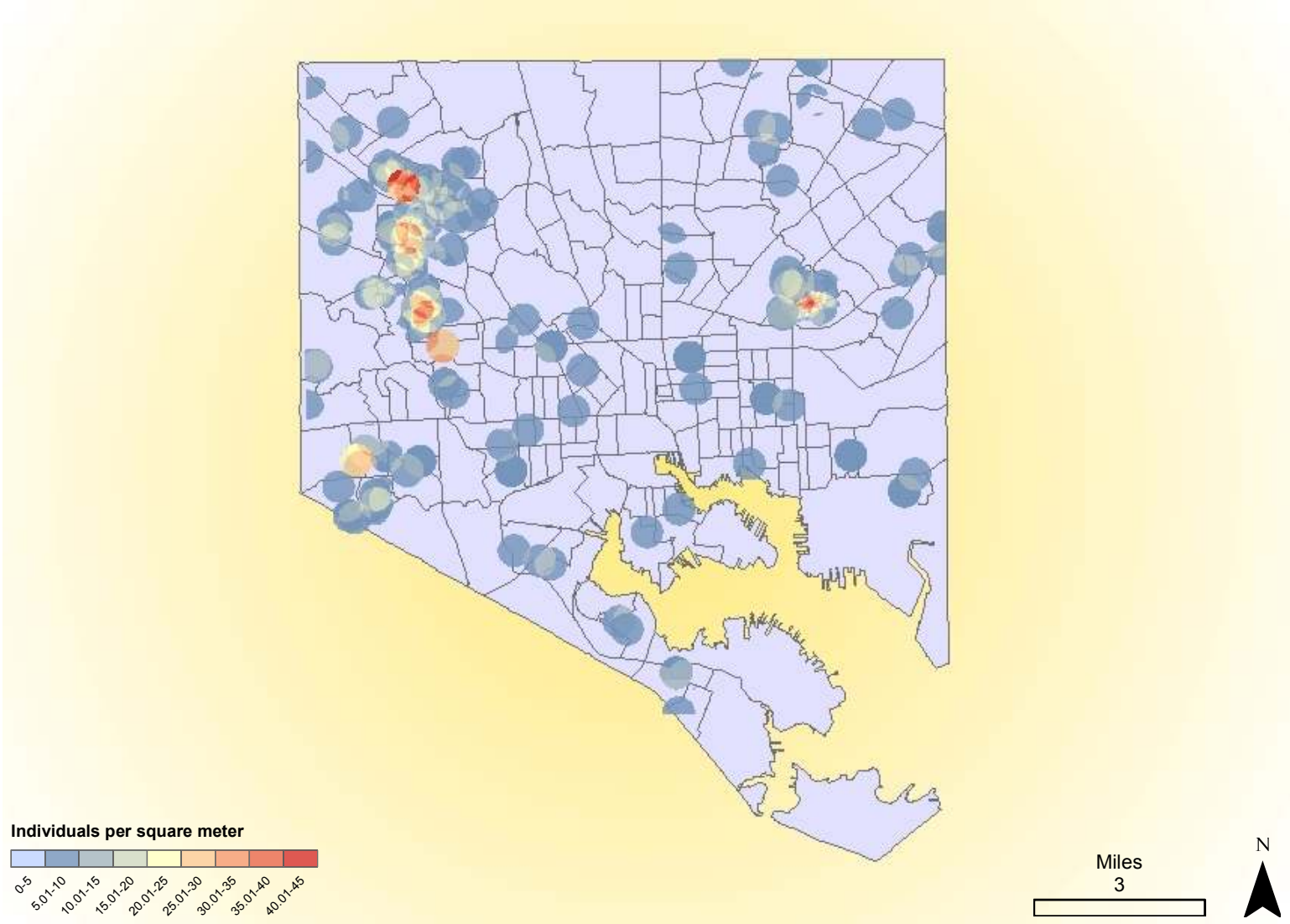

Figure 10. Overlapping spatial clusters of high aggression and all risk factors.

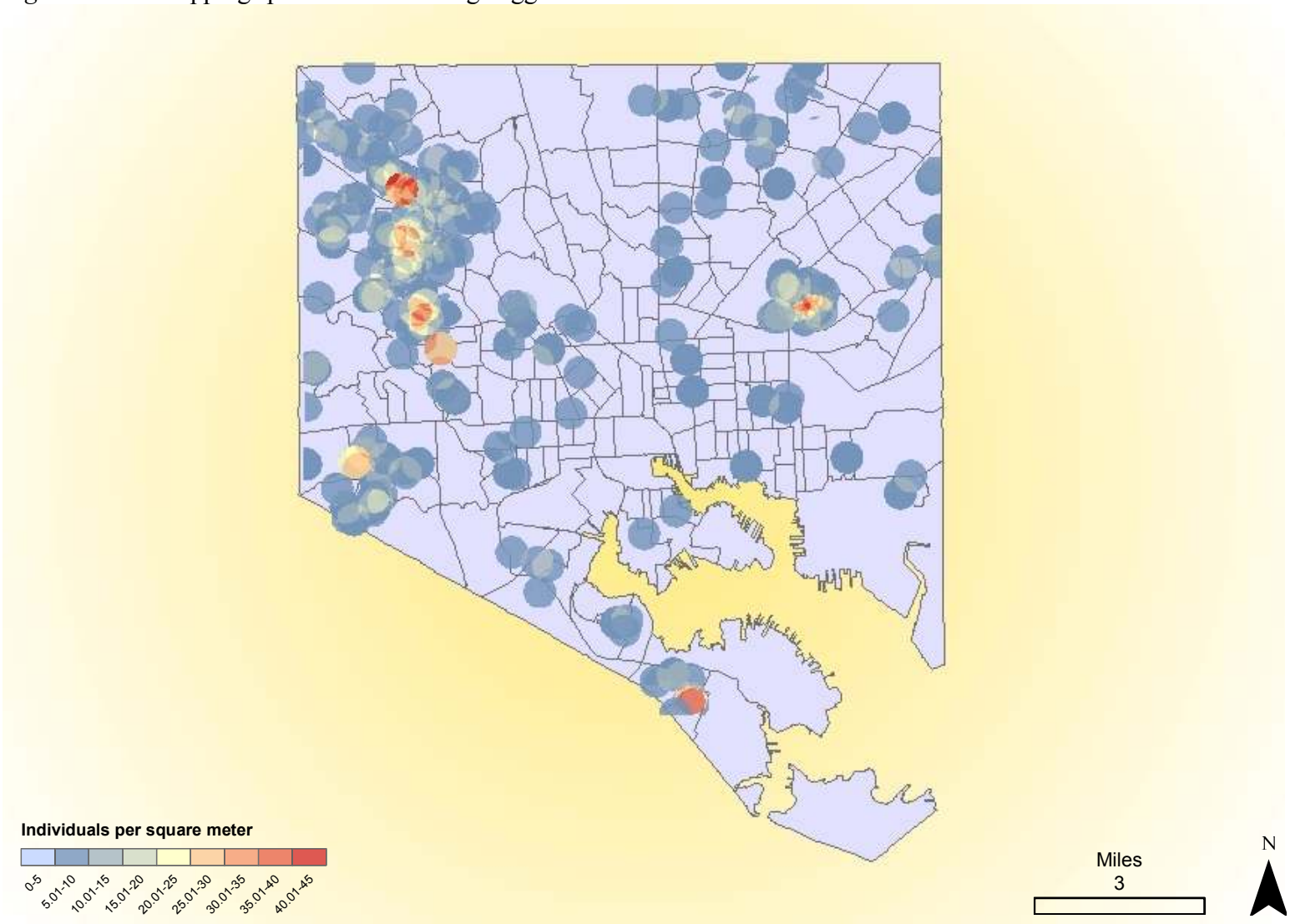

Figure 11. High aggression clusters (9x magnification).

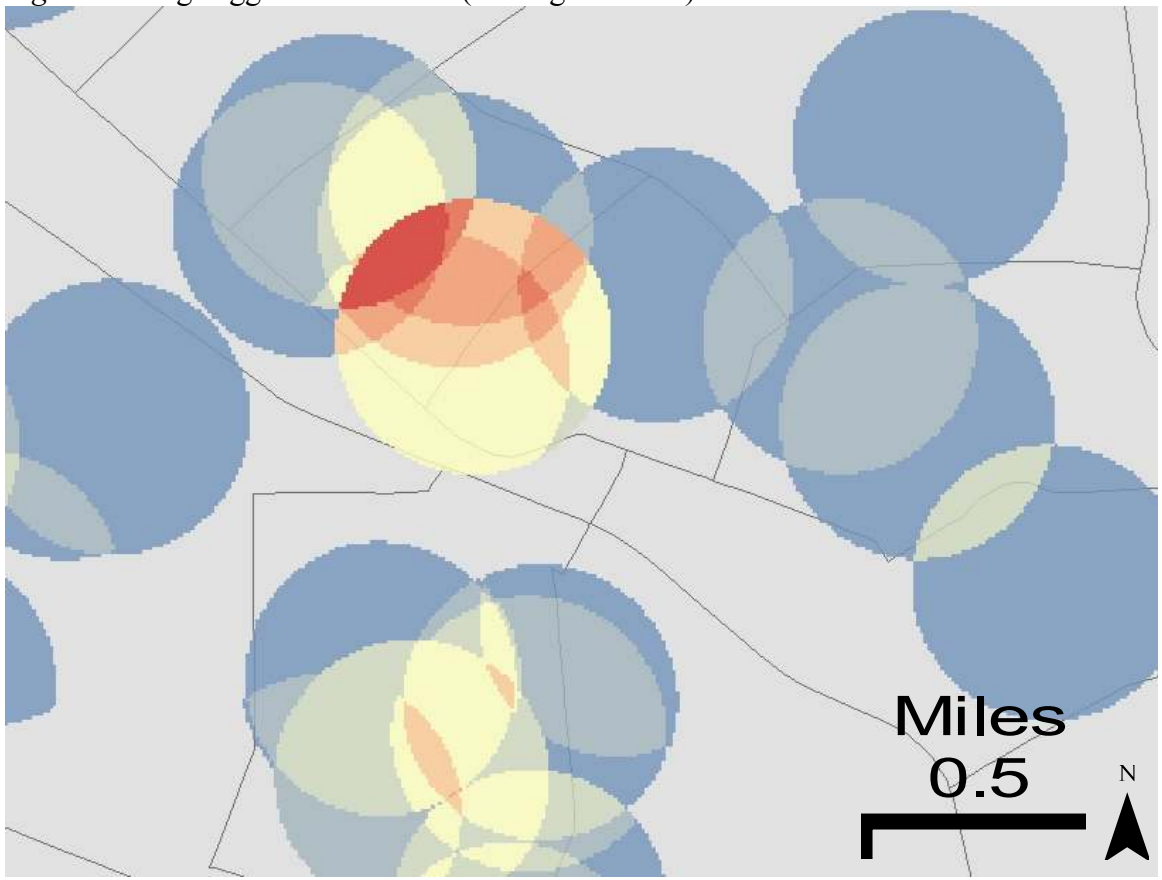

Figure 12. Low parental monitoring clusters (9x magnification).

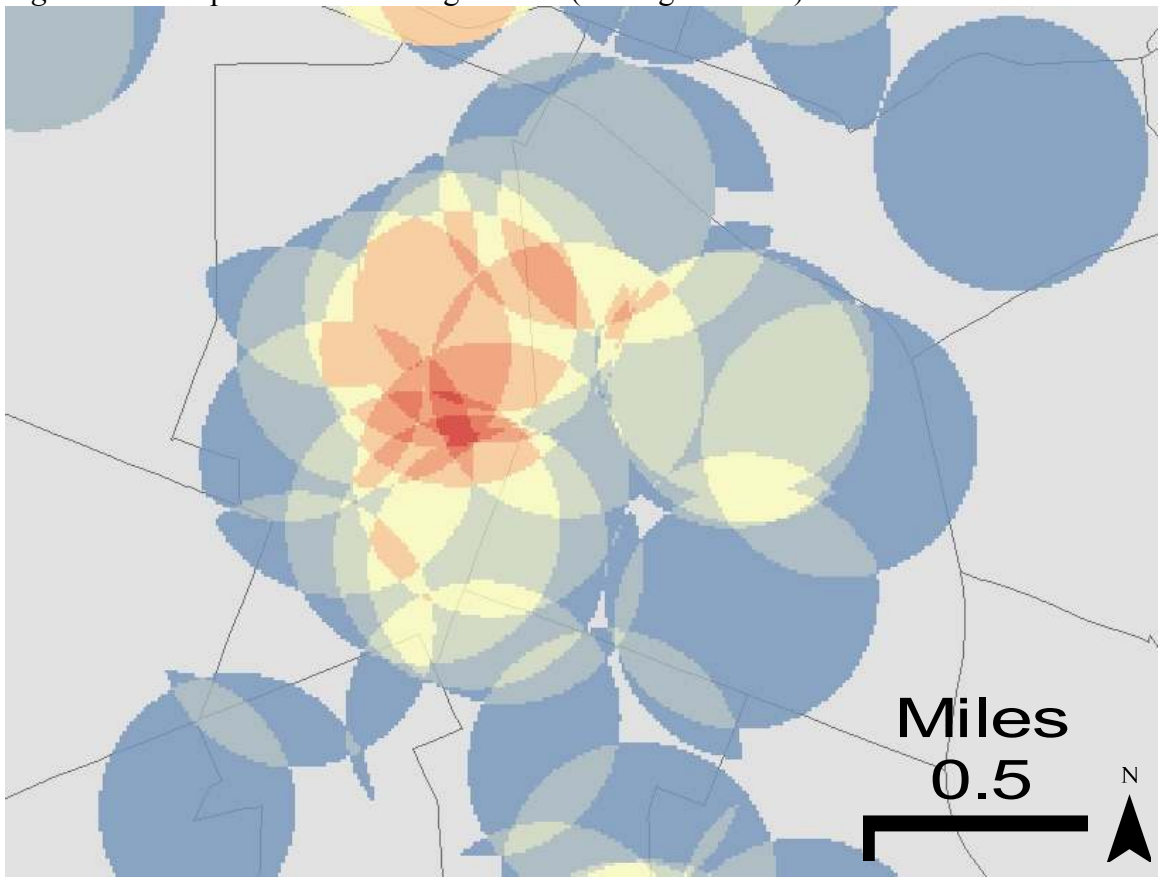

Figure 13. High deviant peer affiliation clusters (9x magnification).

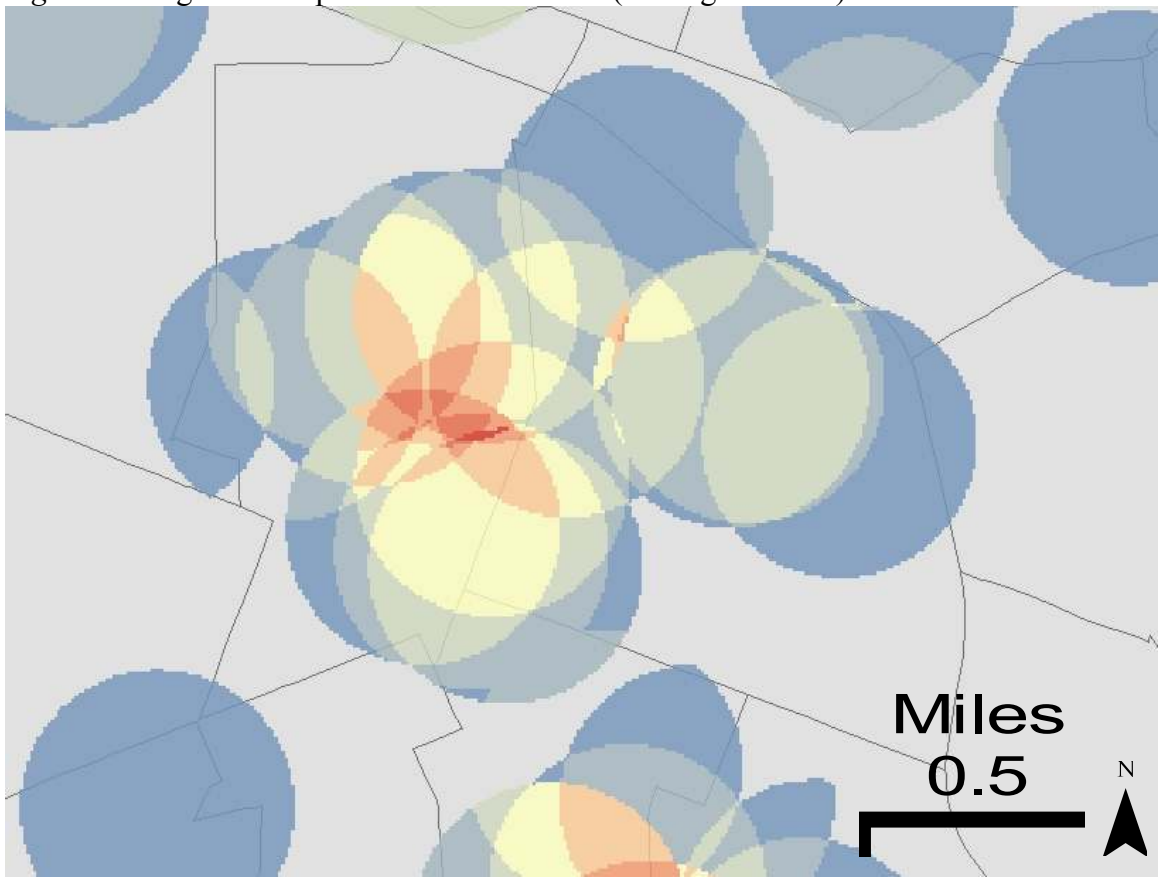

Figure 14. High community violence exposure clusters (9x magnification).

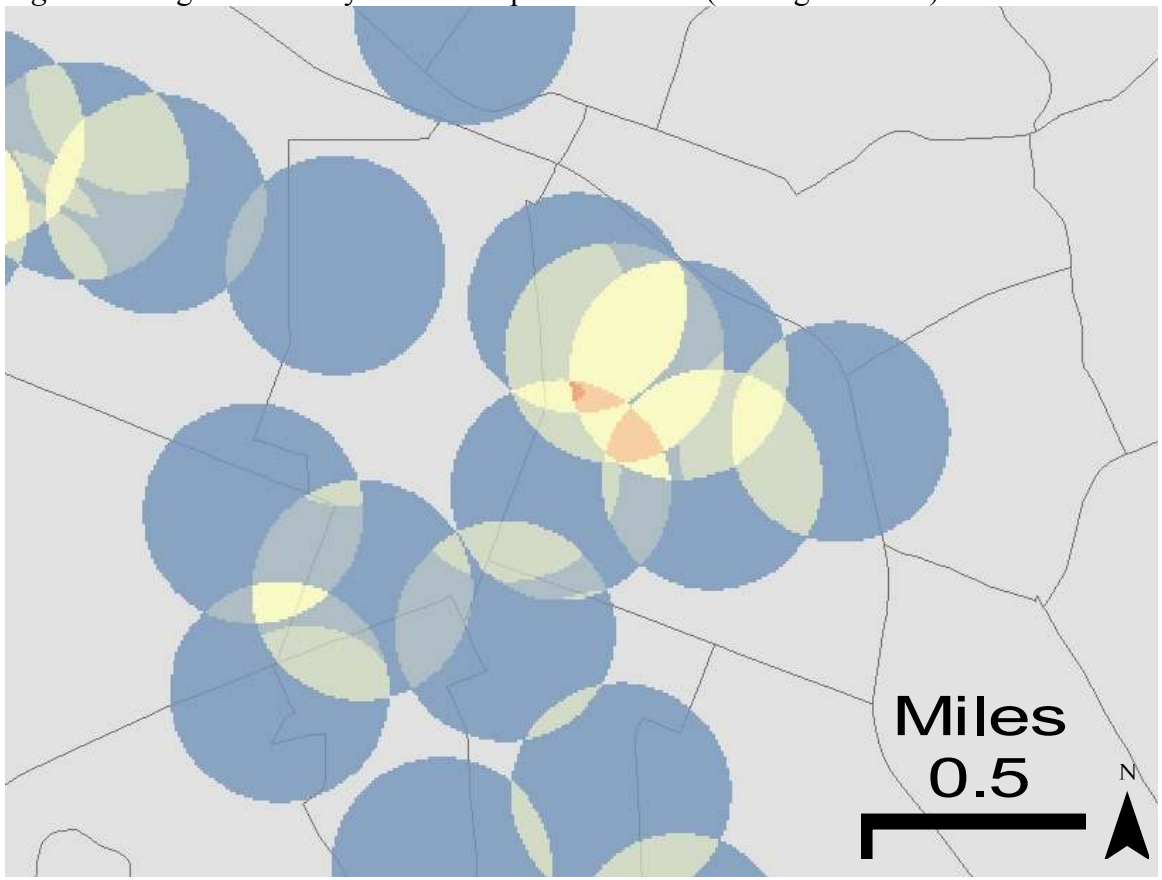
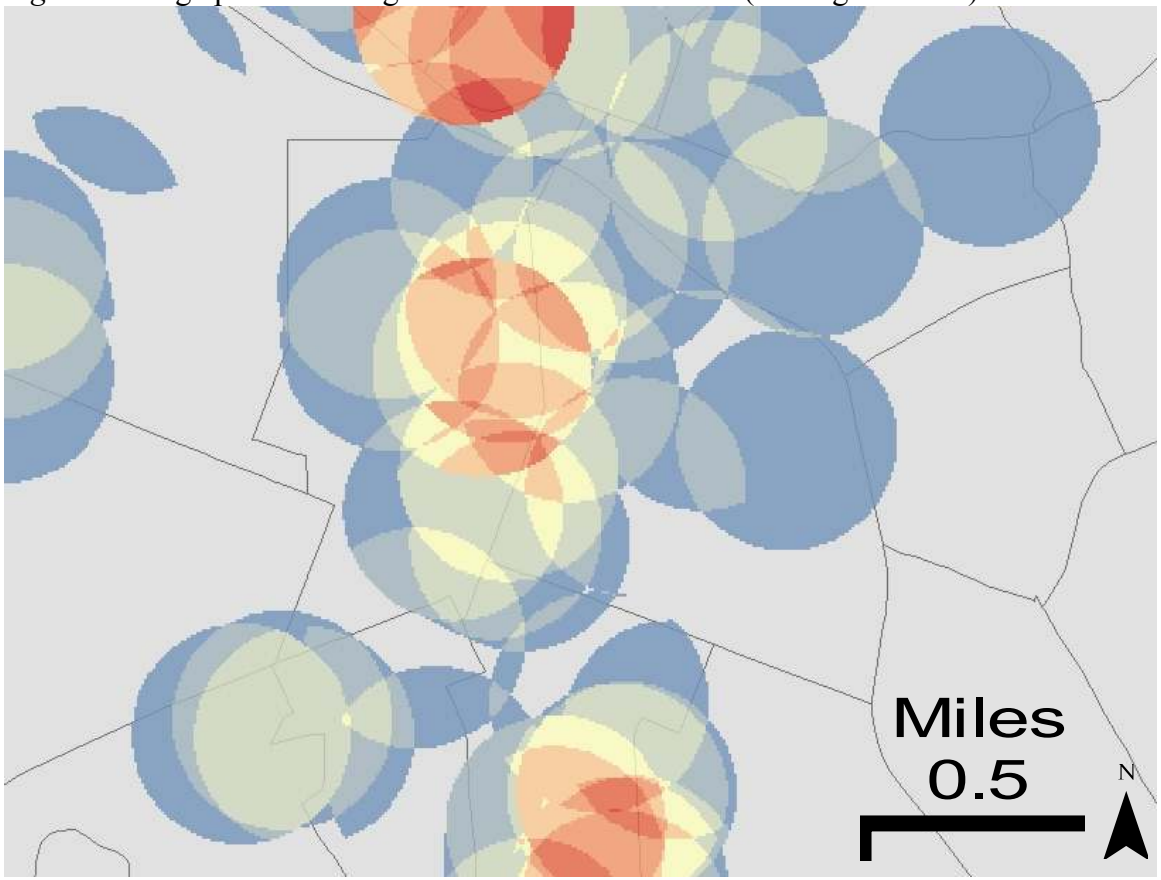
Figure 15. High perceived neighborhood violence clusters (9x magnification).