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Road Networks, Social Disorganization And Lethality, An Exploration Of Theory And An Examination Of Covariates

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ROAD NETWORKS, SOCIAL DISORGANIZATION, AND LETHALITY, AN EXPLORATION OF THEORY AND AN EXAMINATION OF COVARIATES

by

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ABSTRACT

Utilizing a Criminal Event Perspective, the analyses of this dissertation test a variety of relationships to the dependent variable: the Criminal Lethality Index. Data from the National Incident-Based Reporting System, the Census and American Community Survey, the American Trauma Society, and data derived from the Census's mapping TIGER files are combined to create a database of 190 cities. This database is used to test road network connectivity (Gama Index), medical resources, criminal covariates and Social Disorganization variables in relation to a city's Criminal Lethality Index.

OLS regression demonstrates a significant and negative relationship between a city's Gama Index and its Criminal Lethality Index. In addition, percent male, percent black, median income and percent of the population employed in diagnosing and treating medical professions were all consistently positively related to Criminal Lethality. The percent of males 16 to 24, percent of single parent households, and Concentrated Disadvantage Index were all consistently and negatively related to Criminal Lethality. Given these surprising results, additional diagnostic regressions are run using more traditional dependent variables such as the number of murders in a city and the proportion of aggravated assaults with major injuries per 100,000 population. These reveal the idiosyncratic nature of utilizing the Criminal Lethality Index. This dependent variable has proven useful in some circumstances and counterintuitive in others. The source of the seemingly unintuitive results is the fact that certain factors only reduce murders but many factors impact both murder and aggravated assaults, thereby creating difficultly when trying to predict patterns in Criminal Lethality.

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CHAPTER 1: INTRODUCTION

Research surrounding murder has expanded our knowledge of the crime in that it has established economic, demographic, and criminal correlates to murder rates (Wolfgang, 1958; McCall, Land and Parker, 2010). This research has also established the dynamics of the relationships between social disorganization and murder[1], the motivation of the offender and murder, as well as other important contributing factors to the crime (Cohen, Nisbett, Bowdle and Schwarz, 1996; Martinez, Rosenfeld and Mares, 2008; Felson and Painter – Davis, 2012). While research focused specifically on murder is invaluable to our understanding of the crime, it is inherently limited in scope. This limitation stems from the fact that murder research by definition only examines all of those crimes that result in murder. This way of thinking, though informative, inherently misses part of the larger picture in that it does not take into account all of those crimes that *could have been murder*, but for a variety of reasons turned out *not to be murder*[2]. By adopting a different way of thinking, which examines the crimes that could have lead to murder as well as the crimes that did lead to murder, all of those details that kept a crime from turning into a murder become important objects of research and understanding.

[1] For this dissertation, the terms "homicide" and "murder" are used interchangeably.

[2] Though many crimes that are potentially lethal are difficult to discern in traditional data, modern data sources offer researchers options for identifying crimes that were not available in the past. These options include identifying crimes with elements of severe bodily harm but do not result in murder, thereby giving researchers a reasonable approximation of crimes that are "potentially lethal".

The concept of Lethality[3] offers researchers a way of examining not only those factors that raise the rates of homicide but also those factors that may act to lower them.

Assuming that lowered murder rates are the ultimate goal of most public policy regarding murder, lethality research can be a valuable tool for policy makers. If policy makers can act to lower the *lethality* of violence in an area, assuming stable rates of potentially lethal violence, lowered murder rates will naturally follow. The ability of lethality research to study the broader roots of murder compels policy makers to change their focus from asking only what they can do to change potential offenders to also considering what can be changed external to the potential offender that may ultimately act to lower murder rates. In other words, lethality research recognizes murder as the outcome of a social process and allows for the identification of preventative as well as contributing factors in that process (see Luckenbill, 1977).

The concept of lethality is a relatively recent feature of criminology. First proposed in the late 1950s it has seen a steady increase in academic attention paid to it in the past decade (Thomas, Fisher and Hirsch, 2002; Weaver, Wittekind, Huff-Corzine, Corzine, Petee and Jarvis, 2004; Libby and Corzine, 2007; Harris, Libby, 2009; Felson and Painter-Davis, 2012; Konty and Schaefer, 2012). These studies have largely been concerned with the covariates of lethality. Many of these studies have been done on an incident level, examining what factors associated with specific crimes raise the likelihood of a lethal outcome. Factors found to be associated

[3] Lethality is defined as the number of murders divided by the number of murders plus the number of aggravated assaults in an area over a given time frame. This is essentially everything that is a murder divided by everything that could have had the outcome of murder. The values generated will fall between 0 and 1 with 1 representing more lethal outcomes and 0 representing less lethal outcomes. For example, an outcome of .31 would mean that of all the potentially lethal crimes known to law enforcement 31% resulted in a lethal outcome (a murder).

with a rise in lethality include the involvement of drugs, the age of the offender, the age of the victim, the use of a weapon, the type of weapon, and the type of firearm used (Weaver et al., 2004; Libby and Corzine, 2007; Libby, 2009). In addition to contributing factors, researchers are also examining preventative factors.

A preventative factor examined in past research has been the role of medical resources in lowering or raising lethality and murder rates (Doerner, 1983; Doerner and Speir, 1986; Doerner, 1988; Giacopassi, Sparger and Stein, 1992; Long-Onnen and Cheatwood, 1992; Harris et al., 2002; Regoeczi, 2003; Chon, 2010). In general, it has been found that the quicker the access and the more advanced and plentiful the medical resources, the less lethal any given injury is likely to be. One of the major medical resources some studies have highlighted is the role trauma centers play in lowering lethality in a given area (Nathens, Jurkovich, Cummings, Rivera and Maier, 2000; Regoeczi, 2003). These centers have proven invaluable in reducing lethal outcomes and increasing the survivability of major injuries. In addition to the speed, abundance, and quality of medical resources, studies in fields separate from criminology have begun to explore the part that reliability of access plays in lethal and non-lethal outcomes.

One recent field of study that has given attention to maintaining access to medical resources is a subfield of disaster preparedness research that utilizes network reliability analysis to assess the role of road networks in the response to large scale disasters (Sullivan, Novak, Aultman-Hall and Scott, 2010; Taniguchi, Ferreira and Nicholson, 2012). In general this field has found that the more connected a road network, the more resilient it is during large scale disasters. The current study proposes an expansion of this dynamic into “everyday” emergency situations. Under this conception, the more connected a road network the more beneficial it will be to the process of mobilizing the lethality-preventative factor of emergency medical services.

As the research surrounding lethal and non-lethal outcomes expands in multiple disciplines, this study contributes an examination of multiple contributing and preventative correlates of criminal lethality using city-level data. This is a unit of analysis that is not often used in lethality research; however, the city as unit of analysis allows for the identification of ecological correlates of lethality rarely available when utilizing incident-level data. The current study is an examination of multiple ecological factors that may impact the lethality of an incorporated area with over 50,000 residents. A criminal events perspective is used to examine the ecology of lethality in a sample of 192 cities. This perspective works well with the lethality concept because both place emphasis on identifying multiple contributing and preventative factors. In addition to the analysis of correlates utilizing the criminal events perspective, a theoretical test is undertaken using Social Disorganization Theory. This is done to explore the possibility that this well-entrenched theory has implications for the concept of lethality at the city level of aggregation.

Perhaps one of the most significant contributions of this study is a proposed link between more connected road networks, as measured by a network connectivity index, and a lowering of lethality. In addition to road network connectivity as a preventative factor, this study contributes to the understanding of crime by testing other possible ecologically driven relationships such as the linkages of trauma centers, the proportion of young men present in a city, the availability of firearms in a city, and the relative size of drug markets with lethality. Also tested are city-level interaction effects. These are derived from larger aggregate criminogenic variables that the criminal event perspective suggests may be important to the micro confluence of vectors that result in a criminal event. This is in keeping with Anderson and Meier's (2004) call for further study of interaction effects in the criminal events perspective. Finally, this study contributes a test of Social Disorganization variables and lethality at the city level. These tasks are carried out with data gathered from the American Community Surveys (ACS) of the U. S. Census Bureau, the 2010 Census, the Census Bureau's 2010 Topologically Integrated Geographic Encoding and Reference (TIGER) files, and the National Incident-Based Reporting System (NIBRS) compiled by the Federal Bureau of Investigation (FBI). All data have been aggregated to include only incorporated areas of over 50,000 people. Methodologically, this study is novel in that it integrates crime, demographic and geographic data from multiple sources, using a process that includes actively generating data from geographic mapping files. The study that follows is organized into several chapters including one each on theory, literature surrounding Lethality, methods and data, the study analysis, the study results, a discussion and a conclusion.

CHAPTER 2: THEORY

Criminal Events Perspective

The criminal events perspective seeks to incorporate the multiple dimensions of a criminal encounter when theorizing about criminal events (Meier, Kennedy and Sacco, 2001; Weaver et. al. 2004; Libby, 2009). The criminal events perspective is not in and of itself a theory but rather a way of thinking about the *application* of theory. Under this perspective analysis of crimes takes on an understanding that any given crime will have multiple factors all coalescing into a criminal event, which may not even be recognizable as a crime until after it has occurred.

Wolfgang (1958) conducted the first study that recognized factors pertinent to the commission of a crime beyond social characteristics or characteristics of the victim and the offender. Wolfgang included in his analyses factors such as alcohol use, location of crime, and types of weapons used. Though it is limited to the study of homicide, Wolfgang's work would be used as the basis for an increasing understanding of what causes crime in the decades that followed. Expanding on the work of Wolfgang (1958), the criminal events perspective has its first substantive roots as a perspective on theory in the works of Cohen and Felson (1979) and Luckenbill (1977). After Wolfgang, these theorists were some of the first to move away from a purely offender-based criminal motivation approach to crime research towards a more holistic approach. They began to incorporate multiple factors in the commission of a crime, essentially changing the unit of analysis from the offender to the event itself. These theorists each contributed toward the development of the criminal events perspective, but they did not fully mature the approach to theory that the criminal events perspective represents.

Cohen and Felson developed routine activities theory, which states that in order for a crime to occur three things must coexist in a given space: a potential offender, a suitable target, and the absence of capable guardianship. If any one of these things are not present then the crime will not occur. Routine activities theory is a step in the right direction in that it incorporates multiple actors all contributing to the eventual commission of a crime in a given space; however, this theory lacks a way of accounting for a multitude of other factors contributing to the crime (Pino, 2005).

Luckenbill, two years before Cohen and Felson, published a work in which he also identified that multiple factors impact the commission of a crime (Luckenbill, 1977). Luckenbill, drawing from the works of Goffman, identified that the commission of a crime involved multiple actors. He identified a victim, an offender, and bystanders as all being actors that affect the shape of the situation during the commission of a crime. Luckenbill also pointed out, echoing the observations of Wolfgang (1958), that crimes are usually not cut-and-dried cases, even going so far as to posit that in many cases it was difficult to establish who is the victim and who is the offender until after the crime had been committed; sometimes even after the fact it is still difficult to determine culpability. He supported this assumption with an essentially dramaturgical analysis of escalating violence during the commission of assaults, pointing out that often times the victims themselves were aggressive in the lead up to the crime (Luckenbill, 1977). Luckenbill also highlighted, again in the tradition of Goffman and impression management, that verbal *identity attacks* are often observed from both participants in the lead up to a lethal encounter. Luckenbill's approach brings forth social psychological and environmental factors that are not accounted for in Cohen and Felson's routine activities theory; however, Luckenbill's analysis still lacked two important factors that have been accounted for in the criminal events perspective: changes through time and space.

The criminal events perspective evolved from the implications of these two analyses of crime. If one views both of these analyses together then one comes away with an impression that many factors ranging from identity issues to ecological and spatial issues contribute to the expression and outcomes of criminal encounters. This implication spawned not a new theory but a new, more encompassing way of examining crime. Under this analytical approach one should include factors from any theory that is believed to be important in understanding the criminal event one is studying. Mier, Kennedy and Sacco, in their 2001 book discussing the criminal events perspective, stated that a "comprehensive model of crime must take into account the victim, the offender, and the contexts in which the crime occurs" (p.1). The caveat of including the contexts of the crime opens up criminological analysis to the application of biological, psychological, historical, and sociological as well as criminological theory. This approach encourages the most complete picture of a crime that the researcher can produce thereby also engaging the field of criminology to produce more comprehensive and sound theoretical paradigms.

The criminal events perspective is a useful way of approaching the analysis of crime, however, it does have its limitations, not the least of which is that many of the factors that contribute to the commission or lethality of a crime cannot be easily *quantified* and accounted for. The impact of the physical area of effectiveness of a firearm, for example, verses a knife on lethality could be easily controlled for in an experiment, but given the nature of crime data this relationship, though potentially important, is difficult if not impossible to isolate and study. It has been noted in past research that a firearm in a violent encounter is more lethal than a knife (Libby and Corzine, 2007). This is quantifiable and measureable; however, the *reason* why firearms are more lethal than knives cannot be easily quantified. Is the effect due to a firearm's greater penetration into a human body, or is it because firearms remain penetrating and lethal at distances many times greater than knives? Essentially, the criminal events perspective can be very informative because of the breadth of factors that it has the potential to examine, but these factors do eventually have methodological issues that are not easily overcome. The criminal events perspective was originally conceptualized as a way of theorizing about specific criminal events, not discounting but adding to the motivations of the offender as the impetus and necessary conditions for a crime. This way of conceptualizing theory has been largely applied to individual criminal events examining characteristics such as the presence of a weapon, the racial identities of victims and offenders, and the presence of illicit drugs during an encounter (Meier and Sacco, 2001; Weaver et al., 2004; Libby, 2009). Drawing less on the perspective's social psychological roots in Luckenbill and more on its roots in Cohen and Felson's work, this analysis can also be taken in a more ecological direction, examining how the surrounding social and physical environments can impact the expression and outcomes of crimes.

A feature of the criminal events perspective specifically noted by Anderson and Meier (2004) is its suitability to identifying interaction effects. In their 2004 article Anderson and Meier identify multiple interaction effects at lower aggregate levels, even identifying interaction effects across levels of measurement. Anderson and Meier were not the first to identify the criminal events perspective's suitability to interaction effects. The role of interactions in producing criminal events has been studied by many theorists, and this study includes interaction hypotheses with this in mind (Felson, 1979; Stark, 1987; Cohen and Meier et al., 2001; Warr, 2001; Anderson and Meier, 2004).

Though the majority of research utilizing the criminal events perspective has been rooted in individual or event-level studies, this larger aggregate level, more ecological approach is the direction proposed for the current study. Using this approach one can draw from two sources for hypotheses. One source is the perceived unfolding of the crime itself, thereby allowing the researcher to derive testable hypotheses from the perceived common patterns in the commission of the crime. The other source is the existing theory surrounding the crime and its proposed covariates. Given this second source, Social Disorganization Theory becomes pertinent to the development of hypotheses on ecological factors that impact crimes.

Social Disorganization Theory

Social Disorganization Theory has been used primarily as a community-level theory. That being said, it may be possible to apply the theory to larger aggregate levels, though city-level data are far from ideal for testing the effects of relational networks and collective efficacy on crime or lethality (Osgood and Chambers, 2000). Social Disorganization Theory is part of a larger “Environmental Criminology” group of theories. These theories encompass a wide array of criminogenic relationships that have geographic or spatial components that contribute to the commission of a crime in some meaningful way. These relationships include such varied concepts as the spatial distributions of targets and offenders, how urban spatial structures such as transit arteries raise or lower crime in an area, how spatial ethnic diversity may contribute to crime, how surveillance may reduce crime in some situations and not in others, how to create or maintain “defensible space” that is resistant to criminal victimization, policing policies and their impacts, and the target selection processes of offenders among many other things (Brantingham and Brantingham, 1981).

To attain an understanding of the contours of Environmental Criminology a few of the more popular environmental theories will be discussed briefly. Routine Activities Theory, important to the criminal event perspective, is one of the more widely known environmental theories. This theory enters the realm of Environmental Criminology in its basic tenet that certain factors must be present in an environment for a crime to occur (Cohen and Felson, 1979). This theory established environmentally necessary conditions for a crime to occur. Another popular theory is Wilson and Kelling’s (1982) Broken Windows theory. This theory posits that cumulative small property damage from vandalism in an area communicates to other potential offenders that the damaged space is a safer place (in terms of their being less social control present) for criminal’s to commit crimes. In this way small violations such as vandalism lead to bigger violations such as assaults or drug dealing. This theory is environmental in nature in that it establishes the influence a physical space’s influence on a crime through the existence and importance of smaller contributing factors instead of more obvious sufficient conditions. Another widely known Environmental Criminology theory is Oscar Newman's (1972) Defensible Space theory. This theory asserts that several environmental and social factors can be manipulated to create a living space that is hostile to the commission of crime. Newman thought that as long as residents want to defend their space they can use territoriality, natural surveillance, image (of the building or neighborhood), milieu (surrounding crime suppressant assets such as police stations), and safe adjoining space to create an environment with deterrent potential in which potential criminals feel as though they are constantly watched, unwelcome, and more likely to be caught or challenged while committing a crime. Newman contributes to Environmental Criminology by demonstrating that under certain circumstances crime can be lessened in an area by manipulating the physical structure and characteristics of the area. From these examples, it can be seen that Environmental Criminology has contributed to the broader discipline by demonstrating necessary environmental conditions for a crime to occur, the existence of smaller environmental contributing factors, and the ability to reduce crime through the manipulation of people's relationships to their physical environment.

Social Disorganization Theory contributes to the larger field of Environmental Criminology by emphasizing the importance of social relationships and relational networks within a physical environment. Central to Social Disorganization Theory is the idea that more criminogenic factors means more crime; however, these factors can largely be managed through social control, which is facilitated in multiple ways by strong relational networks, or put more simply social organization. Indeed, "social disorganization" was defined by Bursik (1988) as the inability of a community to realize shared values or goals.   Social Disorganization Theory was articulated in the work of Mable Elliot and Francis Merrill in the early 1930s (Elliot and Merrill, 1934; Elliot, 1941). Some of the most enduringly popular early works in Social Disorganization were by Shaw and McKay (1942) and were later famously expanded by Kornhauser(1978), Sampson and Grove (1989), and Bursik and Grasmick (1993).

Shaw and McKay (1942) originally posited that three things impact the relational networks of a neighborhood: ethnic heterogeneity (later re-conceptualized as *population* heterogeneity), population turnover, and poverty (Kornhauser, 1978). For many years Social Disorganization Theory fell out of favor not because of a disbelief in the theory but because of a lack of data capable of testing it at the neighborhood level (Bursik, 1988). In later works with better data, theorists supported Shaw and McKay's work and posited additional variables that may impact a neighborhood's relational networks, including family disruption and open air drug markets among others (Sampson and Grove, 1989; Martinez et al., 2008).

The central theme that emerged from the resurgence of Social Disorganization Theory is collective efficacy, or a neighborhood's ability to realize and enforce common social norms. Though implicit in Shaw and McKay's work, this variable was not fully conceptualized until Sampson and Groves (1989) proposed the idea that a neighborhood's relational networks matter because these affect the likelihood and effectiveness of informal social control. From this idea Sampson and Groves stated that collective efficacy is a combination of mutual trust between neighbors and willingness by those neighbors to intervene and attempt to establish informal social control (Sampson and Groves, 1989; Sampson, Raudenbush and Earls, 1997). In this way neighbors are able to identify what is out of place in a neighborhood and have the confidence, drawn from actual or assumed support from their neighbors, to confront potentially disruptive or criminogenic behaviors. Through this process informal social control is exercised regularly, and a collection of neighbors achieve collective efficacy in regulating the behaviors allowed in their neighborhood.

Given the theoretical assumption about the importance of relational networks in achieving collective efficacy, it follows that any aggregate variable that threatens the strength or stability of those relational networks also diminishes collective efficacy and would lead to an increase in crime rates. As mentioned above, theorists have established these aggregate level threats to relational networks and collective efficacy as including population heterogeneity, poverty, population turnover, family disruption, and criminally based underground economies such as locally operating drug markets.

The theoretical link between Social Disorganization Theory and an area's Criminal Lethality Index has never been tested. The reasoning why this theory should apply to this particular study is as follows: Social Disorganization Theory states that rates of crimes increase in an area because of a lack of collective social control on potential criminals. It stands to reason that this lack of social control affects not only a person's decision to initiate violence, but also extends to the expression or the extent of the violence once it has begun. In other words, if there is an area in which the residents cannot control others' decisions to commit violence the residents will also not likely be able to control the others' decisions concerning the extent of the violence perpetrated on a victim. This lack of control on not only the quantity of the violence but also the quality of the violence, theoretically, will lead to a higher level of lethality in a socially disorganized area.

While the Criminal Event Perspective and Social Disorganization comprise the whole of this study's theory, attention should also be given to what is known about the dependent variable and its covariates. The following section is a discussion of the Lethality Index; and several crime-related ecological features that are likely to be covariates of the Lethality Index. These include increased firearms present in an area, a subculture of violence or an honor culture, medical resources, increased illegal drugs present in an area, increase in the numbers of young males in an area and, argued for the first time here, an area's Road Network Connectivity (Gamma) Index.

CHAPTER 3: LETHALITY, COVARIATES, AND ROAD NETWORKS

Lethality

One approach to conceptualizing homicide is to think of a homicide as an aggravated assault with the outcome of death (Doerner, 1988; Harris, Thomas, Fisher and Hirsch, 2002). In other words, a murder is essentially a lethal assault. With this understanding of the relationship between homicide and assault, one can conceptualize any given geographic area as having a measurable level of criminal lethality. The criminal lethality rate of an area is calculated by dividing the number of murders by the sum of the number of aggravated assaults plus the number of murders (Doerner, 1988). In terms of a quotient, the number of murders is in the numerator, while the total number of murders plus aggravated assaults is in the denominator. Because the number of murders alone will never be a higher number than the number of murders plus aggravated assaults, this creates a number that falls conceptually between zero and one, with higher numbers representing a higher likelihood of lethal outcomes from assaults. If this number were then to be standardized to 100, one might conceptualize it as the percentage of aggravated assaults in a given area that produce one or more fatalities, or put more simply, the percentage of aggravated assaults that are deadly.

It is important to note that the criminal lethality rate is not synonymous with a murder rate. In other words, an area with 100,000 people may have a murder rate of 1 per 100,000, but if that murder were the result of the only aggravated assault to occur in that area for the time measured, then that area's criminal lethality rate (expressed as a percentage) is 100%. On the other hand, if that murder was the outcome of one of the 100 aggravated assaults in the area for the time period, then that area's criminal lethality rate is 1%. The criminal lethality rate is not a function of the number of murders but the ratio of murders to murders plus aggravated assaults. Conceptually this is everything that *could be* a murder divided into everything that is a murder.

Also of note is the clarity of recording and the options that the NIBRS data source offers for the calculation of this variable. The NIBRS system allows for the recording of multiple crimes under one incident. Instead of a county level count of the number of murders, aggravated assaults, robberies and other crimes, NIBRS records data about each crime individually; including data, for those incidents that include multiple victims or offenders, that allows researchers to identify what crimes are committed in conjunction with one another. In terms of conducting research for this work, NIBRS allows for the aggregation of smaller units of measurement.

NIBRS collects data about the offender, the arrestee, the victim and the crime itself, all of which allows for a level of data resolution not attainable from the Uniform Crime Report (UCR). In addition, NIBRS also records many tertiary data about a crime incident that allows researchers to more specifically identify the circumstances of a crime and produce more varied calculations of lethality tailored to the research questions under study. Some of these tailored calculations may include the lethality of only robberies or the lethality of events involving drugs. For this dissertation NIBRS will be used to calculate lethality only for aggravated assaults in which the victim incurred major injuries. The reasoning behind this is discussed below in the Methods and Data section.

Covariates of Lethality

Firearms

Research efforts have explored a number of variables that relate to lethality in general. These variables range in scope from the location of emergency response units to the change in lethality over time. For example, Libby and Corzine (2007), using incident level data from the National Incident-Based Reporting System (NIBRS), explored the relationship between the presence and type of weapon being used in a violent encounter and the likelihood of a lethal outcome. They found that firearms are the most lethal weapons used in violent encounters, with shotguns being the most lethal type of firearm used. These findings were also consistent with Weaver et al. (2004), who in the course of their test of the criminal event perspective also found that age of victim and offender, sex of victim and offender, the commission of a felony, and the mere presence of a weapon all increased the lethality of violent encounters. At the individual level, respectively, the Weaver et al. (2004) study established that the presence of a firearm increased lethality and the Libby and Corzine (2007) study provided evidence that the type of firearm used in an assault also contributed to increased lethality. Additionally, Libby and Wright (2008) established that among other factors, the use of firearms with an automatic fire capability, as opposed to semi-automatic, raised the likelihood of multiple victims occurring in a single incident.

The findings of this research, though not specifically on the ecology of lethality, if applied to a larger aggregate level, have implications for ecological factors such as the availability of firearms to certain segments of the population. Such availability would likely increase both the *quality*[4] of firearms being used in the commission of assaults and the *quantity* of firearms present in an area. This increase in quantity alone would raise the chances of firearms being used in an assault. There would, in turn, be an increased potential for the lethality of assaults in the area in which firearms are available. In this way we see that former studies, while not actively examining the ecology of lethality, have been tangentially providing evidence for the effects of ecological factors such as the presence of illegal firearm markets or the availability of firearms to certain segments of the population on lethality.

Southern Subculture of Violence

Another sub-field of study within lethality research is the study of subcultures and violence. The geographic spread of the cities included in the data set for this study offer an opportunity to address the hypothesis surrounding the presumed Southern distinctiveness of violence. The notion that the South is a more violent region than the rest of the country stretches back to at least the mid 1800s (Whitt, Corzine and Huff-Corzine, 1995). Modern theories surrounding this regional pattern originated with scholars Sheldon Hackney (1969) and

[4] The concept of the quality of a firearm has a strong subjective element. However, it is logical that individual firearms possess certain characteristics that make them better or worse at achieving the goal of the user. For instance, firearms that are not maintained properly are more likely to miss-fire or jam. Also, firearms made under less strict production standards are more likely to suffer accuracy, functioning, or maintenance issues than firearms assembled under stricter tolerances. In addition, and perhaps even more important to the "quality" of the criminal's gun, design flaws, ammunition capacity, caliber, weight, overall length, and the mechanics of firing, cycling, and reloading the firearm can make it more or less suited to urban crime work. Simply put, if the firearm is a tool it is logical that the tools would have variable quality as well as suitability to different jobs (types of crimes).

Raymond Gastil (1971) (Loftin and Hill, 1974; Whitt et al., 1995). The "Gastil-Hackney" thesis posited the existence of a "southern subculture of violence" to explain why southern localities in the United States tend toward higher homicide rates than other areas.

The Gastil-Hackney hypothesis is one of increased homicide rates through a simple increase in lethal violence. The guiding theory for the "subculture of violence" research is that people in the Southern United States maintain a culture independent from the rest of the nation that advocates the use of violence to resolve personal disputes. However, this theory has been challenged since its inception as being based on unfounded assumptions (Loftin and Hill, 1974; Erlanger, 1976) and as committing the ecological fallacy by drawing conclusions on an individual level while using data on the larger aggregate level (Stack, 2002).

Two more recent explanations have been proposed to explain the higher homicide rates in the Southern United States. The first of these theories is not so much a challenge to the idea that the Southern United States experiences more violence as it is a nuancing of the original theory to account for the reasons for Southern use of violence and under what circumstances Southerners become violent. Some violence researchers proposed that the South is not a subculture that promotes violence as an acceptable dispute resolution across all circumstances, but instead is a subculture of honor (Cohen and Nisbett, 1994; Nisbett and Cohen, 1996). According to this thesis the emphasis is not on violence as a means of dispute settlement or a Southerner's willingness to use lethal violence in all situations, but instead the propensity of Southern people to perceive insults to one's personal honor that must then be defended, sometimes with the use of violence.

It is important to note that the Southern Honor Culture hypothesis is not challenging the notion that Gastil put forth that "southerness" is related to lethality but is instead arguing a differing specificity for the reasons for an attack by Southerners. While Gastil argued broadly that the South is a culture that promotes violence more often in all dispute situations, Nisbett and Cohen refined the circumstances under which violence is permissible. They noted that the South is a culture that promotes violence more in some situations and less in others (Stack, 2002). This way of approaching the correlation between Southerners and violence has found support in a variety of studies with variation at an individual level of measurement (Dixon and Lizotte, 1987; Ellison and McCall, 1989; Ellison, 1991). These studies have also established that Southerners are more likely than people from other regions to support the use of violence in *defensive* situations, not in offensive situations. This is even supported by experimental studies by Cohen and Nisbett (1994, 1996) that established that Southern males biologically respond differently to physical contact and insults than other males, especially regarding a larger release of testosterone upon insult.

The major competing theory to the subculture of violence/honor hypothesis states that the South was not a subculture of unbridled violence or a subculture of honor, but a subculture of firearm ownership and public carrying (Bankston, Thompson, Jenkins and Forsyth, 1990). In addition to Southerners being more likely to carry a gun than Non-Southerners, one interesting finding from this line of research is that more Southern women carry guns than Non-Southern women, constituting an entire gun carrying population that is not as prevalent in other parts of the United States (Young, 1986). Put in its simplest form, this hypothesis argues that Southern areas have higher homicide rates because of increased gun ownership. Southerners in this conception are not necessarily more *violent* as more *lethal* than other Americans (Corzine, Huff-Corzine and Whitt, 1999; Libby, 2009). The somewhat semantic debate over "gun culture" or "honor culture" is yet to be settled in the academic arena (Lee, Bankston, Hayes and Thomas, 2007; Copes, Kovandzic, Miller and Williamson, 2009; Felson and Pare, 2010a, 2010b; Ousey and Lee, 2010).

It should be noted that though the debates as to the details are still unresolved, most studies within homicide and lethality research support the idea of some kind of Southern distinctiveness. Also noteworthy is that the majority of these studies provide evidence of the distinctiveness of Southern white murder rates, but not necessarily the distinctiveness of other racial groups' lethal violence (Huff-Corzine, Corzine and Moore, 1986). As such, any hypothesizing in this area should take into account this racial dynamic.

This study will directly test if Southern cities are more criminally lethal cities than non-Southern cities or simply more violence cities on the whole. Simply put, is the Southern United States more violent or more lethal? In this way it will contribute to the literature surrounding Southern distinctiveness and violence. In addition to the presence and type of firearms and a possible "subculture of violence," another consistent finding in lethality research is the impact of medical resources available to a populace on the lethality of a region.

Medical Resources

A series of studies carried out by Doerner and his associates were the first studies to examine specific medical resources and their impact on lethality (Doerner 1983, 1988; Doerner and Speir, 1986). Although Doerner and Speir were the first to look at specific medical resources, the link between advancing medical resources and the inverse relationship between homicide and aggravated assault has been hypothesized by several researchers since the late 1950's (Wolfgang, 1958; Morris and Hawkins, 1970; Rose, 1979; Hawkins, 1983; Wilson, 1985; Regoeczi, 2003). These advances include more rapid communication between the populace and the police/emergency services, increased ratio of medical beds per capita, increased medical personnel per capita, a difference between basic life support training and advanced life support training, and so on (Doerner 1988; Harris et al., 2002). These studies indicate the importance of quality, abundance, and access to the effectiveness of medical resources in a given area. In general, the more advanced the medical resources, the more medical resources that are available per capita, and the better the access to those resources by the populace, the lower the lethality of an area.

Researchers that followed Doerner and Speir examined the link between increasing medical resources and lowering lethality across various dimensions including rural contexts, across time, and between nations (Barlow and Barlow, 1988; Giacopassi, Sparger and Stein 1992; Long-Onnen and Cheatwood 1992; Chon, 2010). In most of these studies, it is demonstrated that increased access to medical resources is key to decreasing lethality. Anything that interferes with the populace's ability to gain quick access to medical resources will increase the lethality of an area in general, and certainly will increase the lethality of criminal encounters involving aggravated assaults.

Trauma Centers

In terms of increasing survivability of assaults and accidents in a given area, trauma centers have proven to be an invaluable medical resource (Norwood et al., 1995; Sampalis et al., 1993; Pepe and Eckstein, 1998; O'Keefe et al., 1999; Nathens, Jurkovich, Cummings, Rivera and Maier, 2000; Regoeczi, 2003). This section addresses trauma centers separately from the medical resources section because trauma centers are complex systems uniquely suited to and specifically designed to decrease the lethality of violent encounters. A trauma center is a special medical center organized specifically to efficiently deal with life-threatening damage to multiple bodily systems. These centers are required to have a doctor on call at all times and a certain amount of resources available at any given moment for treatment of emergency cases with damage to multiple biological systems. Criminally-induced trauma that requires the care of a trauma center is largely due to penetrating damage which is usually inflicted with some sort of weapon, most commonly a gun or a knife.

Trauma centers operate by increasing the quality, abundance, and access to medical resources. For example, trauma centers increase a patient's access to medical resources by having the patient brought as quickly as possible and directly to the trauma center. By keeping a specially trained staff and special equipment in the center they are increasing the quality and speed of those medical resources available for the patient. The closing of trauma centers has been hypothesized to increase the lethality of an area, though this relationship has proven somewhat difficult to isolate due to the simultaneous presence of other ecological elements in a community that might explain changes in a lethality rate (Regoeczi, 2003). One such ecological element to consider may be open air drug markets, which impact lethality in multiple ways.

Drugs and Lethality

Several studies have noted the impact of drug markets on other crimes, including murder and aggravated assault (Blumstein, 1995; Weaver, Clifford Wittekind, Huff-Corzine, Corzine, Petee and Jarvis, 2004). It is a consistent finding that the existence of illicit drug markets in an area increases the amount and lethalness of violence in that area, as well as causing an increase in the commission of other crimes (Blumstein, 1995; Werb, Rowell, Guyatt, Kerr, Montaner and Wood, 2011; Phillips, 2012). In addition, there is evidence that the felony level presence of drugs during a criminal encounter raises the chances of a lethal outcome (Weaver et al., 2004). This is thought to be largely due to the dynamics outlined in Goldstein's tripartite model (1985) and the utterly exposed nature of the actors in the traditionally open air drug market.

Goldstein's tripartite model hypothesizes that drugs contribute to violence in three ways: *psychopharmacologically* through their effects on the drug user's state of mind, *systemically* through the economic maneuvering of different parties involved in the distribution of drugs in what is essentially unchecked capitalism, and *economic compulsively* through the instrumental need of drug users to raise resources to use to acquire drugs. Note that though both systemic and economic compulsive violence are at their roots economically motivated, economic compulsive violence is carried out by drug users to feed a felt need for a drug, and systemic violence is carried out by often sober agents involved in drug distribution. Recent research has provided evidence that while the other two are certainly sources of violence, the *systemic* link is the one that by far contributes the most to both a rise in incidence of violence as well as a rise in the severity of violence (Phillips, 2012). This implies that while drug use is a source of violence (through the psychopharmacological and economic compulsive avenues), drug markets are the major driver behind much of the link between drugs and violence (through the systemic avenue). This is significant because the majority of data regarding drugs and crime are data on drug crimes in a given area, which is often a competent proxy for but not a direct measure of the presence, size, and characteristics of a drug market. Included in the discussion of lethality and drug markets in the paragraph below is an example of how proxy measures of drugs and drug markets can produce informative but also potentially confusing results.

Initially, the academic discussion on the relationship between drug markets and violence, particularly homicide, was one focused on how drug markets increase levels of violence and homicide. This is still the major focus of the academic discussion; however, there is some evidence that drug markets not only increase the number of incidences of violence, but also increase their lethality (Weaver et al., 2004; Libby, 2009; Phillips, 2012). In the Weaver et al. (2004) analysis, the involvement of drugs in a criminal encounter increased the chances of a lethal encounter substantially, regardless of whether the drugs were being dealt, taken, or merely present. However, in the Libby (2009) analysis the intoxication of one or more of those involved in a criminal encounter actually resulted in a substantial decrease in the likelihood of a lethal outcome.

At first glance these two studies seem to contradict one another; upon closer inspection the findings from both may be mutually supportive. Applying Goldstein's tripartite model we see that the study by Weaver et al. is measuring what Goldstein would call systemic violence or the effect of *economically motivated* drug violence from the *distribution* end, <u>not</u> the user's end. The Libby study is measuring the cognitive impacts of *drug use* on lethality, what Goldstein would classify as psychopharmacological violence.

Libby (2009) concludes that incidents in which offenders are sober actually net more lethality than incidences when one or more people are intoxicated. This finding may actually support the Weaver et al. finding that drug dealing is positively related to lethality. A dispute between two or more drug dealers is likely to be between sober individuals engaged in a conflict over resources in which the violence that is done is accomplished in a much more calculated and deliberate manner. In a sense, of these two relationships the psychopharmacological relationship is one in which the offender is generally less motivated and less capable of *lethal* violence, and the systemic relationship is a relationship in which the offender is both more motivated *and* more capable of *lethal* violence. Regardless of the possible finer applications of Goldstein's Tripartite model it has been a consistent finding that an illicit drug market increases the lethality of assaults in an area. It is a logical extension, then, that when a drug market is present, it is a major contributor to the lethality of a given area.

Age and Lethality

Previous works dealing with lethality have examined the offender's and victim's ages as salient factors to lethality (Weaver et al., 2004; Libby and Corzine, 2007; Libby, 2009). The general pattern is toward young adults (18-24) using firearms and being more lethal than any other group, with juveniles actually being the group least likely to use a gun and the group that is the least lethal (Libby, 2009). This is, of course, contrary to "popular wisdom" that is most likely fueled by media depictions of school shooters and juvenile "gang bangers." It appears that these cases, while sensational and plentiful enough to periodically be covered by the news, are actually a small proportion of the total lethal violence in the United States. When categorized by age, young adults, not juveniles, are consistently the largest source of violence and lethal violence in the United States, with violence levels reduced sharply after young adulthood. Additionally, when gender is taken into account, young adult males are consistently the largest source of violence.

When combined with findings regarding firearms and lethality and drugs and lethality the variable of age is capable of generating several hypotheses that allow it to become more than a simple control variable. For example, young adults are the most lethal age group, and the increased presence of firearms in an area is likely to raise that area's lethality. This begs the question if there is a moderating effect of firearms on young adult violence within a given area? In other words, would an increase in access to the most lethal weapon type (firearms) further increase the lethality of the most lethal age group? This question and others surrounding the dynamics of young adult lethality are addressed below in the hypotheses section.

<u>Road Network Connectivity</u>

The relationship between road networks and emergency response has recently come under scientific scrutiny (Libby, 2006; Scott, Novak, Aultman-Hall and Guo, 2006; Sullivan, Novak, Aultman-Hall and Scott, 2010; Taniguchi, Ferreira and Nicholson, 2012). Most of this research has been carried out with an eye towards disaster preparedness; few researchers outside of disaster preparedness have contributed to the literature surrounding the effects of traffic patterns on lethal outcomes (Libby, 2006). This research is part of a subfield of disaster research, titled by Taniguchi et al. (2012) as "Humanitarian Logistics." Though this research has been primarily concerned with disaster preparedness, the analyses carried out on road networks have implications for everyday emergency situations (Libby, 2006; Scott et al., 2006; Sullivan et al., 2010). This research has largely found that the more options a road network has to get around the more reliably emergency medical services operate in emergency situations. Theoretically, this more reliable network would likely mean a decrease in the Criminal Lethality Index in the area the network services as more aggravated assaults are treated and prevented from becoming murders.

The focus of disaster preparedness research on road networks has been the effects of massive damage to the road network and how this impacts both evacuations and lethal outcomes from disasters. In the case of everyday emergency situations it is not likely, however, that one would see the kind of catastrophic damage to the road network that a natural disaster would likely entail. For everyday emergency situations the problem with the network is most likely due to traffic slowdowns, construction projects, or traffic accidents all of which may be less damaging to more connected networks than they are to less connected networks with limited route options. For a more detailed discussion of the theory and application of the concept of network reliability, see respectively Bell (2000) and Taniguchi et al. (2012).

Road networks are conceptualized as a series of links and nodes (Scott et al., 2006; Lai, 2011; Taniguchi et al., 2012). An example of a road network with nodes highlighted can be seen in Figure 1. In less methodological terms nodes are conceptualized as road intersections and destinations of importance and links can be thought of as the lengths of road between those intersections. In general, the more links between nodes in the network the more flexible the whole system. There are three primary types of networks: series, parallel, and bridge (Taniguchi et al., 2012). As demonstrated in Figure 2, a series network is one in which a series of nodes are connected through single links. Damage to any one of the nodes or links would make the whole network impassable; these are the least flexible road networks. A parallel network is one in which nodes are connected through parallel links. In this network damage to a node is disastrous, but damage to one link can be compensated for by travel through the other link. These are moderately flexible networks. Finally, bridge networks are networks in which each node along the network path is connected to more than one other node along the path. In this type of network damage to any single node or link or even damage to several links and nodes can be overcome through rerouting. These are the most flexible networks. The flexibility of a network has a direct impact on network reliability, discussed below. Again, visual representations of each of these networks is available in Figure 1.

The primary concept behind the relationship between road networks and emergency response is network reliability. In trying to describe network reliability in his 2000 book, Bell stated, “A network is reliable if the expected trip costs are acceptable even when users are extremely pessimistic about the state of the network” (p. 534). This brings to the forefront several points about network reliability that should not be overlooked. Firstly, network reliability is a matter of sufficient conditions, not optimal conditions. A network does not have to be operating at the peak of performance to be considered reliable. Secondly, travel through the network incurs costs of one form or another. For a road network we may think of these costs as not simply the cost in gasoline but also the cost in time, the cost in psychological tolls for the driver and, in the case of emergency response, maybe even the cost in lives. Thirdly, though "common wisdom" may hold that a particular network is a "bad" network this does not mean that it is automatically an *unreliable* network, scientifically speaking. For instance, a road network's reputation among its users may be a response to high psychological tolls of driving the network, not a result of unreliability within the network itself.

In an effort to further quantify network reliability, Bell further describes it as a combination of network connectivity and performance reliability (Bell, 2000; Bell and Iida, 1997; Scott et al., 2006). Separate indices are calculated to measure both network connectivity and performance reliability. Conceptually, performance reliability centers on a network's ability to accommodate *X* amount of volume while allowing for changes in commuters' traffic routes. For the purposes of this study, network performance reliability is set aside, and network connectivity is examined instead. Network connectivity can be broadly thought of as a measure of a road network's flexibility, or its ability to cope with damage to the network.

Network connectivity is calculated using the Gamma Index (Scott et al., 2006; Taniguchi et al., 2012). The Gamma Index is expressed as: e/e_{max} where "e" is the total number of links in the network and "e_{max}" is the total number of links that could exist in the network, if all of the nodes in the network were totally connected. The value "e_{max}" can be calculated using this formula: $e_{max} = 3(v-2)$, where "v" is the total number of nodes in the network (Taniguchi et al., 2012). By using the network connectivity index we create an expression between 0 and 1 where 0 represents a totally unconnected network and 1 represents a totally connected network. It bears mentioning that a totally unconnected network is a theoretical possibility that does not exist in reality but is necessary in this instance as a benchmark for lower connectivity.

Conceptually, a network that is more connected should be more flexible and more capable of handling the everyday disruptions to the network such as wrecks, traffic slowdowns, and construction projects that can have severe traffic flow consequences. In any network, a disruption can have an effect on a larger area than simply the site of the disruption; in the case of road networks a disruption at a node (intersection) can impact nodes around it and slow down traffic flow for a larger part of the network. For example, a major wreck at a traffic intersection (a node) can effectively stop the flow of traffic through that intersection thereby clogging the roads (links) expanding out from that intersection, possibly even to the point of jamming up traffic at other intersections (nodes). If this hypothetical network is a less connected network, there may be few options for drivers moving through that network except to wait for the wreck to be cleared or try to slowly pull around the wreck. If this network is a more connected network drivers may avoid the wreck slowdown altogether by choosing an alternate route. Though it is desirable for the average driver to avoid this intersection, it is also more advantageous to emergency responders for traffic to avoid that intersection so as to not slow down the responder's response time and their travel time to the nearest hospital with the injured parties.

When one is considering the implications of this for emergency response and the impact on an area's lethality it becomes obvious that in order to lower lethality a flexible network would facilitate a more consistent and rapid response by emergency medical personnel. Upon a moment's reflection, given network connectivity, it seems as though a gridded road system is more likely to represent a more flexible bridged network and is preferable to a non-gridded system which is more likely to have spots of series or parallel connections. It should also be noted that, even though it is not controlled for in the current study, topography plays a key role in the laying of road networks.

Bridged networks are the most desirable networks in terms of flexibility and the best terrain for laying a bridged network is flat land with no mountains, lakes, or rivers. These natural barriers raise the cost of constructing a bridged network and are often addressed by road planners by simply avoiding them and going around them or simply stopping the street at the barrier's edge. This is done to avoid paying for the costs associated with building bridges over water or tunnels through steep inclines. What this means for road network connectivity, however, is that areas with a multitude of natural barriers such as lakes and rivers are more likely to have parallel or series connections in their network making damage to the links or nodes of those connections a more serious threat to the network's reliability. Imagine, for example, that an emergency develops on one side of a river but the hospital and emergency responders are on the other side of the river. These responders would have to make their way down to a bridge across the river, then over to where the emergency is located, then back to the bridge to get to the hospital. This process is already costly in time, even without damage to the road network. Now consider the consequences of a wreck or construction project on the nearest bridge. In this way we can see that topography plays a large role in the laying of road networks and that the costs and consequences of a less connected network (already higher than a connected network) are increased considerably by damage to the network.

Road Network Connectivity and The Criminal Events Perspective

Murder is somewhat unique in the criminal events perspective in that it is a crime in which emergency services can intervene and prevent the crime from occurring. The majority of criminal events perspective research has been on causative factors; murder offers an opportunity to explore preventative factors. Road networks are important to the criminal event in that they are the avenues by which the majority of emergency medical services are deployed to address an aggravated assault. If the services are successful then the crime of murder never comes to pass. In other words, road network connectivity is related to the criminal events perspective in that it measures preventative factors that operate to greater or lesser effectiveness. Specifically, it is thought that if a city has a more connected network, that city's first responders, police and emergency medical responders, can travel within the city more reliably and respond to potentially lethal crimes more quickly and consistently, thereby lowering that city's criminal lethality. The Criminal Lethality Index offers researchers a uniquely qualified variable for evaluating the relationship between criminal lethality and preventative factors.

Lethality and The Current Study

The literature surrounding lethality supports conceptual links between lethality and a variety of covariates. These covariates include firearms, drugs, age, culture and access to medical resources. This study, in addition to the new application of a well-established theory, proposes an added covariate, the connectivity of the road network in a given area. This variable automatically puts constraints on the methodology of the study. For example, the unit of analysis for this study must be an area large enough to support a road network but distinctive enough to also provide crime data. Also, the variety of lethality covariates yields a variety of testable hypotheses. The specific methodology of the study is discussed in more detail in the section that follows.

CHAPTER 4: METHODS AND DATA

Hypotheses

Drawing on the criminal events perspective and Social Disorganization Theory the current study is focused on several factors and relationships that may increase or decrease a geographic locale's criminal lethality.

Criminal Events Perspective Hypotheses

- **H1**. There is a negative relationship between an incorporated area's Road Network Connectivity Index and the Criminal Lethality Index of the same area.
    - (Gamma Index →Criminal Lethality Index)
      + -
- **H2**. There is a negative relationship between the presence of a trauma center in an incorporated area and the Criminal Lethality Index of the same area.
    - (Trauma Center →Criminal Lethality Index)
      + -
- **H3.** There is a negative relationship between the number of people employed in the diagnosing and treating medical professions in an incorporated area and the Criminal Lethality Index of the same area.
    - (Medical Employees → Criminal Lethality Index)
      + -

- **H4.** There is a positive relationship between the percentage of arrestees in an incorporated area who are arrested in possession of a firearm and the same area's Criminal Lethality Index.
    - (% of Arrestees with Firearm → Criminal Lethality Index)
+ +

- **H5.** There is a positive relationship between an incorporated area's percentage of the male population between 16 and 25 and the same area's Criminal Lethality Index.
    - (% Male 16-24 → Criminal Lethality Index)
+ +

- **H6.** There is a positive relationship between the number of arrestees with drug-related offenses per 100,000 people in an incorporated area and the same area's Criminal Lethality Index.
    - (Drug Arrests per 100,000 → Criminal Lethality Index)
+ +

- **H7**. There is a moderating relationship between the presence of a trauma center in an incorporated area, that area's Road Network Connectivity Index and the same area's Criminal Lethality Index, with the trauma center acting as the moderating variable.
    - (Trauma Center)
↓
(Gamma Index → Criminal Lethality Index)
+ -

- **H8.** There is a moderating relationship between an incorporated area's percentage of the male population between 16 and 24, the percentage of arrestees in an incorporated area who are arrested in possession of a firearm and the same area's Criminal Lethality Index, with firearms availability acting as the moderating variable.

- (% of Arrestees with Firearm)
  ↓
  (% Male 16-24→ Criminal Lethality Index)
  \+ \+

- **H9.** There is a moderating relationship between the number of arrestees with drug related offenses per 100,000 people in an incorporated area, the percentage of arrestees in an incorporated area who are arrested in possession of a firearm, and the same area's Criminal Lethality Index, with the firearms availability acting as the moderating variable.
  - (% of Arrestees with Firearm)
    ↓
    (Drug Arrests per 100,000 → Criminal Lethality Index)
    \+ \+

- **H10.** There is a moderating relationship between the number of arrestees with drug related offenses per 100,000 people in an incorporated area, the percentage of the male population between 16 and 25 in that area and that same area's Criminal Lethality Index, with the percentage between 16 and 24 acting as the moderating variable.
  - (% Male 16 – 24)
    ↓
    (Drug Arrests per 100,000 → Criminal Lethality Index)
    \+ \+

Social Disorganization Theory Hypotheses

- **H11.** There is a positive relationship between the percentage of an incorporated area's population that has lived in the same domicile for less than 5 years and that area's Criminal Lethality Index.
    - (% Live Under 5 Years → Criminal Lethality Index)
+ +
- **H12.** There is a positive relationship between the percentage of an incorporated area's households that are single-parent headed and that area's Criminal Lethality Index.
    - (% Single-Parent Headed → Criminal Lethality Index)
+ +
- **H13.** There is a positive relationship between the percentage of an incorporated area's population living below the poverty line and the same area's Criminal Lethality Index.
    - (% Below Poverty → Criminal Lethality Index)
+ +
- **H14.** There is a positive relationship between an incorporated area's Racial Diversity Index and that area's Criminal Lethality Index.
    - (Racial Diversity Index → Criminal Lethality Index)
+ +

<u>Data Sources</u>

Data for the current study are collected from multiple sources and aggregated into a single data file. The unit of analysis for this project will be cities with each case representing an incorporated area of over 50,000 inhabitants. An N of 190 cases is generated from all incorporated areas of over 50,000 population within the 21 states that are registered NIBRS compliant and have at least 80% of their population accounted for with NIBRS data. Data are gathered for the year 2010 on all cases. The population characteristics for each incorporated area are gathered from the 2010 estimates available from the census (American Fact Finder 2, 2012). The crime data used in the study is gathered from the Federal Bureau of Investigation's National Incident-Based Reporting System (NIBRS) (2010). Information on the presence of a trauma center in the city boundaries of the incorporated areas is gathered from the American Trauma Society's trauma center map. This is a resource that shows the location and ranking of all known trauma centers within the United States.

NIBRS

According to the Federal Bureau of Investigation (FBI) there are currently 21 states that are NIBRS certified and have at least 80% of their population accounted for in NIBRS data (FBI, 2012). NIBRS is a project of cooperation between the Federal Bureau of Investigation and over 6,000 local law enforcement agencies (FBI, 2012). Since 1929 crime data has been collected from local law enforcement agencies by the Federal Government using the UCR. These data are available to the public at several levels of analysis beginning at the county level and ultimately culminating at the national level. The NIBRS is an effort to provide more detailed data on crime in America. It is reported on an incident-based level not automatically aggregated to the county level, and also records a variety of details about the offenders and victims or circumstances in each incident. This allows for a level of detail and flexibility on a large scale that is unprecedented in United States crime research.

One of the greatest contributions of NIBRS, however, is that it addresses the "hierarchy problem" of the Uniform Crime Report. The hierarchy problem is a specific issue with the reporting of data in the Uniform Crime Report in which the reporting agency would only report the most serious crime committed during any one incident. For example a murder as the result of a robbery will count towards the murder total but not the robbery total. NIBRS records that incident as both a robbery and a murder thereby providing a more complete picture of each crime to researchers. While this development does not provide better counts of murder per se, it is pertinent to the current study in that it provides more complete data on other crimes that are theoretically related to murder such as aggravated assaults.

NIBRS collects data on 22 offense categories representing 46 specific crimes. For each specific crime, data tailored to gather information on that offense is collected by the reporting agencies. Using data from NIBRS for 2010, law enforcement jurisdictions can be employed to represent crimes in specific incorporated and unincorporated areas. It is acknowledged that using jurisdictional boundaries will miss a small proportion of the crimes due to jurisdictional overlap with agencies that do not cover specific incorporated areas. It is assumed that these occurrences will not represent the majority or even a large proportion of crimes committed in an incorporated area and that they will occur randomly. Specifically of interest to this study are data from the categories of Homicide, Assault Offenses (specifically aggravated assault), Drug/Narcotic Offenses, and Weapon Law Violations.

2010 Census and The American Community Survey Data

Data on demographics and incorporated area characteristics are gathered from the 2010 Census or The American Community Survey. The American Community Survey is a particularly apt source of data for this study because data can be gathered from incorporated areas on a large range of subjects, from basic demographics to industry characteristics to housing characteristics and more. The Census is carried out every 10 years and endeavors to gather pertinent data on every individual in the nation. The American Community Survey (ACS) is a project maintained by the Census Bureau that collects data from around the nation every year. The ACS does not gather data on every single person but instead uses more cost efficient sampling techniques to estimate larger patterns from data gathered on smaller groups and individuals. The ACS produces one year estimates for cities of 65,000 or more, three year estimates for cities of 20,000 or more and five year estimates for smaller cities and towns. The data gathered for this project are one year estimates; for those cities without 2010 one year estimates 2010 three year estimates are used instead. The specific data gathered and the relevant sources are discussed below.

The American Trauma Society

The American Trauma Society maintains a map of all trauma centers active in the United States. This map is available online and can indicate various details including level of trauma center, helicopter access, 45-minute trauma coverage, and one-hour trauma coverage. For the purposes of this dissertation, each city in the sample is individually visually checked. If a level three trauma center or above is located within a city's boundaries it was given a one, if not it was given a zero. In this way the presence of a trauma center capable of at least stabilizing a victim of multiple injuries is indicated.

Census Bureau TIGER Files

The United States Census Bureau maintains a publically available database of geo-spatial mapping files of the United States. These are called Topologically Integrated Geographic Encoding and Referencing (TIGER) files. The TIGER files are quite comprehensive and are designed for use with geographic information systems (GIS). These files include state-level maps of all census recognized places in the United States as well as county level road network maps. Data for this project originate from the combination and editing of multiple types and geographic levels of TIGER files.

Measurements

Dependent Variable

Criminal Lethality Index (Murders / Murders + Aggravated Assaults)

Previous research has conceptualized lethality as the number of murders divided by the number of murders plus the number of aggravated assaults. This reflects the number of cases that were at risk of becoming murders and the number that did become murders. For the purposes of this study the aggravated assaults will be replaced with aggravated assaults which resulted in a major injury. The NIBRS allows for the identification of aggravated assaults, which also resulted in a major injury. NIBRS major injuries include severe bruising, abrasions, broken bones, cuts, etc. This allows for a cleaner calculation of lethality that includes only events that show bodily harm and, by extension, evidence of possible lethal outcomes. Specifically, this will be expressed as the number of NIBRS reported homicide victims in a jurisdiction divided by the sum of the number of NIBRS reported homicide victims + aggravated assaults with a major injury reported. This will yield a Criminal Lethality Index that is my dependent variable of study. Other traditionally violent offenses such as robbery and rape are not included in the denominator.

Primary Explanatory Variables

Road Network Connectivity Index (Gamma Index)

The first primary explanatory variable is the Road Network Connectivity Index of each incorporated area. The Road Network Connectivity Index is a reflection of a network's flexibility, which is its ability to deal with "damage" to the links (roads) and nodes (intersections) of the network. This variable is an index of the number of links in the network divided by the total possible links in the network. These data are gathered from a source other than NIBRS or the American Community Survey, as explained below.

The Road Network Connectivity Index is a quantitative measure generated from geo-spatial mapping data. Maps of each county road network and each city boundary fitting the criteria are obtained from the Census Bureau Tiger files. Each city boundary is taken from a larger file, indicating all census defined places in a state. Figure 3 illustrates all census defined places in Louisiana, with Bossier City highlighted. From this layer file a new file is created with only the city boundary that is of interest to the study, as can be seen in Figure 4, the city boundary of Bossier City, LA. This map layer file is then combined, with the county/parish road network file, as can be seen in Figure 5. Next, all road networks outside of the incorporated area of interest are dropped leaving only roads that enter within city boundaries, as can be seen in Figure 6. In this way a detailed road map is obtained for each incorporated area above 50,000 population in each NIBRS compliant state with at least 80% of its population accounted for in the NIBRS data. From these maps a count of links and nodes are obtained. Figure 7, a road map detail of Bossier City Louisiana, visually represents the nodes and links of the city's roads. The number of links in the road network are obtained by "dissolving" the road map, breaking each link at the point that it meets with another (at each node), then counting each separate link as its own object creating a new shape file in the process which gives us a count of total links in the network. The nodes procedure is done by creating a new shape file from the incorporated area road map that identifies each point at which a line crosses another (the visual representation of a traffic intersection). This new shape file gives a count of total intersects (intersections). These data are then used to calculate the Road Network Connectivity Index (Gamma Index) for each incorporated area. This is the first primary explanatory variable of the study. From these data hypotheses 1 and 7 will be tested.

Trauma Centers

The second primary explanatory variable of this study is the presence or absence of trauma units operating in an incorporated area, taking into account that some trauma units may be servicing multiple incorporated areas over 50,000 people, such as a trauma center in

Little Rock servicing North Little Rock, technically a separate incorporated area. This spatial association is visually established with mapping data. For those rare cases in which there are politically separate areas that share boarders, these areas will share a combined trauma center indicator. This is based on the assumption that emergency medical personnel will transport the wounded to the nearest emergency assistance and the nearest trauma center or the trauma center most specialized in the type of injuries suffered by the individual. The presence of a trauma center will be established with data from Traumamaps.org, which is an interactive map created by collaboration between the American Trauma Society and the University of Pennsylvania's Cartographic Modeling Laboratory (ATS, 2012). This resource shows all level 1 -3 trauma centers in the United States, regardless of accrediting board. This is a particularly useful resource because there is no single accrediting board for trauma centers as each state passes laws that set the standards for what counts as a trauma center within that state. This means that there is no comprehensive list of American trauma centers except for the list gathered and maintained by the American Trauma Society. The trauma center variable is simply a dummy variable indicating the presence of at least one trauma center servicing a specific incorporated area. This variable will be used to test hypotheses 2 and 7.

Medical Resources

Given the difficulties of collecting the more traditional measures, an incorporated area's general access to medical resources is measured using a proxy variable pulled from 2010 Census data. This proxy is the proportion of the population residing in an incorporated area that are employed in the diagnosing and treating medical professions. While this is not a traditional proxy variable, it is one that is available for each case in the study and operates on a similar logic as more traditional proxy variables for medical resources such as the number of hospital beds in a given area. Information on an area's general access to medical resources is important; however, traditional sources for this, such as the number of hospital beds in an area, are not available for all incorporated areas. The medical employees variable is used to test hypothesis number 3.

Secondary Explanatory Variables

The secondary explanatory variables include a measure of firearms within the incorporated area, the percentage of the population that is male and 16 to 24, and a measure of drugs within the incorporated area. The firearms measure within an incorporated area is measured as the percentage of arrestees in an incorporated area who are arrested while in possession of a firearm. This is a measure provided for by the NIBRS database but is one that has not yet widely come into use by criminological researchers. The percentage of the population that is male and 16 to 24 is gathered from the American Community Survey 2010. The measure of drugs within an incorporated area is measured as the number of arrests per 100,000 population in an incorporated area that are drug offense related. The firearms variable is used to test hypotheses 4, 8 and 9. The variable for drugs within an incorporated area is used to test hypotheses 6, 9 and 10. The variable measuring the percentage of the population that is male and 16 to 24 is used to test hypotheses 5, 8 and 10.

Social Disorganization Variables

These variables are gathered from the American Community Survey. Social Disorganization posits that family disruption, population heterogeneity, poverty, and population turnover all impact crime (Martinez et al., 2008; Olson, Laurikkala, Huff-Corzine and Corzine, 2009). In past Social Disorganization research, family disruption is measured as the proportion of households that are headed by single females in an area (Osgood and Chambers, 2000; Olson et al., 2009). For this study, family disruption is measured as the proportion of households that are single parent headed. This has the advantage of including not only single mothers but single fathers as well. This information is gathered from the 2010 census. Population heterogeneity is measured using the Racial Diversity Index used by Olson et al. (2009) based on the diversity index proposed by Simpson (1949). This index involves dividing the number of residents in each racial category by the total population, squaring the result then summing the remaining numbers and subtracting that number from 1 to create a number between 0 and 1. The closer to 0 the index number is the less heterogeneous the area; the closer to 1 the more heterogeneous. This index can be expressed in the equation:

$$D = 1 - \sum ((n/N)^2)$$

In this formula, “D” represents racial heterogeneity, “n” is the number of people in each racial category respectively and “N” is the total population. The racial groups included in this formula are the Census defined groups of: White, Hispanic, African American and Other Race. In addition to the racial heterogeneity index, these racial groups will be used to calculate the percentage of the population that falls within each. This will create percent White, percent

Hispanic, percent African American and percent Other Race as variables. With the exception of the Social Disorganization model, in which the Racial Heterogeneity Index is included, these percentages will be the race controls for all models of this analysis.

Poverty is measured as the percentage of the population of the incorporated area that are living below the poverty line. Population turnover is measured by the percentage of the population living in the same domicile for less than 5 years. The variable measuring the percentage of households that are single parent headed is used to test hypothesis number 12. The variable measuring racial heterogeneity is used to test hypothesis number 14. The variable measuring the percentage of the population living in poverty is used to test hypothesis number 13. The variable measuring the percentage of the population that has lived in the same domicile for under 5 years is used to test hypothesis number 11.

Control Variables

Control variables include basic demographics such as: the population count for each incorporated area, the population density for each incorporated area, the percentage of the population that is male, the percentage of the population that is African American, the percentage of the population that is Hispanic, the percentage of the population that is "ot[5]her races", the median income of the incorporated area, and the percentage of the population with a bachelor's degree or higher within the incorporated area. Note that the inclusion of percentages of African American and Hispanic are not redundancies with the Simpson Diversity

[5] The "Other Race" category includes all non-White and non-Hispanic peoples that are also non-Black. This includes Native Americans, Asians, Pacific Islanders and Multiracial Ancestry as well as all other races that are neither White, Black or of Hispanic ethnicity.

Index. The diversity index is a measure of the heterogeneity of the population within a given area. The percentages are measures of proportions of racial groups that have experienced a history of social and economic disadvantage and still show signs of this disadvantage. These controls are included because in past research population size, population density, race, gender, income, and education have all been linked to patterns of general violence and murder in particular (McCall et al., 2010; McCall, Land and Parker, 2011). The population density variable is a measure of the proportion of households that have more people than rooms. This variable configuration is used instead of the population per square miles because it more fully represents the underlying concept of shared space and resources. Take for instance a neighborhood that is wealthy and comprised of high rises. This neighborhood would show up as a very dense neighborhood under the "per square mile" measure, even though these individuals have more space and resources than the individuals in a neighborhood with single or double storied homes yet have several people sharing living quarters. In the population per square miles measure these two neighborhoods show up as equal, despite the fact that the underlying disadvantage of shared space is true for one and not for the other.

Also included is information on the region of the United States in which the incorporated area is located. A dummy variable indicating an incorporated area's location in the geographic southern United States is specified. An area's location in the South is determined by census definition and for this dissertation includes areas in the states of: Alabama[6], Arkansas,

[6] Several southern states are not represented in the data, such as North Carolina, Georgia or Florida. In addition, some of the states included in this list have few cases from them, like Alabama, which has only one case associated with it, and that city is wealthier than the average Alabaman city. In short, the southern data, though properly

Kentucky, Louisiana, Mississippi, South Carolina, Tennessee, Texas, Virginia, West Virginia and Delaware. This study has at least one case from each of these states.

Analysis

Ordinary Least Squares (OLS) regression is chosen as the tool of analysis for this dissertation. Though most of the hypotheses are bivariate in nature they will be tested using multivariate models. In addition, when called for, diagnostic OLS regressions are run using not the Criminal Lethality Index as the dependent variable but the more traditional measures of counts of murders or aggravated assaults with major injuries. This is done to illustrate the limitations and differences from traditional crime variables of the Criminal Lethality Index.

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specified are biased by what is reported to NIBRS. It is likely that this bias is the source of the pattern in this work of the Southern variable being unrelated to lethality and in some cases even negatively related to murders and aggravated assaults. It should be noted also, that NIBRS is not representative of the states outside of the South either. This makes regional analysis using NIBRS data difficult at best.

CHAPTER 5: RESULTS

Descriptive Results

Initial analysis is carried out through basic descriptive statistics of the variables. As the dependent variable is essentially continuous and the statistics surrounding the variable do not warrant the use of other estimation methods, the primary analyses are carried out using seven linear regressions. Descriptive results can be viewed in Table 1. As can be seen in Table 1, the dependent variable has a mean of 0.066 with a standard deviation of 0.069. This means that of all the 198 cities represented in our sample on average roughly 7% of all potentially lethal criminal events actually result in a murder. The minimum lethality in an area is 0 and the maximum lethality is 0.50. Upon testing for skewness the dependent variable has a skewness statistic of 2.34. In this sample, zero lethality is achieved not through a lack of assaults but through a lack of murders. The highest score is the result of a smaller city in Utah with very few assaults and murders. The lower numbers create a situation in which the Criminal Lethality Index is higher.

The Gamma Index, our Road Network Connectivity Index, has a mean of 0.233 with a standard deviation of 0.023. The minimum Gamma Index is 0.135; the maximum is 0.273. As the Gamma Index is a relative indicator these numbers translate only as “more connected” and “less connected,” though with a theoretical possibility of 1 it is somewhat surprising that the majority of cities are leaning towards “less connected” than they are “more connected.” The trauma center dummy variable has no mean or meaningful minimum or maximum to report. It is simply an indicator of how many cities have a level 3 or above trauma center within their city boundaries. According to the American Trauma Society (2012) there are five levels of trauma center; level 1 is the most advanced and equipped to handle the most damage to a human's biological systems. Level three is chosen as the cut off for this study because it is the minimum rating for stabilizing trauma victims. Note that trauma is different from regular injury in that it is impacting multiple biological systems at once. Often, if any one of these systems fails it could mean the death of the patient. This variable indicates that 93 out of 191 cities have a level 3 or above trauma center. The variable measuring the percentage of the population that is employed in the diagnosing or treating medical professions has a mean of 1.779% with a standard deviation of 0.763. Its minimum percentage is 0.380 and its maximum percentage is 6.053.

There are three crime-related criminal events perspective variables. The variable measuring the percentage of arrestees found with firearms has a mean of 1.246% and a standard deviation of 1.492. Its minimum percentage is 0 and its maximum percentage is 6.858. The result of 0 as the minimum percentage returns in 20 cases. This is most likely due to reporting errors in NIBRS, though the statistics are not clear enough to discount these cases. The largest number of arrestees from this group of 20 is just shy of 10,000; while the majority of these cities fall between 270 and roughly 3500 arrestees. It is possible that these 20 cities truly did not arrest anyone in possession of a firearm in the year 2010. As such, these cities will remain in the analyses. The variable measuring the percentage of the population that are males

16 to 24 has a mean percentage of 7.475 with a standard deviation of 2.955. Its minimum percentage is 3.705 and its maximum percentage is 23.314. The variable measuring the number of drug-related offenses per 100,000 people has a mean of 599.955 offenses per 100,000 with a standard deviation of 383.126. Its minimum mean is 27.012 per 100,000 and its maximum is 2343.261 per 100,000.

There are four variables measuring factors associated with social disorganization. The variable measuring the percentage of households in a city with occupants who have stayed in the dwelling for at least 5 years has a mean percentage 41.307 with a standard deviation of 8.27. Its minimum percentage is 18.333 while its maximum percentage is 63.011. The variable measuring the percentage of households that are headed by a single parent has a mean percentage of 10.449 with a standard deviation of 3.381. Its minimum percentage is 4.205 while its maximum percentage is 20.575. The variable measuring the percentage of the population that is living below the poverty line has a mean percentage of 15.025 with a standard deviation of 7.190. Its minimum percentage is 2.485 and its maximum percentage is 37.883. The variable measuring the Racial Diversity Index has a mean of 0.454 with a standard deviation of 0.146. Its minimum score is 0.156, indicating a relatively homogenous population and its maximum score is 0.712 indicating a more racially heterogeneous population. The large range of variation for each of these Social Disorganization variables bodes well for analysis as the largest threat to the validity of these traditionally neighborhood-level variables comes from the larger aggregation of city level data and the resulting homogenizing effect that robs the analysis of detail.

There are nine city level control variables. The mean of the variable measuring median income is $32,177.77 with a standard deviation of $8,228.08. For analysis purposes, this variable is standardized to $1,000 so that the median income of 32,177 is now converted to the number 32.117. The minimum median income is $14,402 and the maximum median income is $60,652. The variable measuring population total has a mean of 126,695 with a standard deviation of 128,862. Again, for the purposes of analysis this number is standardized to every 1000 persons in the population. From this the mean population of 126,695 is now 126.695. The minimum population is 50,137 and its maximum population is 787,033. The variable measuring the percentage of a city's population that holds a bachelor's degree or above has a mean percentage of 19.683 with a standard deviation of 8.757. Its minimum percentage is 6.252 and its maximum percentage is 54.284. The variable measuring the percentage of households in a city with more than one person per room in the dwelling has a mean percentage of 2.165 with a standard deviation of 1.396. Its minimum percentage is 0.181 and its maximum percentage is 9.885. The variable measuring the percentage of the population that is male has a mean percentage of 48.687 with a standard deviation of 1.088. Its minimum percentage is 44.701 and its maximum percentage is 52.993. The variable measuring the percentage of the population that is Black has a mean percentage of 14.563 with a standard deviation of 16.087. It minimum percentage is 0.435 and its maximum percentage is 82.179. The variable measuring the percentage of a city's population that is Hispanic has a mean percentage of 11.925 with a standard deviation of 9.809. The minimum percentage is 1.325 and the maximum percentage is 49.813. The variable measuring the percentage of a city's population that identifies as "other race" has a mean percentage of 7.357 with a standard deviation of 4.512. The minimum percentage is 2.598 and the maximum percentage is 26.808. The variable measuring a city's physical location in the Southern United States is a dummy variable that shows 62 out of 198 cities are located in the Southern United States.

Multiple Regression Results

Model 1 (H1, H2, H3)

The first of seven models is estimated to test hypotheses 1, 2 and 3. Results for this model can be viewed in Table 2. As with all models in this dissertation Ordinary Least Squares (OLS) regression is used to test these hypotheses. Collinearity test reveal minimal collinearity [7]issues mostly surrounding the variables measuring income, education and the percentage of medical employees living in an area. This model is significant at the .000 level with an R^2 of 0.199 and an N of 190[8]. Included in this model are the variables measuring the Gamma Index, the presence of a trauma center, the percentage of the population employed in the diagnosing and treating medical professions and all control variables including median income, the population total, the percentage of the population with a bachelor's degree or above, the variable measuring the percentage of households with more people than bedrooms, the percentage of the population that is male, Black, Hispanic and other race, and finally the Southern United States indicator variable.

[7] "Percent employed in the diagnosing and treating medical professions", tolerance = 0.39; "median income", tolerance = 0.34; "percent with Bachelor's Degree or above", tolerance = 0.24; "percent of households with more than one person per bedroom", tolerance = 0.39; "percent African American", tolerance = 0.42.

[8] Eight cases were dropped because the Census had no data on the incorporated area listed in NIBRS and two were dropped because Census data revealed the areas to be under 50,000 popultation.

Hypothesis 1

Within this model 6 variables are significant with at least $p<.05$. For our primary explanatory variables, the Gamma Index and the percentage of medical diagnosing and treating personnel are significant. The Road Connectivity, or Gamma Index, has a coefficient of -0.566 with a standard error of 0.22 and significance level of $p<.01$. This indicates that an increase of 1 in the Gamma Index results in a 56% drop in criminal lethality in an area. This Gamma Index of 1 is only a theoretical possibility, of course, but this does demonstrate that a more connected road network reduces criminal lethality, all else being equal. This supports hypothesis 1.

Hypothesis 2

The variable indicating the presence of a trauma center within the city boundaries of a city has a positive, yet non-significant relationship. As such, this result does not support the negative relationship hypothesized in hypothesis 2. A discussion of this result is included below.

Hypothesis 3

The percentage of the population that is employed in the diagnosing and treating medical professions has a coefficient of 0.025 with a standard error of 0.011 and a significance level of $p<.05$. This indicates that for every 1% increase in the percentage of the population employed in the diagnosing and treating medical professions in an area its criminal lethality increases by 2.5%. This does not confirm hypothesis 3. On the contrary, the negative relationship hypothesized in hypothesis 3 is directly opposite from the positive relationship demonstrated in the data. This result is discussed further below.

Model 1 Controls

Of the controls used median income, the percentage of the population with a bachelor's degree or above, the percentage of the population that is male and the percentage of the population that is Black are all significant. The variable measuring the median income of an incorporated area has a coefficient of 0.003 with a standard error of 0.001 and a significance level of p<.01. This indicates that for every one thousand dollar increase in the median income of an area there is a resultant 0.3% increase in the area's criminal lethality. The variable measuring the percentage of the population with a bachelor's degree or above has a coefficient of -0.003 with a standard error of 0.001 and a significance level of p<.01. This indicates that for every 1% increase in the percentage of the population with a bachelor's degree there is a resulting .003% decrease in an area's criminal lethality. The variable measuring the percentage of the population that is male has a coefficient of 0.012 with a standard deviation of 0.006 and a significance level of p<.05. This indicates that for every 1% increase in the percentage of the population that is male there is a resulting 1.2% increase in an area's criminal lethality. The variable measuring the percentage of the population that is Black has a coefficient of 0.002 with a standard error of 0.000 and a significance level of p<.000. This indicates that a 1% increase in the Black population in an area results in a 0.2% increase in an area's criminal lethality. All other control variables return non-significant.

Model 2 (H4, H5, H6)

Model 2 is used to test hypotheses 4, 5, and 6. Results for Model 2 can be viewed in Table 3. As with all models in this analysis, OLS regression is used. This model is overall significant at the .01 level with an R^2 of 0.065. A test for multicollinearity reveals no is[9]sues of collinearity amongst variables. The variables included in this model are the percentage of arrestees found with a gun in their possession, the percentage of the population that is male and between the ages of 16 and 24, and the number of drug-related arrests per 100,000 population. The controls used in all models are also included with the exception of the median income. This variable is not included due to multicollinearity issues. The addition of the percentage of males 16 to 24 means that median income covaries too heavily with that variable, the education variable, the population density variable, and the percent Black variable.

Hypothesis 4

The percentage of arrestees with firearms is non-significant with a p value of $p < .866$. This result does not support hypothesis 4, which predicted a positive relationship between the percentage of arrestees with firearms and an area's Criminal Lethality Index. The reason for this unexpected result is discussed below.

[9] "Percentage of population that are Black", tolerance = 0.39; no others below a 0.4 level.

Hypothesis 5

The percentage of the population that is male between the ages of 16 and 24 has a coefficient of -0.006, with a standard error of 0.002 and a significance level of $p<.004$. This indicates that for every one percent increase in the population that is male and between the ages of 16 and 24 an area's criminal lethality reduces by 0.6%. This result is exactly opposite from the positive relationship hypothesized in hypothesis 5. The reason for this unexpected result is discussed below.

Hypothesis 6

The variable measuring drug arrests per 100,000 population is non-significant in this model with $p<.998$. This result does not support Hypothesis 6 which predicted a positive relationship between the number of drug-related arrests per 100,000 population and an area's Criminal Lethality Index. The reasons for this unexpected result are discussed below.

Model 2 Controls

Of the controls included only the percentage of the population that is male and the percentage of the population that are Black is significant. The variable measuring the percentage of the population that is male has a coefficient of 0.012 with a standard error of 0.006 and a significance level of $p<.043$. This indicates that for every one percent increase in the population that is male there is a resulting 1.2% increase in an area's criminal lethality. The variable measuring the percentage of the population that is Black has a coefficient of 0.001 with a standard deviation of 0.001 and a significance level of $p<.003$. This indicates that for every one percentage increase in the population that is Black there is a corresponding 0.1% increase in an area's Criminal Lethality Index.

Model 3 (H7)

Model 3 is estimated to test hypothesis 7, which predicts an interaction effect between a city's Gamma Index and its trauma center indicator variable. Results for model 3 can be seen in Table 4. This model, with an N of 190, is overall significant at the .000 level with an R^2 of 0.208. This model has a multicollinearity[10] issue between the interaction term and the trauma center indicator. Included in this model are the variables measuring an area's Gamma Index, the variable that indicates that a city has a trauma center of at least level 3 within its city borders, the percentage of the population employed in the diagnosing and treating medical professions, an interaction term calculated using the trauma center variables and the Gamma Index variable. Also included are the control variables used throughout the analyses.

Hypothesis 7

The interaction term is non-significant with a significance level of p<.167. This does not provide support for hypothesis 7, and we fail to reject the null hypothesis that there is no interaction effect. The trauma center indicator variable remains insignificant just as it was in Table 1. The Gamma Index variable also closely mimics its Table 1 result with a negative and significant relationship. This variable has a coefficient of -0.793 with a standard error of 0.273 and a significance level of p<.004. This indicates that a one unit increase in the Gamma Index, a

[10] "Interaction term", tolerance = 0.008; "trauma center", tolerance = 0.008; "percent with a bachelor's degree or above", tolerance = 0.25; "percent of medical diagnosing and treating employees", tolerance = 0.35; "median income", tolerance = 0.36, and "percentage of households with more than one person per room", tolerance = 0.39.

conceptually totally connected network, results in a 79.3% decrease in that area's criminal lethality. The variable measuring the percentage of the population that is employed in the diagnosing and treating medical professions also has a similar result to Table 1 with a coefficient of 0.026, a standard error of 0.011 and a significance level of $p<.017$. This indicates that for every one percent increase in the population employed in diagnosing and treating medical professions there is a resulting 2.6% increase in an area's criminal lethality.

Model 3 Controls

Of the controls used, median income, the variable measuring the percentage of the population with a bachelor's degree or above, the percentage of the population that is male, and the percentage of the population that is Black all return significant. The median income variable has a coefficient of 0.002 with a standard error of .000 and a significance level of $p<.003$. This indicates that for every one thousand dollar increase in an area's median income there is a resulting 0.2% increase in its criminal lethality. This counter-intuitive result is most likely due to a lowering of assaults than a raising of murders. The bachelors and above variable has a coefficient of -0.003 with a standard error of 0.001 and a significance level of $p<.007$. This indicates that for every one percent increase in an area's population with a bachelor's degree or above there is a 0.3% decrease in that area's criminal lethality. The variable measuring the percentage of the population that is male has a coefficient of 0.012 with a standard error of 0.006 and a significance level of $p<.042$. This indicates that for every one percent increase in the population that is male there is a 1.2% increase in an area's criminal lethality. The variable measuring the percentage of the population that is Black has a coefficient of 0.002 with a standard error of 0.000 and a significance level of p<.000. This indicates that compared to Whites, for every one percent increase in the population that is Black there is a 0.2% increase in criminal lethality.

Model 4 (H8)

Model 4 is estimated to test hypothesis 8, that there is an interaction effect between the percentage of the population that is male 16 to 24 and the percentage of arrestees arrested with a firearm. Results for Model 4 can be viewed in Table 5. This model is significant at the .01 level with an R^2 of 0.128. This model had multicollinearity[11] issues only with the interaction term and the percentage of arrestees found in possession of a gun. Included in this model are variables on the percentage of the population that is male between the ages of 16 and 24, the percentage of arrestees arrested with a firearm, and an interaction term including those variables. Also included are all of the control variables used in the analyses of this dissertation with the exception of median income, which is excluded to reduce multicollinearity.

Hypothesis 8

The interaction term is non-significant with a significance of p<.354. This does not provide support for hypothesis 8 and we fail to reject the null hypothesis that there is no interaction effect. The variable measuring the percentage of the population that is male 16 to 24 has a coefficient of -0.005 with a standard error of 0.002 and a significance level of p<.041.

[11] "Interaction term", tolerance = 0.08; "percentage of arrestees found in possession of a firearm", tolerance = 0.08

This result closely resembles this variable's performance in Table 3. The variable measuring the percentage of arrestees arrested with a firearm is non-significant.

Model 4 Controls

The control variable measuring median income is not used in this model for reasons of multicollinearity. As can be seen in Table 5, of the control variables used the percentage of the population that is male and the percentage of the population that is Black both are significant. The variable measuring the percentage of the population that is male has a coefficient of 0.012 with a standard error of 0.005 and a significance of $p<.035$. This indicates that for every one percent increase in the proportion of population that is male there is a 0.5% increase in an area's criminal lethality. The variable measuring the percentage of the population that is Black has a coefficient of 0.001 with a standard error of .000 and a significance level of $p<.002$. This indicates that a one percent increase in the proportion of the population that is Black there is a 0.1% increase in an area's criminal lethality.

Model 5 (H9)

Model 5 is estimated to test hypothesis 9, that there is an interaction effect between the number of drug arrests per 100,000 population and the percentage of arrestees arrested with a firearm. Results for Model 5 can be seen in Table 6. This model had minimal multicollinearity[12] issues. This model, with an N of 189, is significant at 0.003 with an R^2 of 0.151. This model included a variable measuring the number of drug arrests per 100,000

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[12] "Interaction term", tolerance = 0.23; "percentage of arrestees found with a firearm", tolerance = 0.26.

population, the percentage of arrestees arrested with a firearm, an interaction effect between these variables, and the controls used throughout this dissertation's analyses.

Hypothesis 9

None of the variables of primary theoretical interest are significant. This does not provide strong support for hypothesis 9, and we fail to reject the null hypothesis that there is no interaction effect. It is worth noting, however, that the interaction effect, though not significant at the p<.05 level is approaching significance at p<.079. This finding provides weak support for the hypothesized interaction effect. One unexpected feature of the interaction term is its coefficient of -0.000, indicating a very small yet *negative* effect.

Model 5 Controls

Of the controls used, median income and the variable measuring the percentage of the population that is Black return significant, with the variable measuring the percentage of the population with a bachelor's degree or above and the percentage of the population that is male both approaching significance at the .05 level. The variable measuring median income, in keeping with its past performance in the Tables of this dissertation, has a positive coefficient of 0.003 with a standard error of 0.001 and a significance level of p<.001. This indicates that for every one thousand dollar increase in the median income of an area there is a 0.3% increase in that area's criminal lethality. Again, the reasoning behind this statistic is discussed below. The variable measuring the percentage of the population that is Black has a coefficient of 0.001 with a standard error of 0.000 and a significance level of p<.004. This indicates that with each increase of one percent in the proportion of the population that is Black there is a 0.1% increase in an area's criminal lethality.

Model 6 (H10)

Model 6 is estimated to test hypothesis 10, the existence of an interaction effect between the number of drug-related arrests per 100,000 population and the percentage of the population that are males between the ages of 16 and 24. Results for Model 6 can be seen in Table 7. This model had minimal multicollinearity[13] issues. This model, with an N of 190, is overall significant with 0.009 and an R^2 of 0.128. This model includes the variables measuring the number of drug-related arrests per 100,000 population, the percentage of the population that is male and between the ages of 16 and 24, an interaction term combining the two, and the control variables used throughout these analyses, with the exception of median income which is dropped due to multicollinearity issues.

Hypothesis 10

None of the variables of theoretical interest are significant. These results do not provide support for hypothesis 10 and we fail to reject the null hypothesis that there is no interaction effect. It is worth noting, though, that the variable measuring the percentage of the population that are males 16 to 24 is approaching significance at $p<.074$ and remains negative with a coefficient of -0.005.

[13] "Interaction term", tolerance = 0.09; "drug arrests per 100,000 population", tolerance = 0.11; "percentage of population male 16 to 24", tolerance = 0.31.

Medical 6 Controls

Of the control variables used, the percentage of the population that is male and the percentage of the population that is Black both return significant. The variable measuring the percentage of the population that is male has a coefficient of 0.012 with a standard error of 0.006 and a significance level of p<.044. This indicates that for every one percent increase in the proportion of the population that is male there is a 1.2% increase in an area's criminal lethality. The variable measuring the percentage of the population that is Black has a coefficient of 0.002 with a standard error of 0.000 and a significance level of p<.000. This indicates that as the percentage of the population that is Black increases by one there is a 0.2% increase in an area's criminal lethality.

Model 7a (H11, H12, H13, H14)

Model 7 is estimated to test the four hypotheses informed by Social Disorganization Theory. Results for this model can be seen in Table 8 and Table 9. This model is significant at 0.000 with an R^2 of 0.190. A test of multicollinearity reveals issues with collinearity among several of the variables[14] including the percentage of single parents and poverty as well as the Racial Diversity Index and the percentage of Blacks and Hispanics. This collinearity appears to bias the models towards non-significance. In the interests of testing the specific hypotheses listed above a compromise is proposed. Two models will be estimated, Model 7a and Model

[14] "Percentage of the population with a bachelor's degree or above", tolerance = 0.13; "median income", tolerance = 0.13; "percentage of households single parent headed", tolerance = 0.14; "percentage of population Black", tolerance = 0.16; "Diversity index", tolerance = 0.16; "percentage of population below the poverty line", tolerance = 0.19; "percentage of population Hispanic", tolerance = 0.21; "percentage of the population 'other race'", tolerance = 0.36; "percentage of households occupied by the same people for less than 5 years", tolerance = 0.37.

7b. In the first model (7a) the variables will remain unchanged and we will test for hypothesis support despite the biases.

In the second model (7b) several of the covarying variables will be combined into an index measuring the concept of concentrated disadvantage. The Concentrated Disadvantage Index is composed of the percentage of the population in poverty, the percentage of the population that are single parents, the percentage of the population with less than a bachelor's degree, and the percentage of the population that are unemployed. All of these data are from the American Community Survey or the Census. The Concentrated Disadvantage Index has an alpha of 0.79 indicating a high degree of internal logical consistency, or put more simply, that these variables are all measuring the same underlying concept, concentrated disadvantage. The variables included in model 7a (Table 8) are the percentage of households occupied by the same people for less than 5 years, the percentage of households that are headed by a single parent, the percentage of the population that live below 100% of the poverty line, and a Racial Diversity Index. Also included are the control variables used throughout the analyses in this dissertation. The variables included in model 7b (Table 9) are the percentage of households occupied by the same people for less than 5 years, the Concentrated Disadvantage Index, the Racial Diversity Index, and the controls used in model 7a (Table 8).

Hypothesis 11

Hypothesis 11 predicts a positive relationship between the percentage of households with the same occupants for less than 5 years and an area's criminal lethality. The variable representing the percentage of households with the same occupants for less than 5 years has a coefficient of 0.002 with a standard error of 0.001 with a significance level of $p<.022$. This indicates that for every 1 percent increase in the households with the same occupants for less than 5 years there is a 0.2% increase in an area's criminal lethality. This provides support for hypothesis 11.

Hypothesis 12

The variable measuring the percentage of households in an area that are headed by single parents has a coefficient of -0.008 with a standard error of 0.004 and a significance level of $p<.024$. This indicates that for every one percent increase in single-parent headed households there is a resulting 0.8% decrease in an area's criminal lethality. This is opposite from the positive relationship hypothesized in hypothesis 12. The reasoning behind this unexpected finding is discussed below.

Hypothesis 13

The variable measuring the percentage of the population that is living below 100% of the poverty line has a non-significant coefficient. Hypothesis 13 predicted a positive relationship between the percentage of the population living below 100% of the poverty line and an area's criminal lethality. This result does not provide support for hypothesis 13 and we fail to reject the null hypothesis that there is no relationship between poverty and criminal lethality.

Hypothesis 14

The variable measuring the heterogeneity of an area's racial composition has a non-significant coefficient. Hypothesis 14 predicted a positive relationship between the Racial Diversity Index of an area and that area's criminal lethality. This result does not provide support for hypothesis 14 and we fail to reject the null hypothesis that there is no relationship between an area's Racial Diversity Index and that area's criminal lethality.

Model 7a Controls

Of the controls used in these analyses median income, the percentage of the population with a bachelor's degree or above, and the percentage of the population that is Black all are significant. The variable measuring median income has a coefficient of 0.004 with a standard error of 0.002 and a significance level of p<.019. This indicates that for every one thousand dollar increase in an area's median income there is a 0.4% increase in its criminal lethality. The variable measuring the percentage of the population that holds a bachelor's degree or above has a coefficient of -0.005 with a standard error of 0.001 and a significance level of p<.001. This indicates that for every one percent increase in the population that hold bachelor's degrees or above there is a 0.5% decrease in an area's criminal lethality. The variable measuring the percentage of the population that is Black has a coefficient of 0.003 with a standard error of 0.001 and a significance level of p<.000. This indicates that an increase of 1% in the proportion of the population that is Black sees a corresponding increase of 0.1% in an area's criminal lethality.

Model 7b (Concentrated Disadvantage)

Table 9 contains the results from model 7b. With an N of 190, this model is significant with an F-statistic of $F < 0.0008$ and an R^2 of 0.1597. Multicollinearity testing[15] revealed improved results from Model 7b, though the Diversity Index is still collinear with the race variables. The variable measuring the percentage of households with the same occupants for less than five years is positively related to lethality but misses the significance threshold with $p<0.167$. The concentrated disadvantage variable has a coefficient of -0.007 with a standard error of 0.002 and $p<0.006$. This indicates that for every one unit increase in concentrated disadvantage there is a resulting 0.7% decrease in an area's Criminal Lethality Index. This is most likely due to a larger increase in assaults than in murders. These results are discussed further in the discussion section. The Racial Diversity Index remains insignificant from Table 8 to Table 9.

Model 7b Controls

The median income variable has a coefficient of 0.002 with a standard error of 0.000 and $p<.040$. This indicates that for every one thousand dollar increase in an area's median income there is a resultant 0.2% increase in that area's Criminal Lethality Index. The variable measuring the percentage of the population that is black has a coefficient of 0.003 with a standard error of 0.000 and $p<0.000$. This indicates that for every one percent increase in the percentage of blacks in an area there is a resulting 0.2% increase in that area's Criminal

[15] "Diversity index", tolerance = 0.16; "percentage of population that are Black", tolerance = 0.16; "percentage of population that are Hispanic", tolerance = 0.22; "percentage of population that are 'Other Race'", tolerance = 0.36.

Lethality Index. The dummy variable measuring a city's location in the census defined geographic Southern United States is approaching significance with a coefficient of -0.023, a standard error of 0.014, and $p < 0.101$. This result indicates that a city's location in the South lowers its Criminal Lethality Index by 2.4%.

The results of the previous 7 models have yielded some unexpected findings. Though some of these findings are unanticipated, upon further reflection, most are logical. The origins and implications of these findings, predicted and unpredicted, are discussed in the section that follows.

CHAPTER 6: DISCUSSION AND CONCLUSION

Discussion

The results of this study are informative not only in relation to the hypothesized relationships but also to the idiosyncrasies of utilizing a lethality index as one's dependent variable. In terms of hypotheses, the analyses provided support for two of the hypotheses and directly challenged three hypotheses. In terms of methodology, a number of helpful insights are presented with the failure to reject the null or even the direct challenging of hypotheses that seem straightforward. To better illustrate the relationships of variables across models and the weaknesses of the lethality calculation Table 10 is provided. This table is a variable performance table that presents in three columns each variable's significance and direction across all models estimated for the Criminal Lethality Index as well as across identical models using murders per 100,000 population, and aggravated assaults with major injury per 100,000 population as dependent variables. This is done to show how consistently variables are performing across models and also to illustrate why some variables can be related to murder and aggravated assaults but still return counter-intuitive results for criminal lethality. As none of the interaction effects reached a significance level of $p<.05$ discussion of the models containing them will be restricted to the information these models offer for control variables. This leaves for discussion models 1, 2 and 7.

Model 1

Gamma Index

Model 1 provided evidence for one hypothesis, failed to reject the null of another, and challenged one more. Model 1 provided evidence for the hypothesized relationship between a city's Road Network Connectivity Index (Gamma Index) and that city's Criminal Lethality Index. This result implies that the more connected a road network is the fewer potentially lethal crimes have lethal outcomes. The reasoning behind this result is that a more connected network provides for more options for emergency services to respond to a potentially lethal crime. In other words, more connected streets means more reliable emergency services. This is an important ecological factor that has not been considered in past criminological research.

Applications of Gamma Index and Road Connectivity

The exact mechanism by which the Gamma Index contributes to the lessening of criminal lethality is not explored in this analysis. This mechanism could include the more reliable arrival of medical services or police to the scene of a violent confrontation, or may include a more general reduction in stressors in an area and through this reduction a reduction in the extent of the violence in violent crime. What is known, however, is that the Gamma Index, through whatever mechanism by which it works, is related to the Criminal Lethality Index, possibly by reducing murders more heavily that it does aggravated assaults with major injuries. Again, it should be kept in mind when pondering the implications and applications of this measure that it is effective in reducing the *lethality* of the crime, not the incidence rate of the crime. In other words, it *does not* logically follow that a more connected neighborhood is a safer neighborhood in terms of general crime victimization or even violent crime victimization.

The value of this information to city planners and officials tasked with reducing crime is limited as it stands now. In order to be truly useful to real world application the mechanism or mechanisms by which road network connectivity lowers lethality must be better understood. For example, if this relationship functions in the way that is assumed in this dissertation and provides more reliable emergency support, then it may be more economically feasible in the short term to assign emergency resources to closer locations rather than building new roads and more feasible in the long term to build more roads and utilize fewer police and medical resources over larger areas. However, if this relationship operates more along strain theory lines through a reduction in ambient stressors in an environment then a conceivably equally effective method of reducing stressors is to install better traffic light management systems in addition to or perhaps in the stead of building more connected roads. Regardless of the mechanism by which it works, a broad implication of the criminal-preventative nature of the Gamma Index for city planning is that a certain amount of crime can be literally engineered out of our cities.

In terms of criminological research, the value here is to provide further evidence that physical features of an environment can impact the commission of a crime. Though there is not a cohesive theory on how physical environment affects crime, this acknowledgement of the physical environment playing a role in crime generating circumstances is in keeping with not only the Criminal Events Perspective, but also with several past criminological theories that have attempted to account for physical environmental factors in their analyses. These theories include Routine Activities Theory, Social Disorganization Theory, and the “Broken Windows” thesis among others. The increased use of mapping technology in the future will only enhance our understanding of the role of the physical environment and how it may fit with any number of criminological features.

In addition, though not directly tested, this demonstration of the effect of the Gamma Index provides some evidence that emergency services are important factors in not only responding to but also in preventing serious crimes. Future data collection projects should make some effort to account for specific medical resources, especially given the performance of the medical resources variables used in this study that are discussed below.

Trauma Centers

The result of a non-significant relationship between a city’s trauma center presence and its Criminal Lethality Index is at first a surprise. Upon closer inspection, however, this result may be more of an artifact of data collection than a commentary on the effectiveness of trauma centers. In this analysis 48.7% of cities have a level 3 trauma center or above within their borders. On the surface this looks like a good comparison variable to determine the effect of trauma centers on criminal lethality, as over half of the cities do not have a trauma center. However, what this variable *implies* with its existence and what it *actually measures* are two different things.

What this variable implies is a city’s access to trauma center resources. What it actually measures is simply the physical presence of the trauma center within city borders. The importance of this distinction becomes clear when one actually measures access to trauma resources by taking into account the percentage of cities that are within 45 minutes of a trauma center. In the original variable one would assume that since 51.3% of cities do not have a trauma center they do not have trauma resources. The picture changes drastically when one measures the number of cities within 45 minutes of a level 3 trauma center. Under the new measure of access to trauma resources only 7.3% of cities do not have access to trauma resources. The proportion of cities in the sample within 45 minutes of a level 3 trauma center is 92.7%. In other words, the trauma center variable does not accurately measure access to trauma resources and the variable that does accurately measure access to trauma resources reveals a sample that is saturated with access and therefore virtually a non-variable. Given this, it is no longer surprising that there is a non-significant relationship between trauma center presence and an area's Criminal Lethality Index. Future research should be mindful of the difference between presence and access to trauma resources and also be aware that the majority of the nation already has access to level three or above trauma resources, therefore, measuring the effectiveness of these resources is challenging for want of a control group.

Diagnosing and Treating Medical Personnel

The variable measuring the percentage of the population that is employed in the diagnosing and treating medical professions is not a failure to reject the null hypothesis but instead a result that is a direct challenge to the hypothesized negative relationship with criminal lethality. The result demonstrates a positive relationship in which an increase in the percentage of the population employed in diagnosing and treating medical professions corresponding to an increase in the criminal lethality of an area. It seems counter intuitive that an increase in the proportion of people equipped to deal with medical emergencies would see an increase in the proportion of murders to crimes that could have been murders. It is important to keep in mind that though the data for this project were collected over the course of one year it is cross-sectional and not longitudinal and therefore cannot isolate causality. There are two logical assumed causal relationships given the results. The first is that medical professionals live, in a sense, where they are needed. In other words, higher criminal lethality precedes the location of medical professionals in an area. The second scenario is that medical professionals actually live in more well-to-do incorporated areas that see very little reported aggravated assaults but in which murders, when they do occur, result in a high Criminal Lethality Index. This is even more likely in that many towns of 50,000 residents or more are now suburbs of larger urban areas, setting up a situation in which a medical professional can live in one incorporated area and find employment in another. A statistical analysis reveals that this second scenario is the more likely of the two. As can be seen in Table 11, the mean for the sample of Aggravated Assaults with Major Injuries per 100,000 population is around 145. The sample mean for Murders per 100,000 population is 5.82. If one were to restrict our cases to only those cases that have more than the rough mean of 2% of the population employed in diagnosing and treating medical professions, as well as only cases in which the median city income is more than the rough mean of $32,000 the mean of Aggravated Assaults with Major Injuries per 100,000 population drops drastically to just 22.2 while the mean of Murders per 100,000 population drops to 3.2. As seen in Table 11, this demonstrates that the majority of diagnosing and treating medical professionals live in cities that have over the mean income of $32,000, and that this group of cities with higher income and higher medical personnel have higher lethality through lowered aggravated assault with major injury.

If this seems difficult to understand, imagine an upper class neighborhood with several hundred houses. In this neighborhood there is virtually no street crime and very little in the way of *reported* domestic abuse. A murder in a neighborhood such as this would result in a large Criminal Lethality Index, despite the relatively low levels of violence. It is possible that a similar situation is occurring in more "well-to-do" cities that act as suburbs of larger areas. Lower violent crime rates actually increase the criminal lethality of the area. This scenario becomes even more likely with the discussion of median income's relationship to criminal lethality, addressed in the Controls section below.

Model 2

Percentage of Arrestees with Guns

Model 2 failed to reject the null hypothesis for two hypothesized relationships and provided a direct challenge to another. The variable measuring the percentage of arrestees arrested with a firearm is non-significant, failing to reject the null hypothesis that there is no relationship. Again, this may be true because of an artifact of methodology. The way that the Criminal Lethality variable is calculated makes it a different concept with unlike dynamics than the standard "violent crime X per 100,000" crime proportion variable. Criminal Lethality is not concerned with increasing quantity of crime, therefore, a variable that is known to increase violent crimes does not necessarily increase Criminal Lethality as it is conceptualized here. In order to demonstrate this, a comparison model is estimated. If the dependent variable representing the Criminal Lethality Index is replaced with the more traditional Murders per 100,000 dependent variable the variable representing the percentage of arrestees arrested with firearms becomes significantly and positively related to the new dependent variable. This demonstrates that the variable is behaving consistently with past research. Furthermore, if that comparison model is re-specified with Aggravated Assaults with Major Injuries per 100,000 as the dependent variable the variable measuring the percentage of arrestees arrested with a firearm remains positive and strongly significant. The performance results for all variables across all analysis and comparison regressions can be viewed in Table 10. This table indicates that percentage of arrestees with firearms is consistently not related to lethality but is positively related to both Murders and Aggravated Assaults with Major Injuries per 100,000 in one model each.

This particular variable illustrates well one of the major pitfalls of the Criminal Lethality Index, namely it is not intuitive and if a criminogenic variable boosts or represses both of the variables used to calculate Criminal Lethality then that variable has an increased chance of returning as non-significant in a model that uses Criminal Lethality as a dependent variable. In this case, percentage of arrestees arrested with a firearm represents the use of firearms in crimes which is positively related to both murders and aggravated assaults with major injuries. Because it is related to both in the same way the variable is not related to Criminal Lethality as it is conceptualized here.

Percentage of Population Male 16 to 24

The variable measuring the percentage of the population that is male and 16 to 24 is negatively and significantly related to Criminal Lethality. This is a direct challenge to the proposed positive relationship of hypothesis 5. This relationship appears to be genuine and not an artifact of methodology. Furthermore, the negative relationship surrounding the percentage of the population that is male 16 to 24 holds across the comparative dependent variables Murders per 100 Thousand population and Aggravated Assaults with Major Injuries per 100,000. This variable's relationship with criminal lethality may be explained by the fact that younger people are less likely to die from physical assault than older people. However, this observation does not account for the lowering of aggravated assaults with major injuries. These results have two implications that bear discussing.

First, from a methodological point, this variable affects both of Criminal Lethality's constituent variables in the same way, much as the variable measuring percentage of arrestees arrested with a gun does. Despite this, the Percent Male 16 to 24 variable illustrates that a variable that affects both origin variables in the same way may still return a significant relationship with Criminal Lethality. The way that this is accomplished is through a stronger effect on one variable than the other, despite the similar direction of the relationship. For example, the Percent Male 16 to 24 has a standardized coefficient with Murder per 100,000 of -0.06 and a standardized coefficient with Aggravated Assaults with Major Injuries per 100,000 of -0.186. This demonstrates a stronger negative effect on Aggravated Assaults with Major Injuries than Murder, resulting in a negative relationship with Criminal Lethality.

Secondly, the Model 2 results for the variable measuring the percentage of the population that is male 16 to 24 challenges the findings in the research that imply the majority of violent crime is committed by young males. This is not merely an artifact of the way in which the lethality variable is calculated. In comparison models using Murders and Aggravated Assaults with Major Injuries as dependent variables also return negative results, indicating that as the percentage of the population that is male 16 to 24 increases both Murders and Aggravated Assaults with Major Injuries decrease. This, coupled with the Criminal Lethality result of Model 2 challenges the idea that young males alone create violence.

This negative relationship could be a result of several phenomena. First, this may be a methodological issue. It is possible that including youth 16 and older in the variable specification created a negative relationship with violent crime while if the variable had included males of a little older age it may have returned positive. This is speculation at best. Further, a possibility is that although the majority of violent crime is committed by young males an increased population actually has a suppressing effect at such a larger aggregate level. A third possibility is that an increased proportion of young males only increases violent crime under certain conditions that are difficult to measure with large aggregates.

Drug Arrests per 100,000 Population

The variable measuring the number of drug related arrests per 100,000 population indicates a non-significant relationship. Comparative regressions reveal a non-significant relationship with Murder but a positive and significant relationship with Aggravated Assaults with Major Injuries. The variable, though positively related to aggravated assaults, is not significantly related to lethality. This is possibly due to the way the variable is specified. The variable that measures the number of drug-related arrests per 100,000 population includes all drug-related offenses including dealing, trafficking, and using. According to past research it is the drug-related offenses surrounding dealing and trafficking instead of using that incites the most violence. This variable oversaturates the measure with mostly non-violent offenders. To correct for this problem future research should focus on collecting data about the systemic side of drug use, drug dealing, and trafficking offenses. If drug users can be culled from the available data, it would likely produce a variable much more capable of measuring the most impactful effects of drugs on violent crime in an area, specifically the violent offenses associated with the drug distribution process.

Model 7a

Percent of Households Occupied for Less than 5 Years by Same Residents

Model 7a, testing Social Disorganization informed variables, produced one supported hypothesis, one challenged hypothesis, and two failures to reject the null hypothesis, which may have been due to multicollinearity issues. The variable measuring the percentage of households occupied for less than 5 years by the same residents has a significant and positive relationship. This supports hypothesis 11, the more population turnover in an area, the more lethal that area's criminal violence. This is in keeping with Social Disorganization Theory that assumes a reduction in informal social control as population turnover increases. It is important to note that this result is achieved while controlling for both poverty and median income. This indicates that the occupied for less than 5 years variable is not simply a proxy for economic-based concepts. This provides support for the Social Disorganization notion that a large number of residents simply occupying an area for an extended period of time can lower crime through social interaction. The NIBRS database, combined with mapping data should continue to provide Social Disorganization theorists with opportunities to test tertiary predictions of their community-based theory of crime. This also provides the first evidence that this conceptualization of criminal lethality can be used to test Social Disorganization concepts, provided that one keeps in mind the potential pitfalls surrounding the calculation of Criminal Lethality. Simply put, this is evidence that Social Disorganization affects not only the incidence of violent crime but also the extent of the violence committed.

Percent of Households Headed by a Single Parent

The variable measuring the percentage of households headed by a single parent indicates a negative and significant relationship with Criminal Lethality. This is a direct challenge to the proposed positive relationship hypothesized by hypothesis 12. This is another illustration of how a variable with well-known behavioral characteristics can validly produce results that are initially unintuitive when used with the Criminal Lethality Index. Comparative regression models reveal a positive yet non-significant relationship with Murder per 100,000 but a strong positive and significant relationship with Aggravated Assaults with Major Injuries per 100,000. In keeping with previous Social Disorganization research family disruption has indeed increased violent crime in the sample. However, by greatly increasing Aggravated Assaults with Major Injuries but not overly impacting Murder the variable produces a significant but negative relationship with Criminal Lethality. In other words, an increase in single parent households causes an increase in aggravated assaults which, in turn, augments the denominator without increasing the numerator of the Criminal Lethality Index. In this way a criminogenic variable actually produces the appearance of being crime-suppressive.

Percent of Population Living Below 100% of the Poverty Line

The variable measuring the percent of the population living below 100% of the poverty line indicates a non-significant relationship with the Criminal Lethality Index. Comparative regression analysis reveals a strong positive and significant relationship with both Murders per 100,000 population and Aggravated Assaults per 100,000 population. Poverty is yet another example of how a variable with well-known behavior characteristics produces unexpected results when used with the Criminal Lethality Index. As increased poverty is strongly related to both increased murder and increased aggravated assaults with major injury it produces a Criminal Lethality effect that appears non-significant. Alternatively, this variable may have been null in the model because of issues of multicollinearity. This issue is addressed by model 7b, which incorporates poverty as part of a larger concentrated disadvantage variable.

Racial Diversity Index

The variable measuring the racial diversity of an incorporated area indicates a negative but non-significant relationship with the Criminal Lethality Index. This represents a failure to reject the null of hypothesis 14 that there is no relationship between racial diversity and criminal lethality. Comparative analysis regressions reveal a negative and significant relationship with Murders per 100,000 population and positive but non-significant relationship with Aggravated Assaults with Major Injuries per 100,000 population. Given this variable's negative relationship with murder and positive (though insignificant) relationship with aggravated assault with major injuries, it is somewhat surprising that it has no relationship with criminal lethality. The possibilities are two fold; either the Racial Diversity Index has too weak of a relationship with aggravated assaults with major injuries to produce a significant relationship with the Criminal Lethality Index, or racial diversity is not related to Criminal Lethality as it is conceptualized here.

Model 7b (Concentrated Disadvantage)

Model 7b is estimated to address the multicollinearity issues of the model in Table 8. This model incorporates the percentage of the population that is unemployed with the percentage of the population that is below the poverty line, the percentage of households that are single-parent headed and the percentage of the population that holds less than a bachelor's degree into one variable measuring concentrated disadvantage.   This eliminates the multicollinearity issues of Table 8 and returns a significant but negative result for concentrated disadvantage. As can be seen from the results in Table 10, this variable is positively and significantly related to both Murders per 100,000 population and aggravated assault with major injuries per 100,000 population. This tells us that this is yet another variable that is related to incidence of crime in predictable ways but is related to criminal lethality in counter-intuitive ways. This variable produces more aggravated assaults with major injuries than it does murders and, through this dynamic, produces a negative relationship with criminal lethality due to inflating the denominator to a greater degree than the numerator. Regardless, this result and its comparison analyses provide evidence for the role of concentrated disadvantage in producing violent crime, increasing both murder and aggravated assault with major injuries.

Social Disorganization

Given the performance of the Social Disorganization variables in these analyses this dissertation has given some evidence that Social Disorganization Theory can be applied to the severity of violence but is more suited to predicting frequency of violent crimes. In addition, if Social Disorganization variables are used in future research about the severity of violence a more robust dependent variable should be used than the Criminal Lethality Index as it is calculated here. The variables specified are too closely related to the generation of aggravated assaults with major injuries. Their tendency towards criminogenic effects plays havoc on the underlying relationship of the Criminal Lethality Index. These variables, originally conceptualized as criminogenic, are not as well suited to identifying factors that decrease homicide while not affecting other violent crimes.

Dissertation Controls

Throughout the analyses in this dissertation a specific set of controls was used. The only control not used in every model estimated is median income, which is dropped from three models because of issues of multicollinearity. Through the use of these controls a picture emerges about each of their relationships with the Criminal Lethality Index that is informative.

Median Income

Somewhat surprisingly median income, which was used in 4 of the 7 models, consistently indicated a strong positive and significant relationship with the Criminal Lethality Index. Again, though not immediately intuitive, the origins of this result become clearer when viewed through the lens of the comparative regressions that are estimated for illustrative purposes during the discussion section of this dissertation, the broad results of which can be seen in Table 10. Though not always significant, these analyses collectively reveal a relatively consistent positive relationship with murder and a relatively consistent, though again not always significant, negative relationship with aggravated assaults with major injury. In this way we see that median income most likely produces its strange relationship with the Criminal Lethality Index through a sharp reduction in aggravated assaults with major injury but less of a drop or no effect at all on murders. This produces a consistently positive relationship with Criminal Lethality as it is conceptualized here.

Percentage of the Population with a Bachelor's Degree or Above

The control variable measuring the percentage of the population with a bachelor's degree or above appears in all seven models. This variable has a consistently negative relationship with the Criminal Lethality Index. This indicates that as higher education increases in an area its criminal lethality decreases. It is important to note, however, that this variable is only significantly related to the Criminal Lethality Index when median income is also included in the model. In the absence of median income the variable measuring the percentage of the population that hold a bachelor's degree or above loses significance.

The Percentage of the Population that is Male

The percentage of the population that is male is consistently, in 6 out of 8, models positively and significantly related to the Criminal Lethality Index. In the two models that are not significantly related, this variable is still positively related. This result is not unexpected as past research has overwhelmingly shown that the vast majority of criminal violence, especially lethal violence, is carried out by males more than females (Felson and Messner, 1996; Felson, 1996; Felson and Cares, 2005). Though this is not a surprising result it does serve as a reminder to include in criminological studies variables that take gender into account as a criminogenic factor.

The Percentage of the Population that is Black

The percentage of the population that is Black is used in all seven models and is consistently and significantly positively related to the Criminal Lethality Index. It reveals that consistently as the percentage of the population that is Black increases, Criminal Lethality is increased as well. As shown in Table 10, amongst the comparative regressions estimated, the percentage of the population that is Black is significantly positively related to Murders per 100,000 population in all seven models and significantly positively related to aggravated assaults with major injuries per 100,000 in six out of seven models, with the last model returning null. The fact that this variable is positively related to both murders and aggravated assaults with major injuries whilst still returning a consistently positive relationship to the Lethality Index indicates that the percentage of the population that is Black impacts murders more than it does aggravated assault. In addition, it is worth noting that this is the variable that is the most consistently related to criminal lethality, murders per 100,000 population and aggravated assaults with major injuries per 100,000 population. Out of a total of 24 models specified and tested with percent Black as a control variable in 23 it returned significantly and positively related to the dependent variable of the model. Given the data available for analysis in this work any discussion of the reasons why this is pattern exist is speculative in nature. With that proviso in mind, this pattern may exist because of the lingering negative effects of the openly racially discriminatory period in the United States history, or the continued "institutional racism" of our modern organizations in which a group of people are systematically disadvantaged de facto without prejudicial intent from the institutional organizers.

Either or both of these societal discriminatory forces could be at work to uniquely disadvantage Blacks in America, which in turn leads to an increase in economic, social, and psychological strain and, through various possible mechanisms, an increase in violence and lethality. Regardless of the generative factors this work has demonstrated a consistent pattern between increased percentage of the population that is Black and not only an increase in general violence but also an increase in the lethality of that violence.

The South

Contrary to the predictions and observations of past research the dummy variable indicating a city's location in the geographic southern United States consistently returned non-significant and negatively related across all 8 models, with model 7b returning an approaching significance result once concentrated disadvantage is taken into account. This lack of results is somewhat surprising given the "Southern Honor Culture" theory and a long history of higher violent crime rates than other regions. However, these non-results become even more puzzling as we view this variable's performance across all comparative regressions as well. When used in models with the well-trod dependent variables of Murders per 100,000 population and Aggravated Assaults with Major Injuries per 100,000 population the Southern indicator variable is consistently and significantly negatively related to both. Only when the variable measuring poverty is introduced does the Southern indicator drop out of significance in these tertiary comparative regressions. This is clearly not a result of the way that the dependent variable is calculated, however, this relationship may still be methodologically driven. The data for this study are gathered from the 2010 NIBRS, still a relatively new source of criminological data that offers researchers ways of analyzing data not previously available. This provides us with three alternative explanations for the negative southern/violence relationship. The first is that perhaps NIBRS is simply providing cleaner data than previous studies incorporating the South. Under this explanation NIBRS data provides a challenge to the violent South hypothesis. Also plausible is that previous data were collected in past decades or years and the year of 2010 may genuinely have been a less violent time in the South than in the years of previous studies. If this is the case the question becomes, is this a temporary respite or is the whole region becoming more civil? Finally, this could be an artifact of the way that the "South" was defined in this study. This study included most states that would be considered Southern while previous studies may have been including only some Southern states or only the "deep South" Southern states. Regardless, this result is too distinctive to ignore in future research and may represent a shift in the South's relationship with violent crime.

The Criminal Lethality Index

This study has provided valuable information regarding the potential benefits and downsides of using the Murders / Murders + Aggravated Assaults with Major Injuries calculation of the Criminal Lethality Index. Specifically, this study established that crime-related variables that increase murder but not aggravated assaults will result in a higher lethality index. Also, crime related variables that decrease aggravated assaults without impacting murders will produce increased lethality. Finally, this study provided evidence that variables can increase or decrease both murder and aggravated assaults without being significantly related to the Criminal Lethality Index. In this way we see that this dependent variable is excellent at identifying *protective* factors that decrease murder but not aggravated assaults but is less suited to examining variables that increase or decrease both or decrease aggravated assaults without increasing murders. Also, this variable is vulnerable to the "false positive" of increasing aggravated assaults without impacting murder. This will express itself as a lessening of Criminal Lethality, which is mathematically true but is not accomplished through preventative factors.

Conclusion

This dissertation has successfully brought data together from four separate sources, including mapping generated data, and used them in novel ways to test multiple hypotheses drawn from multiple theoretical areas. This dissertation tested 14 hypotheses and an additional Concentrated Disadvantage Index. Of these 14 hypotheses, support is found for two, challenges are found for three and eight more fail to reject the null hypotheses. In addition to the knowledge gained from out confirmed hypotheses, this dissertation illustrates positive and negative methodological issues surrounding the use of the primary dependent variable, the Criminal Lethality Index. This dissertation has not only provided useful exploration of variables but has also introduced useful methodological techniques and discussion.

The analyses put forth here provide evidence of the protective relationship between Road Network Connectivity and the lessening of lethal outcomes to violent crime. This result thereby opens up new avenues of research on the effects of the physical environment on crime in not only criminogenic ways but also in anti-criminogenic ways. Through the analyses of well-established crime correlated variables these analyses provided a discussion of these variables' relationships to the violent crimes that underlie the Criminal Lethality Index concept and through this discussion gained a better understanding of the intricacies of using a Criminal Lethality Index. The Criminal Lethality Index is a good dependent variable for identifying protective factors to violent crime, but is plagued by intricacies of calculation that produce unintuitive results and occasionally a "false positive" lowering of lethality that is due to an increase in non-lethal violent crime independent of a decrease in murders. In addition, this dissertation's control variables, used throughout the analyses, have provided strong evidence that the percentage of the population that is Black is ecologically linked to an increase in an area's Criminal Lethality Index. This result is consistent across all models, however, the underlying reason for this is still unclear. This dissertation also has demonstrated a consistent result of no relationship between geographic location in the Southern United States and a city's Criminal Lethality Index. This result goes against previous research that has shown the South to be a more deadly, not less deadly, region. In addition to non-significance with criminal lethality, strong evidence of a negative relationship between southern location and murders per 100,000 and moderate evidence of negative a negative relationship between Southern location and aggravated assaults with major injuries per 100,000 population was found.

Limitations

Aggregation

One potential limitation to this study is the level of aggregation and the resulting loss of detail. This analysis is done using incorporated areas with over 50,000 people residing in them. This level of analysis is primarily chosen as a way of providing a cross comparison of multiple city road networks and as a way of bolstering the potential generalizability of the study. That being said, cities of this size are complex aggregates in which much of the smaller community or group data are lost through amalgamation. Though this level of aggregation is not ideal, this aggregate level is called for primarily because it strikes a balance between the realities of data collection and the generalizability of the study. Of primary concern with this issue is how this will affect the data regarding social disorganization, which is primarily a theory about community-level and group-level interactions.

To the author's knowledge no studies have been done examining the proposed link between social disorganization and an increase in an area's Criminal Lethality Index. The unit of analysis used in this study somewhat hampers the suitability of the analysis to address the dynamics proposed by the theory. As Social Disorganization Theory is primarily about *community*-level relationships, by aggregating up to the city level this dissertation loses much of the detail that Social Disorganization analysis has traditionally thrived on. Conceptually, on an aggregate level that offers less detail and has been shown to have inconsistent results when applied to collective efficacy and social disorganization, any results should be taken cautiously (McCall et al., 2010). If the results are significant then it is evidence towards a link between social disorganization and lethality, those results that return non-significant are not *definitive* evidence against the proposed link.

Data Integration

The data for this project is gathered from multiple sources. The source for the crime data (NIBRS) and the source for the demographic and characteristics data (the Census' American Community Survey) are gathered at similar but not precisely the same aggregate levels. NIBRS gathers data not on the incorporated area, as the Census' American Community Survey does, but on the reporting law enforcement agency primarily responsible for the incorporated area. As a result there is a possibility that even within 100% NIBRS compliant areas there will be crimes committed within the incorporated areas' boundaries that are handled by a different agency, such as an aggravated assault near a city boundary that is handled by the county sheriff. This is a potential limitation to the study; however, the vast majority of crime committed within the city boundary should be handled by that city's primary law enforcement agency. In addition, this process works in the opposite direction as well in which some crimes committed outside the incorporated area's jurisdiction are handled by that area's law enforcement agency. As such, and given the large numbers of crimes committed in cities of this size, it is not an unreasonable assumption that the crimes that are shared across jurisdictions are a minority of total crimes reported and as a result not overly impactful on the aggregated crime patterns reported for the city as a whole.

Generalizability

This study is conducted only on incorporated areas within states that have 80% of their population accounted for in NIBRS as of 2010. In addition, the data are gathered only on cases in which the area is incorporated and has a population of over 50,000 individuals. Inherently, this means that any conclusions drawn from the study can only be generalized to midsized and larger cities within those states. The results of this study cannot necessarily be generalized to smaller cities, rural areas, or any areas outside of a NIBRS compliant state. However, even accounting for the limitations of this study the results still represent a valuable contribution to our understanding of crime through a novel exploration of the theoretical covariates of lethality.

Future Research

Future research into anti-criminogenic factors can benefit from the use of the Criminal Lethality Index, if they remain mindful of the sensitivities of the variable. An effort should be made to isolate exactly which measurements of which concepts are appropriate for use with a Criminal Lethality Index. For example, if the concept is general access to medical resources the percentage of the population employed in the diagnosing and treating medical fields is not an appropriate variable to use because it produces a positive relationship with lethality through a shrinking of aggravated assaults. On the other hand, the number of hospital beds available in an area or some measure of literal resources may be a more appropriate fit.

Effort should be made to not only identify which variables appropriately affect the Criminal Lethality Index but an effort should also be made to develop a more robust index that is not as vulnerable to idiosyncratic relationships. The focus should be on creating a dependent variable that responds well to identifying anti-criminogenic factors but is not as prone to false positives, false negatives, and generally unintuitive results. This may be accomplished through focusing on expanding what is considered a potentially deadly crime. Perhaps by diversifying the crimes that go into calculating the denominator a more robust index can be specified. For instance, in data sets that do not solve the hierarchical reporting problem, robberies, rapes, and other potentially violent crime could be included. However, for NIBRS data, it is as yet unclear what can be done to make the criminal lethality variable more resistant to false or unintuitive results. It is important to note, however, that regardless of future efforts some variables will always return unintuitive results given an index such as this. The most important of these is perhaps a measure of poverty which is known to be strongly related to almost all forms of violent crime and therefore has great potential for idiosyncratic behavior with any method of calculating the Criminal Lethality Index.

Future research should continue to focus on exploring the role that physical environment plays in contributing to or hindering the commission of crimes. If there are more protective factors to be found they need to be identified and publicized. Future studies may focus not only on the more efficient flow of emergency response but also expand the theoretical base to explore if theories like General Strain play a role in the relationship between physical environment and crime.

In addition to exploring additional physical environmental factors, the Road Network Connectivity Index should be explored further in its own right. There are still questions to be answered concerning this variable. Future research should endeavor to repeat the results to determine if the pattern holds across different cities and data sources. Also, an effort should be made to lower the unit of analysis to determine if road networks play roles in neighborhood dynamics.

Effort should also be put into further exploring the surprising behaviors of the "Male 16 to 24" and the "Southern Indicator" variables. Both of these variables provided consistent results that run contrary to current theorizing and past empirical findings. These variables should be estimated from different contemporary sources than the NIBRS database as well as further studied using the NIBRS database. This should be done in an effort to isolate if these relationships are simply an artifact of the NIBRS system or if they represent a real challenge to current thinking, or both.

In terms of social disorganization, future research into this theory should incorporate more mapping-based techniques. At its heart, the theory is about smaller community dynamics and the original cohort of Social Disorganization theorists relied heavily on analogue mapping to demonstrate the dynamics of their theory. Increasingly sophisticated modern mapping software combined with a proliferation in available secondary data presents an unequaled opportunity for testing and expanding Social Disorganization research. This dissertation has provided some interesting results for the inclusion of the severity of violence as a potential outcome of socially disorganized areas.

As our technology moves forward it will most likely only become more common and more reasonable to gain access to multiple secondary sources and find ways of usefully combining data. This is only enhanced further by access to mapping software with the ability to map and aggregate not only addresses but also global positioning coordinates, which offer sociologists a way of anonymously gathering primary data that can be easily mapped and aggregated. Given the potential of mapping technologies for social research more emphasis should be put on developing technologies or techniques that allow for more robust data analyses in future research designs. One helpful suggestion is the development of law enforcement data that incorporates GPS coordinates. This can be done relatively anonymously and allow social researchers to aggregate to whatever social unit their study design or theory specifies.

APPENDIX: FIGURES AND TABLES

Figure 1. Road Network Links & Nodes

Note: The dots represent road network nodes, the lines between dots are road network links.

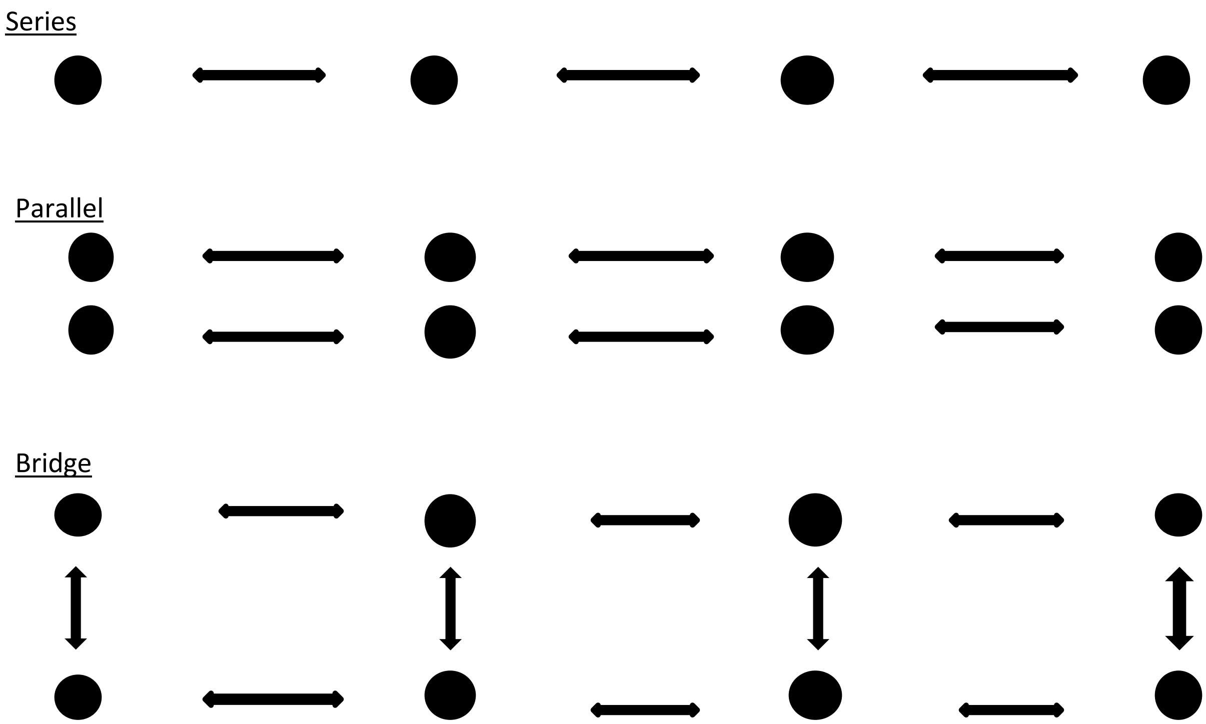

Figure 2. Network Types Illustrated

Note: Circles represent nodes and arrows represent links.

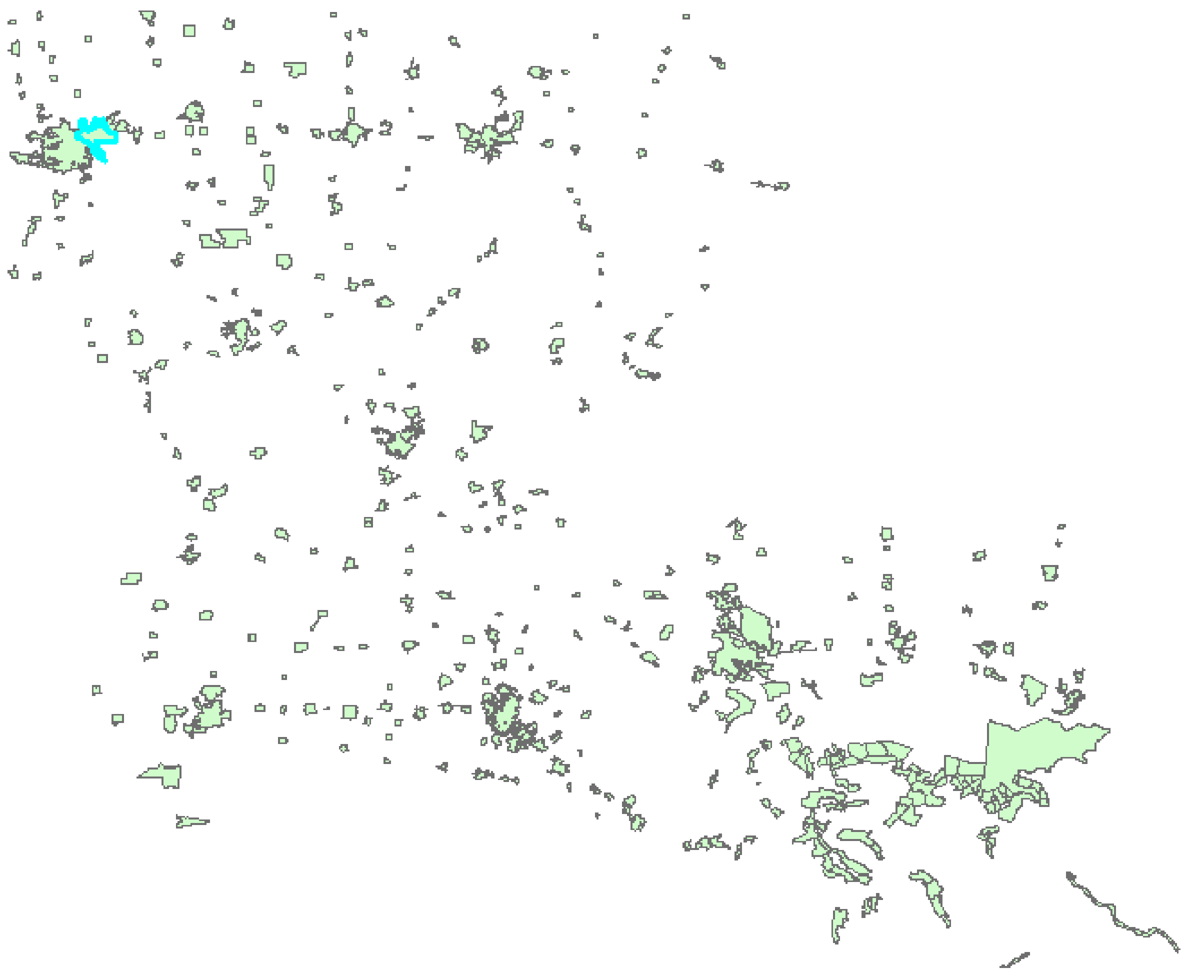

Figure 3. Census Defined Places in Louisiana: Bossier City Selected

Figure 4. Census Defined Place: Bossier City Louisiana

Note: This file is generated from the file in Figure 3.

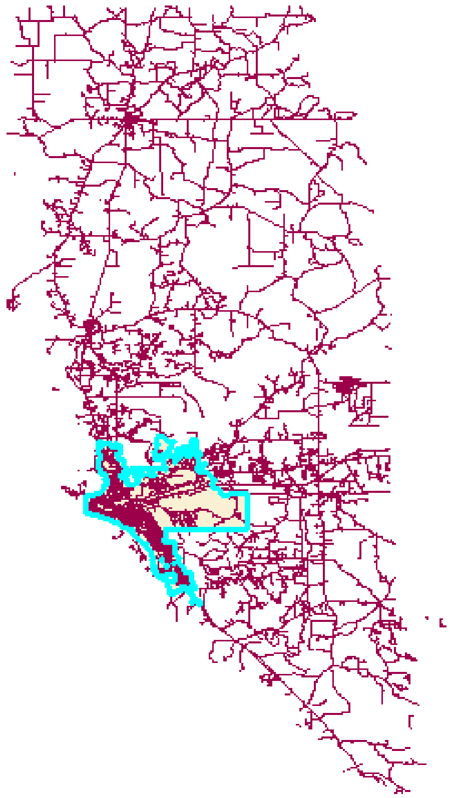

Figure 5. Bossier Parish Louisiana Roads with Bossier City Limits Highlighted

Note: This file is created by combining the file on the county road maps with the file city boundary file in Figure 4.

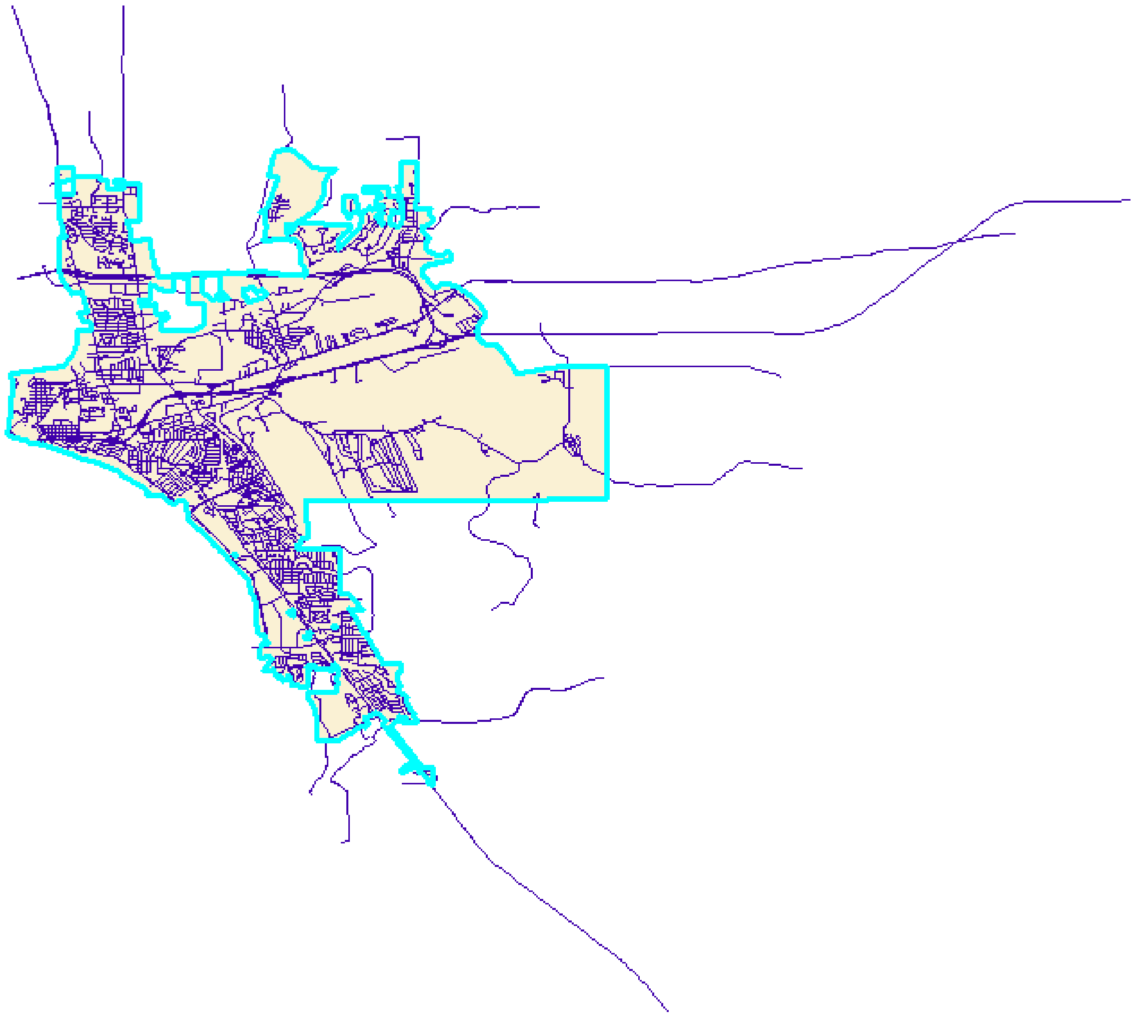

Figure 6. Bossier City Louisiana Roads and City Boundaries

Note: This file is created by dropping all roads from the file in Figure 5 that do not enter city boundaries.

Figure 7. Bossier City Louisiana Road Detail, Nodes & Links

Note: The nodes are represented by dots; the links are the lines between the dots. The Links and Nodes data gathering procedures count each of these respectively, thereby giving us the total number of links and nodes in a city's road network.

Table 1. Descriptive Statistics

Variable	N	Mean	Std. Deviation	Minimum* (Count)	Maximum* (Count)
Dependent					
Criminal Lethality Index	198	0.0663	0.069	0	0.5
Road / Medical Resources					
Gama Index	191	0.233	0.023	0.135	0.273
% Diagnosing & Treating Medical Staff	190	1.779	0.763	0.380	6.053
Trauma Center Indicator	191	-------	--------	0	1
				(98)	(93)
Criminal Events Perspective					
% of Arrestees w/ Firearms	197	1.246	1.492	0	6.858
% of Population that are Males 16 to 24	190	7.475	2.955	3.705	23.314
Drug Related Offenses per 100,000 Population	190	599.955	383.126	27.012	2343.261
Social Disorganization					
% Households w/ Same Occupants Less Than 5 Years	190	41.307	8.270	18.333	63.011
% Households Single Parent Headed	190	10.449	3.381	4.205	20.575
% Population Under 100% of Poverty Line	190	15.025	7.190	2.485	37.883
Diversity Index	190	0.454	0.146	0.156	0.712
Controls					
Median Income/1000	190	32.117	8.069	14.402	60.652
Population Total/ 1000	190	126.695	128.862	50.137	787.033
% Bachelor's and Up	190	19.683	8.757	6.252	54.284
% Households w/ More Than One Person per Room	190	2.165	1.396	0.181	9.885
% Male	190	48.687	1.088	44.701	52.993
% Black	190	14.563	16.087	0.435	82.179
% Hispanic	190	11.925	9.809	1.325	49.813
% Other Race	190	7.357	4.512	2.598	26.808
South Indicator	198	-------	--------	0	1
				(135)	(63)

*Dummy variables have counts in parentheses below their 0 & 1 indicators

Table 2. Model 1. OLS Regression Criminal Lethality Index: Hypotheses 1, 2 & 3

N=190

Criminal Lethality Index	Coefficient	Std. Error	95% Confidence Interval	
Gama Index	-0.566**	0.220	-1.000	-0.132
Trauma Centers	0.002	0.012	-0.021	0.025
% Medical Employees	0.025*	0.011	0.003	0.045
Median Income/1000	0.003**	0.001	0.001	0.045
Population Total/1000	-0.000	0.000	-0.000	0.000
% Bachelor’s Degree Above	-0.003**	0.001	-0.005	-0.001
% Households 1+ per Room	0.003	0.005	-0.007	0.014
% Male	0.012*	0.006	0.001	0.023
% Black	0.002***	0.000	0.001	0.003
% Hispanic	-0.000	0.001	-0.002	0.001
% Other Race	0.001	0.001	-0.002	0.004
South	-0.011	0.011	-0.033	0.011
Constant	-0.504^{+}	0.296	-1.088	0.082

F<0.0001, R^2 = 0.1990; *=p<.05,**=p<.01,***=p<.000,+=p<.10; Median Income and Population have been divided by 1000 for ease of interpretation

Table 3. Model 2. OLS Regression Criminal Lethality Index: Hypotheses 4, 5 & 6

N = 189

Criminal Lethality Index	Coefficient	Std. Error	95% Confidence Interval	
% Arrestees w/ Guns	0.001	0.004	-0.007	0.009
% Males 16 to 24	-0.006**	0.002	-0.009	-0.002
Drug Arrests per 100,000	5.75_e	0.000	-0.000	0.000
Population Total / 1000	-0.000	0.000	-0.000	0.000
% Bachelor's Degree Above	3.04_e	0.001	-0.001	0.001
%Households 1+ per Room	0.004	0.005	-0.006	0.014
% Male	0.012*	0.006	0.000	0.023
%Black	0.002**	0.001	0.001	0.002
% Hispanic	-0.001	0.001	-0.002	0.001
%Other Race	0.001	0.001	-0.001	0.004
%South	-0.000	0.011	-0.023	0.022
Constant	-0.493^{+}	0.276	-1.038	0.052

F< .0122, R^2 = .0658; *=p<.05,**=p<.01,***=p<.000,+=p<.10; Population has been divided by 1000 for ease of interpretation

Table 4. Model 3. OLS Regression Criminal Lethality Index: Hypothesis 7

N=190

Criminal Lethality Index	Coefficient	Std. Error	95% Confidence Interval	
Gamma Index	-0.793**	0.273	-1.331	-0.254
Trauma Centers	-0.136	0.099	-0.333	0.060
% Medical Employees	0.026*	0.011	0.005	0.046
Gamma X Trauma Centers	0.591	0.424	-0.244	1.427
Median Income/1000	0.003**	0.001	0.001	0.005
Population Total/1000	-0.000	0.000	-0.000	0.000
% Bachelor's Degree Above	-0.003**	0.001	-0.005	-0.001
% Households 1+ per Room	0.004	0.005	-0.006	0.014
% Male	0.012*	0.006	0.000	0.023
% Black	0.002***	0.000	0.001	0.003
% Hispanic	-0.001	0.001	-0.002	0.001
% Other Race	0.001	0.001	-0.001	0.004
South	-0.009	0.011	-0.032	0.012
Constant	-0.423	0.301	-1.018	0.171

F<.0001, R^2 = 0.2079; *=p<.05,**=p<.01,***=p<.000,+=p<.10; Median Income and Population have been divided by 1000 for ease of interpretation

Table 5. Model 4. OLS Regression Criminal Lethality Index: Hypothesis 8

N=190

Criminal Lethality Index	Coefficient	Std. Error	95% Confidence Interval	
% Males 16 to 24	-0.005*	0.002	-0.009	-0.000
% Arrestees w/ Guns	0.010	0.011	-0.011	0.032
% Males 16 to 24 X % Arrestees w Guns	-0.001	0.001	-0.004	0.001
Population Total/1000	-0.000	0.000	-0.000	0.000
% Bachelor's Degree Above	0.000	0.000	-0.001	0.001
% Households 1+ per Room	0.004	0.005	-0.007	0.014
% Male	0.012*	0.006	0.001	0.024
% Black	0.002**	0.001	0.001	0.002
% Hispanic	-0.001	0.001	-0.002	0.001
% Other Race	0.002	0.001	-0.001	0.004
South	0.000	0.011	-0.022	0.022
Constant	-0.525+	0.277	-1.072	0.021

F<.0001, R^2 = 0.2079; *=p<.05,**=p<.01,***=p<.000,+=p<.10; Population has been divided by 1000 for ease of interpretation

Table 6. Model 5. OLS Regression Criminal Lethality Index: Hypothesis 9

N=189

Criminal Lethality Index	Coefficient	Std. Error	95% Confidence Interval	
Drug Arrests per 100,000	0.000	0.000	-9.61e	0.000
% Arrestees w/ Gun	0.009	0.006	-0.003	0.021
Drug Per 100,000 X % Arrestees w/ Gun	-0.000+	7.68e	-0.000	1.57e
Median Income/1000	0.003**	0.001	0.001	0.005
Population Total/1000	-0.000	0.000	-0.000	0.000
% Bachelor's Degree Above	-0.002+	0.001	-0.003	0.000
% Households 1+ per Room	0.007	0.005	-0.003	0.017
% Male	0.009+	0.005	-0.001	0.019
% Black	0.001**	0.001	0.000	0.002
% Hispanic	-0.001	0.001	-0.002	0.000
% Other Race	0.001	0.001	-0.002	0.003
South	-0.003	0.011	-0.025	0.019
Constant	-0.504+	0.264	-1.025	0.016

F<0.0031, R^2 = 0.1512; *=p<.05,**=p<.01,***=p<.000,+=p<.10; Median Income and Population have been divided by 1000 for ease of interpretation

Table 7. Model 6. OLS Regression Criminal Lethality Index: Hypothesis 10

N=190

Criminal Lethality Index	Coefficient	Std. Error	95% Confidence Interval	
Drug Arrests per 100,000	4.27e	0.000	-0.000	0.000
% Male 16 to 24	-0.005+	0.003	-0.011	0.000
Drug per 100,000 X % Male 16 to 24	-4.91e	4.40e	-9.17e	8.19e
Population Total/1000	-0.000	0.000	-0.000	0.000
% Bachelor's Degree Above	-0.000	0.001	-0.001	0.001
% Households 1+ per Room	0.004	0.005	-0.006	0.013
% Male	0.012*	0.006	0.000	0.023
% Black	0.002***	0.000	0.001	0.002
% Hispanic	-0.001	0.001	-0.002	0.001
% Other Race	0.001	0.001	-0.001	0.004
South	-0.001	0.011	-0.023	0.021
Constant	-0.495+	0.275	-1.039	0.048

F<0.0091, R^2 = 0.1281; *=p<.05,**=p<.01,***=p<.000,+=p<.10; Population has been divided by 1000 for ease of interpretation

Table 8. Model 7a. OLS Regression Criminal Lethality Index: Hypotheses 11, 12, 13 & 14

N=190

Criminal Lethality Index	Coefficient	Std. Error	95% Confidence Interval	
% Households Occupied<5 years	0.002*	0.001	0.000	0.004
% Households Single Parent Headed	-0.008*	0.003	-0.015	-0.001
% Population in Poverty	-0.008	0.002	-0.004	0.002
Diversity Index	-0.001	0.079	-0.208	0.106
Median Income/1000	0.004*	0.002	0.001	0.007
Population Total/1000	-0.000	0.000	-0.000	0.000
% Bachelor's Degree Above	-0.005**	0.001	-0.007	-0.002
% Households 1+ per Room	0.001	0.005	-0.009	0.011
% Male	0.002	0.006	-0.009	0.013
% Black	0.003***	0.001	0.001	0.004
% Hispanic	0.001	0.001	-0.002	0.003
% Other Race	0.002	0.002	-0.002	0.005
South	-0.023	0.014	-0.049	0.004
Constant	-0.079	0.285	-0.641	0.483

F<0.0003, R^2 = 0.1903; *=p<.05,**=p<.01,***=p<.000,+=p<.10; Median Income and Population have been divided by 1000 for ease of interpretation

Table 9. Model 7b. OLS Regression Criminal Lethality Index: Concentrated Disadvantage

N=190

Criminal Lethality Index	Coefficient	Std. Error	95% Confidence Interval	
% Households Occupied<5 years	0.001	0.001	-0.001	0.003
Concentrated Disadvantage	-0.008**	0.003	-0.013	-0.002
Diversity Index	-0.058	0.079	-0.214	0.098
Median Income/1000	0.002*	0.001	0.000	0.003
Population Total/1000	-0.000	0.000	-0.000	0.000
% Households 1+ per Room	0.004	0.005	-0.005	0.015
% Male	0.004	0.005	-0.007	0.015
% Black	0.003***	0.001	0.001	0.004
% Hispanic	0.000	0.001	-0.002	0.002
% Other Race	0.001	0.002	-0.002	0.005
South	-0.024+	0.014	-0.052	0.005
Constant	-0.157	0.271	-0.692	0.377

F<0.0008, R^2 = 0.1597; *=p<.05,**=p<.01,***=p<.000,+=p<.10; Median Income and Population have been divided by 1000 for ease of interpretation; Concentrated Disadvantage alpha=0.79

Table 10. Variable Performance Table with Comparative Regressions (Total models split into counts of positive, negative, and null results)

	Criminal Lethality Index			Murders per 100,000			Aggravated Assaults w/ Major Injury per 100,000		
	Pos.	Neg.	Null	Pos.	Neg.	Null	Pos.	Neg.	Null
Gamma Index	0	2	0	0	0	2	0	0	2
Trauma Centers	0	0	2	1	0	1	1	0	1
% Medical Employees	2	0	0	0	0	2	0	0	2
% Arrestees w/ Guns	0	0	3	1	0	2	1	0	2
% Males 16 to 24	0	3	0	0	0	3	0	2	1
Drug Arrests Per 100,000	0	0	3	0	0	3	2	0	1
% Households Occupied < 5 years	1	0	1	0	1	1	0	0	2
% Households Single Parent Headed	0	1	0	0	0	1	1	0	0
% Population in Poverty	0	0	1	1	0	0	1	0	0
Diversity Index	0	0	2	0	2	0	0	0	2
Concentrated Disadvantage	0	1	0	1	0	0	1	0	0
Median Income / 1000	5	0	0	1	0	4	0	5	1
Population / 1000	0	0	8	0	0	8	6	0	2
% Bachelor's or Above	0	4	3	0	0	7	0	1	6
% Households 1+ per Room	0	0	8	0	0	8	0	7	1
% Male	6	0	2	4	0	4	0	0	8
% Black	8	0	0	8	0	0	7	0	1
% Hispanic	0	0	8	1	0	7	1	0	7
% Other Race	0	0	8	0	0	8	0	0	8
South	0	1	7	0	6	2	0	3	5

Each of the numbers above represent the number of times the variable returned positive, negative, or null in all regressions run for primary analysis (Criminal Lethality Index) as well as diagnostic analyses (murders & aggravated assaults). To be counted in a positive or negative category a coefficient had to be at least approaching significance at $p<.10$.

Table 11. Demonstration of Unique Status of High Medical Personnel and High Income Cities

	Sample Mean	Mean if Medic % > 2 & Median Income > 32k
Murders Per 100,000	5.82	3.21
Aggravated Assaults with Major Injuries per 100,000	145.00	22.00
Criminal Lethality Index	0.06	0.10

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