# A Spatial Statistics Examination of Changes in Violent Crime Patterns Following a Housing Redevelopment Project

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# ABSTRACT

MICHAEL BACON: A Spatial Statistics Examination of Changes in Violent Crime Patterns Following a Housing Redevelopment Project

The HOPE VI public housing redevelopment program has funded the demolition of many distressed public housing units across the United States, along with the construction of new developments which incorporate public housing with market-rate housing. Among the primary goals of this program is the improvement of the safety and security of the public housing residents as well as their non-public housing neighbors. One such HOPE VI project replaced the Few Gardens public housing community in Durham, NC with an array of mixed-income housing scattered throughout a 96 block area just east of downtown.

Using univariate statistical techniques implemented through a geographical information system (GIS), along with local statistics of spatial clustering, this study examines how the spatial distribution of violent crime changed both in the area around the demolished complex and in the city as a whole during the time period in which the project was executed. While the HOPE VI area remained one of the more dangerous parts of the city, violent crime in the neighborhood declined precipitously between 2002 and 2004. At the same time, however, violent crime increased in several other pockets of the city, including some areas where large numbers of former Few Gardens residents relocated. These results illustrate HOPE VI's capacity for positive change, but also troubling trends in which disorganization and inequality may be replicated elsewhere in the city.

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# 1.Introduction and Background

Few people require an academic study to realize that crime, particularly violent crime, remains a major issue in the urban areas of the United States. Attempts to address crime have generally focused on two avenues of understanding: environmental factors on the one side, including the physical and social environment, and individual factors on the other, focusing on the opportunity to commit crimes, the rational choices of the offender, and means of deterring individuals from becoming offenders. The past few decades have seen a resurgence in the attempt to understand street crime, including violent crime, in the urban context in which they occur, and subsequently to try to prevent crime by altering that urban context through neighborhood revitalization projects, physical redevelopment projects, community building projects, and others.

In this study, I address how several such efforts in a mid-sized southern city have attempted to alter the physical and social environment, at least in part to attempt to reduce street crime. In so doing, I emphasize that any such focus on environmental aspects necessarily implies a spatial focus, and that an understanding of the spatial character of violent crime may help to understand how these environmental influences on crime operate. I begin with a review of theories of social disorganization, including under this broad umbrella a wide range of theoretical approaches to understanding environmental impacts on crime. (I include physical environmental influences under social disorganization theory, because in as much as they involve crime, they become represented in social form.) Also in this chapter, I address the Durham, NC study site, and examine the history of similar

revitalization projects. A discussion of methods and results follow in subsequent chapters.

## Social Disorganization Theory

Ever since Shaw and McKay (1942) noted that crime in economically disadvantaged areas remained high even when the local population turned over considerably, social theorists have searched for how neighborhood, community, and environmental effects influence rates of street crime. The theory of "social disorganization" that Shaw and McKay launched provided an overall framework for understanding these issues. After falling out of favor in the middle of the century in favor of theories of crime prevention which focused more on individuals and opportunities to commit crimes, the social disorganization theory of crime has re-emerged in the past 25 years, and has been joined by several other bodies of theory regarding how local effects influence street crime. I discuss the progress of social disorganization theory, as well as several parallel and derivative bodies of theory in how they posit environmental influences on crime.

The initial study (Shaw and McKay 1942) first proposed social disorganization theory after observing that crime levels remained high in economically disadvantaged neighborhoods, even after the local population turned over and the neighborhood ethnic makeup changed substantially. Rather than ascribe this persistent crime problem in poorer neighborhoods directly to a link between delinquency and economic status, the theory of social disorganization proposed that economically disadvantaged areas experience higher rates of turnover, as citizens who achieve the ability to leave the area do so. According to the theory, this results in a population uninterested in establishing community norms in an area they intend to leave. Additionally, the turnover and heterogeneity of the populace prevent the formation of strong social networks, and consequently impede communication between

residents (Bursik 1988).

The theory fell out of favor from the criminological community for several decades, before a resurgence in the late 1970's pushed it back to the forefront. This revival culminated in two watershed works: a critical review by Bursik in 1988 and an empirical study by Sampson and Groves in 1989. Bursik attributed the previous decline in the theory's acceptance to a disciplinary shift away from "group" analyses of crime, and towards individualistic explanations, such as opportunity and motivation, and states that these shifts "overcompensated" towards the individualistic perspective. Additionally, Bursik cites difficulties accurately measuring both social disorganization as well as the crime and delinquency that the theory claims social organization helps to control (Bursik 1988).

Sampson and Groves addressed this difficulty in measurement of both factors, measuring social disorder through the British Crime Survey, which asked a series of questions regarding an area within a 15-minute walk of the respondent's residence. Questions asked what proportion of the respondent's friends lived within this area, how many community or club meetings the respondent attended, and the propensity for teens to congregate in disruptive groups in the area. Crime rates were also derived from the survey data, asking both if the respondent had been victimized in the area, and if the respondent had ever committed acts of personal violence. Their results provided the first strong empirical support of the social disorganization theory of crime – the measures used to quantify social disorganization did indeed correlate positively with higher crime rates (Sampson and Groves 1989). Subsequent replication of the study using similar data at different time frames provided similar results – social cohesion did indeed appear to correlate with lowered crime rates (Lowenkamp *et al.* 2003).

Despite these successes, some research has indicated that attempts to broadly link social disorganization directly with crime may encounter some obstacles, and that caution is necessary in pursuing these links. In a participatory observation study, Pattillo found that middle class black neighborhoods in urban Chicago encounter difficulties attempting to enforce social order due to the incorporation of gang leaders and members into the traditional social networks. In some ways, a modified version of order is maintained by gangs who enforce orderly behavior but still conduct illegal activities which may undermine the safety of neighborhood residents (Pattillo 1998). In light of studies like Pattillo's, I address the literature surrounding two questions regarding the specifics of how these social networks operate to produce the effects which social disorganization predicts. First, what structural, economic, or cultural factors lead to the formation of these networks? Second, how and by what mechanisms do these networks influence rates of street crime? In order to answer these questions, modern social disorganization literature has both drawn upon related bodies of theory as well as developed new theories to assist in answering them. It is to these I now turn.

## *Social Capital and Social Disorganization Theory*

In general, the motivation for the various theorizations of social capital stems from the desire to integrate models of human behavior based on social theory and those based on economic theory. Social capital theory evolved quite separately from social disorganization theory at first, but as it did with many other aspects of social theory, social capital over time absorbed aspects of disorganization theory. I first discuss the various formulations of social capital theory, then examine the ways in which social capital has entered the social disorganization dialog, and more generally theories of crime prevention.

*Early conceptions: racial income differences and concentrated disadvantage*

One of the first treatments of the term came from Glenn Loury (1977), while discussing negative effects which minority races might experience outside of active human prejudice. In Loury's formulation, a society where people tend to associate within their own race and where one race tends to hold more capital, minority races may suffer disadvantages due to lack of access to more privileged social networks. Loury does not elaborate on the concept of "social capital," but instead advocates development of something to account for reasons why difference in opportunity might persist when individualistic models of economic opportunity predict equality.

Building upon many of Loury's themes, William Julius Wilson's body of work largely concerned questions of the obstacles minorities may face outside of specific racial prejudice. While Wilson, to my knowledge, never explicitly discussed the concept of social capital, many of his concerns clearly echo Loury's. Specifically, in his 1987 work *The Truly Disadvantaged*, Wilson notes:

> (I)n a neighborhood with a paucity of regularly employed families and with the overwhelming majority of families having spells of long-term joblessness, people experience a social isolation that excludes them from the job network system that permeates other neighborhoods and that is so important in learning about or being recommended for jobs that become available in various parts of the city (Wilson 1987, 57).

Wilson's conception of disadvantage incorporates more than just the lack of opportunity enhancement that would otherwise be available through a social network of weak ties. Rather, his work represents an attempt to comprehensively address the entire cocktail of factors which pose obstacles for disadvantaged urban populations, including two specific concerns which relate to crime and social disorganization. First, the central theory of the 1987 work concerns the specific effects of *concentrated* disadvantage, or how the spatial

concentration of high levels of disadvantage creates obstacles above and beyond what the individualized disadvantages would confer. As such, Wilson introduces a spatial aspect into the conception of resources available through social networks. Secondly, Wilson here introduces a notion of *cultural transmission* which is entirely theoretically distinct from social capital conceptions. In this conception, children coming of age in areas of concentrated disadvantage both lack exposure to positive social norms of behavior, and are in turn exposed to more deviant forms of behavior. Again, while this will have little bearing on the dialog on the immediate dialog of social capital, it will come to have a more important bearing in more recent social disorganization literature.

### *Formal treatments of social capital: Bourdieu and Coleman*

While the fundamental notions behind social capital had clearly been kicked around before, two authors published much more formal and thorough treatments of the topic in the 1980's. While Coleman's work (1988) became much more widely read, Bourdieu's treatment (1986) has recently received more notice and praise for its theoretical sophistication (*e.g.*, Portes 1998, Sampson *et al.* 1999, DeFilippis 2001, 2002). In Bourdieu's formulation, social capital is one of three principal forms of capital, (along with economic and cultural capital), and is defined as "the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition." (Bourdieu 1986, 248) His analysis is chiefly concerned with the ways in which transfers between the three forms of capital are mediated, and how these transfers may be exploited in order to realize ultimate gains in economic capital. Any capacity of these social networks by which individuals may realize social capital to also enforce social norms or have any deterrent effect on deviant behavior remains undiscussed

(Bourdieu 1986).

Coleman's conceptualization of social capital derives more from an attempt to bring social theory to the economic theory of rational action. Rather than treat the ways in which socialized man deviates from the predictions of rational maximization as exceptional, Coleman would use social capital as the missing element in the equation which then explains these actions which otherwise appear to be non-rational. More importantly, though, Coleman defines social capital in a broader sense, encompassing both the resources available through social networks and institutions, as well as the networks and institutions themselves (Coleman 1988), a generalization of the term which has drawn criticism (e.g., Portes 1998). In doing so, however, Coleman includes a "normative structure" in his definition of social capital, one which provides for the supervision of children and the imposition of social norms (Coleman 1988, S100). The resemblance of lack of social capital here to social disorganization is not coincidental – Coleman goes on to explicitly equate the two, while discussing microcredit associations:

> But without a high degree of trustworthiness among the members of the group, the institution could not exist – for a person who receives a payout early in the sequence of meetings could abscond and leave the others with a loss. For example, one could not imagine a rotating-credit association operating successfully in urban areas **marked by a high degree of social disorganization – or in other words, by a lack of social capital** (Coleman 1988, S103, emphasis mine).

In doing so, Coleman implicitly establishes social capital as the fundamental operator behind social disorganization. The veracity of this association aside, I maintain that this implication of Coleman's has gone relatively unnoticed in critiques of his conception of social capital, and that it has important implications for the further theoretical development of social disorganization theory.

Social capital went from a social theory to a phenomenon with Robert Putnam's publication of his 1995 article “Bowling Alone: America's Declining Social Capital” (Putnam 1995). Putnam takes the concept of social capital and expands it greatly beyond even Coleman's first generalization of the topic, to include civic engagement and civil society. Putnam's article and subsequent book have become two of the most cited works in social theory, and have drawn criticism identifying issues ranging from his theoretical sloppiness (Portes 1998, DeFilippis 2001, 2002), to shifting the blame for lack of economic development to the disadvantaged (DeFilippis 2001, 2002, Fine 2002), to attempting to de-radicalize all of social science through social capital (Fine 2002). Others have noted the difference between the theoretical implications of Putnam's formulations and his normative conclusions (Bebbington 2002, Williamson 2002), noting that regardless of the expansion of the topic, Putnam is more concerned with the redevelopment of civic engagement in America than the precise theorizations of social capital. While this may make for questionable social science, it probably makes for good politics.

In the context of social disorganization theory, however, Putnam makes some very specific claims which finally bring the concept of social capital into full and complete engagement with social disorganization theory, for better or for worse. In his 1995 article, Putnam identifies two major consequences of “declining social capital,” or what in Bourdieu's formulation would be declining social networks leading to decreases in available social capital for individuals. The first of these two consequences is the loss of avenues for collective political action, leading to a more atomized democracy. Secondly, and more importantly, Putnam identifies the loss of “good neighborliness and social trust,” and claims that these correlate strongly with civic engagement. Whereas Coleman's link to social

disorganization remained couched in strict economic terms, Putnam identifies the link between social trust and social capital as key for understanding differences in capacity for collective action, establishing a strong theoretical link to the core of social disorganization theory.

Making practical sense of this link, however has proven more difficult. While social capital has been fertile theoretical ground for other aspects of social theory, it does not fit cleanly into disorganization models. Particularly under Putnam's formulation, measurements of social capital are likely to look very similar to measurements of strict social disorganization (although reversed), and are likely to be equally difficult and clumsy to quantify. In the past decade, the key theoretical step in incorporating the concept of social capital, and more generally social organization, into predictive models of crime has been Robert J. Sampson's concept of collective efficacy.

### *Collective Efficacy: A Proximate Expression of Social Capital and Social Organization?*

Sampson and Raudenbush (1997) introduced collective efficacy as practically measurable quantity, defining it as "social cohesion among neighbors combined with their willingness to intervene on behalf of the common good." In introducing collective efficacy as a concept, the authors acknowledge that a wide variety of factors may influence this measurement. The mere fact that its definition is effectively a combination of "social cohesion," which could be implicitly linked to social disorganization or social capital, with an ambiguous mediator involving willingness to intervene, makes it difficult to incorporate into parsimonious models. Even so, looking beyond its definition, the authors found that collective efficacy could be reliably quantified using survey data, and hypothesized that high

levels of collective efficacy strongly correlated with reduced violent crime. For quantification purposes, Sampson and Raudenbush represented collective efficacy as a composite index of two categories of survey questions, one concerning "informal social control" and the other concerning "social cohesion and trust." In the former, residents were asked how likely their neighbors were to intervene to stop various forms of unruly behavior by local youths. The latter measured residents' assessments of how tightly knit the community was, and how much they depended on and trusted each other. As a composite index, the authors found that not only was collective efficacy strongly correlated with decreased levels of violent crime, but also that measures of concentrated disadvantage and residential instability which otherwise correlated strongly with reduced crime were largely mediated in statistical models by collective efficacy. In short, according to Sampson and Raudenbush (1997), collective efficacy acted as the proximate expression of social organization and social capital in regards to the suppression of violent crime. Or, as Morenoff *et al.* (2001) put it, collective efficacy is the "logical extension of systemically based social disorganization and social capital theory."

Sampson and a variety of associates followed the 1997 paper with a flurry of studies incorporating collective efficacy into various facets of criminological research (*e.g.*, Morenoff and Sampson 1997, Sampson *et al.* 1999, Sampson and Raudenbush 1999, Raudenbush and Sampson 1999, Morenoff *et al.* 2001), and collective efficacy has largely been adopted into the social disorganization literature at large (see Kubrin and Weitzer 2003 for a review). Of particular note is the Morenoff *et al.* (2001) study, which focused on the spatial interdependence of neighborhoods with regards to violent crime and collective efficacy. The authors note that the concept of the "urban village," a self-contained

neighborhood independent of surrounding neighborhoods, pervades urban research even though it qualitatively has little resemblance to the realities of the modern city. Certainly true closed urban villages exist, particularly within particularly ethnic or religious enclaves, but these represent the exception more than the rule. The authors here give three distinct reasons why crime rates of neighborhoods, in this study homicide, are spatially interdependent: First, neighborhood boundaries are inherently artificially drawn, and therefore create divisions where the processes influencing homicide rates have none. Second, homicide offenders are likely to commit crimes near their homes, thereby creating a proximity effect. Finally, interpersonal crimes, such as violent crime in general and homicide in particular, are based on social interactions and are therefore subject to diffusion processes. To examine these trends, the authors analyze measures similar to those used in the Sampson and Raudenbush (1997) study, but use measures for individual census tracts in Chicago along with survey data tied to those tracts. In their findings, tracts with high levels of collective efficacy but surrounded by areas of low collective efficacy experienced significantly higher levels of crime than high tracts surrounded by high values. Conversely, tracts with low values for collective efficacy surrounded by tracts with high values had significantly lower crime than those with low values surrounded by low values. In so doing, the authors show not only provided more support for collective efficacy as a deterrent of crime, but also demonstrate that it is fundamentally a spatial process (Morenoff *et al.* 2001).

### *Social Networks as Obstacles to Collective Efficacy*

One theoretical advantage of the collective efficacy turn is that it separates the existence of social networks, social organization, and social capital from their ability to suppress violent crime, removing the assumption that their very existence implies a

normative capacity within the community. The need for such separation becomes apparent in studies such as Patillo's (1998) study of middle class black neighborhoods in Chicago. Her ethnography of the area uncovered a number of what in pure social disorganization theory would be contradictions, where neighborhoods with very high levels of social organization with strong desires to suppress crime end up unable to suppress crime because of the very social networks that make them organized. In many cases, those working hardest to reduce crime rates are tied into networks which also provide refuge for gang members, allowing them to escape arrest and prosecution, because those gang members emerge from the same strongly bonded community and are hence members of these networks.

Browning *et al.* (2004) examine this phenomenon, bringing to bear the full scope of social disorganization theory. The authors identify two views of social networks, one in which they suppress crime (following classic social disorganization theory), the other in which they provide a means for cultural transmission and support of deviant behavior (following both Wilson and Pattillo). In order to reconcile these, they build upon Portes' framework for social capital to build a model of "negotiated coexistence," under which the dense social networks in the Chicago neighborhoods in question both attempt to enforce social norms while protecting those connected to the networks from full enforcement. In their statistical analysis (which also follows Morenoff *et al.* 2001 in including a spatial lag component), the collective efficacy of a neighborhood is often impeded by the presence of dense social networks. As such, the authors note that weak social ties, those of community organization and not of kinship or institutional ties, may be more responsible for producing collective efficacy than strong, dense social ties (Browning *et al.* 2004). This model of social networks and their impact on crime may be the most sophisticated and empirically useful yet

produced.

### *Order Maintenance and Social Disorganization Theory*

One last theoretical variant of social disorganization theory comes from the order maintenance policing strategy, also known as the "broken windows" strategy. While this theory of crime emerged from criminology and police theory rather than social theory, its widespread popularity and controversial nature has lead to substantial research into its claims, providing for further integration into the social disorganization literature. Here I discuss order maintenance policing and its implications for social disorganization theory as a whole.

While many of the same ideas existed in criminological literature before its publication, "Broken Windows: the police and neighborhood safety," the 1982 article by Wilson and Kelling in the Atlantic Monthly is most often cited as the seminal article on reduction of serious crime through order maintenance. In it, Wilson and Kelling develop a narrative of a national police force that had become more focused on solving individual crimes and making subsequent arrests, rather than a more general duty of maintaining order on the streets and other public places. Both physical disorder – graffiti, damaged property, and actual windows that are broken – and social disorder – aggressive panhandlers, public drunkenness, solicitation for prostitution, and youth congregating on street corners – become hallmarks of "no one caring" in a community, and therefore lead to a rise in serious crimes such as assaults, robberies, and burglaries (Wilson and Kelling 1982).

As a conversational article rather than a logically strict publication, "Broken Windows" either directly identifies or implies several links between disorder and other societal ills without strong empirical support. At points, the authors imply that disorder

directly leads to increased crime, and at others imply that disorder is part of a spiral of decline that feeds off of and contributes to both crime and fear of crime. In the following passage, Wilson and Kelling imply a strong link between disorder and fear of crime:

> At this point [the neighborhood experiencing heightened disorder] it is not inevitable that serious crime will flourish or violent attacks on strangers will occur. But many residents will think that crime, especially violent crime, is on the rise, and they will modify their behavior accordingly. They will use the streets less often, and when on the streets will stay apart from their fellows, moving with averted eyes, silent lips, and hurried steps. "Don't get involved." (Wilson and Kelling 1982, p32)

As advocates of a particular change in policy rather than the specifics of social theory, Wilson and Kelling left the pathways and mechanisms of these impacts ambiguous, which, as I discuss below, has caused some confusion and debate as to what constitutes the true "broken windows" thesis for order maintenance.

### *Early empirical support for order maintenance and policy implementation*

The theory initially enjoyed a positive reception among both social researchers and policy makers. While limited research throughout the 1980's endorsed the concept (Sampson and Cohen 1988), Skogan's 1990 work offered an empirical foundation for the theory. Skogan aggregated survey data from neighborhoods inside four US cities, deriving measures of disorder and of crime victimization from these data. Using simple regression techniques, Skogan identified positive relationships between disorder and victimization rates due to robbery and burglary, and negative relationships with neighborhood satisfaction and intent to remain in the neighborhood. Surveying these data, Skogan declared that "broken windows need to be fixed." (Skogan 1990) Supporters of order maintenance policing quickly cited Skogan's study, claiming it "established the causal links between disorder and crime – empirically verifying the 'Broken Windows' hypotheses." (Kelling and Coles 1996, p24)

Meanwhile, the proponents found converts among prominent policy makers, particularly William Bratton, first of the New York City Transit Authority Transit Police Department and later of the New York Police Department. Bratton embraced the notion of order maintenance policing, first in his "take back the subway" campaign, and later in his "quality-of-life" policing effort as head of NYPD. Each campaign targeted both physical disorder, in the form of graffiti and vandalism, as well as social disorder, tackling aggressive panhandling, loitering, vagrancy, prostitution, and other forms of aggressive solicitation. Subsequent to the implementation of policies that targeted these forms of disorder, crime of all levels fell, including assaults and robberies not explicitly targeted by the order maintenance functions of the police. Proponents cited these gains as further evidence of the efficacy of the order maintenance program (Kelling and Coles 1996).

### *Critiques of order maintenance policing*

The primary critique of order maintenance policing came from Harcourt, who challenged the assertions of what Kelling calls the "Broken Windows hypothesis." Primarily, Harcourt re-analyzed the data used in Skogan's 1990 work, and discovered that in many cases, the correlation coefficients reported by Skogan lacked statistical significance, and that all effects disappeared when the data from Newark, NJ were removed from the study, under suspicion of different circumstances under which they were collected. Harcourt also dismissed the declining crime rates in New York City, noting that many other cities around the United States achieved equal or greater drops in crime without implementation of order maintenance policing. Harcourt credits these drops instead to enhanced reporting, a national increase in police officers under the COPS program, increased use of GIS technology for crime trend analysis, and the decline in use of crack cocaine. Based upon these arguments,

Harcourt strongly refuted Kelling and Cole's assertion that existing studies such as Skogan's proved the "Broken Windows" hypothesis of a strong causal link between disorder and crime, and expressed strong doubt that such a causal link existed (Harcourt 2001). Additionally, Harcourt criticized the social norms of order enforced by order maintenance policing as "subject creation," in the terms of Foucault, claiming that these norms were subjectively created, and were not appropriate for basing legal policy upon (Harcourt 1998, Harcourt 2001).

In response, Thatcher (2004) has argued that while Harcourt's critiques cast doubt on the strongest versions of the order maintenance hypothesis, this does not in and of itself preclude the value of order maintenance in general. In drawing a parallel with racial school integration, Thatcher points out that while predictions for improved performance from minorities upon which much of the justification for the integration was founded failed to materialize, the policy of integration was a good one. In turn, he argues, decreasing disorder has value of its own beyond its ability to suppress violent crime. He also disputes the relevance of Harcourt's Foucauldian analysis, agreeing that social norms are constructed but arguing that this does not detract from their validity or importance (Thatcher 2004).

*Further empirical work and integration with social disorganization, collective efficacy*

At the same time, several researchers attempted more robust studies of the links between disorder and crime. Most found some correlation, but found that social disorganization, socioeconomic factors, and social capital were much more strongly linked, with disorder having little or no causal impact on crime levels. (Borooah and Carcach 1997, Sampson and Raudenbush 1999) Increasingly, instead, social research began to find disorder either merely correlated with crime, both stemming from the same causal actors, rather than

disorder directly acting as an in-line causal actor of crime itself. (see Thacher 2004 for a review) Alternately, a new formal model began to emerge with roots in the social disorganization literature, regarding disorder as part of a cyclical feedback loop, feeding on crime and a third factor, of which social disorganization was a part. Sampson and Raudenbush (1999) identified this third factor as collective efficacy, integrating the disorder dialog with their conception of collective efficacy.

The Sampson and Raudenbush paper represents the strongest empirical examination of both social disorganization as well as physical and social disorder yet published. At the core of the study was a methodology of systematic social observation (SSO), conducted by videotaping 23,816 face blocks in Chicago and then coding a selection of them for aspects of physical and social disorder. These data were compared against a neighborhood-level survey of both crime victimization as well as neighborhood connectivity, expectations of social norms, and opinions of local delinquency. Additionally, exogenous factors such as land use patterns and concentrated disadvantage were aggregated from census data. The authors found little support for a strong causal link between disorder and crime rates. Instead, collective efficacy appeared to have a greater impact on crime reduction. Furthermore, the authors found limited support for a three-way circular model, in which social disorder, crime rates, and collective efficacy act in a positive feedback loop (Sampson and Raudenbush 1999).

A follow-up work by the same authors using a new analysis of the same data introduced more theoretical concerns for just how disorder impacts both social organization and crime. Using the data from the systematic social observations described above, the authors compared perceptions of disorder in survey responses with their own quantified levels of disorder. In so doing, they found that the perception of disorder and objectively

quantified disorder were very weakly correlated. Instead, perceptions of disorder among both black and white residents were higher in predominantly black areas and lower in predominantly white areas. The authors contend that this demonstrates how racist preconceptions of urban areas may be internalized by both white and black residents, and may contribute to perpetuating urban inequality (Sampson and Raudenbush 2004).

### *A Missing Link: Community Development*

For all of the various theoretical strands which have gone into social disorganization literature, precious little research has sought to understand what strategies for building social capacity within a neighborhood would likely yield the best results, and to what degree community development efforts have been successful in this regard. Much of the basis of community development springs from works such as those of William Julius Wilson (1987, 1996), as an attempt to ameliorate the problems of concentrated disadvantage. Out of this, discussions have emerged regarding community capacity building, involving practical techniques for how to make community building work (see Chaskin 2001 for a review). This conversation about capacities has started to absorb dialogs of social capital and social networks (Chaskin 2001). Additionally, Fraser *et al.* (2002) have examined how community building has come to dominate narratives of neighborhood revitalization, and how these narratives may create problems of inequalities of benefits (for an additional review, see Fraser 2005). Community development has also been criticized as a means for continued devolution of state responsibility (Herbert 2005). However, theoretical links between community capacity and concepts such as social disorganization and collective efficacy remain unexplored.

## *Moving Forward with Social Disorganization*

Modern social disorganization embraces a broad and diverse array of theoretical perspectives, which is perhaps not surprising given its age and the amount of attention it and related fields have seen over the past few decades. While much has already been written regarding new directions in social disorganization theory, I wish to highlight three points which emerge from the best of recent literature. First, while multiple authors have recently noted the importance of incorporating spatial effects in social disorganization research (Kubrin and Weitzer 2003, Thatcher 2004), as a point of focus it is important enough to bear repeating. The Morenoff *et al.* (2001) study clearly and dramatically demonstrated how much impact spatial effects may have. Additionally, the emergence of a wide variety of new spatial techniques (some of which are discussed in the following chapter) provide for robust new methods to examine these effects. While this study lacks the scope to comprehensively address the full scope of social disorganization theory, I intend it as a first step in that direction in examining these.

Secondly, while the theoretical vagueness of collective efficacy may frustrate attempts to create parsimonious models of the social processes behind it, I argue that it represents a strong organizing principle for practical empirical research in social disorganization. The work of Sampson and others has demonstrated collective efficacy as a quantity which is both easily measurable using survey data and which strongly correlates to reduced crime. As such, the concept rests at the fulcrum point between crime and social networks. On the one side, there remains a broad range of questions regarding the mechanisms through which collective efficacy reduces violent crime, following the path that Browning *et al.* (2004) have taken. On the other, there remains the question of how social networks, social capital, disorder, and

social organization combine to produce collective efficacy. One of the outstanding questions behind order maintenance policing strategies remains whether these strategies reduce crime because of the increased willingness of the community to suppress crime in the face of reduced disorder or because of simple increased enforcement and the use of "broken windows" to justify harsher police tactics. A simple question in this regard would be to examine how measures of collective efficacy changed from before a broad scale order maintenance police initiative to after it, and examine how those changes correlated with drops in crime.

More directly relevant to the purposes of this study, there remains the question of how community development may work to decrease crime. If collective efficacy truly does represent a major point of interaction between social norms and violent crime, a major concern of community development strategies should be how any interventions to build community impact collective efficacy, if the goal is to reduce crime. Additionally, given the operational differences which are shown above to emerge between strong social ties and weak social ties, developing an understanding of how community building functions in relation to these ties could help to improve the effectiveness of future efforts. Taken as a whole, a social disorganization dialog which focuses on these three directions should produce knowledge which not only illustrates under-theorized yet important social processes, but should also provide guidance to the ways in which attempts to control crime through community measures may maximize the results of their efforts.

## A Study of Durham, NC – HOPE VI and Violent Crime

This study examines how a neighborhood revitalization effort in Durham, NC, funded and implemented through the HOPE VI program, has altered the spatial distribution of

violent crime within the central city. Here I briefly detail the HOPE VI program and the study site. Methodologies for examining these changes and specific methods used in this study are discussed in the second chapter.

### *HOPE VI*

In 1992, the United States Congress appropriated funds to create what would become the HOPE VI program of the federal Department of Housing and Urban Development (HUD), to address "severely distressed public housing" through a comprehensive program of demolishing the worst housing complexes and rebuilding more dispersed, mixed-income units in their places (NHLP 2002). The goals of the project included "changing the physical shape of public housing" and "lessening concentrations of poverty by placing public housing in nonpoverty neighborhoods and promoting mixed-income communities." As of 2002, over 70,000 public housing units had been demolished under the HOPE VI program in over 250 projects around the country (NHLP 2002). Supporters credit the program with helping "transform the physical and social landscape of some of the nation's toughest neighborhoods, creating markets where there were none" (Cisneros and Katz 2004), while critics charge that it "has been the source of new problems as serious as those it was created to address," including a shortage of public housing and exclusion of input from residents (NHLP 2002).

### *Few Gardens and the Durham HOPE VI Project*

In August of 2000, HUD awarded a $35 million grant to the Durham Housing Authority (DHA) for the redevelopment of a 96 block area in northeast-central Durham, surrounding the 50-year old Few Gardens public housing complex. The winning grant was celebrated among local politicians as a means for reducing crime in the area (Dainow 2000). Indeed, much of the local political momentum for the project came from a public reaction to

two shooting incidents in the area, one resulting in the death of a two-year old, the other in the paralysis of a five-year old (Wise 2003). Even today in its marketing materials, the Durham HOPE VI project cites "A Safe and Secure Neighborhood" as one of its four major goals for the project (DHA HOPE VI website). The most dramatic evidence of work on the project took place in July 2003, when DHA demolished the Few Gardens complex, and again local leaders cited the importance the project would have in increasing safety in the neighborhood (Bridges 2003a, 2003b).

### *Crime Displacement*

With crime such a major reason why DHA targeted Few Gardens for demolition, we raise the question of how crime rates have changed from before the demolition to after it. Creating "A Safe and Secure Neighborhood" tops the list of "Revitalization Principles" in the Durham HOPE VI Revitalization Plan (DHA 2002). However, displacing a large segment of residents who have been victims and potentially perpetrators of crime to other areas of the city which are marginally improved yet still have average incomes below the citywide average may simply move the same crime to other parts of the city. The city of Durham is unlikely to view the project as a success if it makes one neighborhood safer at the cost of making other neighborhoods more dangerous. One major question hanging over the revitalization effort must then be, how much are gains, if there are any, at the HOPE VI site offset by increased crime elsewhere in the city?

One previous study has examined how the spatial pattern of crime has changed surrounding a HOPE VI project. Suresh (2000) used crime victimization data and basic hot spot detection to examine how the spatial patterns of aggravated assault, homicide, and rape changed in the Park Duvalle neighborhood following the demolition of a nearby public

housing complex and reconstruction of mixed income housing under the HOPE VI program. While crime in the Park Duvalle neighborhood in Louisville, Kentucky declined significantly, multiple smaller hot spots of crime sprung up in other parts of the city. This change in patterning does not lead to easy conclusions – on the one hand, a decline of massively concentrated crime within a small area may make the problem significantly more manageable, but on the other hand, it is not the goal of HOPE VI to simply recreate similar problems in other parts of the city. It bears noting that while the Park Duvalle project in Louisville took place much earlier than the Few Gardens project in Durham, the construction and physical development portions of both projects were executed by the same firm, The Community Builders.

### *Understanding the Character of Changes in Spatial Pattern*

Given that the HOPE VI project fundamentally addresses environmental impacts on crime and not individual aspects such as offenders, I maintain that any changes in crime patterning are best understood under the constraints of social disorganization theory. In an ideal situation, an examination of these changes would incorporate measures of how social organization, social networks, collective efficacy, and any number of other factors changed over the course of the HOPE VI redevelopment, and would incorporate more complex models of why change occurred. These analyses, however, are beyond the scope of this study. Instead, I aim to use the tools of spatial analysis to help characterize and understand the nature of the spatial changes in violent crime which occurred during the HOPE VI redevelopment project, and then to examine this characterization in the spatial context of the HOPE VI area and other parts of the city.

# 2.Methods and Methodology

In order to examine how the HOPE VI project has impacted the spatial distribution of violent crime, I examine the basic patterning in univariate statistics across space, in the context of qualitative knowledge about the actions in that space. As such, the fundamental methodology here uses quantitative methods to illustrate the patterns, and then examines the areas identified as significant in a qualitative context. In this chapter, I first discuss techniques used in crime mapping and in spatial statistical analysis from a theoretical perspective, focusing on methodological issues which arise when performing these analyses. I then detail the specific steps used in the collection, preparation, and processing of data for the purposes of this study. Results and conclusions are discussed in the subsequent chapter.

## Spatial Statistics, Spatial Analysis, and Urban Crime – A Methodology

As Paez and Scott (2004) note, "A characteristic of most urban processes is the fact that they are intrinsically spatial and, moreover, space-dependent" (Paez and Scott 2004, p54). Urban crime is clearly no different. The technological advances of the last two decades have permitted an explosion of new techniques as well as data available for use in urban analysis. One of the most important developments for the analysis of crime has been the emergence of statistics which examine both patterns across the full extent of a study area and localized variations in those patterns.

### *Using GIS and Spatial Analysis to Examine Crime*

For some time now, criminology has utilized spatial analysis to aid understanding of the impacts of the physical and structural environment on crime rates. Recently, Loukaitou-

Sideris (1999) used spatially paired blocks to examine differences in the physical environment between high crime and low crime bus stops. Wang and Minor (2002) examined the relationship between the spatial distribution of employment, access to employment, and crime. Ceccato and Haining (2004) examined crime in relation to political borders, specifically how transportation nexi and proximity to borders may increase the incidence of crime by providing avenues for evasion of law enforcement. Additionally, the past decade in particular has seen a great increase in the use of new technologies such as GIS for the analysis of crime and increased efficacy of policing. (Lochner and Zietsman 1998, Craglia, Haining, and Wiles 2000, Garson and Vann 2001, Vann and Garson 2001)

Application of spatial techniques to the questions of social and physical disorder, social disorganization and collective efficacy, and crime victimization has been less widespread. Doran and Lees (2005) applied GIS techniques to the impacts of physical disorder on crime and fear of crime in Australia, focusing particularly on temporal effects. Matei, Bali-Rokeach, and Qiu (2001) built upon the work of Lynch (1960) and Gould (1966) to use mental mapping techniques to construct maps of fear of crime in Los Angeles. The authors collected a survey on crime and avoidance which included a color-in map of the city where respondents could indicate the level of fear they felt in that area using various colors. Color values were scored, allowing a composite surface of generalized and subdivided fear of crime to be created (Matei, Bali-Rokeach, and Qiu 2001).

One particularly promising avenue of research has focused on land use and crime. Kurtz, Koons, and Taylor examined the relationship between commercial vs. residential land use, physical deterioration, and resident controls on crime and calls for service. Among the findings were that blocks containing functioning storefronts consistently had higher levels of

calls for service, and higher levels of reported crime victimization. (Kurtz, Koons, and Taylor 1998) In contrast, among the findings of the landmark Sampson and Raudenbush study were that blocks with mixed land uses were positively correlated with increased disorder, but often negatively or uncorrelated with crime rates. (Sampson and Raudenbush 1999) Wilcox et al. (2004) went a step further past Kurtz, Koons, and Taylor and examined to what degree disorder may mediate the impact crime-related impact of public land uses, such as commercial areas, schools, playgrounds, and open space. Using survey data to quantify physical disorder and neighboring between residents, the authors tested various models of crime impacts using officially reported crime data. The findings were remarkably mixed – the impact of businesses upon assaults and burglaries was partially mediated by physical disorder, whereas the impact of open spaces such as parks and plazas was partially mediated by neighboring, but also by income level. (Wilcox 2004)

### *Univariate Statistics for Local Spatial Cluster Analysis*

Before the advent and then widespread availability of Geographic Information Systems (GIS), the computation required for most spatial statistics made all but the simplest forms prohibitively expensive to calculate. As such, examinations of spatial pattern were limited to relatively rudimentary comparisons of observed values versus those expected under a random distribution, such as nearest neighbor comparisons and presence/absence scores in a spatial grid of quadrats. With the advent of greater computational capacity, as well as increased facilities for locating data points on a coordinate grid system such as the Global Positioning System and easy access to address geocoding, the field of spatial statistics has seen considerable advancement.

One concern in any advanced spatial statistic is establishing spatial association

between data observations. This is usually accomplished with a matrix of values indicating the association between two observations, as in the well known Moran's *I* statistic of spatial autocorrelation:

$$I = \frac{n}{\sum_i \sum_j w_{ij}} \frac{\sum_i \sum_j w_{ij}(\hat{x}_i \hat{x}_j)}{\sum_i \hat{x}_i^{\,2}} \qquad (1)$$

Here, *n* indicates the number of observations, $\hat{x}_i$ indicates the deviation from the mean at the *i*th observation, and the weights matrix $w_{ij}$ holds a value for the relation of the *j*th observation to the *i*th observation. In its most primitive form, this weights matrix may hold a 1 for positions involving two adjacent observations, and a 0 for positions involving non-adjacent observations. A range of more advanced forms exist to permit relations between non-adjacent observations, including, perhaps most commonly, using the inverse of the distances between all sets of two relevant points as the weights.

While the Moran's *I* provides a measure of the total spatial autocorrelation for the dataset, low values of *I* may fail to represent patches where similar values are clustered within the overall data set. It is these local patches, or local spatial clusters, which the statistics addressed here attempt to locate and represent.

### The Getis-Ord $G_i(d)$ Statistic of Local Spatial Clustering

The basic $G_i(d)$ statistic (see equation 2), as defined by Getis and Ord (1992), examines localized aspects of the degree to which values spatially proximate to a focal value are more likely to be similar than would be expected under a random distribution.

$$G_i = \frac{\sum_{j=1}^{n} w_{ij} x_j}{\sum_{j=1}^{n} x_j} \qquad (2)$$

Because it is locally calculated, the statistic may illustrate patterns of clustering in data sets which Moran's *I* cannot differentiate from a random distribution. And although the statistic is only strictly normally distributed when the underlying population follows the normal distribution, it approaches normality as the number of data values used to calculate each local statistic increases, thereby allowing significance testing with *Z*-scores. Under the $G_i$ statistic, the weights matrix is required to contain zeros for values representing each point's spatial association with itself. The $G_i^*$ statistic, on the other hand, permits each point's value to be incorporated into calculation (Getis and Ord 1992). The practical implication of this is that the $G_i^*$ statistic should be used when the focal point should be considered part of the spatial clustering, and is hence more widely used.

The initial formulation of the statistic required a symmetrical binary matrix, with weights of 1 indicating either adjacency between two values or indicating a spatial distance smaller than some threshold (Getis and Ord 1992). However, a later revision of the statistic broadened it to permit weights matrices with non-binary values (Ord and Getis 1995). I discuss the selection of an appropriate weights matrix in more detail below.

### *The LISA Decomposition of Moran's I*

Following the spirit of the $G_i$ and $G_i^*$ statistics, Anselin (1995) defined a new class of statistics, called Local Indicators of Spatial Association, using the following criteria:

a) the LISA for each observation gives an indication of the extent of significant spatial clustering of similar values around that observation.

a) the sum of LISAs for all observations is proportional to a global indicator of spatial association. (Anselin 1995)

Anselin also provided a general form for these statistics to take, then noted that several existing global statistics of spatial association could be decomposed into their local parts using this form. He also provided local decompositions of both Moran's *I* and Geary's *c* using this method. Specifically, the local Moran is defined as follows:

$$I_i = z_i \sum_j w_{ij} z_j \quad (3)$$

This statistic provides a mechanism for identifying localized areas of high spatial autocorrelation within a dataset. Anselin also notes that the statistic can be used similarly to the $G_i^*$ for locating clusters of high association (Anselin 1995).

### *Properties of* $G_i^*$ *and Local Moran's* I

It is important to note that while the $G_i^*$ and local Moran measure related quantities and may produce similar results, the underlying properties that they measure differ in nature. The $G_i^*$ quantifies the degree to which nearby values vary to each other in relation to the overall variance in the global set of values. The local Moran quantifies the degree to which the set of nearby values vary from the focal value in relation to the degree to which the set of global values vary from the focal value. In practice, if localized patterns of spatial association are present and the trends largely continuous, the $G_i^*$ and local *I* should identify roughly similar areas.

Additionally, the two statistics differ in the interpretation of high and low values. While in both cases extremes of high or low values indicate strong trends, the specific meaning of each differs between them. For the $G_i^*$ statistic, the difference in sign of the Z-

score test of significance indicates the direction of the clustered trend. High $G_i$* scores indicate above-average values clustered more tightly than would be expected given a random distribution, whereas low $G_i$* scores indicate either clusters of below-average values, or the presence of above and below average values packed tightly together. As such, the sign of the $G_i$* Z-score illustrates the difference between clusters of low and high values, but there remains confusion with low scores as to the nature of the clustering (Getis and Ord 1992). In contrast, high local Moran's scores indicate that the surrounding values are more like the focal value, high or low, whereas low local Moran's values indicate that the surrounding values are less like the focal value than a random distribution would predict. As such, the local Moran solves the issue of determining whether extreme scores are caused by like pairings or dislike pairings, but do not address whether the values themselves are higher or lower than expected (Anselin 1995). For each statistic, the underlying confusion may be resolved with a re-examination of the original data. Still, based on the differences in what each statistic measures, I assert that there is value in calculating both scores for a given data set, as the similarities and differences between the results may be illustrative.

## *Issues With Spatial Analysis*

The calculation of local spatial clustering statistics requires a number of decisions for which there are not yet established best practices. I discuss here the modifiable areal unit problem, issues involving the selection of the weights matrix, and issues regarding incorporating population data into crime statistics.

### *The Modifiable Areal Unit Problem*

While starting with point data provides flexibility with regards to the selection of areal units, it also introduces the modifiable areal unit problem (MAUP) into the analysis.

Concern with this problem stems from the infinite number of arrangements of areal units into which the point data could be aggregated, and potential biases which may emerge based on the set of areal units chosen for analysis. In general, an acceptable set of areal units should minimize variance within units at the desired scale of analysis, while still having sufficient numbers of units with high enough counts to provide meaningful variance between units. Areal units which are too high in number and too small in size will result in few units having high values, and an overabundance of units with small or zero values. As a result, the high number of units with small values will dilute the effect to the point that meaningful patterns become lost. While no hard and fast rules exist for determining the proper number of units, one rule of thumb for aggregated statistics states that the mean number of points per areal unit should be greater than two (A. Moody, pers. comm.).

Additionally, variation in the size and shape of the areal units within a single arrangement may create bias in the statistical results. Larger areal units will naturally tend to have greater inter-centroid distances and a greater number of adjacent units than small units, as well as tending to include a greater number of points than smaller units, even when points are randomly spatially distributed. Units which are elongated or concave will also tend to have a greater number of adjacent units, and calculating distances between irregular units and other units will yield different results, depending on whether inter-centroid distances or edge-to-edge distances are used. However, if the underlying process is spatially heterogeneous, enforcing a rigid areal unit system will result in many empty units and a few densely packed units.

Much research has gone into potential effects caused by the MAUP and potential systematic solutions for it (see Paez and Scott 2004 for a review). For the purposes of this

study, I have elected to use two different areal unit schemes. First, I aggregate all points representing reported violent crime by census block. There are two major advantages to using census blocks. First, some limited demographic data, including residential population, are readily available on a per-block level. Second, the blocks themselves already vary in size and shape according to the density of residential and commercial development, which functions moderately well as a crude predictor of the population exposed to risk of violent crime in that area. Areas of dense population or commercial development tend to have small, tightly clustered census blocks, while large undeveloped or sparsely developed areas will have larger, sprawling census blocks.

However, the irregularity of census blocks introduces an element of uncertainty into any statistic which uses them as areal units, as discussed above. In order to check for bias created by this irregularity, I also aggregate all crime locations to a regular lattice of uniform square cells. The regularity of shape and size of the cells removes a potential source of bias from the calculations. However, due to the patchy nature of residential development in central Durham, the lattice would necessarily create equally sized zones in densely packed neighborhoods as in protected natural areas or large tracts of warehouse and industrial sites with little daily population. The contrast between the census blocks and the regular lattice allows for exploration of biases generated by each.

### *Selecting an Appropriate Weights Matrix*

For all spatial statistics, a major challenge not normally present with non-spatial statistics is finding a simple quantifiable way of representing the spatial association between all observations. In raster data, the association can be inferred by selecting a window around the focal cell, as the regularity of the data will always ensure uniformity in the distances.

However, in data sets where areal units may be differently sized and spaced, these distances must be formalized and incorporated into the calculation of the statistic. For most spatial statistics, including the ones used in this study, this comes in the form of a distance weights matrix in which each element holds a value representing the unidirectional association between a pair of observations.

*Table 1 Established methods for constructing a weights matrix for spatial association, after Getis and Aldstadt (2004)*

- spatially contiguous neighbors
- inverse distances raised to some power
- lengths of shared borders divided by the perimeter
- bandwidth as the $n^{th}$ nearest neighbor
- ranked distances
- constrained weights for an observation equal to some constant
- all centroids within distance *d*
- *n* nearest neighbors
- bandwidth distance decay
- Gaussian distance decline
- "tri-cube" distance decline function
- local statistics model

In its most basic form, this weights matrix may hold a simple value indicating the presence or absence of adjacency between observations, in the form of a 1 for two adjacent areal units and a 0 for non-adjacent areal units. The symmetrical binary weights matrix may also be used to denote areal units which fall within a given distance of each other, with no differentiation of weight based on distance (Getis and Ord 2002). Non-binary weights matrices may also be used to represent a more complex underlying spatial association (Ord and Getis 1995). While a wide range of different schemes have been used, ranging from simple derivations to complex formulas (see Box 1), Getis and Aldstadt (2004) caution that in all cases the weights matrix should be established with some theoretical justification of the spatial associations underlying it.

### *Normalizing Crime Rates By Population*

While researchers often have a reflexive tendency to want to adjust the rates of occurrence for events such as crime to population, the core methodological reasons for doing so may be overlooked. Fundamentally, the justification for examining these per-population rates comes from the demographic concept of risk, initially developed to examine mortality rates. When the concept of risk is adapted to other events, however, care must be taken to ensure that the risk rates are only calculated for the population exposed to the risk, that any proxies used for calculation do in fact provide good estimates of the at-risk population, and that duration of time an individual is exposed to the risk be taken into account (Preston *et al.* 2001).

For certain crimes, particularly residential burglary and home invasion, measures of the vulnerable population are easy to derive, because they will align closely with the residential population of an area, for which census data are available. However, for other crimes, such as violent crime, where people are as likely or more likely to be victimized outside of the home, such as on the street or at commercial or employment centers, measures of residential population often do not reflect the vulnerable population, particularly at fine scales such as block groups and blocks. For instance, areas with high density retail development may draw thousands of people a day, during which time they may be at risk of violent crime, but census data from a block which only includes commercial development will indicate that the population is zero.

Multiple methods have been developed to address this difficulty in assessing the vulnerable population. One technique is to apply the average population per unit area from a larger spatial extent to smaller areal units, thereby smoothing the population over the study

area. The advantage in doing this is that crimes which occur in a vacant block across the street from a densely developed block will incorporate the nearby residents as part of the vulnerable population. This method raises the issue, however, that this may create steep edges at the borders of the census tracts, which introduces false effects, particularly in statistics of autocorrelation and local spatial clustering. This problem may be partially averted by assigning a value for the vulnerable population for an areal unit equal to the residential population within a fixed distance of the borders of that areal unit. While this solves the issue of edge effect by creating uniform smoothing, both this method and the previous method assume a geography of activity in which people are most active in areas close to their residences, whereas in contemporary urban settings, individuals may spend the vast majority of their waking hours in employment, commercial, and entertainment centers far from their homes. As such, these methods may treat the cores of urban central business districts as if they had very low vulnerable populations, while assigning a high value to a large unoccupied tract of protected land across a freeway from dense development.

For analysis at large spatial scales within the United States, some specific data on employment are available. Both the U.S. Census Bureau and the Internal Revenue Service collect and publish employment data in the form of number of workers within an area, as well as paired values matching place of residence and place of employment. However, these data often specify location at the county level, which for the purposes of block-level analysis is clearly insufficient granularity.

### *To Normalize, or Not to Normalize?*

The difficulties illustrated above in identifying an appropriate measure of the at-risk population for crime demonstrate the potential problems with using census data and

employment data to estimate a vulnerable population. In addition to these issues, there remains the question of whether normalization by any census or employment measure is even appropriate for crime type. For instance, in examining the spatial patterning of vehicle thefts and of vandalism in Stockholm City, Ceccato and associates (2002) noted that the appropriate basis of risk would be the actual number of cars present in an area. Because estimates of number of cars would be extremely difficult to assess, the researchers elected to use the number of hectares within each areal unit as a basis for standardization. In contrast, for residential burglary, the researches elected to use census data for number of households (Ceccato, Haining, and Signoretta 2002).

In the application of spatial statistics, some level of standardizing based on area may be incorporated into the weights matrix which establishes the association between cells. If an inverse distance weighting between centroids is used, then large plots will necessarily have their counts diluted to some degree in their influence on the local statistics for neighboring regions. As a result, if values are already normalized based on space, such as in the work by Ceccato and associates (2002), then inverse distance formulations may not be desired. On the other hand, if fixed-size areal units are used, normalization by spatial area is clearly not necessary (Craiglia, Haining, and Wiles 2000).

### *Examining Temporal Change*

While examinations of the spatial structure of crime in a given year will provide some insight, if changes in the spatial patterns in response to urban events or interventions are of interest, how crime has changed within the city clearly becomes of interest. If comparable measurements of crime are available for at different times, the difference between these times may be treated as a spatial variable in and of itself. Spatial statistics such as the $G_i^*$ and the

local Moran's *I* simply require that the spatial variable in question have a natural origin. In the case of difference between crime rates, the origin of zero will indicate no change in crime, thereby providing a natural origin.

Implicit in examining a simple difference between crime rates is the identification of a temporal scale over which the most dominant changes will occur. The selection of the two endpoints for analysis will thereby emphasize any effects which operate most strongly at that temporal scale. Particularly in univariate analysis, multiple underlying spatial trends will be homogenized into a single observed effect, and so an examination of change in these trends will tend to be biased towards the strongest effect in that time scale, even if it is not the strongest effect over longer or shorter time scales. As such, if a particular effect under analysis operates within a given range, a endpoints should be chosen which delineate the time period under which the greatest change is expected.

## Methods for the Durham Study

As discussed in the first chapter, the goal of this study is to determine how spatial patterns in violent crime have changed following the demolition of the Few Gardens complex and the subsequent construction of the HOPE VI mixed income housing project. In order to accomplish this, I use a spatially explicit data set of all violent crimes reported by the police within a given year as a univariate representation of violent crime. From these, I use spatial statistics to identify spatial patterning within the city. I then examine this spatial patterning in the context of purely locational data which details the boundaries of the HOPE VI project and the new places of residence for the former residents of Few Gardens. These analyses help illustrate both how the HOPE VI project has changed the spatial character of crime in Durham, as well as how it has affected the safety experienced by former residents of the

project.

I specifically selected violent crimes, which I define as the sum of all aggravated assaults and robberies, for a number of reasons. First and foremost, these crimes are often considered among the most severe and of greatest concern to policy makers. Secondly, they are fundamentally interpersonal crimes, most frequently committed against one individual by another, and thus are more responsive to changes in social dynamics, as opposed to the location of property or other external factors which influence crimes such as burglary or larceny. Additionally, I exclude simple assaults from this analysis, because preliminary analysis shows that these crimes were largely clustered around bars and nightclubs where minor fights may be more likely to break out, and hence obstructed analysis of other city-wide trends. While some measures of violent crime incorporate sexual assaults and homicides, I exclude sexual assaults because they require a very different model of potential victims and potential offenders than other violent crimes, and I exclude homicides because they are both much rarer and much more unevenly distributed events.

## *Data Preparation*

Because all crime report data were obtained in the form of a point shapefile with associated attributes, the data required several additional preparation steps before being processed. Chiefly, because this study concerns the frequency of violent crime, and because the $G_i^*$ and local Moran's $I$ statistics require spatially explicit quantities rather than point data, areal-specific counts were required. Here I discuss the specific preparation of the data.

### *Spatial Crime Data*

This study focuses on a single primary data set of all crimes within the city limits of Durham reported to the Durham Police Department (DPD) from 2002 through 2005. This

data set owes its existence to the Durham Crime Mapper project, a public information project established by the DPD in response to requests from the local Partners Against Crime (PAC) groups for more information in a more timely manner regarding crime. In response, the DPD began to geocode all crime reports by address and maintain them in shapefile format for publication via the web. Additionally, DPD agreed to make a restricted version of this data set available for research purposes, with geographic information included.

Upon delivery from the DPD, the data consisted of a single ESRI point shapefile containing all points from 2002 through mid-2005. In order to permit further processing, I segmented the data by year, then split out portions by crime type as needed. As provided from the DPD, each crime is coded under the FED_CLASS variable. Table 2 shows the types of crime which collectively defined violent crime, and their associated codes.

*Table 2 Types of crime and associated code used to define violent crime*

| ***FED_CODE*** | ***Crime Type*** |
|---|---|
| 5 | Robbery – Firearm |
| 6 | Robbery – Knife or Cutting Instrument |
| 7 | Robbery – Other Dangerous Weapon |
| 8 | Robbery – Strong Arm |
| 9 | Aggravated Assault – Firearm |
| 10 | Aggravated Assault – Knife or Cutting Instrument |
| 11 | Aggravated Assault – Other Dangerous Weapon |
| 12 | Aggravated Assault – Hands, Fists, or Feet |

For the purposes of this analysis, I wished to examine the immediate effects of the demolition of the Few Gardens complex and the relocation of many of its residents. With the

demolition occurring in July 2003, and residents relocating primarily in the months immediately preceding, I chose to examine annual crime rates for the years 2002 and 2004. After splitting violent crimes in 2002 and 2004 into separate shapefiles for each, I aggregated the sets into counts per areal unit for various different sets of areal units described below. Aggregation was performed using the spatial join feature of ESRI's ArcMap product, which produced a simple count of the number of points in each set which fell inside the boundaries of each areal unit. These counts became the primary representation of crime victimization in the spatial analysis discussed below.

I note briefly that the data as provided by the DPD includes significantly more detailed information on the dates and times of individual offenses. As such, many different possible ways of subdividing the data set exist which might illuminate various aspects of crime distribution. For this study, I elected to examine changes between two different complete calendar year, regardless of the day of year or time of day when the crimes were committed. While variability undoubtedly exists across diurnal and seasonal ranges, attempts to analyze fine-grained changes in the spatial distribution require large numbers of points in the data set as a whole, which are not available when numbers are split individually. Additionally, yearly subdivisions align with the federally mandated annual Uniform Crime Reports which police departments must file. Furthermore, in the case of violent crime, offenses are a concern regardless of when they occur or what time of year. While more finely grained temporal data may be of interest in improving monitoring, prevention, and enforcement, for the purposes of evaluating the effects of the HOPE VI project these variations merit less emphasis.

### *Census Data*

In order to examine population trends, I obtained several different sets of census data. All data were obtained from ESRI's Data Portal site (http://www.esri.com/data/index.html), which provides Census data sets (among others) which have already been converted into shapefile format or .dbm format, making them convenient for use in ESRI's ArcGIS software packages. I obtained two different spatial scales of census data for Durham County: census blocks and census tracts. I also obtained the rudimentary SF1 report data for each, and integrated it with the spatial data via spatial joins on the **STFID** field, which is unique for each census unit.

The final set of census blocks for analysis resulted from first an automatic selection of census blocks with any segment of their borders within three miles of the center of downtown Durham, followed by a manual adjustment. This adjustment involved trimming and expanding in order to get eliminate irregularly shaped blocks which greatly stretched beyond all others, and to restore small census blocks which were not initially included but which filled gaps between larger blocks which had been included. Finally, because the crime data originated with the Durham Police Department and hence are limited to crimes that occur within the city limits, I excluded census blocks which fell outside the city limit. The resulting study area ranged roughly between the following bounds: Martin Luther King Jr. Boulevard to the south, the Joyland neighborhood to the east, Duke Forest to the west, and the Eno River to the north. This represents roughly a third of the area of the city of Durham, and I state subjectively that it represents the older urban core of Durham.

Census tracts were selected to both align roughly with the census block set, and to be completely within the city limit.

*Lattice Spatial Grid*

While census blocks provided the areal units for preliminary analysis, irregularities in size and shape of the blocks may introduce errors into the calculation of spatial statistics. As such, a regular lattice of units of equal size and shape may help to correct for these errors. I used the GenerateLattice tool, written by Eran Rivlis and available from the ESRI ArcScripts archive, to create a several different lattices of square cells of different sizes to compare for use in crime analysis. As discussed above, the selection of an appropriate cell size requires a trade-off between increased grain and aggregating at a high enough level that the variation between counts is enough to find differences in the spatial stats.

To create a regular lattice system for the city, I first focused on attempting to identify a cell size which would roughly approximate four rectangular blocks together. Due to the lack of a regular grid system in Durham, although the blocks are generally rectangular, there is no block length or width which predominates the city. However, many block lengths in Durham range around 200-250 feet, so a lattice of 500 ft. by 500 ft. cells was tried initially. Preliminary aggregations resulted in a very sparsely populated matrix. The mean count per cell was well below 1, not close to the two-events-per-block rule of thumb discussed above, and preliminary statistical runs found little to no difference in patterning from a random distribution. Additionally, due to the number of cells involved, statistical calculations became very computationally time consuming. As a second run, I created a lattice of 1000 ft. by 1000 ft. cells and re-aggregated the data. Counts and preliminary patterns improved, but many of the same symptoms still resulted. The event count per cell at this level of grain averaged to around 1.4. Next, I tried a cell size of 1320 ft., equal to .25 miles, a distance frequently used in planning literature to identify close walking distance in a neighborhood

(for example, Nasar *et al.* 1995). This yielded a mean count per cell of 2.1, and preliminary statistical runs showed stronger signs of non-random patterning.

### *Weights Matrix Determinations*

In preliminary analyses using the census block areal unit set, I created the weights matrix using a simple inverse distance formulation, a commonly used formulation, as a starting point for examination. For this set, this resulted in clear zones of high and low clustering across multiple types of crime in different years and formulations. However, when the regular lattice areal unit set was used, preliminary results found very little spatial patterning of crime within the study area. I interpret this result to indicate the diluting effect of the larger number of under- or non-populated zones in the study area with the regular lattice. In order to address this issue, I tried different weights matrices to eliminate this effect. Among the weights matrices applied were the strict queens-rule adjacency matrix (incorporating both vertex and edge adjacency), a range of distance-based boolean adjacencies, and an inverse distance matrix with a maximum distance threshold, beyond which pairs of were treated as unassociated. Comparable examinations of spatial patterning with each of these weights matrices showed substantially more spatial patterning.

As discussed above, the final decision in selecting a weights matrix must be grounded in an underlying understanding of the processes at work. The inverse distance formulation represents a basic first-order gravity model of spatial association, which assumes that the spatial association between units is highest at close distances and declines with increasing distance. For violent crime, a wide range of underlying factors may be influencing rates, and these factors will operate a range of spatial scales. However, for this analysis, I examine trends which operate below the city-wide scale but above the block level. In this regard, I

assume that the two primary human scales involved will be neighborhood-level effects and, given that violent crime is inherently interpersonal, those which involve the movement of perpetrators and victims. Movement via automobile or city bus service will be unlikely to show strong distance-decay effects within city limits, so I will assume that strong spatial trends which emerge from movement effects will be based on pedestrian movement. As such, a distance of .5 mi should incorporate most neighborhood-level and pedestrian-level effects. Based on this, for final analysis I used an inverse distance matrix with a half-mile maximum distance threshold to represent the spatial association between cells in the lattice.

### *Population Data*

Given that the residential population as determined by the census at the block level may not be appropriate for estimating the vulnerable population, and as such may not be appropriate for normalizing data to estimate crime rates which accurately reflect risk, I determined that simply calculating the number of crimes per resident in each census block was not appropriate for determining the spatial patterning of risk of crime. In order to rectify this difficulty, I attempted to derive a more realistic spatial distribution of the vulnerable population from the census block data. I assigned each cell in the lattice grid the sum of all census blocks whose centroid fell within a half-mile distance of its edge. This assignment incorporates pedestrian and short distance automotive movement from residential areas, but fails to take into account medium and longer distance movement. As such, values should be acceptable for commercial districts which serve primarily local automobile traffic and pedestrian traffic. This may be a significant source of error in Durham, where a substantial majority of personal travel occurs via automobile.

For census tract data, I considered the basic reported residential population to be an

accurate representation the vulnerable population. At this scale, the tracts will include both residential and commercial areas, so will allow for some degree of movement within tracts. Tracts with population of 1000 or lower – tracts within the central business district – were excluded from calculation due to the non-resident population effect.

In all cases, I used data from the 2000 year Census to estimate the current population. This clearly does not incorporate changes in population which may have occurred by 2002 and 2004, and therefore represents a potential source of error in the statistics.

### *Spatial Data Regarding the HOPE VI Project*

Additional data provided by the Durham Housing Authority and an evaluation of the HOPE VI project at the UNC Center for Urban and Regional Studies supplied the spatial footprint of the impacts of the HOPE VI project. A simple polygon representing the boundaries of the area approved for expenditure of HOPE VI dollars identified the location of the impacts of the physical and structural portions of the project, particularly the newly constructed housing. Additionally, I used geocoded addresses of the new addresses for all former Few Gardens residents still participating in Durham Housing Authority programs to link the findings in crime rates within the city to how those crime rates are experienced by the former residents.

## *Data Processing*

### *Crime Rates at the Tract Level*

In examining the broader trends at the census tract level, I reported standardized rates, calculated as the per capita violent crime rate in each census tract as a percentage of the city-wide per capita violent crime rate for that year. I then generated choropleth maps of these census tracts based on these standardized rates for both 2002 and 2004.

### *Clustering of Crime at Finer Scales*

*Table 3 Durham city-wide crime rates used for standardization*

| | ***2002*** | ***2004*** |
|---|---|---|
| City-wide Violent Crimes | 1459 | 1429 |
| Violent Crime per 1000 Residents | 7.801 | 7.640 |

The primary analysis examining changes at the finer scale consisted of the two local statistics of spatial clustering discussed above – the Getis-Ord $G_i^*$ statistic and the local Moran's *I*. The $G_i^*$ was calculated using the ArcToolbox script included in the ArcGIS 9 package from ESRI. For rendering purposes, the scores were rendered by Z-score to illustrate areas of high and low significance. The local Moran's *I* was calculated using the GeoDa package from the Spatial Analysis Lab at the University of Illinois – Urbana-Champaign. Basic rendering of the statistic came from the internal rendering of significance values from GeoDa.

# 3.Results

## Standardized Per Capita Violent Crime Rates at the Census Tract Level

Maps of population standardized crime rates for 2002 and 2004, shown in Map 1, reveal significant changes in the rates between 2002 and 2004. Within the boundaries of the HOPE VI project, rates for 2002 ranged from 240% to 360% of the city-wide average. By 2004, these rates had dropped to the 200-220% range, still over twice the city-wide average, but clearly lower than the 2002 rates. This decline was not limited to the area inside the HOPE VI district, though – all but two of the census tracts neighboring the HOPE VI area saw declines in violent crime. However, it is worth noting that one of the two neighboring census tracts contains McDougald Terrace, an area which contained one of the highest number of relocated residents from Few Gardens. This is an exception to the overall trend in the central neighborhoods of the city, where crime rates broadly decline (See Map 1. All maps located in Appendix A.).

Census tracts in the central business district were excluded, because while many people visit these areas on a daily basis and thus are exposed to the risk of violent crime in the area, each contains very few residents. As such, per capita crime rates per tract come out abnormally high, and are not suitable for comparison with other census tract values.

## $G_i$* Local Spatial Cluster Analysis by Census Block

In examinations of the Getis-Ord $G_i$* statistic for area-normalized rates per census block for both 2002 and 2004, shown in Map 2, similar trends appeared between the years. In each year, a large cluster of high violent crime rates covers the central business district and

northeast-central Durham, including the HOPE VI revitalization region. Also in both, a smaller cluster covers the West End and Lyon Park neighborhoods. In the later map, however, both regions have shrunk in size. In 2002, large clusters of low rates of violent crime rim the northwestern edge of the study area, but in the 2004 analysis, these clusters have both shrunk and decreased in intensity. These results indicate crime becoming less spatially clustered, and diffusing more throughout the city.

The census block results are problematic, however, in that the small areal size of each of the blocks leads to the vast majority of the blocks contained zero violent crime events for both years. This sparsity actually reduces the resolving power of the statistics, given the infrequency of the results. Because of this, further attempts to examine clusters in per census block change indicated essentially no clustering in change for the entire city (not shown). Hence, while this census block analysis shows the declining clustering of violent crime, consistent with the census tract results, the areal units are too spatially fine to provide sufficient inter-unit variability for full analysis using the spatial statistic. Additionally, the unevenness in areal size of the census blocks creates differences in the likelihood that a block will be identified as part of a cluster. In large census blocks, small clusters within a portion of the block could exist, but would be "washed out" in the calculation of crimes per areal unit by the larger size of the census block. Furthermore, in particularly small census blocks, the small area in the denominator means small changes in violent crime counts cause large fluctuations in the areal rate.

## $G_i^*$ Local Spatial Cluster Analysis by Lattice Grid

On the quarter-mile square lattice grid, unlike the census blocks, units are evenly sized and spaced and therefore should eliminate the biases caused by the unevenly sized and

shaped census blocks. As such, $G_i$* results on the grid provide a significantly different view. In a 2002 vs. 2004 comparison, shown in Map 3, while the large area of positive clustering appears in each, many smaller clusters appear in other parts of the city, indicating both clusters of high and low crime rates. In comparison between the two years, it is evident that there are shifts occurring in the specific locations of high value clusters. These trends are more clearly visible from $G_i$* results for spatial clustering of change in per cell crime counts. Map 4 identifies a large cluster of decline in violent crime rates covering the eastern part of the central business district as well as the Hope VI area and a large region to the north. This is consistent with the results shown in Map 1 of changes at the census tract level. However, also consistent with the census tract maps, the lattice grid analysis shows several smaller pockets of increasing violent crime. Several of these areas of increased crime rates fall near other DHA public housing complexes not receiving funds through the HOPE VI program.

One difficulty with the $G_i$* analysis remains its inability to discriminate between areas of frequent adjacent low values and areas where low and high values occur more closely than would be expected by random distribution. As such, using only this statistic, I am unable to determine whether the low *Z*-scores in the $G_i$* mapping are due to clusters of low values or areas of non-random intermingling of low and high values.

## Local Moran's *I* Analysis by Lattice Grid

In contrast to the $G_i$*, the local Moran's *I* statistic specializes in distinguishing between areas where strongly similar values co-occur and where strongly dissimilar values co-occur. Additionally, the local Moran's provides a statistically different yet pragmatically similar method for analyzing high and low areas of spatial clustering of crime rates. Map 5 shows the results of a local Moran examination of changes in violent crime rates per lattice

cell between 2002 and 2004. These results show subtle differences from the $G_i$* analysis. For one, the cluster of decline in crime rates covering the central business district and the HOPE VI district, while largely the same in nature, does not extend quite as far in all directions. More importantly, areas of strong decline in and around the HOPE VI area are dotted with a small number of areas where values sit up significantly higher than those around them. An important feature of these statistics, however, is that areas of slightly above average crime rates will be more likely to be identified as a "high-low" region when surrounded by low values. As such, the pink squares intermixed with the large block of blue in Map 5 do not necessarily indicate pockets of increasing crime, but may indicate pockets where crime has not fallen as significantly as the areas around them.

Another way in which the local Moran's analysis echoes that of the $G_i$* analysis is the identification of areas of the city outside the HOPE VI region where violent crime is increasing. Maps 4 and 5 also show the location of the former residents of the Few Gardens complex which remained in a DHA housing program. While these residents relocated to a number of different parts of the city, Map 4 illustrates that in many of the areas where large numbers of former residents relocated to, particularly McDougald Terrace, Oxford Manor, and Damar Court, violent crime increased somewhat between 2002 and 2004. The standardized rates from the census tracts illustrate that even after these increases violent crime is still far lower in these new neighborhoods than it was in the area around Few Gardens before it was demolished. Even so, the detection of trends over a two year span indicates a meaningful swing towards increased violent crime in these areas.

## $G_i$* Analysis of Population Standardized Violent Crime Rates

While the aggregation of violent crime counts to a regular lattice grid provides areal

standardization, that aggregation contains no correction for underlying differences in population. Map 6 shows an analysis similar to Map 4, but rates are standardized by the half-mile population buffer described above before calculating the $G_i^*$ statistics. The areas identified as having significantly clustered differences in rates between 2002 and 2004 are almost entirely areas with low residential population but high commercial traffic, including the central business district downtown, a large commercial strip along Hillsborough Rd., commercial centers on the east side of town, and the area surrounding the city's waste management facilities. These clusters likely emerge from small changes in actual counts of violent crimes being amplified by very low residential population values, thereby masking any results occurring elsewhere in the city. Additionally, these areas are unique because not only do they have low local populations, they are also surrounded by areas with low population, thereby preventing the model from recognizing any population within the half-mile buffer distance. It is reasonable, therefore, to conclude that even with the half-mile inclusion buffer surrounding all cells, large areas of low population still confound attempts to base spatial statistical calculations on rates standardized to the residential population.

# 4.Discussion

The univariate quantitative methods used in this study do not lend themselves directly to quantitatively evaluating explanatory models of violent crime. However, the characterization which these methods provide of the changes in spatial patterns of crime may then be applied in a qualitative examination in the broader context of the driving forces of neighborhood change in Durham.

## The Impact of HOPE VI

While the various tests of changes in spatial violent crime distribution show at times differing results, a handful of trends are clear in all of them. Without question, consistent with perceptions of the police and of residents as reported in the local newspapers, the Few Gardens area experienced far and away the most violent crime of any location in the city in 2002. Additionally, between 2002 and 2004, with the demolition of Few Gardens and the construction of the HOPE VI project, violent crime in the area declined precipitously. Both census tract analysis and single year cluster analysis still show that northeast-central Durham retained some of the highest rates of violent crime in the city in 2004 and that these rates were still highly clustered, but they were far lower than they were in 2002.

The methodology employed here provides no mechanism for determining the exact causes of this change. However, given the very short time frame involved, the underlying causes of the shift in pattern must be spatially explicit and limited, because the decline did not occur citywide, and they must be limited to the two-year period. As such, while this analysis does not incorporate other factors which might have influenced the change, the

combination of the demolition of Few Gardens and the expenditure of over $30 million on a mixed income housing redevelopment throughout the district clearly stands out. I can think of no other factor which approaches the level of impact on the urban landscape, and therefore conclude that the most parsimonious explanation for the decline in crime rates in the area relates to the HOPE VI project.

Accepting this conclusion, though, raises the question of the mechanism by which the HOPE VI project produced these changes. Much of the justification behind the HOPE VI project came from Wilson's theory of concentrated disadvantage, with the idea that mixed income housing such as HOPE VI should reduce the spatial concentration of this disadvantage. Proponents of order maintenance policing, on the other hand, would likely be quick to identify the rather substantial decrease in physical disorder in the area. Others might identify the increased attention and surveillance that the area has received, and note that potential offenders might look elsewhere when faced with such surveillance. And finally, Sampson and his colleagues could argue that the HOPE VI project somehow increased the collective efficacy with which the surrounding community worked to enforce social norms.

## Increased Crime Elsewhere in the City

Concurrent with the decreases in crime in the HOPE VI area were increases in violent crime in a handful of smaller pockets throughout the city. Understanding these trends presents more of a problem than understanding the trends in the HOPE VI area, because there is no single factor which overwhelms the changes on the urban landscape. In light of the changes in east Durham discussed above, potential explanations for these pockets of increase fall into two categories – causes that are associated with the HOPE VI project directly, and those that are not. The higher occurrence of violent crime in some areas where former Few

Gardens residents relocated to hints at a connection, but this connection presents as many questions as answers. While violent crime did arise near several of the complexes, many former residents also relocated to the Cornwallis Road, Edgemont Elms, and Forest Hills Heights complexes, all of which saw clusters of decline in violent crime following the relocation. This casts doubt on any contention that this relocation solely caused the increases.

If any connection does exist, the relatively small number of residents who actually relocated to any given housing complex in comparison to the number of other residents already living there makes it highly unlikely that the actual former Few Gardens residents perpetrated the additional violent crimes. More likely explanations that involve the relocated residents exist. One such possible explanation is that as lower income, often politically and economically marginalized citizens, the former residents may be more prone to robbery, and hence are more likely to be victimized wherever they live. Another such explanation follows on the work of Pattillo and Browning, in which while committing no criminal activity, the former residents may belong to social networks which may at times serve to protect offenders. As such, violent crime may be more likely to occur in the areas they live. However, this also fails to explain why violent crime decreased in many of the neighborhoods to which other former residents relocated. In this light, I do not perceive such effects which are linked to former residents to be a major factor in the patches of increase, although the limited scope of this study precludes more definitive conclusions.

If, on the other hand, increased investment, surveillance, order, or collective efficacy at the HOPE VI complex causes the area to be less attractive to offenders, they may seek out areas where these factors are lower. The anecdotal data and subjective impressions provide

more support for this. Damar Court and Oxford Manor, two complexes that saw an increase in violent crime rates, lie in areas with aging infrastructure. Oxford Manor sits behind a large shopping center, including a Wal-Mart, which has not been physically upgraded in several years. In contrast, Edgemont Elms, a complex which saw decreases in violent crime, lies within the HOPE VI district. Forest Hills Heights, another such complex, sits just on the other side of the Durham Freeway from the American Tobacco Historic District, a private historic redevelopment of a shuttered cigarette manufacturing plant which received substantial public subsidy.

This raises the concern, particularly articulated by Fraser (pers. comm.), that while the HOPE VI investment may help to rehabilitate the physical area it targets, some of the former residents may miss out on the benefits due to forced relocation, and that the new neighborhoods they relocate to are beginning to experience the same sorts of issues which troubled the Few Gardens complex. Although none of the new neighborhoods that these residents have relocated to experienced violent crime levels in 2004 anywhere close to the violent crime rates at Few Gardens in 2002, the increases in violent crime over just a two-year period near these other complexes poses a troubling trend for the future. While there is no certainty that these trends will continue, local governmental excitement over the success in the HOPE VI district should not blind local decision makers to the potential problems which may emerge in other complexes which have not received the same attention. In this vein, I hope that the results of this study may provide some direction to areas in need of further attention.

## Methodological Issues

Aside from what information these results may yield about the situation in Durham,

the process of the study revealed a number of methodological issues involved in the application of spatial statistics to crime. Regarding the modifiable areal unit problem in regards to crime analysis, the results of this study provide an ample demonstration that it is indeed a problem. Selection of the size and shape for the units to take represents the most basic difficulty presented in selecting areal units. Large units, such as census tracts, allow for easier normalization by population and ensure enough reported crimes in each unit to provide for a meaningful range of values, as well as helping to weed out minor, spurious shifts, but only provide a very coarse view of the spatial patterning. Small units, on the other hand, such as census blocks, allow for greater spatial resolution, but they so restrict the number of reported crimes in each unit that the application of spatial statistics becomes difficult. Additionally, analysis at such a fine grain may become susceptible to being overwhelmed by noise resulting from minor shifts.

In addition to issues regarding the size of the areal unit, these results demonstrate the importance of how the shapes of the areal units are defined. Census units follow meaningful boundaries of the urban landscape, but particularly in a city such as Durham which lacks a regular grid system, census blocks will vary greatly in size, and some will have irregular shape features, such as long narrow stretches or concave regions. On the other hand, while the regular lattice grid enforces a regularity of shape and size, the arbitrary positioning of the boundary lines means that individual blocks, apartment complexes, and housing projects will be split between two (or possibly four) units. For most purposes, the advantages of the regular lattice will outweigh the difficulties, but each study must evaluate the merits of both approaches on a case-by-case basis.

An even greater difficulty encountered in this study, with more substantial

implications for results, is how to represent the population at risk of victimization. With the available data, the most successful results for this study came from simple normalization by area. This should not suggest, however, that this result implies that spatial variations in at risk population are unimportant – rather, it should suggest that this population is very hard to accurately quantify in a spatial form purely from census data. Given sufficient data and processing resources, a spatially explicit model of active population at various times of day would provide a far more robust basis for deriving locally standardized crime rates.

## Directions for Further Work

While this study provides hints at strong effects underlying the spatial distribution of violent crime in Durham and how projects like HOPE VI may alter that distribution, for the most part they remain hints. Similar work with spatial statistics to provide stronger, more robust understanding of these distributions would require both additional data sources, quantifying the many factors which might contribute to the changes in spatial distribution, as well as multivariate statistical techniques in addition to the univariate techniques used in this study. As discussed earlier, the most meaningful if potentially difficult additional factor which could be added to this study would be a spatially explicit representation of the vulnerable population. This conceivably could be developed as an activity model incorporating residential, employment, and retail data, as well as traffic counts and transportation models. Alternately, a spatial interpolation model could be built from empirically collected activity counts at key areas of the city. Even here, however, spatial interpolation becomes difficult, because activity counts do not vary smoothly along Euclidean distances, but follow rigid features of the urban landscape.

Census data in addition to residential population levels could also be incorporated,

using measures such as income, employment, and demographic data to develop measures of concentrated disadvantage along the lines of the Morenoff *et al.* (2001) study. Furthermore, if, as discussed above, public and private investment in an area may influence crime rates, spatially explicit data sets containing information such a local transportation spending, private commercial investment, and housing construction might provide explanatory context. For quantifying measures such as social connectedness, social order, and community organization, a wide variety of well established survey techniques exist, including Sampson and Raudenbush's (1997) measures of collective efficacy. Measures of physical and social disorder collected through systematic social observation techniques would allow future studies to further address the order maintenance policing debate.

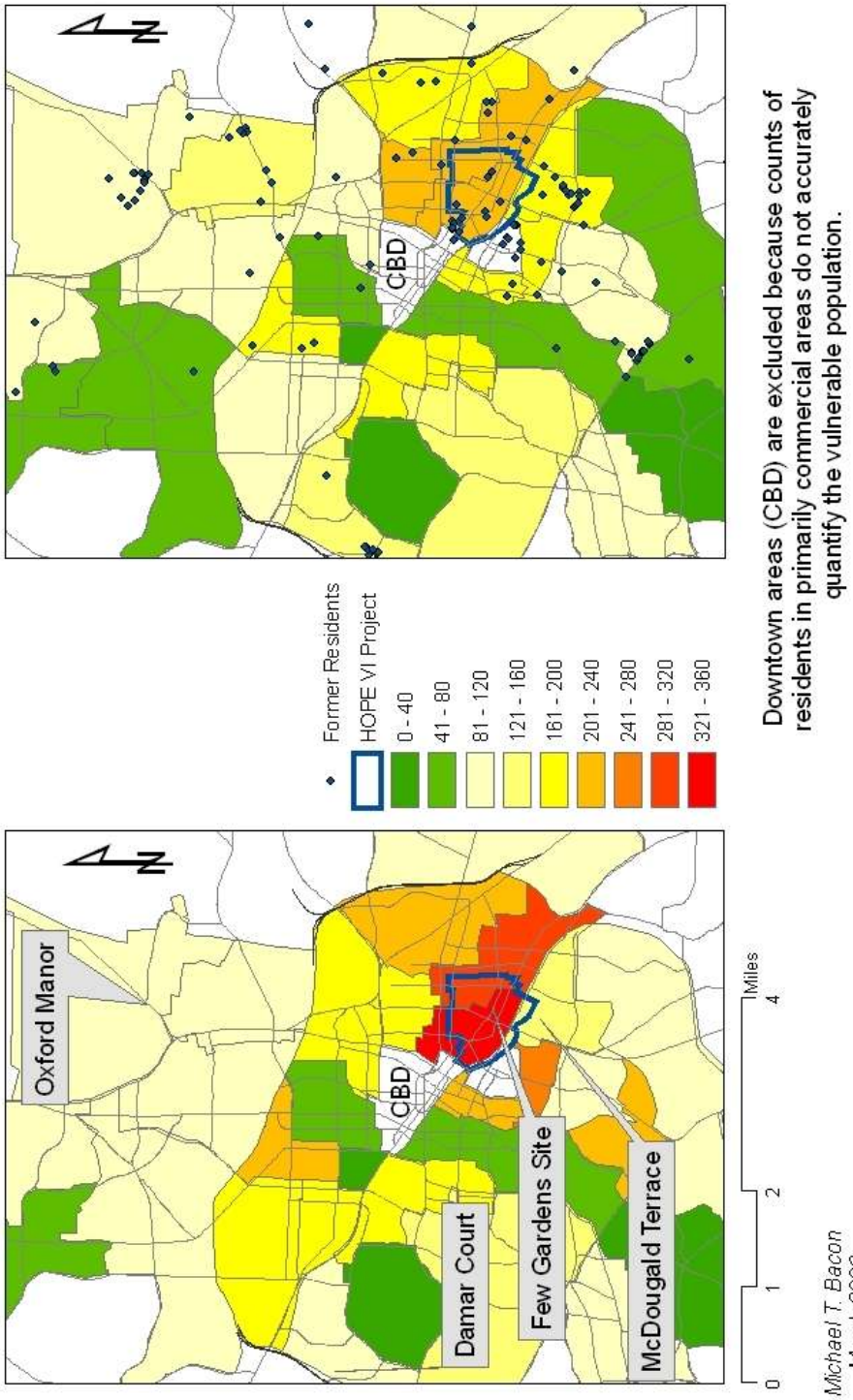
With some collection of these data sets in hand, spatial regression stands out as the most logical multivariate technique for examining spatial trends in crime. In many ways, the work and results of this study lay the groundwork for a more comprehensive spatial regression analysis. Like the univariate techniques discussed here, spatial regression requires the definition of areal units and the establishment of a spatial weights matrix. Additionally, Getis and Aldstaat (2004) advocate for the construction of a weights matrix based on the optimization of certain aspects of the local $G_i^*$ statistic for key spatial variables, and go on to demonstrate the efficiency of this technique in improving the results of regressions. As such, the work here to develop methods for calculating the $G_i^*$ could also contribute to an improved spatial regression.

Finally, there remains a strong need for qualitative data collected from residents, community leaders, city officials, law enforcement officers, and other stakeholders, both to ensure that the trends identified using qualitative analysis are not spurious or misleading, and

to provide deep theoretical understanding of the processes and practices which create the urban landscape of safety and crime victimization. In this examination, the analytical framework must incorporate both ways in which the physical and economic processes shape the patterns of social interactions, and the mechanisms by which the social and political forces produce the physical and economic landscape. The most robust theoretical models will incorporate this socio-spatial dialectic, and not merely focus on models of unidirectional causality. I feel that this should not be understood as a particular difficulty in examining urban crime, although the aspects of crime which necessitate this dual examination framework may cause theoretical headache. Instead, I see criminological analysis as a particularly measurable and politically important aspect of urban studies which provides insight into a broader complex of urban social structures. And, as detailed earlier, I feel that the spatial aspect of these structures has been neglected for too long, and merits substantial future attention.

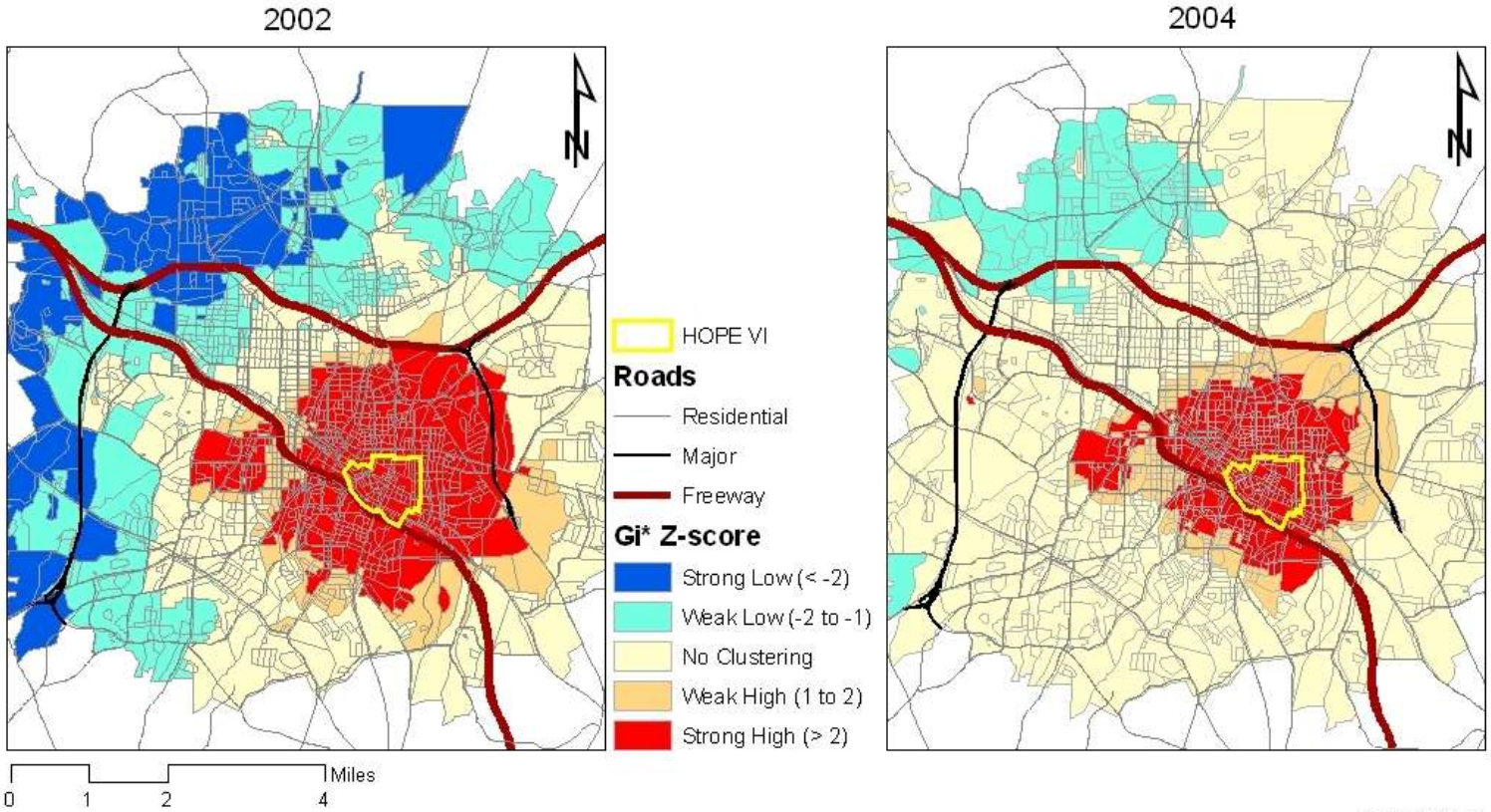
APPENDIX A

**Map 1:** Per Capita Rate of Violent Crime by Census Tract as a Percentage of City-Wide Rate



## Map 2: $G_i$* Statistic of Local Clustering of Violent Crime

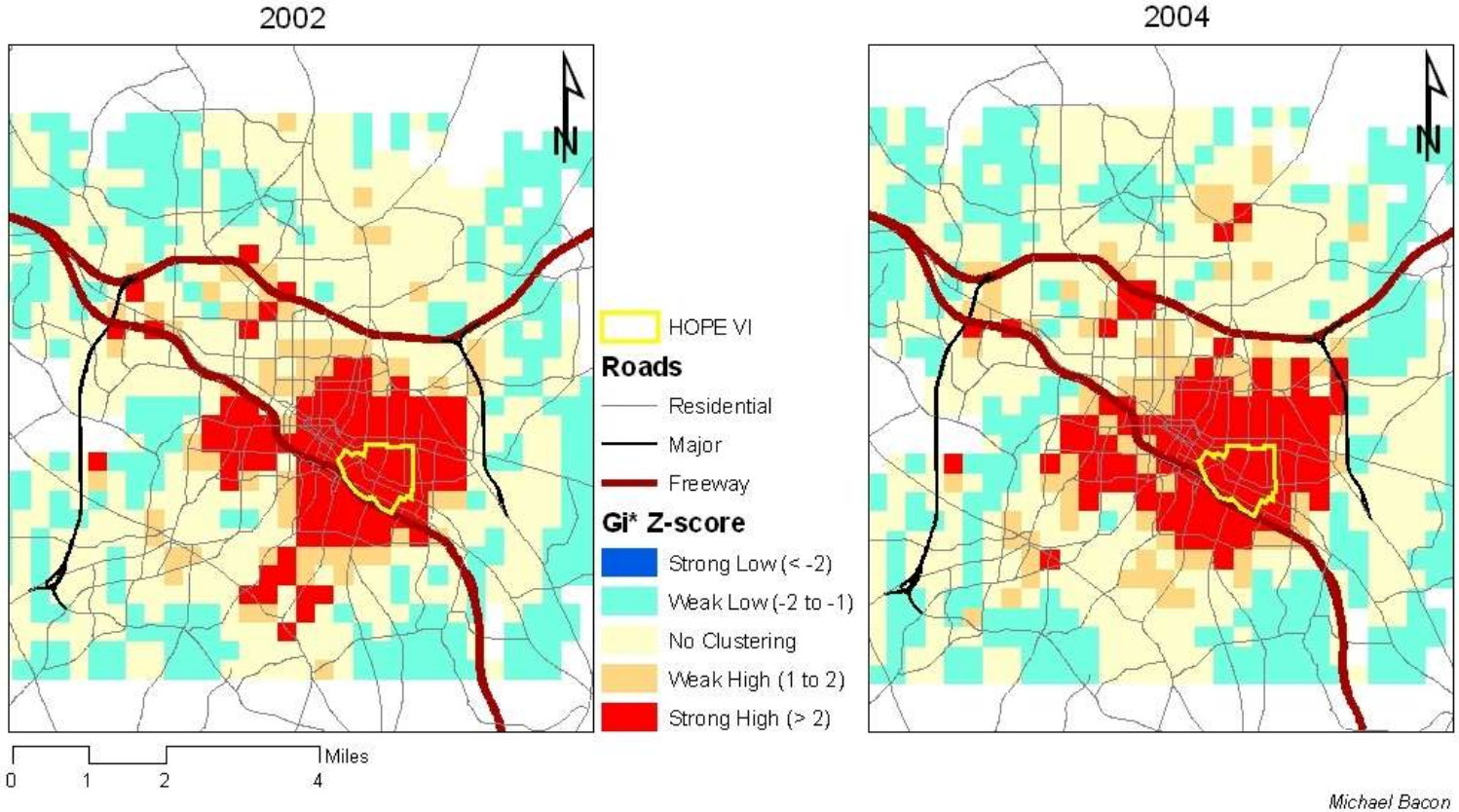
Points Aggregated to Census Block, Normalized by Area




*Michael Bacon*
*April 2006*

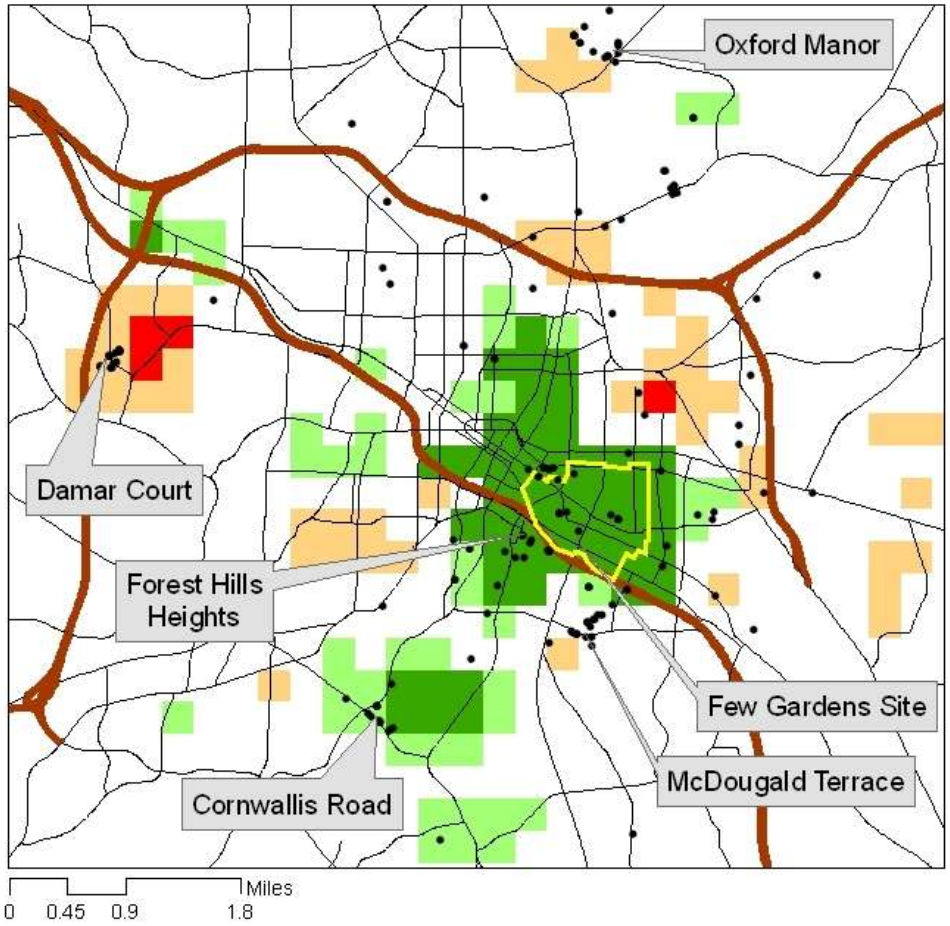
# Map 3: $G_i$* Statistic of Local Clustering of Violent Crime

Points Aggregated to Quarter-Mile Lattice Grid



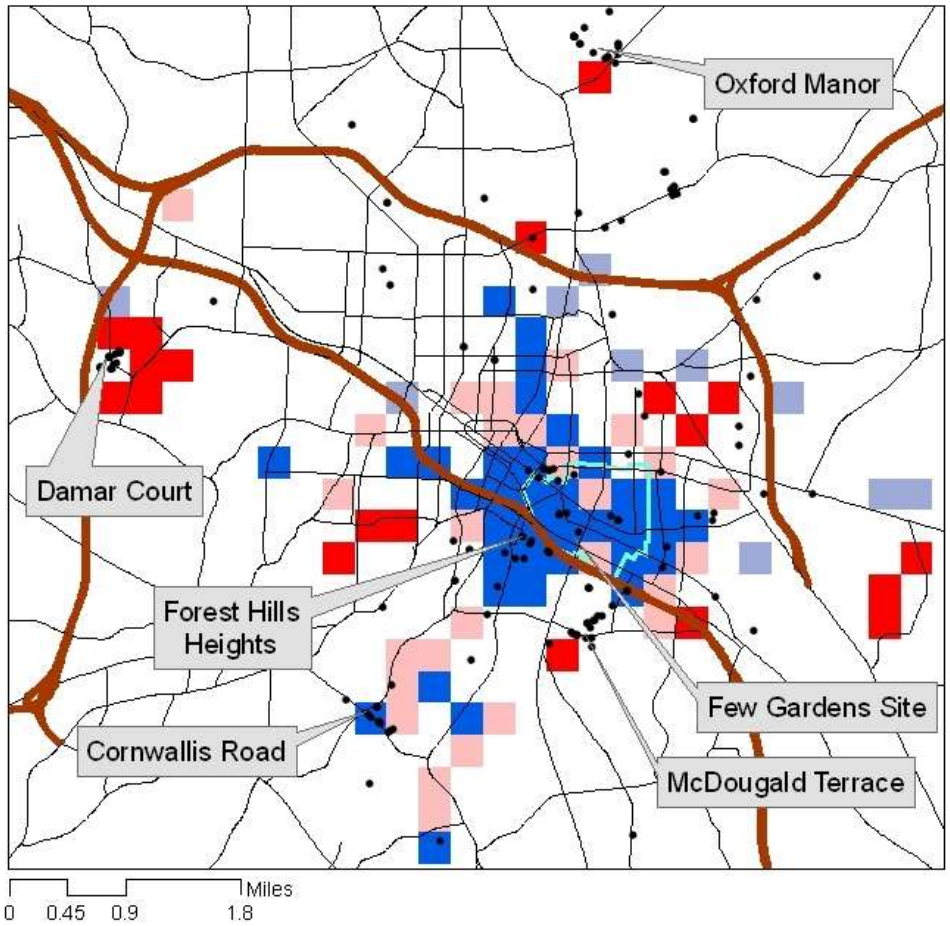

*Michael Bacon*
*April 2006*

# **Map 4**: $G_i^*$ Cluster Analysis of Change Between 2002 and 2004 in Violent Crime (Robbery and Aggravated Assault)




*Michael T. Bacon*
*2006*

**Map 5**: Local Moran's *I* Cluster Analysis of Change Between 2002 and 2004 in Violent Crime (Robbery and Aggravated Assault)




Labels identify three existing public housing complexes and the site of the former Few Gardens complex, demolished under the current HOPE VI program.

**HOPE VI Project Boundary**

Few Gardens/NE Central Durham

**Violent Crime**

**Local Indicator of Spatial Autocorrelation**

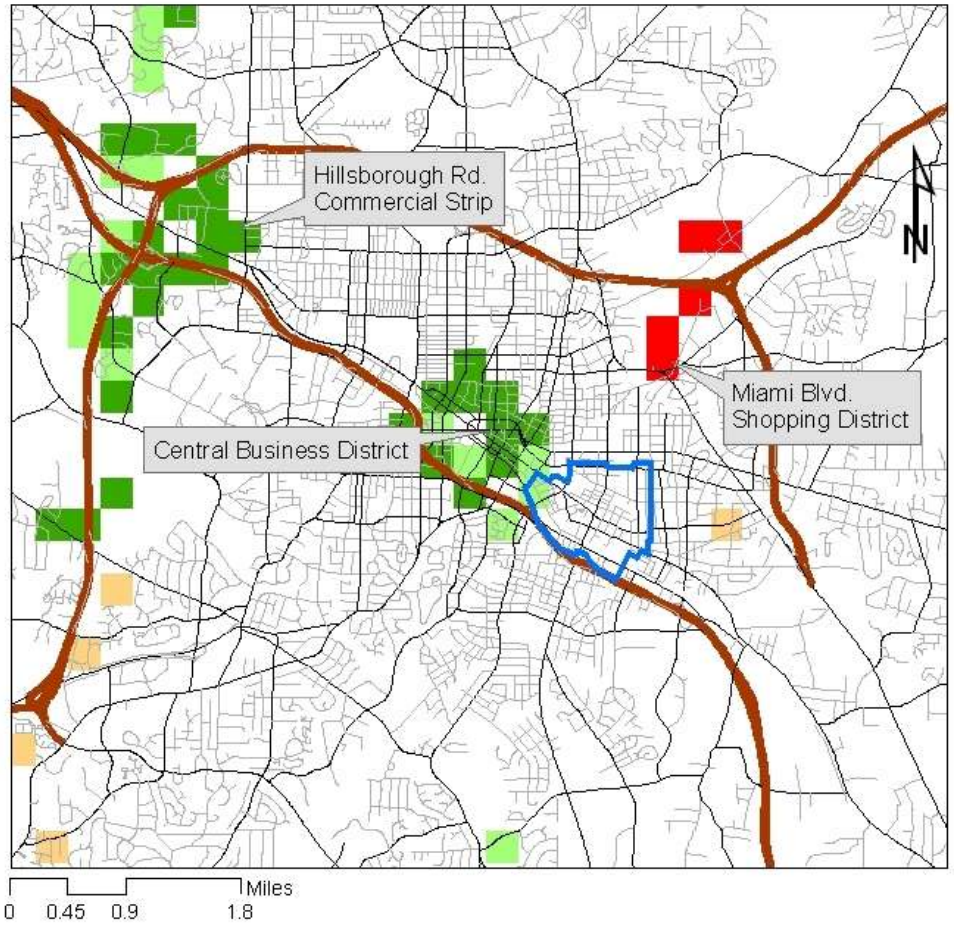
- Not Significant
- High-High
- Low-Low
- Low-High
- High-Low
- Former Few Gardens Residents

**Roads**

- Collector
- Freeway

*Michael T. Bacon*
*2006*

# Map 6: $G_i^*$ Cluster Analysis of Population Adjusted Change in Violent Crime Between 2002 and 2004




Clusters identified by $G_i^*$ analysis appear in areas of high foot traffic but low population. Low population values amplify changes in crime, which then cause these commercial areas to stand out in analyses of change. This demonstrates, more than anything, problems with the buffered population model.

**HOPE VI Project Boundary**
Few Gardens/NE Central Durham

**Gi* Z-score**
Strong Low (<2 Std. Dev.)
Weak Low (<1 Std. Dev.)
No Clustering
Weak High (>1 Std. Dev.)
Strong High (>2 Std. Dev.)

**Roads**
Residential
Collector
Freeway

*Michael T. Bacon*
*April 2006*

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