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**A Spatial Analysis of Non-Emergency Requests for Service and Violent Crime
in St. Louis, Missouri**

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2014

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Abstract

The “Broken Windows” thesis posits that disorderly conditions are likely to incite a downward spiral in an area, eventually leading to crime. In contrast, collective efficacy theorists argue that crime and disorder are manifestations of the same underlying issue; as such, disorder could be construed as an opportunity for citizens to mobilize against a problem in their neighborhood. This research employs longitudinal administrative data regarding requests for non-emergency services (“311” calls). Prior research has examined this measure as an indicator of disorder; however, these requests are representative of citizen action against disorder, and thus may better represent a form of social control or collective efficacy. Using data from 9,577 blocks in St. Louis, MO, this paper analyzes the spatial distribution of requests for service regarding physical disorder and violent crimes over a period of five years (2009-2013). After controlling for neighborhood demographic characteristics and land use, requests for service are positively and significantly related to violent crimes in the area. This finding suggests that requests for non-emergency services are an indicator of neighborhood disorder, and provides support for the broken windows theoretical framework.

I. INTRODUCTION

The relationship between disorder and crime is among the associations most examined by neighborhood-level studies in criminology. The broken windows approach posits that disorder is a precursor to minor crime, and if left unchecked, will eventually escalate into serious crime. However, the neighborhood social processes that are set in motion in response to disorder can also provide insight to the criminal activity in an area. Collective efficacy theorists would argue that communities which demonstrate a willingness to combat disorder in the neighborhood are also likely to be willing to intervene against crime; as such, crime and disorder could both be construed as results of a paucity of willingness to mobilize against issues, or as indicators of a low level of collective efficacy in an area. While previous research involving the study of physical disorder has often required a substantial investment of resources for techniques such as systematic social observation, in the current age of “big data”, a new measure is worth considering.

Many metropolitan areas now operate non-emergency service request systems (often known by the number “311”), which contribute a large quantity of information related to local issues that is openly available to the public. By categorizing the types of requests, these data can serve as an indicator of various physical “incivilities” occurring in a city. Data representing the locations of requests for service over multiple years can provide valuable insight for policymakers and local community leaders in regard to areas in need of a high level of maintenance, as well as offer predictions for the future needs of communities. In recent history, the City of St. Louis has had one of the highest rates of homicide, as well as other violent crimes, in the nation (U.S. Department of Justice: FBI,

2014); this disproportionate rate engenders additional gravity to the present findings, specifically in regard to their relevance for policy at the local level.

Requests for service can be treated as an indicator of disorder, which would predict a positive relationship with future crime, according to the broken windows framework. In the small amount of extant literature linking nonemergency requests for service and crime, the measure has been employed as an indicator of disorder (O'Brien et al., 2015; O'Brien & Sampson, 2015). While these reported issues of disorder will eventually be repaired by municipal service providers, the requests still provide a record of areas in which disorder existed at one point. However, reported instances of disorder, which are captured by requests for service, may be different from disorder that is left unreported; requesting services is a dynamic process between citizens and local government, not merely a static indicator of the presence of disorder. The present study addresses this issue with an alternative hypothesis regarding the construct that is represented by the measure of requests for service.

Some theorists would argue that disorder and crime are manifestations of the same underlying cause (e.g. Sampson & Raudenbush, 1999). A lack of collective efficacy inhibits the willingness of residents to intervene or mobilize against both crime and disorder. Therefore, placing requests for service could alternatively be analyzed as an indicator of collective efficacy, in that the community is exerting control over the problems in their neighborhood by requesting services. Citizens making a request are acting to combat disorder and aim to have their community improved. This mobilization of resources against disorder is a discrete concept, which differentiates requests for service from other

assessments of observed disorder or perceived levels of disorder. The measure of requests for service also provides insight into the relationship of residents with the local government, tapping into the social disorganization concept of “public control” (Bursik & Grasmick, 1993). While both theoretical propositions regarding the underlying concepts represented by the measure of requests for service are logical, the analyses at hand offer a test of these competing hypotheses.

As a measure, a database of requests for service provides a record of citizens soliciting intervention in their neighborhood from municipal service providers, which could be construed as an indicator of residents’ acknowledgement of governmental efficacy, or even legitimacy. The present research focuses on physical disorder; however, the breadth captured by the measure of requests for service allows for the inclusivity of the definition of disorder to be tailored to the specific research question. This data source is particularly amenable to longitudinal study, and thus provides an alternative perspective to prior work employing cross-sectional methods, such as systematic social observation of disorder. This measure of requests for service is also well-suited for replication, allowing this study to examine the generalizability of prior findings using requests for service to study crime.

This research serves a dual purpose, first by providing information about the geographic distribution of requests for service over time, as well as exploring the relationship between these requests for service and crime. The work at hand aims to answer the research questions: How do requests for service relate to violent crime? and Is the measure of requests for service representative of disorder, or does it indicate collective

action against disorder? The present paper will first provide a review of extant literature to compare the two competing frameworks of broken windows and collective efficacy, as they relate to requests for service. Theoretically, a positive association between requests for service and crime would suggest the measure acts as an indicator of disorder and provide support for the broken windows framework; a negative relationship with crime could imply requesting services represents a mobilization of resources against disorder by the community, as would follow from collective efficacy theory. The third section of the paper will review Daniel O'Brien and colleagues' (2015) exploratory research aimed at determining how best to use non-emergency requests for service in relation to existing criminological theory. The present study will go on to expand on said methodology by considering the act of reporting as a possible indicator of a neighborhood social process, as opposed to using the measure solely as an indicator of disorder and decay.

Methodologically, the present research will examine the generalizability of prior findings by carrying out the work on a heretofore unstudied city, over a longer period of observation than has been performed thus far. Employing negative binomial regression, the impact of requests for service on three types of violent crime will be examined. These relationships will be studied using "egohoods" as the unit of analysis (Hipp & Boessen, 2013). The study at hand aims to function as an examination of the underlying constructs of a relatively novel measure by analyzing the relationship between requests for service and crime, using the theoretical frameworks of broken windows and collective efficacy.

II. LITERATURE REVIEW

A. Requests for Service as an Indicator of Disorder

One of the most well-known theoretical linkages between crime and disorder comes from the “Broken Windows” thesis, put forward in an influential article by Wilson and Kelling in 1982. These scholars argued that the escalation of disorder is the root cause of crime at the neighborhood-level. Visible signs of disorder suggest that an area is uncontrollable and acts as a cue to potential offenders that residents are less likely to enforce prosocial norms (St. Jean, 2007). The idea of “signaling” exemplifies the importance of visual (and semi-permanent) cues. This concept is encapsulated in the incivilities thesis, which proposes that physical decay and social disorder both contribute to fear of crime, community decline, and eventually lead to crime (Taylor, 1995). Poor maintenance of an area can be perceived to indicate a lack of monitoring by residents (O’Brien et al., 2015). This framework would suggest that instances of disorder reported through requests for service would be associated with higher levels of crime.

Originally, the broken windows thesis emphasized the impact of disorder in relation to residents’ fear of crime; this fear was hypothesized to incite withdrawal among residents and discourage intervention against crime (Wilson & Kelling, 1982). However, the scope of variables of interest has been broadened to reflect the neighborhood condition more generally, and thereby include actual crime rates as a function of incivilities (Taylor, 2001). Residents’ perceptions of disorder have often been linked to fear of crime/victimization at the individual and neighborhood levels (Skogan, 1986). However, substantial empirical research shows that individual perceptions are a result of numerous factors, and are not

always highly correlated with objectively observed measures of the same construct (Taylor, 2001; Brown et al., 2004; O'Brien et al., 2015). Therefore, the approach of surveying residents about their general perception of disorder in the neighborhood is related to, but distinct from analyzing residents' behavior in making a request for service.

Sampson and Raudenbush (1999) differentiated between the concepts of physical and social disorder, defining physical disorder as “the deterioration of urban landscapes”, while social disorder is “behaviors involving strangers and considered threatening” (p. 603-604). Physical disorder is able to be measured more consistently, as opposed to social disorder which is more sporadic (Yang, 2010). Requests for non-emergency services capture issues related more to persistent physical disorder, and the measure is not likely to indicate a high volume of issues related to social disorder. For instance, in the five years of requests for service analyzed in the present study, there were only seven requests regarding homeless individuals and only two issues were reported via “311” that went on to be referred to the police department. This low frequency of requests related to typical types of social disorder demonstrates that the measure of non-emergency requests for service would not be a reliable indicator for social disorder. Physical disorder lends itself much more readily to sustained observation, often has an obvious course of repair, and is generally not criminal in and of itself, all of which make a preferable concept for examination in the present study.

In relation to neighborhood processes, physical disorder can be linked to the idea of responsibility for public areas or a sense of investment in the neighborhood as a whole, beyond one's private property. Requests for service capture residents' concerns about their

own property or the private property of others, yet they also function as a major channel for issues regarding disorder in public spaces. O'Brien and Sampson (2015) differentiate between these concepts as "private neglect" and "public denigration." These are conceptually distinct, in part, because the individual responsible for the upkeep of private property is generally the owner of the property; however, the sense of responsibility for communal spaces in a neighborhood is diffused across residents. In many cases, the local government may be the party that is responsible for the upkeep of public areas; but if an issue arises, the burden to submit a request for maintenance is shared among numerous community members. At the very core of the broken windows approach is the axiom implying: things that are "broken" need to be fixed (Bellafante, 2014). This is particularly relevant when the responsibility of rectifying disorder falls on local government service providers; although, residents also must demonstrate investment in their community by initiating a request for service to ameliorate disorderly conditions.

Cross-sectional studies often demonstrate a significant relationship between crime and disorder; for instance, one analysis in Pittsburgh, PA found that physical disorder accounted for 35% of the variation in total crime across neighborhoods (Wei et al., 2005). Brown and colleagues (2004) demonstrate that rater-observed physical disorder was associated with violence, but individuals' perceptions of disorder did not predict crime. However, longitudinal research regarding the association between crime and disorder is inconsistent. Taylor's (2001) longitudinal work shows that the relationship to crime depends on the indicator of disorder that is employed; rater-assessed disorder demonstrated a positive and significant relationship to homicides, but did not apply to other types of

crime. Recent trajectory analyses for Seattle, WA found that existing disorder is only associated with future violence about 30% of the time (Yang, 2010). The analyses performed in the present study aim to contribute to this literature by examining the longitudinal relationship between disorder and violent crime over five years, using a relatively novel indicator of disorder.

B. Requests for Service as an Indicator of Collective Action

To only consider requests for nonemergency services as an indicator of disorder does not account for the fact that requesting services is a behavior that must be undertaken by an individual. Theoretically, placing a request for service can be construed as a mobilization of resources against a community problem. A request for service may be more indicative of the desire for a resolution to disorder, than simply a record of an instance of disorder. Although the measure has not yet been employed to be representative of collective action to combat disorder, it is plausible that requesting government intervention against disorder would have a negative impact on future violent crime in the area. The following section will consider how the concepts of public control and collective efficacy can provide a framework whereby citizen action against disorder will be predictive of fewer crimes in an area. Collective efficacy can be viewed as a characteristic of a neighborhood regarding the capacity of the community to mobilize to enforce norms, whereas public control specifically examines the ability of the community to maintain social organization by drawing resources from public agencies. This section will first review more specific definitions for public control and collective efficacy, followed by how these concepts each

relate to disorder and requests for service, and finally consider their hypothesized impacts for violent crime.

Public Control

Social disorganization theory suggests that structural factors at the neighborhood-level influence social processes, which have an impact on aggregate levels of crime (Shaw & McKay, 1942). Neighborhood characteristics such as poverty, heterogeneity, and residential instability are thought to negatively influence the functioning of the core social institutions in an area and reduce the formation of ties between residents. Certain structural characteristics of communities are also thought to contribute to the likelihood of residents intervening to prevent criminal behavior (Bursik, 1988). In a wide array of empirical research, these factors put forth by social disorganization have been shown to be relevant in impacting violent crime. Bursik and Grasmick (1993) extended social disorganization theory by developing the concept of “public control” as a counterpoint to informal social control; this additional dimension of control demonstrates that part of a community’s ability to enforce norms comes from the capacity to draw services from outside public agencies (Hunter, 1985). Thus, communities lacking public control are more likely to be disorganized. While much emphasis is placed on “private” or informal efforts against crime from within communities, public control can function to reduce the isolation of disadvantaged communities by creating a bridge between local government and neighborhoods. Communities that are more organized and less isolated, as would result from greater public control, are likely to be associated with less crime; thus, theory suggests that communities that have greater public control will have less violent crime.

Taylor (2001) presents a “structural perspective” on the origins of disorder, arguing that they are likely to be spatially distributed according to levels of public control (Bursik & Grasmick, 1993). Disorganized communities are less able to effectively garner the support of governments to intervene against disorder on their behalf (Skogan, 1986). Disadvantaged areas offer fewer incentives for local government or outside interest groups to stymie decline. Disinvestment in an area by institutions (e.g. mortgaging and insurance firms) can upset neighborhood stability, and incite decline (Skogan, 1986). The structural perspective links physical incivilities with “differential service delivery and [lax] code enforcement” (Taylor, 2001). Empirical research by McCord and colleagues (2007) supports the structural perspective, finding that residents in lower-status neighborhoods are more likely to perceive higher levels of disorder (p. 313). Ethnographic research in Chicago demonstrates that criminals do not interpret physical disorder as a lack of care by residents, but instead “as a sign that the city’s government does not consider that section of town as a priority” (St. Jean, 2007: p.199). Public control is relevant in the procurement of law enforcement services, as well as for acquiring government assistance to ameliorate physical disorder; higher levels of public control are hypothesized to be negatively associated with disorder and crime.

The concept of public control is also very pertinent to explaining citizen engagement with municipal governments, particularly through requesting services to combat disorder in their communities. Empirical evidence suggests that individuals who own their own home are four times more likely to report public issues than renters (O’Brien, 2015). Areas with more homeowners would then demonstrate a higher

propensity to request services from local government, which contributes to a greater likelihood of physical disorder being resolved. One of the ways in which areas can be disadvantaged is in the lack of political capital, which is arguably required for the procurement of services at the local level. A community that engages with the government by capitalizing on assistance from public agencies to combat disorder demonstrates greater public control and could be considered more socially organized. Disorganized communities that lack public control will be less likely to make requests for service from local government to reduce disorder, which is hypothesized to contribute to higher rates of violent crime in the area.

Collective Efficacy

One of the most well-known extensions of social disorganization theory is the concept of “collective efficacy,” which proposes explicit mechanisms by which structural characteristics impact crime rates at the neighborhood-level (Sampson et. al, 1997). Collective efficacy consists of two components: social cohesion and informal social control. Social cohesion is the feeling of mutual trust and shared norms among residents of the same community. Informal social control refers to the willingness of residents to intervene in issues for the good of the neighborhood. This conceptualization of social control is as a more enduring characteristic of a community, and not merely episodic behavior used in coercion (Hunter, 1985). Collective efficacy encompasses community processes that function to uphold agreed upon norms; the degree to which community members engage in these processes makes collective efficacy a characteristic that will vary across neighborhoods. Empirical research demonstrates that collective efficacy mediates a

portion of the impact of structural characteristics on crime at the aggregate level (Sampson et al., 1997); it is hypothesized that areas with higher levels of collective efficacy will have lower rates of violent crime.

Neighborhoods vary in their capacity to “realize common values... and maintain effective social controls” (Sampson et al., 1997). It is assumed that for the vast majority of communities, order would be preferable to disorder; however, differing outcomes arise because neighborhoods vary in their levels of collective efficacy, which impacts their capacity to ameliorate disorder. Sampson and Raudenbush (1999) argue that the relationship between crime and disorder is actually spurious, as both are actually a result of a lack of collective efficacy. Their research, using data from the Project on Human Development in Chicago Neighborhoods, demonstrates that the association between disorder and crime disappears once structural factors and collective efficacy are controlled; although, the relationship between disorder and robbery persisted (Sampson & Raudenbush, 1999). If disorder and crime are results of low levels of collective efficacy, requesting services from local government to combat disorder could indicate a high level of collective efficacy in a neighborhood.

Brown and colleagues (2004) found that collective efficacy moderated the positive relationship between observed disorder and crime (p. 368). This suggests that residents in areas with high levels of collective efficacy are affected by disorder differently than neighborhoods with low levels of collective efficacy. Disorder can breed a feeling of powerlessness (Geis & Ross, 1998), which erodes the cohesiveness and mutual trust required for collective efficacy. If residents feel powerless against the disorder in their

neighborhood, they may be less likely to seek solutions to the problem (e.g. requesting services from local government), resulting in further entrenchment of disorderly conditions. This could point to a need for an outside actor, such as local government, to provide assistance in order to interrupt the downward trajectory of disorder and crime in an area. Communities which are low in collective efficacy are less able, or less willing, to employ resources to combat disorder; this suggests residents in these areas may not make a request for service if they encounter disorder in their neighborhood.

Few requests for service by residents in an area could be construed as an indicator of a low level of collective efficacy. Skogan (1986) finds that a reduction in municipal services induces community destabilization; however, an effective civic infrastructure has the potential to promote collective efficacy. This is exemplified by the item on the original collective efficacy scale regarding informal social control, which asks respondents about the likelihood of their neighbors taking action if “the fire station closest to their home was threatened with budget cuts” (Sampson et al., 1997). Accordingly, it is hypothesized here that areas with more requests for municipal services may be communities with higher levels of collective efficacy. The present research examines the potential use of requests for service as an indicator of community action against disorder. Therefore, one hypothesis proposes that areas with higher levels of collective efficacy would be those with more requests for service, which would predict fewer violent crimes.

C. Measurement of Requests for Non-Emergency Services

The use of a relatively novel measure presents certain challenges. This section aims to briefly examine the range of methods that have been used to assess disorder, and provide

an overview of how requests for service can be utilized as an indicator of disorder or collective action in urban areas. The foundational work by Daniel T. O'Brien and colleagues (2015) provides a methodology for employing non-emergency requests for service to test the broken windows framework, and O'Brien and Sampson (2015) utilize said methodology to test the association between requests for service and crime in Boston; this section next provides a review of these influential studies, as they relate to the present research.

Measurement of disorder began with surveys of residents regarding their perceptions of neighborhood disorder. This evolved into examining certain structural characteristics implying disorder (Taylor, 2001), and continued to advance with Sampson and Raudenbush's (1999) method of systematic social observation (SSO). In 80 neighborhoods in Chicago, vehicles drove along 23,816 blocks while videotaping, in order to capture disorderly conditions; these tapes were then rated by independent researchers (Sampson & Raudenbush, 1999). This is among the most comprehensive and objective measures of physical deterioration at the neighborhood-level for a single timepoint. That said, it is also the most resource-intensive method of assessing disorder, which is why the practice is so infrequently employed. Steenbeek & Kreis (2015) argue that using perceptual measures of incivilities is insufficient, and proper testing of the broken windows framework requires an objective measure of physical disorder (e.g. SSO or independent observers' assessments). Other studies have used subsets of calls to police departments for services, which avoids some of the issues related to respondent perceptions or observer biases (Skogan, 2012; Boggess & Maskaly, 2014).

In the age of “big data” and demands for increased transparency in government, large-scale administrative datasets are becoming more commonly available to the public. Many cities have a department which handles non-emergency service requests, frequently under the phone number “311”. This type of system originated in 1997, when the U.S. Department of Justice aimed to alleviate “911” operators from non-emergency calls (Schwester et al., 2009). It is interesting how these requests for service exemplify Hunter’s (1985) observation that the onus of upholding community norms, particularly in regard to incivilities, has shifted away from residents of the neighborhood, due to an increasing expectation for the State to fulfill these duties (pp. 238-239). Skogan (1986) argues that high levels of perceived disorder undermine residents’ view that the issue can be addressed from within the community, which leads to a greater need for government or outside intervention.

Data collected by “311” operators allow for an innovative way to examine disorder and resident engagement in urban areas. Instances of disorder are typically linked with an address or specific location, enabling it to be mapped using a geographic information system (GIS) (Schwester et al., 2009); the time and date of these instances are more accurately recorded by official records, than measures which rely on respondents’ recall (Skogan, 2012). Publishing these data increases accountability by service providers, and the information can also be used to predict areas that are (or will be) in need of services. These data are of minimal cost to collect, and the method is easily replicated across cities and over time. Administrative databases such as this are able to provide greater “breadth and depth” than prior strategies for measuring disorder (O’Brien et al., 2015). While

systematic social observation has many advantages, employing requests for service offers a different set of advantages. These records of requests for service allow for areas to be tracked continuously over time, whereas systematic observation can generally only provide a cross-sectional snapshot based on data from a single timepoint. Further, requests for non-emergency services exemplify a dynamic interaction between citizens and local government; the product of systematic social observation is static information that requires researcher interpretation to define whether something should be considered a problem or not.

Using an administrative record of resident requests implies a baseline level of severity; these are issues that are persistent and/or bothersome enough that an individual desired intervention by local government (Kubrin, 2008). Although this may exclude some more minor forms of disorder, employing requests for service can be considered a more conservative estimate of physical deterioration in an area¹. Surveys regarding disorder typically solicit residents' general perceptions of disorder in their neighborhoods; requests for service are able to contribute a different perspective on physical disorder, by tracking specific issues or complaints which are tied to precise locations, as opposed to opinions regarding the area as a whole. In accordance with broken windows' original proposition to emphasize areas that are at the "tipping point" (Wilson & Kelling, 1982), employing citizen

¹ As previously mentioned, requests for service regarding social disorder in the present data were infrequent, therefore these analyses focus on physical disorder; the rarity of social disorder issues captured in these data cause it to be a less reliable measure than as a measurement of physical disorder (Steenbeek & Kreis, 2015).

requests for service can be construed as an indicator that disorder is present, but residents do not feel it is beyond reclamation.

The initial methodology for linking these requests for service to the theory of “broken windows” was proposed by O’Brien, Sampson, and Winship (2015). Using data from Boston, Massachusetts, these scholars analyzed 16 months of requests for service in order to operationalize the data as a measure of physical disorder that would be suitable for testing the broken windows framework. As previously mentioned, O’Brien and colleagues (2015) make a distinction of physical disorder as either private disorder (that which is a result of an individual’s lack of upkeep) or public denigration (issues which fall to the local governmental agencies to maintain). After analyzing the content of the measure, its validity and reliability for capturing disorder were tested.

O’Brien and Sampson (2015) continued this work in an analysis using the aforementioned methodology to analyze the impact of physical and social disorder on crime in Boston. The data represent primarily residential areas over a two year time period. Their results suggest a social escalation model, whereby private conflict better predicted public violence, as compared to public disorder predicting public violence (O’Brien & Sampson, 2015). These innovative uses of administrative records provide a strong foundation for continued research to explore the association between crime and disorder in urban areas. This research will directly address a limitation of prior work by analyzing the relationship over five years, a longer period of time than previously observed. Further, the analyses in the present study will build upon their findings by examining the relationship

between requests for service and violent crime for land use types beyond only residential areas.

D. Current Study

The present study expands on O'Brien and colleagues (2015) use of requests for service as an indicator of disorder. On one hand, the measure is examined as indicative of instances of disorder; however, the current study conversely proposes that requests for service may better represent a process of collective action against disorder. Neighborhood-level theories, such as social disorganization and collective efficacy, are used to frame these social processes in relation to their hypothesized effects on requests for service. The research questions this study aims to address are: How do requests for service relate to violent crime? and Is the measure of requests for service representative of disorder, or does it indicate collective action against disorder? It is hypothesized that the relationship between requests for service and crime may vary depending on the type of crime; therefore separate models will consider three types of violent crime (homicide, robbery, and assault).

III. DATA & METHODS²

A. Study Site

Geographically, the City of St. Louis is bounded on the east by the Mississippi River and is otherwise surrounded by the much more populous St. Louis County, with City and County being distinct entities. St. Louis City is not a part of St. Louis County (or any other county), which is unlike many metropolitan areas such as Chicago, Illinois, which is

² This research project was approved by the University of Missouri-St. Louis Institutional Review Board on February 14, 2016.

within Cook County. Many parallels can be drawn between the present structure of St. Louis and Shaw and McKay's (1942) conception of Chicago as a series of concentric circles. The innermost zone (which borders water to the east) is the core downtown area, and heavily concentrated with industrial and other non-residential land uses. Historically, there has been a migration of affluence toward the suburban areas to the west of downtown, into the outermost zones. This is particularly important for a metropolitan area such as St. Louis, where migration past a certain boundary qualifies individuals as residents of St. Louis County, and no longer of St. Louis City. This inequality of wealth and a loss of the City's population have an impact on the property values and taxes collected by local government, which bears on the capabilities of municipal service provision (i.e. requests for service to combat disorder) (Pendall & Hedman, 2015).

This population loss in the City of St. Louis has impacted the land use of the city, resulting in a high number of vacant properties that have been reclaimed by the municipal government, and are being held by the City until they are able to be sold for development (Logan, 2012). However, future prospects for investment are generally impacted by the surrounding area's level of abandonment (Skogan, 1986); this has resulted in areas with high concentrations of vacant land use, particularly in the northern parts of what could be considered "zones" 2 and 3 (Shaw & McKay, 1942). This is doubly burdensome for municipal service providers, in that there is less tax revenue generated from the seized properties and the City also must assume the cost of property maintenance (Logan, 2012). This increase in vacancy and general neighborhood decline can be partially attributed to out-migration to the surrounding County, yet can be more distally related to the

deindustrialization trend of the economy and the decline of manufacturing that has depressed many other metropolitan areas in the “rust belt” of the Midwest.

The loss of population and increasing number of vacant properties in St. Louis City has often been labeled as a consequence of “white flight”, or the out-migration of whites to more affluent areas in St. Louis County (Gordon, 2009). The City of St. Louis has a majority of African-American residents (50%, compared to 45% white residents); whereas, St. Louis County is 70% white, and has only 23% African-American residents (U.S. Census Bureau, 2010). Among metropolitan areas with large African American populations, St. Louis is considered the ninth most segregated region in the country (Logan & Stults, 2011). This has resulted in a disproportionate number of minorities in certain areas of the City of St. Louis, which impacts the ethnic heterogeneity of the sample area. Substantively, this racial segregation contributes to the condition of social isolation described by William Julius Wilson (2009), which may influence the relationship between a community and municipal service providers.

The violent crime rate for the City of St. Louis remains well above the average for most metropolitan areas in the United States (U.S. Department of Justice: FBI, 2014). It is possible to see how characteristics of the City of St. Louis, such as racial segregation and a declining tax base, could be theorized to play a role in this higher rate of violent crime. However, St. Louis is not alone in confronting these types of challenges; other metropolitan areas facing similar issues of population loss or declines in manufacturing (e.g. Cleveland, Pittsburgh) may demonstrate a relationship between disorder and crime that is similar to the association which is explored for St. Louis in the present analyses. Thus, the present

results may be generalizable to other mid-sized cities in the region, but would require further testing to be sure.

B. Unit of Analysis

The debate over the definition and operationalization of the “neighborhood” is well-documented in criminological research, as well as in many other disciplines. One challenge arises from the use of neighborhood boundaries defined by the Census Bureau (e.g. census tracts or block groups) or by the cities themselves, which can be somewhat arbitrarily constructed. Because of the inadequacies associated with many of these traditional ecological units of analysis, the present study employs “egohoods” as introduced by Hipp and Boessen (2013). An egohood is measured as a radii with a certain distance from the center of each block, and factors in the characteristics of all blocks that fall within the determined distance (see Figure 1). This process creates a “buffer” around each block, which will overlap with the buffers of other blocks, making up egohoods. Interdependency between egohoods is created through this overlapping approach, in that blocks which are closer together will share more of the same buffers. This can be seen in Figure 1, where blocks A and B are closer together, and thus their buffers overlap more; as compared to the egohood of block C, which is further away, and thus overlaps with fewer blocks. By employing egohoods, these analyses are able to account for the impact of the larger area or environment around a block or block group.

A common definition of neighborhood asks respondents to consider the area within “a 15 minute walk from your home” (Sampson & Groves, 1989); this implicitly suggests the area of a neighborhood, but does not ask residents about their explicit definition of the

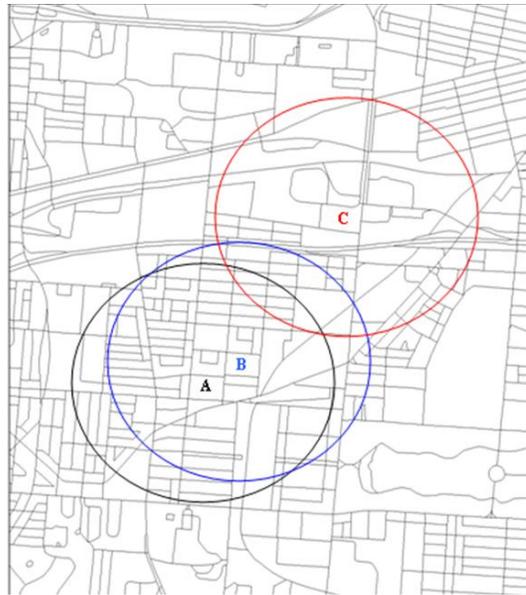


Figure 1. Half-Mile Egohoods Calculated for St. Louis City Blocks.

bounds of their neighborhood. Further, such measures are subject to respondents' judgments and potential biases in regard to which area constitutes their community; empirical research has found that perceptions of neighborhood boundaries are influenced by individual characteristics such as: educational attainment, immigrant status, and if an individual has social ties in the neighborhood (Sastry et. al, 2002). Egohoods are not dependent on individual perceptions, but are a unit of analysis that utilizes a standard geographic size (Hipp & Boessen, 2013). Extant literature in the area of "mental mapping" suggests that most individuals place their residence at the center of what they define as their neighborhood (Coulton et al., 2001; Hipp & Boessen, 2013). Egohoods account for this tendency by calculating a measure centered on each block; by employing a small-scale unit (i.e. census block), all residents will reside relatively close to the center of the block. This centered measure is preferable to assuming that residents near the edges of a large unit

(e.g. a census tract) are not affected by characteristics or events in the adjacent neighborhoods.

Egohoods are an appropriate unit for examining requests for service because residents may be affected by disorderly conditions that are nearby, but not within the same unit of analysis (i.e. census tract, block group, or other definition of neighborhood). Suttles (1972) was among the first to voice concern over using non-overlapping boundaries to draw neighborhoods. The idea of the “egohood” addresses this issue by employing a smoother measure, which more accurately describes the reality of fluid social processes (Hipp & Boessen, 2013). If disorder does indeed act as a “contagion”, with existing disorder inciting more disorder in nearby areas, then measurement would be hampered by using non-overlapping boundaries (Boggess & Maskaly, 2014). Steenbeek and Kreis (2015) point out that there is no theoretical principle that would prevent disorder and crime from moving across administratively defined neighborhoods (p. 514); their results supported the notion that disorder is not confined by neighborhood boundaries (Steenbeek & Kreis, 2015). Egohoods explicitly account for the disorder of all adjacent areas, which seems likely to influence the overall perception of an area by potential offenders and the services requested by residents.

Population-based measures, such as those used by the census, aim to define boundaries that maximize homogeneity “with respect to population characteristics, economic status, and living conditions” (U.S. Census Bureau, 1994: p 10-1). Egohoods capture the differences that are actually present in cities, and are thereby able to account for the impact of heterogeneity. Inequality and racial/ethnic heterogeneity can be concealed

by census tract or block group aggregations with boundaries that are drawn to maximize homogeneity. These concepts inherently make between-group comparisons, which would be at odds with certain spatial measures that aim to minimize differences within each unit. When using egohood aggregations, inequality has a significant impact on crime, a result that is often obfuscated when measures at the tract level are used (Hipp & Boessen, 2013). These opposing findings highlight the consequences associated with differing definitions and operationalizations of “the neighborhood” (Boessen & Hipp, 2015). The impact of the unit of analysis on a measure of ethnic heterogeneity is relevant here because ethnic heterogeneity is included as a control variable in the present analyses.

Egohoods have the potential to be used in the study of many different neighborhood processes; the present analyses will employ this unit of analysis to examine three types of violent crime. The initial use of egohoods demonstrated their capacity to explain more variation and better predict violent crime than census block-group or tract-level measures (Hipp & Boessen, 2013). Varying the distance of the radius (0.25mi, 0.5mi, and 0.75mi) produced relatively similar results in those analyses, with the half-mile measure being the most predictive of the geographic distribution of assault, robbery, burglary, and motor vehicle theft; the quarter-mile distance better predicted homicide and larceny (Hipp & Boessen, 2013: p.305). Egohoods improve the model fit for explaining the locations of crime, as compared to non-overlapping units of analysis, which suggests that egohoods are able to better represent the social context by incorporating the effects of the larger, surrounding environment for each block.

The current study employs egohoods of a half-mile radius³. In the original paper detailing this methodology, Hipp & Boessen (2013) found the half-mile distance to be the size which best predicted robberies and assaults; this distance was chosen for the research at hand, in part, because those types are the two most numerous crimes in the data employed in the present analyses. A half-mile radius is thought to be large enough to capture variability in the measures of interest. Egohoods are based on a uniform geographic distance which imparts consistency to the spatial size of the unit of analysis; this can be considered in comparison to employing census tracts or other definitions of neighborhoods, which will vary in size of geographic area encompassed.

C. Data

The term “big data” makes reference to the growing trend of enormous datasets that are being continuously aggregated across nearly all sectors of the economy and many other fields relevant to research (Manyika et al., 2011); the amount of information being amassed will likely only continue to multiply. While “big” data present new methodological challenges, the widespread availability of information can be highly beneficial for researchers. Data employed in the present study come from four independent data sources; two measures are time invariant (census demographics and land use assessments), while requests for service and crime are measured annually, over five years (2009-2013). The sources of data will be discussed in more detail when describing the variables employed in

³ Results were found to be largely consistent across all distances of egohoods examined in the present analyses (0.25, 0.5, 1.0, and 2.5 miles); only the half-mile radius results are reported here for clarity and brevity.

the present analyses. Egohoods are calculated from 9,577 census blocks in St. Louis; measured over five years, this constitutes a total of 47,885 observations.

1. Dependent Variables

Violent crime is the chosen outcome based on theoretical guidelines and prior empirical research. Previous evidence points to a significant relationship between disorder and violent crime, as opposed to all crime (see Sampson & Raudenbush, 1999; Kelling & Sousa, 2001; St. Jean, 2007). Based on the escalation mechanism proposed in the broken windows thesis, violent crime would be an eventual consequence of persistent disorder (Kelling & Sousa, 2001). Certain types of property crime (e.g. vandalism) may overlap conceptually with indicators of physical disorder (Yang, 2010); if property crime were to be included in the dependent variable, there could be a tautological problem between one of the predictors and the outcome of interest. For example, using requests for service regarding graffiti to predict crimes of vandalism could be problematic because the two are qualitatively similar. In order to avoid confounding measures of disorder and crime, Weisburd and colleagues (2015) argue that violent crime and serious street crime should be the principal outcomes of interest.

The dependent variables examined in these analyses are three types of violent crime: homicide, robbery, and assault. These types are considered in individual models, over the course of five years. Crime counts are based on official reports from the St. Louis Metropolitan Police Department. These counts are summed and analyzed as a rate per year for each egohood. Violent crime is more often reported to police, and more accurately recorded in official measures (Gove et al., 1985). These three types of crime were chosen

to examine the potential for varying impacts of disorder between different violent crime types. The three crimes represent varying degrees of severity (Wolfgang et al., 1985) and differ in how frequently they occur, on average. St. Jean (2007) also posits distinct motivations between the types, with robbery being a “predatory” crime, whereas assault is viewed as a “grievance” crime. While the individual circumstances of each crime are likely more nuanced than those stated motivations belie, it is an important point, in that requests for service may operate differently for different types of violent crime.

2. Independent Variables

i. Requests for Service

Data regarding requests for service were obtained from the City of St. Louis Citizens’ Service Bureau and categorized to reflect physical disorder. The Citizens’ Service Bureau (CSB) handles non-emergency service requests for the City of St. Louis (InPrint, 2010). Requests for non-emergency services can be submitted to the CSB through multiple channels. These options include: in-person, online, by phone (“311”), by fax, or by using Twitter to “tweet” at the agency. Individuals making a request are given a unique service request number, which allows them to check the status of their request throughout the process, increasing accountability by the local government. All requests pass through a centralized agency, and are then delegated to the appropriate City department (a total of 55 different departments) (InPrint, 2010). Data are recorded identifying: a unique request number, the type of request, the location of the issue, the responding department, the date of the complaint, and the date of resolution. Citizens have the option to provide their contact information, or the request may be placed anonymously.

This operationalization of requests for service aimed to capture instances of disorder that are likely to be visually discernable by any individual observing the neighborhood. The public issues that are encompassed by this characterization of disorder could function as visual cues to potential criminal offenders, suggesting that residents may be unable or unwilling to enforce prosocial norms in the neighborhood (St. Jean, 2007). This excludes issues that occur “behind closed doors” and are not visible to the public, as well as violations that may not be distinguishable as disorder by a typical observer. Imposing this definition on the sample of requests resulted in six types of disorder, signaling issues related to: trash, plants, graffiti, light outages, damaged buildings, and damaged streets/sidewalks. There is no definitive theoretical reason to suspect differential consequences for crime between these six types of disorder; therefore, requests regarding these categories were combined to create one measure of physical disorder⁴. Counts of requests for service in these categories were summed to create a total for each half-mile egohood, and then divided by the population of the egohood to convert the measure to a rate; this accounts for the variations in the number of residents in each equally sized egohood. This variable was then multiplied by 100 to adjust the measure to be a rate per 100 residents.

Rates of requests for service per egohood ranged from 0 to 5800 per 100 residents; there was a great deal of variation in this measure, with an initial standard deviation of 153.9. There is no explicitly apparent reason for these exceedingly high numbers of

⁴ A principal components factor analysis was performed on these categories and they all loaded on a single factor, indicating they represent a single construct of physical disorder. All six categories loaded on one Eigenvector with an Eigenvalue of 3.35, the Eigenvalue for the next factor was 0.92. The factor loading values were all above 0.58.

requests in certain areas. The extreme nature of the highest values introduces considerable skewness into the measure of disorder⁵. Thus, egohoods with requests for service in the top one percent of the distribution were considered outliers and excluded from further analyses. The data show a distinct break at the 99th percentile, making it the most appropriate cut point for the trimmed measure. The cut-off value employed was 133.3 requests for service per egohood, per year; again, this measure is operationalized as a rate per 100 residents in each egohood. Trimming the top one percent from this measure reduced the mean by about nine, and lowered the standard deviation to 11.2. After excluding these outliers, the total number of observations in the analyses equaled 47,630.

ii. Demographics

Demographic characteristics employed in the present analyses include: concentrated disadvantage, residential stability, distribution of resident ages, and ethnic heterogeneity. These data were obtained from information in the 2010 Decennial Census at the block-group and block levels. Concentrated disadvantage is operationalized using principal-components analysis which combines: 1) percent single parent households; 2) percent in poverty; 3) median household income; and 4) median home value (see Boessen & Hipp, 2015 for a further discussion of this measure)⁶. The measure of residential stability is operationalized as a factor score of the percent of homeowners and the average length of

⁵ When including egohoods in the top 1% of the distribution of requests for service in the regression models, the impact of disorder remained positive and significant for all types of crime; however, the magnitude of the effect was decreased due to the extreme variability in the measure. The estimated coefficients for many of the control variables increased.

⁶ For census variables that were only available at the block-group level, values were imputed for individual blocks based on other known block-level characteristics. This approach can better predict values for the smaller ecological units than would be achieved by apportioning the block-group information down to all units at the block-level (Boessen & Hipp, 2015).

residence. These two variables demonstrate a strong bivariate correlation ($r > 0.7$)⁷. Distribution of resident ages is measured by the percent of residents between the ages of 15-29, which are the ages individuals are theorized to be most likely to engage in criminal behavior. Ethnic heterogeneity employs a Herfindahl index, where higher values represent greater heterogeneity within the egohood (Boessen & Hipp, 2015). A score of zero on the index would represent a perfectly homogenous area, where one race comprises 100% of the neighborhood; the maximum value is 0.8, indicating that all races are equally distributed within the egohood. Five racial categories were included: White, Black, Latino, Asian, and other races.

iii. Land Use

This research improves upon prior work by considering potentially differing relationships between requests for service and violent crime for a variety of types of land use. Land uses are not randomly distributed throughout urban areas; therefore it is vital to consider this variable when aiming to explain the spatial variation of crime. Some studies have found a positive relationship between nonresidential land use and physical deterioration (Taylor et al., 1995; Wilcox et al., 2004). If certain land use types lead to greater physical deterioration and decay, neighborhoods with larger proportions of those land uses may exhibit heightened needs for municipal services. In a spatial analysis of crime and requests for service in Boston, investigators excluded downtown and institutional regions on the grounds that they are likely to “generate idiosyncratic patterns”

⁷ Principal-components factor analysis shows that the two measures have very low uniquenesses (0.1468) and have an Eigenvalue of 1.7.

(O'Brien & Sampson, 2015); this suggests the relationship between requests for service and crime may in fact be different for varying types of land uses. Thus, it is important to include land use measures in analyses of this relationship; if land use variables are omitted, then other predictors may be erroneously capturing what is actually the effect of land use.

Types of land use for each block are determined by the Tax Assessor's Division of the Planning Department for the City of St. Louis, and properties are then coded into categories based on their primary function (e.g. residence, commercial business)⁸. These measures are calculated as a percent of the block area, for each type of land use. The categories employed in these analyses include: single family residences, multi-family residences, retail businesses, vacant properties, and industrial areas. The three remaining categories of land use (i.e. "parking" "religious" and "other") were combined as the reference category and excluded from the analyses to avoid perfect multicollinearity in the models. Descriptive statistics for all variables are available in Table 1.

D. Analysis Plan

Negative binomial regression utilizing random-effects was performed for the panel data, due to the dependent variable being a count measure (using the Stata command `xtnbreg`)⁹. Poisson regression was not employed because the outcome variables demonstrate evidence of overdispersion¹⁰, thus violating the assumption of the Poisson

⁸ Land use types are very stable over short timeframes and few properties demonstrate changes in their uses as approved by city zoning requirements or restrictions.

⁹ A likelihood-ratio test suggests that the panel estimator employed here is significantly different from a pooled estimator ($p < 0.001$).

¹⁰ After the top 1% of the distribution has been excluded, the variance of the measure is 123.7, while the mean is much lower, at 23.6; this substantial difference indicates overdispersion is present in the measure.

distribution that the variance must be equal to the mean¹¹. A likelihood ratio test of the overdispersion parameter suggests that the present analyses demonstrate overdispersion that is significantly different from zero, indicating the Poisson distribution is not appropriate. Random effects were chosen because the dispersion of crime may vary across neighborhoods for unidentified reasons. The use of random effects was preferable to fixed effects¹² here because the analyses aim to compare differences between areas, not changes within areas. Over the study period of five years, there is not likely to be substantial within-area change for most communities. Further, the control measures of neighborhood demographic characteristics and land use employed in this study are time-invariant characteristics, which would be dropped from the model if fixed effects were employed. Because these controls are important in modeling the social processes of interest, random effects were employed for these analyses.

The 2010 population was used as an exposure measure in all models, which estimates the results in the form of a crime rate. A model was performed for each type of crime in order to observe the effects for the different crimes, individually. In order to assess the substantive magnitude of the effect sizes, the analyses also examine the percent change in the outcome variable per a standard deviation increase the independent variable (Long & Freese, 2006). This is calculated using the formula:

¹¹ While there are many areas that have zero counts for crime, particularly for rare violent crimes like homicide, zero-inflated models were not utilized due to the proposition of “excess” zeroes, which suggests that some areas have a distinct process for displaying a zero count. It is not hypothesized here that some egohoods would exhibit zero crimes for reasons that differ from other egohoods, therefore zero-inflated models are not employed in these analyses.

¹² A series of dummy variables was created to indicate the year of each observation, in order to function as a fixed effect in the models. This serves to capture yearly changes that were common to all egohoods. However, the inclusion of the fixed effect did not substantially change the results.

$$\text{Percent Change in } Y = (100 * [\exp(\beta_1 X_i * \sigma_{xi}) - 1])$$

Equation 1.

where (Y) is the dependent variable, (β_1) is the slope coefficient for the independent variable (X_i), and (σ_{xi}) is the standard deviation of (X_i). Multicollinearity between the predictors did not appear to be an issue, with a mean VIF score of 1.93 for the final model¹³.

The outcome variable is taken from a year ahead of the predictor variables (i.e. 2009 independent variables are used to predict the same area's crime in 2010). This allows the analyses to establish the proper temporal ordering necessary for determining causality¹⁴. The analyses are a true panel design, where one egohood's measure of disorder is employed to predict the *same* egohood's violent crime in the following year. One year is the chosen time interval because it allows enough time for events of interest (requests for service and crimes) to accumulate, yet provides data for multiple time intervals to examine changes longitudinally. An observation period that is too short may give the impression that there are no requests for service or violent crimes, when actually the small time interval obscured them; whereas a period that is too long may mask marked variations in the outcomes over time. Interactions between requests for service and certain control variables were hypothesized to potentially explain variability in requests for service and crime¹⁵. However, testing concentrated disadvantage, residential stability, and residential

¹³ The highest individual VIF score was 2.78 for the land use category of single-family residences.

¹⁴ A measure of violent crime was included in some of the models as an independent variable, but this did not substantively influence the results; therefore the measure was excluded from the final model to avoid issues of endogeneity.

¹⁵ Requests for service were also thought to possibly have a nonlinear relationship with crime; however linear models of the association better characterized the relationship between disorder and crime, than did models employing quadratic or cubic transformations of the requests variable.

land use yielded no substantive interactions with requests for service as they relate to violent crimes.

IV. RESULTS

Both the dependent variable and the measure of disorder are time-varying, while demographic characteristics and land use are time-invariant. Descriptive statistics for all measures are reported in Table 1. Homicide is the most infrequent type of crime examined in the present analyses; the average count of homicides per egohood is relatively constant across all five years, ranging from a low of 1.51 in 2012 to a high of 1.81 in 2010. Counts of robberies per egohood show a general decline over the period of observation in the present study. Robberies were most frequent in 2009, with 34.1 per half-mile egohood and declined to 19.5 by 2013. Assaults are the most frequent type of crime in the data employed in these analyses; this crime type also showed a decline over the five years examined in this study. The year 2009 had the most assaults per egohood, with an average of 87.6 which declined to 60.8 by 2013.

Requests for service regarding physical disorder are operationalized as a rate per 100 residents in each half-mile egohood. This measure of disorder was highest in 2011, with an average of 36.7 requests per egohood; the frequency of requests is relatively consistent across years, with the lowest average being 31.2 requests in 2012. As previously mentioned, there are a small number of egohoods with extremely high counts of requests for service, and those observations were treated as outliers. When the top one percent of the distribution of egohoods is excluded, the average rate of requests for service per

Table 1. Descriptive Statistics of Selected Variables 2009-2014 (Aggregated to Half-Mile Egohoods)

		2009		2010		2011		2012		2013		2014		
	Variable	Mean	SD	Mean	SD									
Time-Variant	Violent Crime													
	Homicide	-	-	1.81	2.33	1.62	1.98	1.51	1.82	1.62	2.20	1.99	2.09	
	Robbery	-	-	27.86	20.74	27.94	22.74	23.63	18.87	19.51	14.79	20.92	17.20	
	Assault	-	-	71.60	46.67	70.44	48.10	66.37	45.11	60.77	43.85	53.10	39.10	
	Requests for Service	31.86	144.61	35.69	184.00	36.72	172.42	31.21	126.71	31.29	132.00	-	-	
Requests for Service (Excluding Outliers)	22.47	12.04	24.48	11.88	25.79	11.29	22.80	10.31	22.63	9.77	-	-		
Time-Invariant	Structural Characteristics													
	Concentrated Disadvantage			5.48	8.69									
	Residential Stability			0	1.00									
	Percent Homeowners			43.61	17.97									
	Average Length of Residence			8.90	3.67									
	Percent Aged 15-29			25.71	8.54									
	Ethnic Heterogeneity			0.35	0.21									
	Land Uses													
	Single Unit Residences			33.35	37.32									
	Multi Unit Residences			18.04	26.71									
	Industrial			7.53	23.80									
	Retail			24.50	36.91									
Vacant			7.89	17.20										

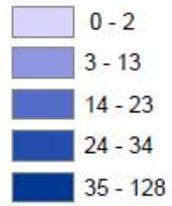
egohood in all years decreases by approximately ten. This reduces the variability in the measure and results in the highest average being 25.8 requests (2011) and the lowest being 22.5 (2009).

For the residential stability measure, the average percent of homeowners per egohood is 43.6% and the average length of residence is 8.9 years. The age distribution of the neighborhood is measured as a percent of residents that are young people; on average, 25.7% of residents in each egohood are between the ages of 15 to 29. Lastly, land use is also a time-invariant measure. Single unit residences make up the largest average share among the land use types, at 33.4% of the area. Vacant land and industrial areas are the least common land use types on average, about 8% for each type.

The spatial distribution of requests for service and the various violent crime types are depicted in Figures 2-4. Requests for service are spread throughout the city, but tend to be located most heavily in the southeastern and northwestern parts of the city. Services are least requested in the downtown business district and the Midtown area of the city. Homicides are located mostly in the northern part of the city, both east and west sides (Figure 2). Robberies are widely distributed throughout St. Louis; many occur in the downtown area (despite few requests for service in this neighborhood). In south St. Louis, robberies heavily cluster toward the eastern half of the city, following a similar distribution to that of requests for service (Figure 3). Assaults seem to be more evenly split between the northern and southern parts of the City, compared to the other two crime types that concentrate more heavily in the northern half of the City (Figure 4). Further, assaults seem

Figure 2 - St. Louis, MO

Requests for Service - 2010



2011 - Homicides

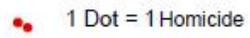
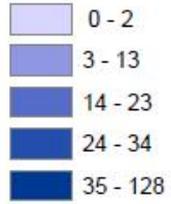


Figure 3 - St. Louis, MO

Requests for Service - 2010



Robberies - 2011

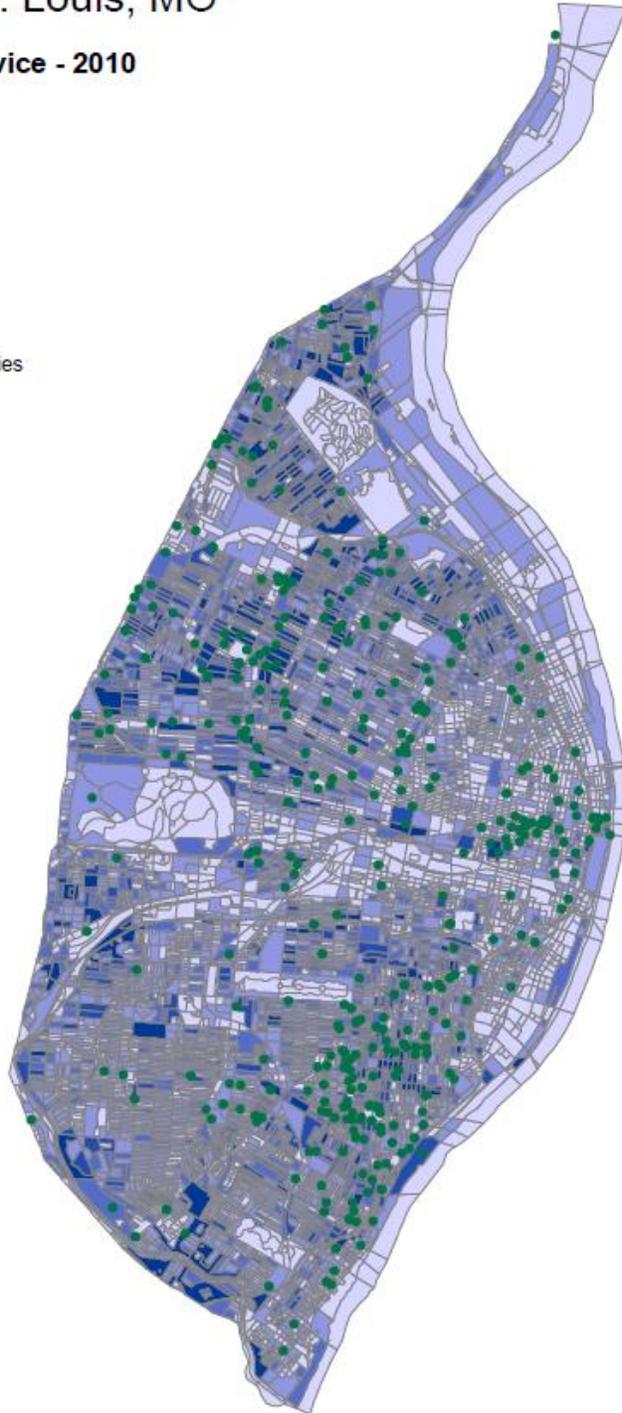
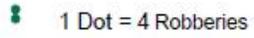
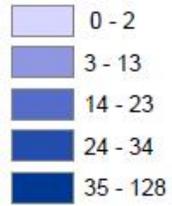
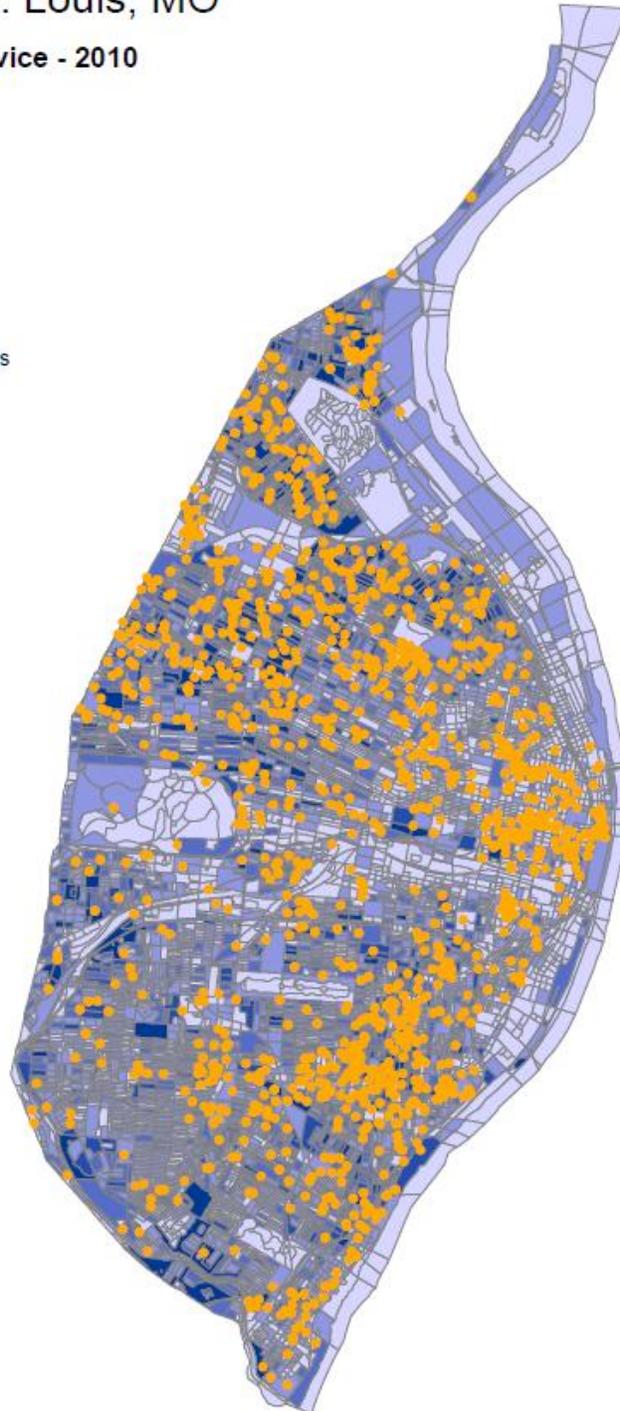
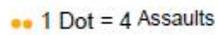


Figure 4 - St. Louis, MO

Requests for Service - 2010



Assaults - 2011



to cluster more closely with entertainment districts (e.g. Laclede's Landing, Soulard, sports stadiums) than robberies or homicides.

Requests for Service

In examining the time-series negative binomial regression model, requests for service demonstrate a positive and significant relationship with all three types of crime (Table 2). Initially, this would suggest that this variable better represents disorder, as opposed to collective efficacy, because theory predicts a positive relationship between disorder and violent crime. A one standard deviation increase in requests for service results in 22.4% and 16.8% increases in robberies and assaults, respectively. The relationship between requests for service and homicide is stronger; a one standard deviation increase in requests for service is associated with a 28% increase in homicide. The direction of this relationship suggests that these requests for service are indicative of physical disorder; this provides initial support for the broken windows theoretical framework. If the relationship had been negative, the evidence would have supported the hypothesis that requests for service were more indicative of a social process, like collective efficacy.

Neighborhood Demographic Characteristics

All demographic predictors are significant for all three violent crime types, with the exception of the impact of ethnic heterogeneity on robbery. As expected, concentrated disadvantage shows a positive relationship with all three types of violent crime in the model. A one standard deviation increase in concentrated disadvantage would result in robbery and assault both increasing by 40% and 42%, respectively. Concentrated

Table 2. Negative Binomial Regression Model (Using Random Effects) for Three Types of Crime

Variables	Homicide		Robbery		Assault	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
Requests for Service	0.0222***	(0.0007)	0.0182***	(0.0003)	0.0140***	(0.0003)
Concentrated						
Disadvantage	0.0872***	(0.0012)	0.0390***	(0.0007)	0.0405***	(0.0006)
Residential Stability	0.0191	(0.0125)	-0.3440***	(0.0077)	-0.2430***	(0.0066)
Age	-0.0031*	(0.0012)	-0.0054***	(0.0007)	-0.0034***	(0.0006)
Ethnic Heterogeneity	-0.3830***	(0.0468)	0.1590***	(0.0306)	0.0718**	(0.0257)
Single Unit						
Residences	-0.0032***	(0.0003)	-0.0026***	(0.0002)	-0.0025***	(0.0002)
Multi-Unit						
Residences	-0.0016***	(0.0003)	-0.0005*	(0.0002)	-0.0013***	(0.0002)
Industrial	-0.0038***	(0.0004)	-0.0018***	(0.0003)	-0.0003	(0.0002)
Retail	-0.0014***	(0.0003)	-0.0001	(0.0002)	-0.0001	(0.0002)
Vacant	0.0008	(0.0004)	0.0002	(0.0003)	-0.0011***	(0.0002)

Note: * $p < .05$; ** $p < .01$; *** $p < .001$

disadvantage has the strongest impact on homicide; a one standard deviation increase in this factor score is associated with a 113% increase in homicide.

Theoretically, residential stability would be expected to predict fewer violent crimes in the area. This is true for the findings for robbery and assault; however, residential stability is not significant for predicting homicide. A one standard deviation increase in the measure of stability is associated with a 29% and 22% decrease in robberies and assaults, respectively. Concentrated disadvantage and residential stability demonstrate the strongest relationships with violent crimes.

The variable representing the neighborhood age distribution measures the proportion of the area's residents who are between the ages of 15 and 29 years old; extant

literature would suggest that individuals between these ages are more prone to committing crimes. However, results here demonstrate a negative association between violent crime and areas with a greater proportion of young people. The variable is negative and significant for all types of crime; although, the magnitudes of the effects are small. Per a one standard deviation increase in the proportion of young residents, we see an average 3% decrease for homicide and assault; robbery is slightly larger, with a 5% decrease per one standard deviation increase in proportion of young residents. This relationship is consistent and significant across all types of crime, but it is in the opposite direction that would be predicted by individual-level theory. These findings, which are contrary to theory, can be common to ecological analyses, and potentially stem from the treatment of young people as a homogenous group with identical propensities to engage in crime (McCall et. al, 2013).

Social disorganization theory would posit that neighborhoods that are more ethnically heterogeneous are likely to have more crime, due to heterogeneity inhibiting the formation of social ties and causing social norms to be more varied. Here, the effect of ethnic heterogeneity largely depends on crime type. For homicide, ethnic heterogeneity is negative and significant; a standard deviation increase in the measure of ethnic heterogeneity results in an 8% decrease in homicide. Ethnic heterogeneity shows a significant, but positive relationship with robbery and assault. A one standard deviation increase in the measure of ethnic heterogeneity is associated with a 3.3% increase in robberies and a 1.5% increase in assaults. These varying results suggest that the effects of ethnic heterogeneity may be contingent upon type of crime, which is in contrast to what is hypothesized by social disorganization theory.

Land Use

Types of land use vary in their associations with robbery, assault, and homicide. Both types of residential land use (single- and multiunit) display a consistently negative and significant relationship with violent crime. Specifically, single family residences exhibit a negative and significant relationship to all types of crime. Homicide demonstrates the strongest relationship, with an 11% decrease compared to the “other category” for a one standard deviation increase in the single family residences. Assault and robbery have slightly weaker relationships: 9% decreases in both crime types for a standard deviation increase in land used for single family residences relative to the reference group. Land used for multi-family residences mirrors the relationship of single family housing and crime; albeit the relationship is weaker for land used for multiple residential dwellings, with the largest percent decrease being 4% compared to the reference group, as displayed by homicide. This aligns with theory, in that residential land uses are protective against violent crime (Taylor et al., 1995).

Land used for retail and industry, as well as vacant land exhibit inconsistent relationships with crime. Industrial areas are associated with significantly fewer homicides and robberies; assaults are not significantly related to industrial land use. Homicide and robberies exhibit 9% and 4% decreases relative to the “other” category of land use, respectively. The theoretical reasoning regarding the hypothesized impact of industrial areas is also conflicting; there are likely fewer convergences of offenders and targets in industrial areas (Stuckey & Ottensman, 2009), however collective efficacy is also presumably lower in areas with large proportions of industrial buildings.

Retail businesses have a negative and significant association with occurrences of homicide; however, this relationship is not significant for the other two types of crime. The magnitude of the effect on homicide is small; a one standard deviation increase in retail properties reduces homicide by about 5% compared to the reference group. This could suggest that the increased probability of detection (“eyes on the street”) at times may outweigh the increased availability of targets in these areas, which may in part explain the inconsistent findings.

Vacant land use has previously been used as a proxy for disorder in neighborhood research. Yet, for this sample, the proportion of land that is vacant is not significantly related to robbery or homicide. However, vacant land is a significant predictor of assault in the model; a one standard deviation increase in vacant land would result in assault decreasing by approximately 2% relative to the “other” category of land use. The varying significance of the coefficients and small magnitude of the results suggest the relationship between vacant land use, disorder, and crime may be more nuanced than previously conceived.

V. DISCUSSION

The relationship between disorder and crime has long been of interest in criminology; the present findings support an association between the two concepts. Here, analyses demonstrate that requests for service are positively associated with future violent crime in an area. Over a five year period, requests relating to physical disorder were significantly related to later increases in the violent crime rate for communities in St. Louis,

MO. This relationship persisted after controlling for theoretically relevant demographic factors and land use. The impact of requests for service on homicide was stronger than that for robbery and assault. As previously mentioned, St. Louis has a disproportionately high rate of homicide; thus, the larger effect sizes for this type of crime may be related to the above average rate of this severe crime. Further, homicide is generally the crime least likely to go unreported to the police (Gove et al., 1985); therefore, robberies and assaults that are not reported may introduce error into the measure for those two types of crime.

This study expands upon prior work by examining the effects of requests for service on crime for land uses other than primarily residential areas. The findings of these analyses support the extant literature that posits a protective effect of residential land use against violent crime (e.g. Taylor et al., 1995). There is virtually no extant literature analyzing the relationship between requests for service and violent crime for areas that are not residential neighborhoods, creating a potential issue of an omitted variable. The research at hand found that the relationship between nonresidential land uses (retail businesses, industrial areas, and vacant land) and crime is somewhat inconsistent. For instance, vacant land demonstrated a negative effect on assault, yet did not significantly impact homicide or robbery. The municipal government is responsible for the upkeep of a large proportion of the vacant properties in St. Louis (Logan, 2012); future research may benefit from obtaining and analyzing data that differentiates municipally held vacant land from other vacant areas. The negative relationship of industrial areas to violent crime provides evidence that a lack of suitable targets in these areas (e.g. Skogan, 1986) may outweigh the impacts of decreased monitoring of said land uses (e.g. Boessen & Hipp, 2015). These

varying relationships across land uses highlight the need for closer examination of the impact of land use, beyond limiting the scope to residential areas, as has been the case in prior work.

The findings of these analyses support the broken windows framework as put forward by Wilson and Kelling (1982). Disorder that is public and persistent is associated with increases in future crime; this provides evidence that aligns with the idea of disorder as a “signaling” mechanism to potential offenders. More specifically, this work builds upon O’Brien and colleagues’ (2015) initial use of non-emergency requests for service to test the relationship between disorder and crime. However, in contrast to the findings of O’Brien and Sampson (2015), these analyses uncover a significant relationship between public disorder and future violent crime. The present study furthers the research on requests for service and crime by examining the association longitudinally over five years, which addresses a limitation of previous work analyzing requests for service and crime with only two timepoints, over two years (O’Brien & Sampson, 2015). Employing five years of data in the present study provides a greater number of requests and crimes for analysis, and offers a more comprehensive picture of the relationship between disorder and violent crime.

These data have many strengths, which bolster the findings. Firstly, the relationship between public disorder and violent crime was examined over a period of five years, the longest examination using this data source up to this point. This allows for the proper temporal ordering required to examine causality; and further, using data from more than two time points helps to guard against errors resulting from anomalous effects that are

specific to a short time interval. It is also beneficial that records of requests for service are maintained by a source that is completely independent from that of the outcome measures (violent crime records). This operationalization of disorder offers certain advantages in comparison to surveying residents about their general perceptions of disorderly conditions in the neighborhood, because this measure identifies specific instances of disorder, which are tied to precise locations and can be categorized by type of issue. Using egohoods as the unit of analysis provides a new examination of the disorder-crime relationship, which offers a unique perspective compared to studies using administratively defined boundaries. Egohoods have been shown to better predict crime than using non-overlapping units of analysis (Hipp & Boessen, 2013). This measure is particularly apt for the study of disorder because instances of physical disorder are likely to affect nearby areas, which may not be within the same census tract or block group.

These data offer many advantages; however, the analyses were not without limitations. Firstly, employing this data source as a representation of disorder is still very much in the exploratory phases. Large-scale administrative records were not collected with the intention of being analyzed as a test of criminological theory; therefore, there may be a great deal of “noise”, or information that is unrelated to disorder that is captured by this measure (O’Brien et al., 2015). This required the present study to identify and exclude requests for service that were not indicative of physical disorder; these distinctions are not always definitively clear and may introduce error into the measure. Inherent biases may exist in analyzing only reported instances of deterioration. Communities may differ based on their level of “tolerance” of disorder, or at what threshold intervention is deemed to be

required (Skogan, 1986). There is likely to be variation in awareness of the request system, as well as differential propensities to engage with the local government to obtain services. Future research could cross-validate this measure by comparing it to a cross-sectional measure of systematically observed disorder, similar to the adjustment factor calculated by O'Brien and colleagues (2015). This would provide some insight on variations between reported and unreported disorder.

Other limitations extend from the possibility of multiple requests regarding the same issue; future research could further investigate this potential issue by gathering data in a way that allows for the differentiation of requests pertaining to the same issue. Because egohoods build in interdependency based on nearby areas, spatial autocorrelation is built into the units. While other statistical methods might employ spatial lags to attempt to include measures to control for dependency (i.e. spatial autocorrelation) between observations, egohoods are based on the opposing assumption, which is that the units are not independent. Future research may consider employing a spatial error model to adjust the standard errors as a statistical control for spatial autocorrelation (see Hipp & Boessen, 2013 pp. 310-11 for a discussion of such models). However, spatial error models are based on non-overlapping or discrete units, which are associated with certain drawbacks, as previously discussed.

Further, for egohoods that are located near the city limit, data regarding requests for service are not available for the areas within the egohood which are outside of the city boundary. Future research may improve on this limitation by incorporating additional data on requests for service from the municipalities that are adjacent to the city limit. The

outcome measure examined was official records of reported crimes, which is problematic due to the exclusion of unreported crimes. However, empirical research has found that reporting of violent crimes is not systematically biased based on neighborhood characteristics (Baumer, 2002). Future research has the potential to further explore this proposed measure of disorder and improve upon these limitations.

The results from the analyses left some proposed hypotheses unconfirmed. Principally, it was suggested that requests for service may be representative of a social process, like collective efficacy or public control. Specifically, it was hypothesized that disorder which is mobilized against by the community (i.e. by placing requests for service) could serve as an indicator of the presence of collective efficacy in the neighborhood. However, the positive relationship between requests for service and violent crime provides support for the measure being more indicative of physical disorder, and not a good proxy for collective efficacy. This research is limited due to the lack of a direct measure of collective efficacy; an indicator of the level of collective efficacy for an area could be utilized to examine the relationship between requests for service and collective efficacy in a community. Future research could gather data on instances of disorder that are unreported to municipal agencies; if unreported disorder is able to be controlled in the analyses, requesting services to rectify disorder might then demonstrate a collective action process that would be negatively related to crime.

Some findings from these analyses were unexpected. In particular, it was surprising that a higher proportion of young residents in an area demonstrated a negative relationship with all three types of violent crimes. Extant literature consistently finds that young people

are more likely to commit crimes, so we would expect that areas with more young people would have more crime. The magnitude of the effects from this age variable were small in comparison to other predictors, which suggests its negative impact on crime is not as strong as other variables in the model. These observed outcomes may be, in part, due to the examination of the relationship aggregated to the ego-hood-level, as opposed to considering the relationship at the individual-level; McCall and colleagues (2013) discuss these varying results based on differential institutional engagement. Future research could further explore these findings by including a measure of youth engagement with conventional or prosocial institutions.

It is also notable that the direction of the effect of ethnic heterogeneity varies based on crime type. While this predictor is significant for all three types of crime, more heterogeneity is associated with increases in robbery and assault, but decreases in homicide. Part of this variation may extend from the fact that the overwhelming majority of homicides are intraracial; in 2013, 90% of black victims were killed by black offenders and 83% of white victims were killed by white offenders¹⁶ (U.S. Department of Justice, 2014). The motivations behind these different crime types may also partially explain the varying effects of ethnic heterogeneity; St. Jean (2007) posited robbery as a “predatory” crime, which would imply the offender is looking to gain something beneficial from the victim (e.g. money or goods). Opportunities for such crime may be more abundant in areas with more “mixing” between groups or greater heterogeneity; this contrasts with homicide,

¹⁶ Percentages reflect homicides with a single victim and single offender where the race of victim and offender were known to law enforcement.

which is generally perpetrated by someone who knows the victim (Fox et al., 2011). Historically, social disorganization theory has proposed that more ethnic heterogeneity is likely to increase crime; however, the findings here suggest that the effect of ethnic heterogeneity is variable for different types of crime.

Beyond an exploration of methodology, these analyses provide important implications for policy. Findings presented here highlight the importance of local government service delivery and investment in stabilizing neighborhoods against disorder. There is a significant relationship between citizen requests for service and violent crime, above and beyond the impact of structural characteristics. While issues such as concentrated disadvantage and residential instability are difficult for policymakers to directly address, disorderly conditions are much more amenable to intervention. Further, this system provides information to local government about the quantity and type of services (e.g. graffiti removal, street maintenance, plant upkeep, etc.) being required in various locations, which can allow for forecasting of the future needs of communities. By better understanding these patterns and their consequences, service delivery can be improved, which should lead to reduced disorder and crime.

Identification of “hot spots” of disorder can provide practical information for municipal service providers; the demonstrated implications of requests for service, as they relate to crime, may also be useful for police departments (Yang, 2010). Further, the potential uses for requests for service extend beyond examining crime, and could likely inform research in areas such as behaviors related to public health or varying levels of citizen engagement for political science. The research at hand demonstrates the

applicability of the measure in testing its impact on violent crime; as employed here, the findings suggest the most appropriate use of the measure of requests for service is as an indicator of disorder, as outlined by the broken windows framework. Methodologically, a relatively novel measure was further developed in this research. This work adds to evidence supporting a relationship between disorder and crime. Finally, the study contributes information on the functioning of local government and provides data of practical significance for policy in St. Louis.

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